Is Business Failure Due to Lack of Effort?

Empirical Evidence from a Large Administrative Sample

Mette Ejrnæs
University of Copenhagen and The Danish National Centre for Social Research

and

Stefan Hochguertel
VU University Amsterdam and Tinbergen Institute

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Abstract

We study entrepreneurs' behavioral responses of effort (moral hazard) to avoid business failure. This is done in the context of an unemployment insurance scheme available to the self-employed, where we estimate how much of the transition probability to unemployment can be causally attributed to being insured. To disentangle moral hazard from selection effects we use an institutional feature of the Danish unemployment system that provides an additional motive to choose insurance (an early retirement option). We estimate a bivariate random effects probit on a self-employment sample drawn from register data. We find that those who are insured are 2 percentage points more likely to subsequently become unemployed compared to the uninsured, however only 0.6 percentage points can be attributed to behavioral responses.

Keywords: moral hazard, entrepreneurs, self-employment, unemployment insurance, panel data

JEL codes: C33, C35, J2, D82, L26, J65

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Correspondence to: `mette.ejrnes@econ.ku.dk` and `s.hochguertel@vu.nl`.

1 Introduction

Businesses come and go. The vast majority of disappearing firms consists of very small, and often young, unincorporated firms without any employees. Whereas this churning is arguably a necessary side effect of economic dynamism, huge risks are involved from the point of view of the individual owner-manager. Markets or societies at large need to and do provide insurance mechanisms.

There exists a small but growing literature on entrepreneurs and insurance mechanisms. Fan and White (2003) argue that access to the capital market coupled with the possible recourse to bankruptcy proceedings featuring asset exemptions and (partial) debt discharge in fact constitutes a prime insurance mechanism in the United States that encourages would-be entrepreneurs to actually start up new ventures. Further related empirical studies (among which Primo and Green (2011) and Armour and Cumming (2008)) are based on state or country data and identify the total effect of bankruptcy laws on the proportion of self-employment, finding that forgiving bankruptcy laws have a positive overall effect on the proportion of self-employment.

One of the unintended side effects of insurance, however, is moral hazard, i.e., a behavioral response to insurance that is caused by the mere existence of insurance itself. In the business case, this may mean excessive risk taking or inappropriate precaution against failure. Both can be viewed as a result of lack of effort. The adverse social welfare implications can be important. They can materialize in, for instance, inefficiently high costs due to overinflated bankruptcy filings, or job search (crowding) externalities when the formerly self-employed individual tries to find a job. The studies on bankruptcy laws as insurance device also discuss issues of moral hazard and adverse selection. It is empirically difficult to tell moral hazard (behavioral response post contract) from selection effects (sorting in a heterogeneous population, pre contract).[1] None of the empirical studies using bankruptcy variation isolates moral hazard effects.[2]

Despite a very large literature on incentive provision for wage earners' work effort (reviewed in Parsons (1986)) very little empirical research has been conducted on effort effects under asymmetric information for the self-employed. This is disappointing, as there is a number of theoret-

[1] See the empirical insurance contract literature (Chiappori, 2000; Cohen and Siegelman, 2010).

[2] To our knowledge all of the studies focus on either the proportion of self-employed (e.g. Armour and Cumming, 2008; Primo and Green, 2011) or self-employment entry (e.g. Fan and White, 2003; Lee et al., 2011) but do not explicitly study failure of entrepreneurs. Only Fan and White (2003) report briefly on ending businesses.

ical contributions stressing the importance of incentivizing entrepreneurs through private contracts with a financier (Bergemann and Hege, 1998; Repullo and Suarez, 2000; Chakraborty and Citanna, 2005; Clementi and Hopenhayn, 2006, and Newman, 2007). One of the few empirical papers is Paulson et al. (2006). Building on an occupational choice model of Aghion and Bolton (1997), they infer that moral hazard is consistent with the data: failure prevention is low on the agenda of low-wealth prospective entrepreneurs, so they will be either redlined or offered a costly incentive-compatible contract. Successful borrowers will then reduce their borrowing when wealth increases. This is observed in Thai cross sectional data.

We, instead, study the case of Denmark, where voluntary unemployment insurance (UI) is the main (partial) income insurance mechanism for the self-employed, and we do find a way to show the existence of moral hazard and to precisely quantify its importance. Specifically, we examine to what extent the transition from self-employment into unemployment can be attributed to moral hazard effects as opposed to selection effects.

Our paper is conceptionally related to a set of papers that investigate the effect of variation in UI insurance parameters (benefit levels; potential benefit duration, PDB; eligibility) on the subsequent incidence of unemployment for workers, or on the length of employment spells. One interesting example is Winter-Ebmer (2003) who studies the effect of an increase in PDB on unemployment entry for workers in Austria. We might view the PDB variation as a change along the intensive margin, conditional on being insured. Jurajda (2002) studies the effect of benefit levels on employment durations using data from the United States. Another couple of examples are the studies by Green and Riddell (1997) and Baker and Rea (1998) who both use Canadian data and regional/temporal variation in the length of qualification periods (weeks of required UI contribution payments viz. employment) before becoming UI benefit eligible. Shorter qualification periods shorten employment spells that end in unemployment. Additional literature studying the impact of UI parameter variation on the subsequent incidence of unemployment is reviewed in Krueger and Meyer (2002). Our paper instead, will exploit changes along the extensive margin, as our data contains idiosyncratic variation in insurance status.

The main idea of this paper is straightforward to understand, once the institutional context has been sketched. UI in Denmark is a large insurance program, but obtaining UI cover is at the discretion of the individual. Insurance is highly subsidized by the government, and applicants cannot be rejected.[3]

While we can control for industry risk (or peer-group risk) to characterize unemployment risk classes, we need an instrument that captures variation in the demand for insurance without being correlated with unobserved factors in an equation measuring unemployment risk in order to identify moral hazard. Such an instrumental variable is provided by an orthogonal incentive to join the UI system: insurees have the option to participate in an early retirement (ER) program (de-coupled from social security) which is not available for non-insured. UI participants become ER-eligible if they sign up for UI at least 10 years before the earliest ER entry age of 60. Half-way through our sample period, eligibility conditions were changed and individuals needed to enroll at least 20 years before the earliest ER entry age. This policy change provides the relevant variation in our instrument to be non-collinear with age or cohort effects that may be present in the data anyhow.

Figure 1 illustrates very neatly the force of the ER incentive, by showing for the cohort of males born in 1945 UI insurance rates as a function of time. The age threshold leads to a discrete jump in the enrollment rate in the year when individuals turn 47 by 11.5 percentage points. The reform will lead to different cohorts having differential age thresholds.

Figure 1 about here

The exceptionally rich data we use constitute a 10% random sample of the Danish self-employed population, and come in the shape of classical panel data (longitudinal individual observations at annual frequency), spanning 20 years. All information derives from government registers, most notably population registers and tax and benefit administration records.

The raw data suggest that insured self-employed have an annual exit rate to unemployment of almost 3 percent while the exit rate of uninsured self-employed is less than 1 per cent. The empirical estimation approach taking into account the endogeneity of insurance choice relies mainly on a bivariate random effects probit model. Our data allows controlling for demographics, income, health, industry, etc., at a very detailed level. Furthermore, we also control separately for age, cohort and time effects.

The bivariate probit results reveal that only about 30 percent of the original difference between

[3] In contrast to, for instance, car insurance settings (Abbring et al., 2003), no price discrimination or experience rating takes place, as the UI 'contract' is 'one-fits-all' and the choice is 'take-it-or-leave-it'.

insurees and non-insurees can be attributed to moral hazard, as the marginal effect of being insured is only about 0.6 percentage points. This effect is precisely estimated. The remaining 70 percent of the difference is generated by sorting or selection effects or heterogeneity. Our results survive a battery of sensitivity checks. This leads us to conclude that business failure is not predominantly due to lack of effort.

Summarizing the contributions of the present paper, we provide first-time empirical evidence on the relevance of moral hazard for entrepreneurs within a “large insurance program”. We provide a link between the risk of bankruptcy and incentives to insure that are unrelated to risk-reducing benefits of insurance, and show the identification of moral hazard through institutional design. We show empirically that the self-employed have a demand for insurance, and we take care of the endogeneity of insurance choice by exploiting exogenous variation in the sample that comes about by way of a policy change (‘natural experiment’).

Furthermore, this paper adds to the scarce literature that empirically identifies and quantifies moral hazard effects among entrepreneurs. Although these effects are identified in a particular setting, we deem it reasonable that they resonate more general effort choices for entrepreneurs.

The remainder of the paper proceeds as follows. Section 2 provides relevant details on the main institutional features of the Danish UI and ER system. Section 3 contains our insurance model and puts it in the institutional context. Section 4 gives a brief data introduction, specifies clearly how our instrumental variable is defined and provides descriptives and the intuition of where identification comes from in the data. Section 5 contains a brief review of estimation strategy, presents estimation results and comments on sensitivity checks. Section 6 concludes.

2 Institutional Background

This section provides some background information on the Danish system applicable to the period under study (1981-1998).

The vast majority of firms in Denmark are small, unincorporated businesses in sole proprietorship. 90% of all firms have less than 10 employees (in 1999). Self-employed entrepreneurs have two main institutional income insurance mechanisms at their disposal: bankruptcy proceedings and unemployment insurance. There are two types of proceedings in which the bankruptcy law foresees:

those extending to corporate liabilities, and those intended for personal liabilities including debt of unincorporated businesses. The latter protection was included in the bankruptcy reform act of 1984 in Denmark, making discharge of some part of debt possible for small firms but typically involving a repayment plan out of income for the remainder of nondischarged debt.

We argue, however, that bankruptcy proceedings are not of first-order importance for the majority of self-employed entrepreneurs in Denmark, unlike in the United States. Armour and Cumming (2008) list the various provisions of a number of bankruptcy acts in international comparison and show that the Danish legislation is substantially less forgiving than the US bankruptcy act.

Unlike in the United States where insolvency is not a necessary condition for bankruptcy and debt discharge, filing for bankruptcy in Denmark is tied to being "hopelessly indebted and [...] the proceedings [being] warranted by the circumstances of the debtor" (Alexopoulos and Domowitz, 1998). Out-of-court settlements are subject to rules and discretionary negotiation outcomes. Thus, bankruptcy, insolvency, and debt restructuring will apply only in the minority of cases where a self-employed person terminates his business. In many cases, decreasing or nonpositive profits will be reason enough to close shop, without being insolvent.

Rather, unemployment insurance provides the main mechanism to partially insure against income losses. Denmark is one of the very few countries where unemployment insurance is voluntary[4] and where, quite uniquely, also the self-employed can insure themselves along with wage employed workers (Schoukens, 2000). Comparing the number of registered firm bankruptcies (including the corporate ones) with the number of self-employed that subsequently register as unemployed, shows that the latter figure exceeds the former by 50% on average during our observation period.[5]

The insurance system is organized around about 35 private, industry/occupation-specific unemployment insurance (UI) funds. A typical UI fund is a not-for-profit organization without selection restrictions for applicant members. UI funds finance UI benefits through membership fees, payroll taxes and government subsidies.[6]

Benefit duration can be characterized as generous in international comparison: This used to be 84 months until 1996, when it was reduced to 60 months; during the 1990s there have been changes

[4]Sweden and Finland are the other examples mentioned in Parsons et al. (2003).
[5]Numbers exclude the agricultural sector.
[6]Lentz (2009) reports that the average worker pays about 1/3 of the actual premium, the rest being subsidies.

also to include activation programs with mandatory participation that starts within 12 months of first registration.

Parsons et al. (2003) report for the year 1995 that the contribution paid by an individual amounted to about 3,600 DKK for a wage employed worker and to about 4,000 DKK for a self-employed person. These figures exclude administration costs, which can vary substantially across UI funds.

There are mainly two funds that focus on the self-employed, DANA and ASE. The funds are free (within legal limits) to determine regulation of benefit entitlements, although there tends to be close alignment. Self-employed's insurance status is restricted to always being full time.[7] To illustrate, according to ASE regulations, the self-employed and entrepreneurs can file for UI benefits in cases where all of the following conditions apply:

- the UI fund membership has lasted for at least 12 months
- the applicant has worked at least 52 weeks full-time during the past 3 years, and has run his business for at least three years
- the applicant enrolls with the public job center from the first day of unemployment
- the applicant is willing to take on any job as a wage employee; the benefit recipient must perform active job search while receiving compensation
- the business is sold, liquidated, or leased (mutually irrevocably for a period of at least five years).

The self-employed may also temporarily suspend their business and register as unemployed upon experiencing an extraordinary event. In such cases, the event must be beyond control of the self-employed and excludes ordinary industry risk. The idea is to insure idiosyncratic exogenous shocks. Incomes must have been critically exhausted.

The amount of the UI benefit is a function of an average of profits of the two best performing annual financial reports within the last five financial years during which the applicant was UI fund member. The parameters of that function are set centrally and are not at the discretion of the individual fund: the benefit rate equals 90% of the average profit (excluding interests, including depreciations

[7] In what follows, we shall interchangeably speak of UI fund membership and being insured.

and labor market contribution), bracketed by a ceiling and a floor. The ceiling/floor correspond to that for workers.[8] In the data, the majority (about three in five) of self-employed would face potential benefits corresponding to the ceiling, and much of the rest (about one in three) would see potential benefits corresponding to the floor.

Jobless persons not covered by UI fund benefits, including those who have exhausted the maximum benefit period, can receive social assistance. The social assistance depends on spousal income and individual circumstances, but is for the vast majority considerably lower than the UI-benefit. To receive social assistance the requirements are that the person is registered as unemployed and is actively searching for a job. Municipalities can, however, coerce recipients to work in public sector jobs.

The Danish old-age retirement pension is compulsory and foresees in retirement from age 67 onward. Integrated in the UI fund system, however, is an early retirement (ER) option open exclusively to UI fund members, allowing retirement at a reduced pension from age 60 onwards. The ER scheme was introduced in 1979, with an eye towards general labor market conditions at the time, and politically supported with the argument that it would bring relief to 'worn-out' blue-collar workers. Access to the ER system is possible irrespective of whether an individual is a wage earner or self-employed. The latter have to sell their business before they can claim benefits. UI fund members aged 60 and older used to qualify if they had been enrolled in the UI system for the last 10 years, typically leading to a spike in the enrollment hazard at age 50, both for wage earners and even more pronounced for self-employed workers.

Importantly, there is no additional premium associated with benefiting from the ER plan. In other words, ER can be had at zero marginal cost for the interested participant. ER benefits correspond to the UI benefits, as discussed earlier. However, once an individual has commenced his ER period, other labor market activities, and hence additional income generation possibilities, are largely precluded.[9]

OECD (2006) illustrates the incentive effects of the ER system (and its current implementation) by showing that the 'implicit tax on continued work' from age 60 onward exceeded 50%. Due to these incentives and because of its generosity, ER became a very popular exit route from the labor force, but

[8] The ceiling amounted to about 135,000 DKK p.a. in 1996, 173,000 DKK p.a. in 2006. 1000 DKK $\approx$ 134 Euro. The floor amounts to 82% of the ceiling, and is essentially due to minimum wage regulation that applies for wage employed (thus, about 142.000 DKK p.a. in 2006). For temporary suspensions, the benefit rate equals 80% of the ceiling.

[9] Small-scale activities, amounting to not more than 200 hours worked per year, were admissible.

caused financial strain to the system and hampered productivity growth. The most important reform during the early 1990s concerned a policy shift in 1992 that required continued membership of at least 20 years before retirement, implying the latest age for joining a UI fund decreased to 40. Individuals aged between 40 and 50 in 1992 were required to join the UI fund in 1992 and stay members until 60 if they were to collect early retirement benefits. For reference, we shall denote members of the cohorts unaffected by the 1992 reform as being subject to the 10-year-membership rule, while those who are falling entirely under the new regime as being subject to the 20-year rule. We shall show below that the empirically relevant variable for enrollment is the implied age threshold and not membership duration per se.[10] Figure 2 illustrates how different cohorts are affected differently in different years in terms of enrollment age requirements.

Figure 2 about here

The ER system was substantially overhauled in 1999. We shall be looking at the situation in the years before the 1999 reform.[11]

During the sample period, other self-employment-relevant policy changes were introduced. From 1986 to 1993, a special subsidy scheme was available that was aimed at the unemployed to setting up their own business. Eligible persons could receive 50% of the maximum unemployment benefit as a start-up allowance for a period of up to 42 months (*iværksætterydelsen*). With the advent of the 1994 labor market policy reform, which launched an array of active labor market programs, the scheme was re-designed (*etableringsydelse*), with maximum subsidy duration of 30 months, before it finally expired at the end of 1997. In our empirical work, we control for participation in such programs by way of including a dummy variable.

[10]To be precise, the rules are framed in terms of minimum numbers of contribution years. When we speak of minimum required enrollment periods of 10 (20) years, the actual rules allow for some additional slack by specifying that the individual needs to have paid contribution at least during 10 (20) out of the last 15 (25) years. For the purposes of constructing our instrument in our empirical work we rely on the implied minimum enrollment period of 10 (20) years, since this is not subject to choice.

[11]Focus of that reform was in particular flexibility in terms of retirement age and possibilities to continue paid work while receiving ER benefits. The reform also made ER eligibility depend on a special contribution to the ER system Beskæftigelsesministeriet (2001), Beskæftigelsesministeriet (2005).

3 A Model of Unemployment Insurance Choice

3.1 Set-up

We now turn to modeling the choice of insurance against unemployment. The model will deliver empirical equations that can be used to estimate individual unemployment risk, and will identify the moral hazard effect of insurance on experiencing unemployment.

The model, while fairly standard and static, incorporates some of the salient features of the Danish unemployment system, as detailed in Section 2. We consider its exposition helpful to relate clearly our identification strategy to follow.

An individual has a take-it-or-leave-it choice in terms of UI. The insurance contract offered by UI funds is an undifferentiated pooling contract: it specifies a single premium and a single benefit which do not depend on insuree characteristics. UI funds have no possibility of declining membership to an applicant. As a consequence, UI funds are not concerned about selection issues, and there is no pricing response when the pool of insurees changes quality over time. No effort is made at separating the population of insurees in the system by offering a menu of contracts. Given these characteristics, we need not model the contract or any other decisions of the insurer.

Let us consider a utility maximizing agent whose utility function u depends on current consumption, C, and leisure, l. Since the model is static, consumption equals income. We make minimal assumptions on u.

Let $u(C,l)$ be twice differentiable and concave in each of its arguments, $u_1(C,l) > 0$, $u_2(C,l) > 0$, $u_{12}(C,l) = u_{21}(C,l) \geq 0$, $u_{11}(C,l) < 0$ and $u_{22}(C,l) < 0$. Income, and hence consumption, is a random variable since it depends on the state of the world. We consider two states: the agent is active as a self-employed entrepreneur, E, or he is unemployed, U. To simplify the exposition we normalize leisure to zero in state E, $l^E = 0$, and to one if unemployed, $l^U = 1$. Following Chiu and Karni (1998), we instead introduce a parameter $\gamma \geq 0$ capturing intensity of preferences for leisure in the utility function, such that $u = u(C, \gamma l)$.

Denote the probability of unemployment by $\pi \in [0,1]$. The expected utility can then be written

$$\mathrm{E}(u(C)) = (1-\pi) \cdot u(C^E, 0) + \pi \cdot u(C^U, \gamma).$$

Unemployment risk is partially insurable by paying premium P. Let s indicate the insurance status ($s = 1$ if the agent is insured and 0 otherwise). If the agent is insured he receives unemployment benefits B when unemployed. Reflecting Danish institutions to first approximation, we assume B to be constant (i.e., independent of past earnings, see page 7). If the agent is not insured he will receive social assistance (welfare), A, which is likewise constant. The difference between benefits and assistance is that benefit eligibility is tied to UI fund membership when a premium must be paid. Assistance is available without payment of premia (see Kim and Schlesinger (2005) for an adverse selection model with private insurers and a government-provided consumption floor).

Allowing for additional non-labor income Y^0, the agent's consumption possibilities depend on the following sources: Y^E earnings (in state E), B, A, and P. Consumption in state E is conditional on insurance status s and equals $C^E = Y^E + Y^0 - P \cdot s$; consumption in state U is $C^U = Y^0 + A \cdot (1 - s) + (B - P) \cdot s$. Furthermore, we assume that earnings net of the insurance premium exceed benefits net of premium, which in turn exceed social assistance: $Y^E - P > B - P > A$. This way, we avoid that social assistance, which an agent can collect without directly paying contributions, dominates incomes associated with participating in the labor market. For the purposes of this paper, we ignore feedbacks in a general equilibrium sense and those that run via the government budget constraint, and will therefore not model the financing of social assistance or the UI system.

Now, consider the possibility that the unemployment probability is partly chosen by the agent,

$$\pi = \pi(\theta, e).$$

We assume π depends on two factors: an exogenous individual risk component, $\theta \in \mathbb{R}$, capturing both e.g. region-specific unemployment risk, but possibly also macro or industry risks, and secondly, effort $e \in [0; 1]$.[12] We assume $\pi(\theta, 0) = 1$, so that agents with strong preferences for leisure will purposely provide no effort to make sure that they will be unemployed. We make the following additional assumptions on first and second derivatives of π: $\pi_e < 0$, $\pi_{ee} > 0$, $\pi_\theta > 0$ and $\pi_{\theta e} > 0$. These imply first-order stochastic dominance of $\pi(\theta, e^a)$ compared to $\pi(\theta, e^b)$ for any two effort levels $e^a > e^b$. The assumption implies that the probability of unemployment is decreasing in effort, but increasing

[12] This is in line with the notation used in Chiu and Karni (1998). Essentially it makes deriving analytical results concerning moral hazard easier, a case we consider below.

effort has decreasing returns. Higher exogenous risk leads to a higher unemployment probability. And finally, for given increase of effort, the unemployment probability decreases more when exogenous risks decrease. Put differently, it is easier to prevent unemployment out of own effort when times are good.

Effort is associated with utility costs (search or time cost, or cost of avoiding employment loss), denoted $f(e)$, with $f'(e) > 0$. Without loss of generality, we assume that $f(e) = \lambda e$, $\lambda > 0$.

The problem of the agent is to choose both insurance status s and effort e,

$$\max_{s=\{0,1\},e} E(u(C,e)) = \max_{s=\{0,1\},e} (1-\pi(\theta,e)) \cdot u(C^E,0) + \pi(\theta,e) \cdot u(C^U,\gamma) - \lambda e.$$

The budget constraint, given that we consider a single period with fixed UI system parameters, is directly incorporated into consumption. To solve the problem we compare the optimal effort provided in the two cases where the agent is or is not insured, and then determine whether utility is higher with or without insurance. In the following we assume $u(Y^0+Y^E-P,0)-u(Y^0+B-P,\gamma) > 0$ and $u(Y^0+Y^E,0)-u(Y^0+A,\gamma) > 0$ (the agent prefers working with earnings over being unemployed with benefit/social assistance).

3.2 Choice of Effort and Moral Hazard

The model yields the standard predictions in terms of effort choice (for further details see Ejrnæs and Hochguertel (2011)). Assuming an interior solution we can show that the optimal effort level as not insured depends on various model parameters:

$$e^{\star I} = e(\underset{-}{\theta}, \underset{-}{\lambda}, \underset{-}{\gamma}, \underset{+}{Y^E}, \underset{-}{Y^0}, \underset{-}{B}, \underset{+}{P}).$$

Subscripted signs indicate the sign of the partial derivative of the function with respect to the argument. The sign on θ is determined by our assumption that $\pi_{e\theta} > 0$ (otherwise, reverse).

It is also possible to show that effort decreases to zero as the UI replacement rate approaches unity,

$$e^{\star I} \to 0 \quad \text{if} \quad Y^E \to B^+.$$

Similarly we can show that that the optimal level of effort when insured. The signs of the derivatives of effort with respect to model parameters are as follows

$$e^{\star 0} = e(\underset{-}{\theta}, \underset{-}{\lambda}, \underset{-}{\gamma}, \underset{+}{Y^E}, \underset{-}{Y^0}, \underset{-}{A}).$$

The effort undertaken by insured and uninsured agents can be compared due to our assumptions on derivatives of π. We find

$$e^{\star 0} \geq e^{\star I}. \tag{1}$$

In addition, if $\lambda < -\pi_e(\theta,1)\cdot(u(Y^0+Y^E-P,0)-u(Y^0+B-P,\gamma))$, both insured and uninsured will provide maximum effort, $e=1$, and if $\lambda > -\pi_e(\theta,0)\cdot\ (u(Y^0+Y^E,0)-u(Y^0+A,\gamma))$ no-one will provide any effort, $e=0$.[13] This behavioral effect (moral hazard) arises because of the cost of effort and the preference for leisure. If there is no cost of effort, $\lambda=0$, then there is no moral hazard problem, since in this case both insured and uninsured will provide maximum effort. One can show several features associated with the moral hazard problem. We will say that moral hazard becomes more pronounced if the difference between the effort provided by insured and non-insured, $e^{\star 0}-e^{\star I}$, increases. Moral hazard decreases if A increases, if P increases or if B decreases.[14]

In general we can write the optimal effort as a function of insurance status, cost of effort and the various income sources:

$$e^{\star} = e(\underset{-}{s}, \underset{-}{\theta}, \underset{\leq 0}{\lambda}, \underset{-}{\gamma}, \underset{+}{Y^E}, \underset{-}{Y^0}, \underset{-}{A}, \underset{-}{B}, \underset{+}{P}).$$

Given optimal effort in the insured and non-insured state, we write

$$\pi^{\star 0} \equiv \pi(\theta, e^{\star 0}), \quad \text{and} \quad \pi^{\star I} \equiv \pi(\theta, e^{\star I}).$$

3.3 Choice of Insurance

To find the optimal insurance status the agent compares the expected utilities when insured and not insured, $\mathrm{E}u^I$ and $\mathrm{E}u^0$. Let $D = \mathrm{E}u^I - \mathrm{E}u^0$. The agent will choose to insure himself if $D > 0$.

It then follows that agents with higher exogenous risk θ are more likely to insure themselves,

[13]This case arises the agent prefers drawing social assistance to working.
[14]This implies that the gain from being insured becomes smaller.

$\partial D/\partial\theta > 0$. Assuming continuity and monotonicity of $D(\theta)$ and that $\lim_{\theta\to-\infty} D(\theta) < 0$ and $\lim_{\theta\to+\infty} D(\theta) > 0$,[15] there will be a "threshold level of risk" $\tilde{\theta}$ where an agent is just indifferent between being insured or not $D(\tilde{\theta}) = 0$. Absent further restrictions on functional form of π, an explicit expression for $\tilde{\theta}$ cannot be given.

Agents with a low risk of unemployment ($\theta < \tilde{\theta}$), will choose not to insure themselves against unemployment ($s = 0$) while agents with a high risk of unemployment will take out an insurance ($s = 1$). We label this 'selection'.[16]

One can show that the insurance decision is affected by the individual risk, the cost of effort and the income sources

$$s = s(\underset{+}{\theta}, \underset{+}{\lambda}, \underset{+}{\gamma}, \underset{?}{Y^E}, \underset{?}{Y^0}, \underset{-}{A}, \underset{+}{B}, \underset{-}{P}).$$

We remark at this stage that the effect of earned and unearned income cannot be signed in general.

3.4 Separating Selection and Moral Hazard

The presence of selection can be identified if the insurance status is observed and individual risk is partially observed. Partition the individual exogenous risk into two components, $\theta = \bar{\theta} + \varepsilon$, of which $\bar{\theta}$ is observed by the econometrician, and ε is only known to the agent. We assume that $\bar{\theta}$ and ε are independent. Insurance status as a function of parameters is then given by

$$s = s(\bar{\theta} + \varepsilon, \lambda, \gamma, Y^0, Y^E, A, B, P).$$

Even if part of the individual risk is unobserved, a positive correlation between $\bar{\theta}$ and s indicates selection.

The main problem is to identify moral hazard. The problem arises because both ε and effort e are only known to the agent. To illustrate the identification problem, consider the impact of insurance status on the risk of becoming unemployed. We assume that agents have rational expectations of

[15] This assumption imposes restrictions on $\lim_{\theta\to-\infty} \pi(\theta, e)$ and $\lim_{\theta\to+\infty} \pi(\theta, e)$. If this assumption is not fulfilled we have that either all will choose to be insured or no-one will choose to be insured irrespective of the level of exogenous risk θ.

[16] We shall refer to the risk-insurance correlation generically as a selection effect. This includes all kinds of sorting and heterogeneity effects. The institutional context (government subsidies as residual budget balancing) does not strictly allow specific welfare-theoretic interpretations of such effects as 'adverse selection'. Selection may exist independently of whether the moral hazard problem is present.

the risk of unemployment, implying $\Pr(U) = \pi(\theta, e)$. Since effort is unobserved we can use the expression for optimal effort

$$\Pr(U) = \pi(\theta, e(s, \lambda, \gamma, Y^0, Y^E, A, B, P)).$$

The effect of effort could be detected through the effect of insurance status. Unfortunately, this will not work unless we are able to fully control for the effect of individual risk, θ. Using the partitioning into $\bar{\theta}$ and ε, the model can be written as

$$\begin{aligned} s &= s(\bar{\theta} + \varepsilon, \lambda, \gamma, Y^0, Y^E, A, B, P) \\ \Pr(U) &= \pi(\bar{\theta} + \varepsilon, e(s, \lambda, \gamma, Y^0, Y^E, A, B, P)). \end{aligned}$$

The model predicts that being insured increases the likelihood of becoming unemployed through its effect on effort. However, the positive impact is caused by both moral hazard and selection. Moral hazard implies that insured agents provide less effort, which increases π, while selection implies individuals with a high ε are more likely to insure themselves but also have a higher risk of unemployment. Therefore, the effect of insurance status on subsequent unemployment does not disentangle the moral hazard problem from selection effects.

To overcome this problem, we exploit the early retirement feature of the Danish unemployment insurance system: for some agents (at some ages) additional benefits associated with the insurance are available. The benefit R is the option to retire early, which can be used at least 10 years after the insurance choice has been made. By assuming time-separability between today where the insurance choice is made and the future where the retirement option can be exercised, we model the retirement option as an additive term enhancing utility, where β is a discount factor. The problem of the agent is then

$$\max_{s=\{0,1\},e} E(u(C,e)) = \max_{s=\{0,1\},e} (1 - \pi(\theta, e)) \cdot u(C^E, 0) + \pi(\theta, e) \cdot u(C^U, \gamma) - \lambda e + s\beta R.$$

Due to additivity, optimal effort conditional on insurance status is unaffected by the additional benefit.

Optimal insurance status will, however, be affected positively. This implies that the problem is

$$s = s(\overline{\theta} + \varepsilon, \lambda, \gamma, Y^0, Y^E, A, B, P, R) \quad (2)$$

$$\Pr(U) = \pi(\overline{\theta} + \varepsilon, e(s, \lambda, \gamma, Y^0, Y^E, A, B, P)). \quad (3)$$

By using the variation in insurance status caused by the additional benefit we can identify the effect of insurance status solely caused by the moral hazard problem. The identifying assumption is that the discounted value of the retirement option is uncorrelated with the unobserved individual risk ε.

The empirical results presented in Section 5.3 below can be interpreted under this assumption. We shall devote some space in Section 5.4 to discussing the validity of the instrument.

4 Data and Descriptives

4.1 Register Data

The CAM 10% Sample is based on a 10% random sample of the Danish population aged 16 and above from the Danish National Register. The data thus covers more than half a million individuals. Underlying the data are various administrative sources which are linked into a single large database. Sampled individuals are followed over time, annually, from 1981 onwards. We use all waves up to and including 1998. The sample is unbalanced in the sense that new qualifying residents (turning 16, or newly arrived immigrants) enter, whereas people leave due to death or emigration.

Due to its administrative nature, the data is very reliable in terms of measuring observable income reports and tax file status of individuals. In particular, any relevant fact that is related to receiving benefits is accurately observed, such as membership in a UI fund or labor market status. Labor market status is recorded in calendar week 48 (late November) of any given year. Insurance status (UI fund membership) is recorded as per December 31 in any given year. Individuals are classified self-employed according to their main economic activity in that particular week.

Individuals are classified unemployed when registered as such with a job center. Importantly, registration at a job center is not limited to UI fund members. It is a condition not only for receiving UI benefits, but also for receiving social assistance benefits. The data will therefore even record those as unemployed that are not eligible for UI benefits.[17,18]

Unemployment can be measured in two ways. First, using the week-48 labor market indicator, we observe the stock of unemployed in that week. Second, the data records the ‘unemployment degree’ during the entire year, i.e., the fraction of time registered as unemployed. In the empirical analyses we exploit both measures.

Due to its sheer size, the CAM 10% Sample covers a very large number of self-employed individuals and will hence reliably reflect population transitions in terms of labor market status and insurance membership. Sample size is important because of three reasons: (a) the level of self-employment in Denmark is rather low in cross-European comparison, (b) transitions are not very frequently observed and are essential for our analysis, and (c) as can be gleaned from the empirical literature on self-employment, there is substantial heterogeneity requiring large samples in order to reliably measure responses to policy variation and changes in characteristics.

We restrict the sample according a few observable variables, in order to reduce heterogeneity. First, we only consider Denmark-born males with Danish citizenship. Second, we restrict attention to the age group of 25-59 year olds, since we are primarily interested in individuals choosing UI fund membership and occupation before actually exiting into early retirement.

We exclude students and individuals who are retired at the time of observation, as well as those who are out of the labor force in every year. We also exclude any remaining observations of persons receiving public pensions in a given year.

We exclude all individuals that in the period 1981-1998 have been working either as wage earners or self-employed in the agricultural sector. Sectoral change strongly affected employment opportunities for these people. Moreover, there are likely behavioral differences between farmers and other self-employed persons that are not easily explained by observables.

[17]We have no reason to presume that unemployed non-UI-fund-members may not register as being ‘unemployed’ and would be counted as ‘out of the labor force’ in the data. The transition rates from out of the labor force (in particular into employment) are the same for both UI fund members and non-members. If non-members actually had been unemployed we would expect them to a larger extent to return to employment.

[18]Further note that being registered as unemployed does not automatically imply receipt of benefits for UI fund members, but take-up rates are about 97%.

4.2 Labor Market Status and Unemployment Insurance Status

Inspection of the raw data reveals that the sample grows with time, reflecting population growth and labor market expansion. On average, 9% of all individuals in the sample are self-employed, with a strong negative time trend (10.3% in 1981 to 7.7% in 1998).[19] Compared to other published statistics from Denmark the level is somewhat higher, owing to the fact that we only consider males aged 25-59, with self-employment being a predominantly male activity with strong age patterns.

Figure 3 further breaks down self-employment (as percentage of the labor force) by time and year-of-birth cohort, for selected cohorts. Older cohorts appear to be more likely self-employed than younger ones (cohort effects, suggested by the 'vertical difference' between the various lines), while behavior also changes with age: the oldest cohorts appear to be leaving self-employment quicker, while the younger ones appear to become more likely self-employed as they grow older. Time effects (business cycle patterns) are less clearly visible.

Figure 3 about here

Turning to UI fund membership, Figure 4 displays the percentage of UI fund members among those in self-employment.[20] Again, we see a number of pronounced patterns in the data. The first panel relates to some of those cohorts that were subject to the rules before the policy change in 1992 ('10 year membership rule'), the last panel relates to those who were clearly subject to the new regime ('20 year rule'). The graph in the middle refers to some cohorts falling into the intermediary regime (compare Figure 1, discussed in the introduction, and which is drawn irrespective of self-employment status). People from the 10-year-rule join UI funds as they get older, the curve flattening out towards them reaching age 60. There is a clear upward jump in the figure at age 50. Likewise, we observe a distinct time effect for the people from the intermediary group whose enrollment hazard peaks sharply in 1992, the year when the new rule came into force and provided the incentive to join in that particular year and stay member for reasons of ER eligibility. The enrollment rate after 1992 for this group exceeds that of the 10-year-rule group by, on average, 5 percentage points (80 v 75 percent) at even earlier ages, suggesting that the law change may have pushed additional people into joining the insurance funds (perhaps those who did not want to forfeit the option for ER eligibility). Finally, the

[19] See Ejrnæs and Hochguertel (2011) for details.

[20] Qualitatively similar effects are found if we also consider wage workers.

figures for the 20-year-rule group display likewise a pronounced jump at age 40. This group quickly (at early ages) reaches an enrollment rate of close to 70%.

Figure 4 about here

The last panel of Figure 4 reveals a somewhat pronounced dip in enrollment, occurring between 1989 and 1992, across all cohorts from the late group. Some institutional changes between 1988 to 1989 in the UI legislation may provide a partial explanation, leading to substantial reduction in the generosity of the program. For instance, UI benefits were only indexed with half of the change in CPI. The dip will not have been triggered by the early retirement incentives, which is the more important aspect for our purposes.

Also, in 1992 there was a general increase in the membership rate of UI funds, even among cohorts that were not affected by the reform. An obvious explanation is a very high unemployment rate at the time (which peaked in 1993). We will control for the general increase by including the regional unemployment rate. In addition, an exhaustive set of time dummies will be included, making sure that specific patterns will not compromise identification of the parameter of interest.[21]

It is instructive to have a look at UI fund entry rates, split by the years before and after the ER eligibility incentive is relevant. If we condition on being self-employed but not insured in year $t-1$, we find a UI entry rate of 9.49 percent per year before the eligibility incentive becomes relevant. At the last year to sign up this rate increases to 30.10 percent and afterwards the rate falls back to 11.19 percent (Ejrnæs and Hochguertel (2011)). This shows that the self-employed are much more likely to join a UI fund while reaching the deadline for signing up in order to be eligible for ER incentives.

The descriptives reported here suggest two things: (a) there is an insurance motive to join the UI fund, resulting in a transition rate into UI funds of roughly 10% (this motive is present both before and after the reform); (b) there is an additional incentive to join the UI fund stemming from the ER plan, resulting in an additional 20% transition. It is the ER incentive that stimulates in particular the self-employed to join the insurance fund and to not subsequently leave it.

[21] Effectively we are using the larger increase among the cohorts affected by the 1992 reform compared to the remaining cohorts.

5 Estimation and Results

5.1 Econometric Approach

We proceed to estimate the effect of unemployment insurance on subsequently becoming unemployed. This can be most simply and transparently done using a binary regression estimating the probability of being unemployed in year t when the past state of origin is self-employment. We measure unemployment in year t by an indicator equal to one if the individual was registered unemployed in excess of 10% of the year ('unemployment degree'), and zero otherwise.

Introducing notation for the econometric model, let $y^{\star}_{jit}$ denote the latent variable j (say, the demand for insurance or the propensity to become unemployed) for individual i at time t. We model this as a function of a vector of observables x_{jit}, as well as unobservables ξ_{it},

$$y^{\star}_{jit} = \beta_j x_{jit} + \xi_{it}.$$

We observe the indicator $y_{jit} = \mathbf{1}[y^{\star}_{jit} > 0]$ in the data, where $\mathbf{1}[A]$ takes value 1 if A is true and zero otherwise. The specification of the probability model is completed by making assumptions on the structure and distribution of the unobservables. In particular, we shall assume that ξ_{it} equals the sum of a random individual effect η_{ji} and an error term ε_{jit}.

We choose a random effects model in order to be able to calculate marginal effects of the coefficient of interest on the probability of becoming unemployed. We do cross-check in the sensitivity analysis with a fixed effects approach.

Both random effects and errors are assumed i.i.d., the random effects (bivariate) normal, the errors (bivariate) standard normal,

$$\begin{pmatrix} \eta_{1i} \\ \eta_{2i} \end{pmatrix} \sim \mathcal{N}\left(0, \begin{pmatrix} \sigma^2_{\eta_1} & \rho_\eta \sigma_{\eta_1} \sigma_{\eta_2} \\ \rho_\eta \sigma_{\eta_1} \sigma_{\eta_2} & \sigma^2_{\eta_2} \end{pmatrix}\right), \qquad \begin{pmatrix} \varepsilon_{1it} \\ \varepsilon_{2it} \end{pmatrix} \sim \mathcal{N}\left(0, \begin{pmatrix} 1 & \rho \\ \rho & 1 \end{pmatrix}\right).$$

The univariate and bivariate random effect probit models are estimated by Maximum Likelihood. We rely on Gauss-Hermite quadrature and a Newton-Raphson optimization algorithm, supplying analytical first and second derivatives.

We start the analysis with estimating (standard) univariate random effects models for unemployment, y_{2it}, hence assuming $\rho = \rho_\eta = 0$, and include in x_{2it} the lagged insurance indicator y_{1it-1}. These estimates allow us to calculate the marginal effect of being insured on the probability of becoming unemployed as the difference in the predicted probability $\Pr(y_{2it} = 1|\cdot)$ when the insurance indicator y_{1it-1} is set to 1 and 0, respectively. The predicted probabilities are conditional on the observed regressor values in the sample, hence we calculate the sample average partial effect of insurance. Since the probabilities are also a function of the unobserved random effects, we integrate them out (Monte Carlo) using the estimated distributional parameters. These calculations are done post-estimation.

The univariate models are interesting in their own right, as they may give us some understanding as to the importance of sorting in a heterogeneous population into unemployment. However, they are potentially misspecified in the sense that they disregard the endogeneity of insurance. To take account of the latter, we model the insurance decision by a function of observables and unobservables, and allow for cross-equation correlation among both the individual-specific effects and the idiosyncratic errors. Fully spelled out, the bivariate model is:

$$\text{(insurance)} \qquad y^\star_{1it} = \gamma z_{it-1} + \beta_1 x_{it-1} + \eta_{1i} + \varepsilon_{1it} \qquad (4)$$

$$\text{(unemployment)} \qquad y^\star_{2it} = \alpha y_{1it-1} + \beta_2 x_{it-1} + \eta_{2i} + \varepsilon_{2it} \qquad (5)$$

as implied by (2) and (3).

We also introduce an instrumental variable into our insurance choice equation (4), the institutional rule of ER eligibility, z, to make sure that the identification of α is not entirely coming from functional form assumptions. In the following subsection we discuss the instrument. Given proper handling of the insurance endogeneity, the resulting average partial effects of insurance from (5) correspond to average treatment effects in the population of interest.

5.2 Estimation Sample and Specification

We consider the sub-sample of people who have been self-employed in at least three consecutive years before transitioning into unemployment, conforming with the institutional rules for drawing benefits. We further restrict the estimation sample to those that are not classified as unemployed according to this measure in any of those three years. The latter restriction reduces the sample size very slightly.

We are left with 13,434 individuals and 86,092 observations in the estimation sample.

Both the unemployment measurement and the sample exclusion are meant to reduce the number of individuals that temporarily dip into unemployment when in between jobs or ventures, as well as to clean out those that in the initial three-years period are partly self-employed and partly unemployed. We prefer to work with a sample allowing to observe actual transitions from (full-time) self-employment to unemployment, to obtain a cleaner estimate of the effect of interest. A sensitivity analysis (Section 5.4) will check some of the sample restrictions as well as specification choices.

We use a specification that closely mirrors the economic model set out above but also controls for characteristics or conditions found relevant in the empirical literature.[22] The unemployment equation (5) should therefore include not only insurance status, but also observable risk, and proxies for the cost of effort and the marginal value of leisure (taste shifters) and human capital. Furthermore, we ought to control for own income and exogenous resources (such as spousal income and wealth). Additional taste shifters included relate to marital status ("single"), having children of age 17 or younger living in the household, and the number of years of experience as wage-earner, which will pick up labor market attachment. We further wish to control for health as far as observable. Unfortunately, data limitations leave us no choice but to use the receipt of sickness benefits as health or illness measure.

We control for whether a start-up allowance was received for persons entering self-employment from unemployment through active labor market programs. Income from self-employment (surplus or profit of business) is included linearly, supplemented by a dummy whether it was negative. Income and wealth amounts are measured in constant 1981 million DKK.

Model parameters such as the unemployment insurance premium, and effectively also the unemployment benefit level have no or only marginal variation in the cross section (see page 7). Their temporal variation will be picked up by the time dummies included. The potential social assistance cannot be calculated since it depends on an assessment of the individual's needs. It is conceivable that the risk to become unemployed also differs across regions, industries and education groups. We hence include additional sets of dummy variables. Education is a relevant proxy for both human capital and life-time earnings potential or permanent income, industry dummies pick up differential

[22]Taylor (1999), Bates (1990) and Holmes and Schmitz (1996) found that human capital variables are important for the duration of self-employment. Carrasco (1999) focuses on aggregate labor market conditions that are important for exits from self-employment.

industry risks in bankruptcy and unemployment, and regional dummies allow for geographical differences in unemployment risk (local labor markets). In addition, we refine the risk indicators by what are essentially interaction effects, i.e., in our standard specification we measure regional unemployment risk by the time-varying regional unemployment rate calculated from the micro data and include it over and above the regional effects.[23]

In all our models we control for age, cohort and time effects by including a cubic polynomial each in age and cohort together with a exhaustive set of time dummies.[24]

We do this to make sure that the instrument is not picking up age, cohort or time effects and that the identification only comes through the changes over year and cohort in the retirement eligibility rule. The independent variation in the instrument is coming from the fact that different cohorts face different eligibility ages.[25] Under the assumptions that cohort, age and time effects enter additively and that errors are additively separable, the model is non-parametrically identified (see Appendix A for details.)

Table 1 about here

Table 1 supplies summary statistics, broken down by insurance status in year $t-1$. As indicated by the variable labels, most regressors have been lagged at least once or three times. These lags ought to make sure that the value we condition on is pre-determined for the choice under consideration, and not a current choice variable that is determined jointly with the outcome variable of interest.

There is substantial state dependence in insurance status. On average, 9% enter insurance between two years, and less than 2% exit. Clearly, those who are insured are more likely to transition into unemployment than those who are uninsured. The difference is about 1.8 percentage points (also see Table 3). We see further pronounced observable differences between both groups. Some of the difference in unemployment between the insured and the uninsured may simply have to do with heterogeneity rather than behavioral responses: the insured subsample is, on average, more likely to be older, married, poorer (in terms of wealth or income), experienced (as wage earner), and receiving

[23] In sensitivity tests we alternatively include an education-specific unemployment rate or an industry-specific bankruptcy rate.

[24] There are at most 18 years from 1981 to 1998 per individual, and three years are being used to condition the sample on self-employment status, leaving time series of maximum length 15. Since we also include polynomials in age and cohort that have a linear term each, we have a maximum of 13 time dummies for 1986-1998.

[25] See Figure 2.

start-up support.

Finally, the Table also displays means for three sets of variable groups that we wish to control for in the estimation, but whose coefficient estimates we shall suppress in what follows: education, industry affiliation, and region of residence. Among the highest educated we find fewer insured, there are intuitive correlations between insurance status and industry, and we find that those from the capital region are much less likely to be insured.

5.3 Estimation Results

In Table 2 we present estimates of the univariate model for two different specifications. The simple specification only includes insurance status together with age, cohort and year effects and the main specification contains all the covariates described above.

The standard deviation of the random effects distribution is very precisely estimated, indicating a substantial statistical contribution of the random effect to the model.

Table 2 about here

The estimation results show that membership in a UI fund has a large and significant positive correlation with unemployment. The average marginal effect is 2.2 percentage points (see Table 3) and is hence in the same order of magnitude as the sample average unemployment probability: insured individuals are twice as likely to fall into unemployment than uninsured ones.

The marginal effect falls to 1.8 percentage points (see Table 3) when we include more covariates in the main specification. A likelihood ratio test reveals that inclusion of these observables that are partly suggested by theory are a statistically important addition to the model.

Table 3 about here

However, these estimates do not reveal if this difference is due to selection or sorting effects caused by unobserved characteristics (heterogeneity) or due to moral hazard (the causal effect of insurance).

The estimation results of the bivariate model, taking account of the endogeneity of insurance are shown in Tables 4a (insurance enrollment) and 4b (unemployment incidence). Across both specifications, the random effects modeling is a valuable addition in a statistical sense. We do note, conforming with intuition, that the estimated random effects standard deviations (σ_{η_1} and σ_{η_2}) decrease as more observables are being added to the model. At the same time, both correlation coefficients ρ and ρ_η are robustly and precisely estimated, with the random effects correlation ρ_η being about twice as large as the idiosyncratic error correlation ρ. As these correlations are large and positive, our bivariate modeling approach is indispensable. The same unobserved factors that lead people to choose insurance also predispose them to unemployment. This is consistent with a selection into the unemployment insurance.

Table 4a about here

Commenting briefly on the estimates, we consider the insurance equation first (Table 4a). We find that the instrument (the retirement incentive) has a large and significant effect on the likelihood to be insured in all three specifications. The Wald test statistics (χ^2-distributed with 1 degree of freedom) for the instrument to be relevant is 80.3 for the simple specification and 33.2 for the main specification. This indicates that we do not have a problem with weak instruments.

The average marginal effect (separately displayed in Table 3) of the presence of the retirement incentive varies from 2.6 to 3.7 percentage points across specifications. It is smaller than the raw data suggested (Figure 4), but does control for both observed and unobserved heterogeneity. In particular, we control for age, cohort and year effects in a very flexible way. We view this as convincing evidence that the measured effect is not due to a pure age or cohort or time effect but is in fact separately identified by the changing retirement incentive.

Continuing with a focus on the main Specification, the Table shows that the probability of being insured against unemployment also varies across background characteristics. The results show that being single has a strong positive impact on the insurance and income of the spouse has a significant negative impact. Both effects are consistent with a substitution between formal insurance obtained through UI fund membership and informal insurance provided by the spouse. Also the age of the spouse has a strong positive impact. This could also be related to informal insurance, where an older spouse's labor supply can provide less insurance. An alternative explanation could be that spouses tend to sign up together and if the spouse is older she will have to sign up before in order to become eligible for early retirement. Having a non-working spouse and having children both decrease the likelihood of an insurance. A plausible explanation could be that persons with these family characteristics will be more likely entitled to means-tested social assistance and therefore have less need of an unemployment insurance. Both income earned as self-employed and wealth have a negative impact, but neither of the effects are significant.

Previous labor market experience as wage earner has a strong positive impact on the likelihood of being insured, owing to the higher insurance rate among wage earners. Persons who previously have received support to start up their business are more likely to be insured, which may be explained by the institutional setting. Among the perhaps less intuitive results we find that the regional unemployment rate has a negative impact. Note, however, that we have controlled for both year and regional effects, so the displayed coefficient on the unemployment rate reflects only the remaining variation.[26]

Table 4b about here

Turning to the equation for unemployment in Table 4b, we still find a positive and significant effect of the insurance on the probability of subsequent unemployment. However, both coefficient and average partial effect have dropped to a mere third of that in Table 2. The marginal effect of insurance amounts to 0.6 percentage points after instrumentation. We shall return to this observation in Section 5.5.

We discuss the other covariates in the main Specification. Results show that the probability of unemployment varies across age, industries, and education groups. Furthermore, we also find that spouse not working and spouse income have a strong negative impact. A possible explanation could be positive correlated heterogeneity between spouse's preferences for leisure or that a non-working spouse increases the value of leisure (both results are found in the literature on joint retirement). We also see that self-employed which can generate a high income (successful self-employed) and have higher wealth levels (being more robust to adverse shocks) are less likely to become unemployed. According to our theoretical model, non labor-market income such as spousal income and return on wealth should increase the probability, but in the current specification it is difficult to say if this is a pure income effect or if these measures also act as proxies of abilities or human capital e.g. via assortative mating.

Also health affects the probability, such that the probability increases for persons with bad health.

[26]The sign on the regional unemployment rate changes if region dummies are excluded. Similar remarks apply when we use different measures of the macro risk. Education, region, industry, and year dummies thus absorb much of potential macro shocks.

This effect is consistent with illness increasing the value of leisure or the cost of effort. Finally, we find that self-employed who previously received support for start-up are more likely to become unemployed. Again, this can be due to lack of abilities. Marital status and children does only have a small and insignificant impact. Interestingly, it seems as if the covariates which have a strong impact on the insurance decision only have a minor impact on the unemployment decision. In general our results are consistent with those previously found in the literature.

5.4 Sensitivity Tests and Goodness of Fit

In this subsection we perform a number of sensitivity tests on our main specification. Results of the sensitivity checks are in Table 5, where we report the estimates of our key parameter α. Full results are available on request.

Table 5 about here

The first set of sensitivity tests investigates the impact of the random effect assumption. The first variation replaces the univariate random effects probit with a fixed effects logit model. Considering this model is of interest since we can relax some of the strong assumptions that we need to make in a random effects setting, in particular the uncorrelatedness between regressors and individual effects. The latter is the reason why it is conceivable that the fixed effects estimate of α may be less susceptible to endogeneity bias than the random effects counterpart. To the extent that selectivity operates only through fixed characteristics as opposed to the idiosyncratic error term, the fixed effects estimate of α will be consistent. Sample size is reduced to a tenth, as only observations with changes in the dependent variable (unemployment) contribute to the likelihood. We exclude industry, education, region, and past experience from the specification, since there are only very few individuals who change category in any of those measurements. The coefficient and standard errors displayed are rescaled with factor $\sqrt{3}/\pi$ to make them comparable to the probit metric. The rescaled coefficient stays comparable in magnitude to the random effects counterpart, however.

One interpretation of this result is that much of the selection is indeed working through the time-varying heterogeneity. In that case, the fixed effect logit estimator is subject to endogeneity bias. An alternative explanation is a potential correlation between the random effect and insurance status that biases the bivariate probit estimate. We think this is less likely given the large set of covariates we are able to control for, including detailed measures of education and industry affiliation.

A second set of specification check compares the simple bivariate specification with a similar one where we replace the age and cohort polynomials with an exhaustive set of dummy variables in age and year of birth. The estimate of the coefficient of interest stays remarkably close, suggesting that the age and cohort polynomials are good parsimonious approximations to the true but unknown underlying age and cohort patterns. The likelihood does decrease considerably, and the change is significant, but the degrees of freedom are also quite large (136). We prefer the polynomial version for computational reasons.

The third sensitivity test shows results from a linear probability IV model with fixed effects in both equations. Again, we just condition on age, cohort and time, using a full set of dummies, but no other covariates. This model is worth considering because it makes the weakest assumptions on the unobservables and keeps the functional flexibility in the conditioning set. It falls into the class of nonparametric models considered by Blundell and Powell (2003) (see Appendix A). The result indicates that the impact of insurance is positive and borderline significant. The confidence interval of the coefficient estimate covers the value of the marginal effect that we obtain from our bivariate probit model, see Table 3. The linear probability model does impose a global marginal effect, however. Since our data are concentrated in the tail of the distribution, we do prefer a binary choice approach.

The following battery of checks are based on variations on the main specification from the bivariate probit model.

In the fourth deviation we define our indicator of unemployment based on labor market status in week 48, instead of the measure that refers to the whole year. We estimate again a positive significant coefficient which is slightly larger, although the difference is not significant.

In the next two variations we replace the aggregate risk measure 'regional unemployment rate' with (1) an education-specific unemployment rate (calculated from the micro data) and with (2) an industry-specific bankruptcy rate (available as a separate series from Statistics Denmark, from 1984 on). The estimates are virtually unchanged for both models.

Next, it may be of interest to explore if different subgroups of the population experience different speeds of falling into unemployment. The risk may be particularly high for declining industries, since upon receiving a shock that pushes the firm towards bankruptcy it will be more difficult for the self-employed entrepreneur to steer away from unemployment if in general the industry does not support as many firms as previously. (Declining industry effects have been found to be of importance in the layoff literature, e.g., Idson and Valletta (1996)). We flag as declining industries those whose employment share show a marked decrease over time in our estimation sample. These are manufacturing and retail. We find that individuals working in the declining industries have a higher propensity to insure themselves, but there are no significant heterogeneous effects in terms of unemployment transitions.

The eighth specification check excludes income-related variables and wealth. While those are significant in the baseline, and their exclusion impacts on some of the other coefficients in the model, the parameter of interest is almost unaffected, and hence there is no bias from including these potentially non-exogenous variables.

The ninth variation explores to what extent there is additional dynamics in the estimated process coming through the regressors, in particular the income-related variables and receipt of start-up support benefits. This may be a reasonable approximation to a more flexible dynamic model that might condition equations (4) or (5) on own lagged values. As the discussion around Table 1 showed, the change of insurance status between two years is limited, and so is the change in the probability of unemployment. Both would a-priori not suggest much scope for dynamics. Indeed, our estimates are very close to the baseline, and the coefficient of interest α changes only very little.

The tenth variation draws a different sample, but estimates the same model: here, we only condition on being self-employed (and not unemployed) in the previous year.[27] Whereas the sample grows by nearly one half, the estimated coefficient only changes little. The change is negative, which is expected given that the sample is now contaminated with self-employed that strictly speaking do not qualify for UI benefit receipt.

Finally, we consider to which extent our estimates might be biased by an initial conditions problem. Our model is not a dynamic model in the sense that the lagged endogenous variable were included as a regressor. Furthermore, the main specification contains covariates that are likely to capture relevant information about conditions prior to the onset of the conditioned self-employment spell i.e. receipt of start-up support. We implement a simple version of the Wooldridge (2005) approach by

[27] We also only use regressor values lagged at most once.

including an indicator for being unemployed in the initial state, that is in period $t-4$. The inclusion of this variable does not affect any of our estimates, however.

The main conclusion to be drawn from the exercise is that the estimates are remarkably robust. The parameter estimates from the bivariate probit survive all kinds of specification changes. We cannot entirely exclude remaining misspecification due to a potential correlation between individual effects and regressors. The alternative fixed effects IV linear probability estimates, however, yield estimates that compare favorably in magnitude with the implied average partial effects from the RE probit analysis.

In order to get some idea how well the bivariate probit model fits the data, we look at some summary measures of predicted values. Table 6 predicts probabilities for insurance choice ($\hat{P}_{1it}$) and unemployment ($\hat{P}_{2it}$) from the estimated parameters for each observation, while integrating out the random effects. Comparing to sample averages in the data, the average predicted probability for being insured is quite close to the observed average indicator. The model only slightly overpredicts the average unemployment incidence. We also construct per observation an indicator whether or not the predicted probability exceeds the threshold of 0.5 (i.e., $\hat{I}^{0.5}_{jit} \equiv \hat{P}_{jit} \geq 0.5$), and use this as the predicted dummy variable. The distribution of these dummies is very different from the data, however. One reason is certainly the fact that the marginal distribution of predicted probabilities is left skewed for the insurance choice and strongly right skewed for the unemployment incidence.

Table 6 about here

Leaving the predicted dummies unchanged will hence make it impossible to assess in how far the model reflects the correlation in the data. We therefore calculate a new predicted indicator defined by $\hat{I}^{\tau_j}_{jit} \equiv \hat{P}_{jit} \geq \tau_j$ that is obtained by shifting the number τ_j away from 0.5 such that $\hat{I}^{\tau_j}_{jit}$ corresponds to the marginal probability P_j observed in the data (column 1 of Table 6). The bivariate distributions in Table 7 show that the model picks up the correlation in the data very well.

Table 7 about here

Closing this section with a short discussion on the quality and validity of the instrument, there are two conditions that a good instrument has to fulfill. First, it needs to be correlated with the instrumented variable. Figure 1 and the first stage estimation (see Table 4a) clearly show that this is the case. Second, there must be no correlation between the error in the outcome equation and the instrument. Potential candidates that might induce such a correlation are preferences of leisure and health status. The latter is included in the specification by means of a regressor. Preferences for leisure are partly controlled for by covariates relating to spouse characteristics. In addition, the retirement decision is quite far in the future (at least 10 years ahead). This should weaken the correlation if it exists. Alternatively, our fixed effects IV approach (linear probability model) is based on the same instrument, and takes account of time-invariant preferences for leisure. It produces an estimate of α that is comparable to the marginal effect from the bivariate random effects probit.

5.5 Discussion of the Results

Moving on to a short discussion of the economic interpretation, the bivariate model identifies the causal effect of having an insurance on subsequent unemployment through the parameter α in (5), when the selection into insurance (4) is adequately modeled. This is what we call moral hazard, occurring conditional on being insured. The treatment effect α in the bivariate model is quite precisely estimated and its magnitude is unaffected by a host of specification changes.

Our results show that the marginal effect of insurance is about 0.6 percentage points and significant. This indicates that moral hazard exists. We also find evidence for selection both through observables, but mainly through the unobservables.

To quantify the impact of moral hazard we can decompose the observed difference between insurees and non-insurees into moral hazard effects on the one hand and selection or heterogeneity effects on the other hand. A comparison of the raw transition rates (see Table 3) suggests that insurees are about 2.2 percentage point more likely to become unemployed. Controlling for observables this number falls to 1.8 percentage points and controlling for endogeneity caused by unobservable the effects falls further to 0.6 percentage points. This suggests that moral hazard effects accounts for about 30 percent of the observed difference, while the remaining 70 percent is explained by heterogeneity and selection.

In a standard insurance contracting context, the determinants of $y_1^\star$ that are unobservable to the insurer or non-contractible may give rise to adverse selection effects in the sense that an ensuing response from the insurer results in further pricing certain risk groups out of the market. In the context of the subsidized Danish unemployment insurance, this is of little direct concern. The absence of price effects could imply that there are more sorting effects into the insurance market also by observables than there would have been in a market with price responses.

Concluding with a short glance at related literature, our findings can be compared to estimates obtained elsewhere. Close in spirit are some articles on the effect of UI parameter variation on labor market outcomes of workers. Baker and Rea (1998) study Canadian data for which workers need to be employed prior to being able to draw UI benefits when unemployed. The entrance requirement varies across time and provinces. The policy shock was an accidental lapse in UI legislation. The authors find a decreased hazard of exiting to unemployment when the entrance requirements are tightened. Similar, in the sense of looking at the probability of becoming unemployed is Winter-Ebmer (2003), who studies the intensive margin of UI parameter variation on measured outcomes and conditional on being insured. The separation of moral hazard from selection effects is not focus of the analysis. His data are from Austria where counties with a large number of steel workers experienced a quadrupling in UI potential benefit duration. The author finds that workers in affected regions were observed with higher probability to flow into unemployment. On the entrepreneurial side, the study of the effect of bankruptcy exemptions by Fan and White (2003) briefly discusses firm exits, finding no pronounced effects, however. The authors likewise do not attempt to distinguish selection and moral hazard. To our knowledge the only other paper that empirically has considered moral hazard among entrepreneurs is Paulson et al. (2006). These authors report evidence of moral hazard although in a somewhat different context. Our moral hazard results are also broadly in line with the study by Chetty (2008), who finds that moral hazard effects explain at most 40% of the increased unemployment duration caused by increased UI benefits. Contributions to the car insurance literature seem to only find residual moral hazard of lesser importance (e.g., Chiappori (2000), or Abbring et al. (2003)).

6 Conclusions

In this paper we empirically identify and estimate the magnitude of moral hazard effects among self-employed in an environment where a partial insurance mechanism exists against income loss. Such insurance systems (exemption levels and debt discharge in bankruptcy proceedings are other examples) are of first-order importance for individuals' willingness to take on large risks.

Although moral hazard plays a prominent role in the theoretical literature that studies incentive provision through contracts when the entrepreneur contracts with a financier, empirical evidence on the existence and magnitude of moral hazard effects for the self-employed is very scarce.

We do provide such evidence. We examine to what extent the transitions from self-employment to unemployment are due to the mere fact that the person is (voluntarily) insured against unemployment risk. In keeping with the usual interpretation in the insurance literature, we view such effects as evidence of lack of effort to prevent business failure.

The main empirical specification takes the form of a bivariate random effects probit model for insurance choice and unemployment incidence, estimated on a large longitudinal sample of self-employed individuals drawn from register data. To disentangle such moral hazard effects from selection effects we use an institutional feature of the Danish UI system that provides an additional motive (an early retirement option) for taking up insurance at certain ages. We exploit an eligibility reform of this early retirement option within our sample period as an instrument ("natural experiment") to achieve identification.

To summarize our results, we find that the raw data suggest that insurees are more likely to subsequently become unemployed than the uninsured. The difference in transition rates is about 1.8 percentage points, and hence very sizeable compared to a raw unemployment rate of about 2 percent in the sample.

This observed difference will be due to both selection and moral hazard. Correcting for age, time, and cohort effects in a univariate model, the marginal effect of insurance actually increases to 2.2 percentage points. If we furthermore control for individual characteristics the marginal effect of insurance decreases again to 1.8 percentage points.

Moving to the bivariate model, the marginal effect drops to 0.6 percentage points. This suggests that of the original difference only about 30 percent is due to moral hazard, while the remaining 70 percent is due to heterogeneity or sorting. The main contribution of this paper is thus to be able to establish the existence of moral hazard and to quite precisely estimate its magnitude. To our knowledge this is the first study that quantifies the moral hazard effect among self-employed and we provide first-time empirical evidence on the relevance of moral hazard for entrepreneurs within a "large insurance program". The overall magnitude is not very big, however, such that only a limited proportion of business failure can be attributed to the lack of effort.

Many if not most countries will exclude the self-employed from UI or other formal insurance mechanisms, possibly for fear of them exploiting the system. Our results suggest, however, that the Danish system that is in some sense particularly vulnerable to such behavior, does not suffer from moral hazard to a large extent. There is reason to believe that these behavioral responses are probably higher in the the actual system than in a counterfactual scenario where insurance parameter choice (premium, level and duration of benefits, etc.) were to optimally anticipate on such behavior. Hence, provision of or easing access to insurance to the self-employed in other countries may deserve consideration.

Our results are obtained in a Danish context where a formal unemployment insurance is available to the self-employed. Although, many if not most countries will exclude the self-employed from formal insurance mechanisms, the self-employed have other insurance devices at their disposal where moral hazard effects also could potentially exist. For instance, in the literature on US bankruptcy legislation the potential existence of such effects has been acknowledged but not yet formally tested. Our result suggests that a thorough investigation of potential moral hazard effects for the US institutional context may merit future attention.

References

Abbring, J. H., Chiappori, P.-A., and Piquet, J. (2003). Moral hazard and dynamic insurance data. *Journal of the European Economic Association*, 1:767–820.

Aghion, P. and Bolton, P. (1997). A theory of trickle-down growth and development. *Review of Economic Studies*, 64:151–172.

Alexopoulos, M. and Domowitz, I. (1998). Personal liabilities and bankruptcy reform: An international perspective. *International Finance*, 1:127–159.

Armour, J. and Cumming, D. (2008). Bankruptcy law and entrepreneurship. *American Law and Economics Review*, 10:303–350.

Baker, M. and Rea, S. A. (1998). Employment spells and unemployment insurance eligibility requirements. *Review of Economics and Statistics*, 80:80–94.

Bates, T. (1990). Entrepreneur human capital inputs and small business longevity. *Review of Economics and Statistics*, 72:551–559.

Bergemann, D. and Hege, U. (1998). Venture capital financing, moral hazard, and learning. *Journal of Banking and Finance*, 22:703–735.

Beskæftigelsesministeriet (2001). Selvstændig virksomhed i arbejdsløshedsforsikringen. Policy report, Ministry for Employment, Copenhagen.

Beskæftigelsesministeriet (2005). Evaluering af efterlønsreformen: 'den flexible efterløn'. Policy report, Ministry for Employment, Copenhagen.

Blundell, R. and Powell, J. (2003). Endogeneity in nonparametric and semiparametric regression models. In Dewatripont, M., Hansen, L. P., and Turnovsky, S. J., editors, *Advances in Economics and Econometrics: Theory and Applications, Eighth World Congress, Volume II*, pages 312–357. Cambridge University Press, Cambridge.

Carrasco, R. (1999). Transitions to and from self-employment in Spain: an empirical analysis. *Oxford Bulletin of Economics and Statistics*, 61:315–341.

Chakraborty, A. and Citanna, A. (2005). Occupational choice, incentives and wealth distribution. *Journal of Economic Theory*, 122:206–224.

Chetty, R. (2008). Moral hazard versus liquidity and optimal unemployment insurance. *Journal of Political Economy*, 116:173–234.

Chiappori, P.-A. (2000). Econometric models of insurance under asymmetric information. In Dionne, G., editor, *Handbook of Insurance*, pages 365–394. Kluwer Academic Publishers, Boston, MA.

Chiu, W. H. and Karni, E. (1998). Endogenous adverse selection and unemployment insurance. *Journal of Political Economy*, 106:806–827.

Clementi, G. L. and Hopenhayn, H. A. (2006). A theory of financing constraints and firm dynamics. *Quarterly Journal of Economics*, 121:229–265.

Cohen, A. and Siegelman, P. (2010). Testing for adverse selection in insurance markets. *Journal of Risk and Insurance*, 77:39–84.

Ejrnæs, M. and Hochguertel, S. (2011). Is business failure due to lack of effort? Empirical evidence from a large administrative sample. Working paper #08:2011, Danish National Centre for Social Research, Copenhagen.

Fan, W. and White, M. J. (2003). Personal bankruptcy and the level of entrepreneurial activity. *Journal of Law and Economics*, 45:543–567.

Green, D. A. and Riddell, W. C. (1997). Qualifying for unemployment insurance: An empirical analysis. *Economic Journal*, 107:67–84.

Holmes, T. J. and Schmitz, J. A. (1996). Managerial tenure, business age and small business turnover. *Journal of Labor Economics*, 14:79–99.

Idson, T. L. and Valletta, R. G. (1996). Seniority, sectoral decline, and employee retention: An analysis of layoff unemployment spells. *Journal of Labor Economics*, 14:654–676.

Jurajda, S. (2002). Estimating the effect of unemployment insurance compensation on the labor market histories of displaced workers. *Journal of Econometrics*, 108:227–252.

Kim, B. J. and Schlesinger, H. (2005). Adverse selection in insurance markets with government-guaranteed subsistence levels. *Journal of Risk and Insurance*, 72:61–75.

Krueger, A. B. and Meyer, B. D. (2002). Labor supply effects of social insurance. In Auerbach, A. J. and Feldstein, M., editors, *Handbook of Public Economics*, *Vol. 4*, pages 2327–2392. Elsevier, Amsterdam.

Lee, S.-H., Yamakawa, Y., Peng, M. W., and Barney, J. B. (2011). How do bankruptcy laws affect entrepreneurship development around the world? *Journal of Business Venturing*, 26:505–520.

Lentz, R. (2009). Optimal unemployment insurance in an estimated job search model with savings. *Review of Economic Dynamics*, 12:37–57.

Newman, A. F. (2007). Risk-bearing and entrepreneurship. *Journal of Economic Theory*, 137:11–26.

OECD (2006). Denmark. Economic survey, OECD, Paris.

Parsons, D. O. (1986). The employment relationship: Job attachment, work effort, and the nature of contracts. In Ashenfelter, O. and Layard, R., editors, *Handbook of Labor Economics, Vol. II*, pages 789–848. North Holland, Amsterdam.

Parsons, D. O., Tranæs, T., and Lilleør, H. B. (2003). Voluntary public unemployment insurance. Unpublished, George Washington University.

Paulson, A. L., Townsend, R. M., and Karaivanov, A. (2006). Distinguishing limited liability from moral hazard in a model of entrepreneurship. *Journal of Political Economy*, 114:100–144.

Primo, D. M. and Green, W. S. (2011). Bankruptcy law and entrepreneurship. *Entrepreneurship Research Journal*, 1:art. 5.

Repullo, R. and Suarez, J. (2000). Entrepreneurial moral hazard and bank monitoring: A model of the credit channel. *European Economic Review*, 44:1931–1950.

Schoukens, P. (2000). Comparison of the social security law for self-employed persons in the member states of the European Union. In Pieters, D., editor, *Changing Work Patterns and Social Security. EISS Yearbook 1999.*, pages 63–98. Kluwer Law International, London.

Taylor, M. P. (1999). Survival of the fittest? An analysis of self-employment duration in Britain. *Economic Journal*, 109:C140–C155.

Winter-Ebmer, R. (2003). Benefit duration and unemployment entry: A quasi-experiment in Austria. *European Economic Review*, 47:259–273.

Wooldridge, J. M. (2005). Simple solutions to the initial conditions problem in dynamic, nonlinear panel data models with unobserved heterogeneity. *Journal of Applied Econometrics*, 20:39–54.

Figures and Tables

Figure 1: UI Choice and Change of ER Eligibility (cohort born 1945)

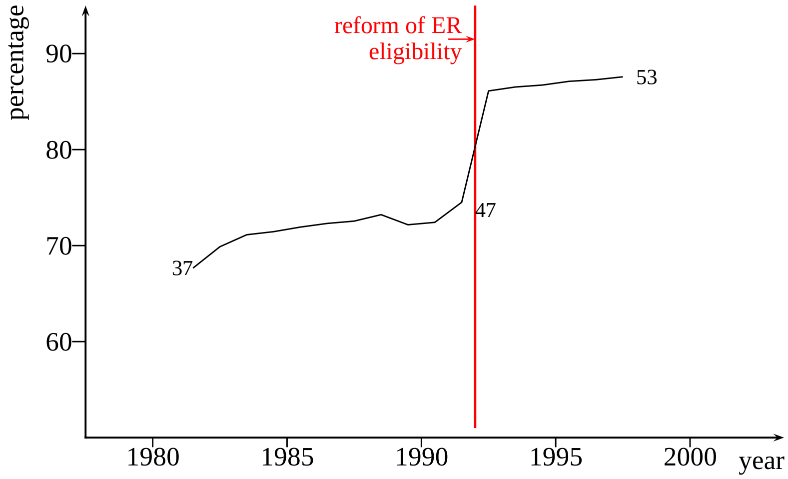


Figure 2: Regimes of Early Retirement Rules, by Year-of-Birth Cohort and Year

YEAR	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
YOB																		
1922	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76
1923	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75
1924	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74
1925	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73
1926	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72
1927	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71
1928	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70
1929	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69
1930	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68
1931	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67
1932	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66
1933	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65
1934	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64
1935	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63
1936	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62
1937	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61
1938	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60
1939	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59
1940	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58
1941	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57
1942	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56
1943	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55
1944	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54
1945	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53
1946	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52
1947	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51
1948	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50
1949	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49
1950	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48
1951	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47
1952	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46
1953	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45
1954	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44
1955	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43
1956	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42
1957	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41
1958	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
1959	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39
1960	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38
1961	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37
1962	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36
1963	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35
1964	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34
1965	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33
1966	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32
1967	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
1968	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
1969	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29
1970	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28
1971	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27

LEGEND

sample exclusions

- (light grey) not in sample (likely not yet participating in the labor market or potentially eligible for early retirement)
- (dark grey) not in sample, eligible for old-age pension

minimum required insurance ages to qualify for early retirement at age 60

- (blue) initial situation, valid from 1980
- (yellow) those affected by the 1992 reform

Figure 3: Self-employment by year-of-birth cohort and year in percent of labor force

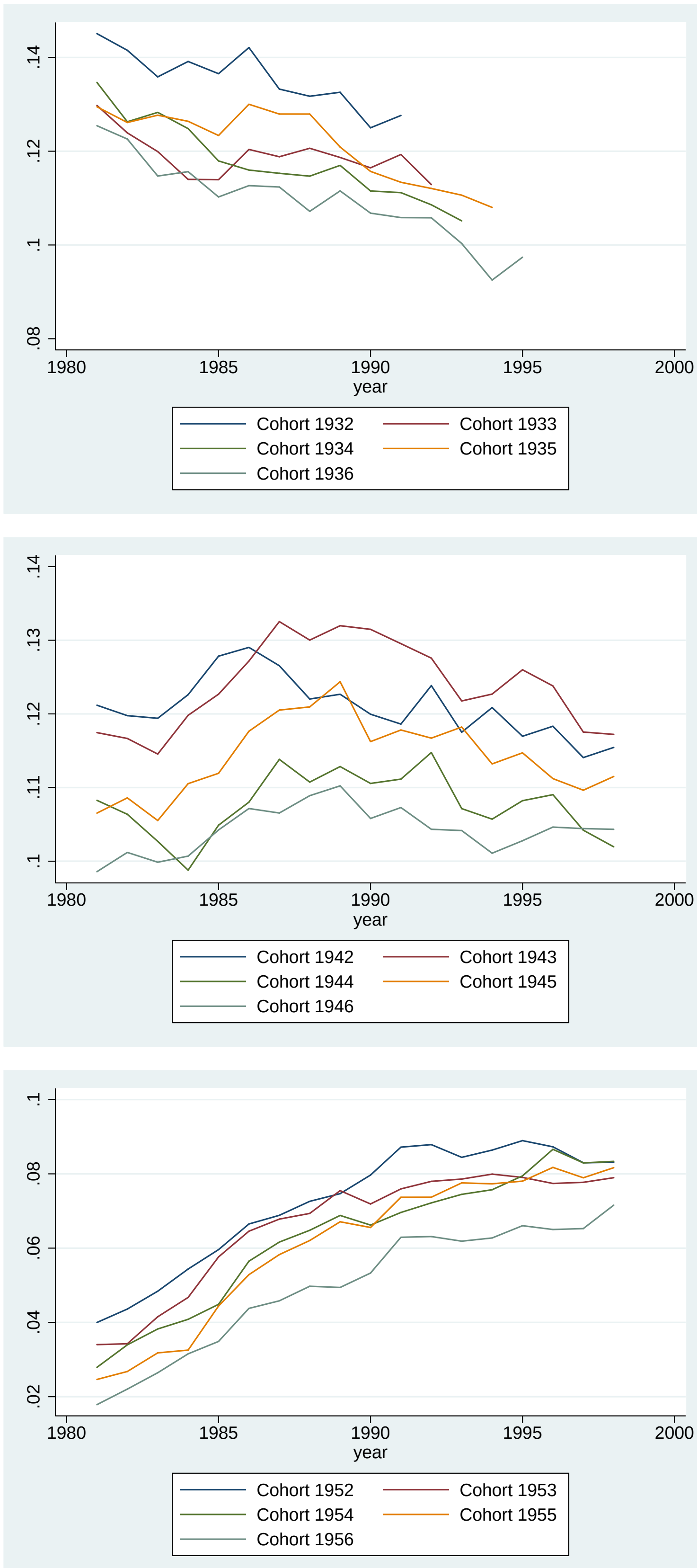
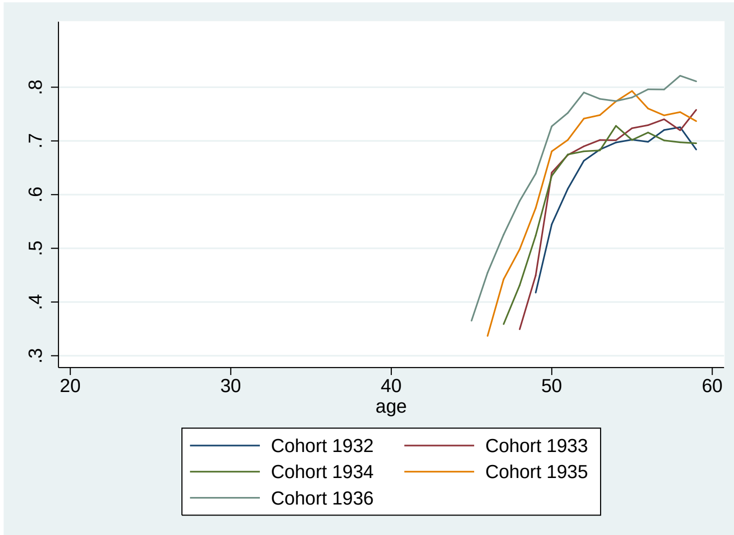


Figure 4: UI Fund Membership as Percentage of Labor Force



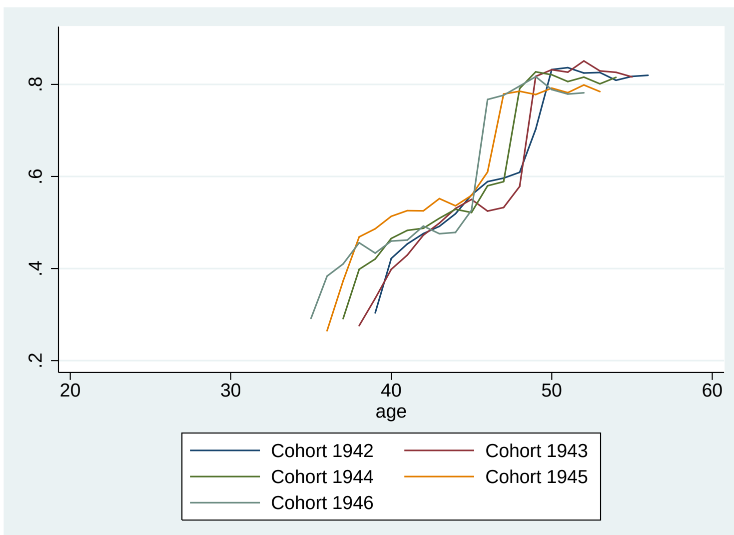


Table 1: Means, Estimation Sample

Variable	All	uninsured, $t-1$	insured, $t-1$
UI fund member, t	0.654	0.091	0.983
at least 10% of time unemployed, t	0.019	0.008	0.026
early retirement eligibility, $t-1$	0.447	0.301	0.532
age	46.3	44.7	47.3
year of birth	1944	1945	1944
regional unemployment rate, $t-1$	0.066	0.065	0.067
age spouse, $t-1$	37.1	33.8	38.9
spouse does not work, $t-1$	0.078	0.098	0.066
total income spouse, $t-1$	80,006	76,872	81,834
income from self-employment, $t-3$	189,751	200,617	183,413
had negative income from SE, $t-3$	0.025	0.030	0.022
wealth, $t-1$	128,175	183,480	95,916
experience (years) as wage earner, $t-3$	7.5	6.5	8.1
receipt sickness benefits, $t-1$	0.002	0.002	0.002
marital status: single, $t-1$	0.137	0.177	0.113
children age ≤ 17 living at home, $t-1$	0.505	0.567	0.468
receipt SE start-up support, $t-3$	0.013	0.003	0.019
education:			
elementary school	0.236	0.236	0.236
high school	0.028	0.047	0.017
vocational education	0.548	0.446	0.608
short further education	0.032	0.032	0.032
bachelor degree	0.041	0.051	0.035
master degree/PhD	0.102	0.175	0.060
missing education	0.013	0.013	0.012
industry, $t-1$:			
accountants, lawyers, consultants	0.069	0.096	0.054
manufacturing	0.064	0.058	0.067
machinery	0.043	0.048	0.041
building, construction crafts	0.177	0.150	0.192
cars: wholesale, retail, repair	0.092	0.078	0.101
wholesale	0.055	0.049	0.058
retail	0.147	0.115	0.166
hotels, restaurants	0.038	0.026	0.044
transport	0.109	0.101	0.113
financial services	0.030	0.036	0.026
technology & capital intensive	0.008	0.010	0.007
cleaning	0.017	0.022	0.014
health & care	0.060	0.107	0.032
services	0.052	0.061	0.046
missing	0.040	0.044	0.037
region:			
Copenhagen	0.174	0.234	0.139
Zealand North	0.130	0.161	0.111
Zealand South[†]	0.122	0.116	0.125
Funen	0.085	0.076	0.091
Aarhus	0.172	0.154	0.183
Jutland South	0.096	0.081	0.105
Jutland Middle	0.132	0.113	0.143
Jutland North	0.089	0.066	0.103
Number of observations (NT)	86,092	31,717	54,375
Number of individuals (N)	13,434		

Source: CAM 10% Sample; Danish males, 25-59, selfemployed in previous three years, and further restrictions (see text). [†]Includes Bornholm.

Table 2: Transitions from Self-employment to Unemployment (Random Effects Probits)

variable	Simple Specification coeff.	std. error	Main Specification coeff.	std. error
UI fund member, $t-1$	0.5780	0.039***	0.5031	0.036***
age	0.3890	0.186**	0.3338	0.172*
age squared/100	−0.9650	0.383**	−0.9355	0.351***
age cubed/1000	0.0847	0.028***	0.0781	0.026***
cohort/10	−0.9899	1.189	−1.5945	1.093**
cohort squared/100	0.3011	0.214	0.2946	0.187
cohort cubed/10000	−0.2117	0.157	−0.2159	0.137
regional unemployment rate$\times$10, $t-1$			−0.3742	0.213*
age spouse/100, $t-1$			0.0560	0.272
spouse does not work, $t-1$			0.1372	0.044***
total income spouse, $t-1$ [100kDKK]			−0.1540	0.030***
income from self-employment, $t-3$ [mDKK]			−0.7834	0.086***
had negative income from SE, $t-3$			−0.0055	0.069
wealth, $t-1$ [mDKK]			−0.0713	0.013***
experience [100 years] as wage earner, $t-3$			0.0318	0.224
receipt sickness benefits, $t-1$			0.4499	0.170***
marital status: single, $t-1$			0.2039	0.129
children age $\leq$ 17 living at home, $t-1$			−0.0598	0.033*
receipt SE start-up support, $t-3$			0.3289	0.077***
[13] year dummies (p-value)	0.0000			0.0000
[6] education dummies (p-value)	—			0.0001
[14] industry dummies (p-value)	—			0.0000
[7] region dummies (p-value)	—			0.0694
σ_η	0.7971	0.061***	0.4802	0.0634***
Log-likelihood:	−7,883.2			−7,482.5

Notes: Sample description: see Table 1. Asterisks indicate significance levels: *** 1% or less, ** 5% or less, * 1% or less. All specifications include an overall constant term.

Table 3: Marginal or Average Partial Effects / Average Treatment Effects

Effect of	instrument on insurance status	insurance status on unempl.
raw data, Table 1		1.76
univariate model		
— Simple Spec., Table 2		2.23
— Main Spec., Table 2		1.82
bivariate model		
— Simple Spec., Tables 4a, 4b	3.72	0.57
— Main Spec., Tables 4a, 4b	2.65	0.64

Notes: Marginal effects calculated for the estimates in Tables 2, 4a, and 4b. All marginal effects expressed as percentage point changes.

Table 4a: Insurance Choice and Transitions from Self-employment to Unemployment (Bivariate Random Effects Probits) — Insurance Choice

variable	Simple Specification coeff.	std. error	Main Specification coeff.	std. error
early retirement eligibility, $t-1$	0.3749	0.042***	0.2526	0.044***
age	−2.0067	0.150***	−2.4423	0.155***
age squared/100	5.1946	0.327***	5.8853	0.335***
age cubed/1000	−0.3657	0.024***	−0.4170	0.025***
cohort/10	3.2929	1.243***	−1.7045	1.368
cohort squared/100	0.4024	0.260	1.0924	0.286***
cohort cubed/10000	−0.5299	0.189***	−0.9300	0.206***
regional unemployment rate$\times 10, t-1$			−0.5346	0.191***
age spouse/100, $t-1$			2.9585	0.366***
spouse does not work, $t-1$			−0.2677	0.043***
total income spouse, $t-1$ [100kDKK]			−0.0610	0.030**
income from self-employment, $t-3$ [mDKK]			−0.0502	0.062
had negative income from SE, $t-3$			0.0583	0.069
wealth, $t-1$ [mDKK]			−0.0028	0.011
experience [100 years] as wage earner, $t-3$			4.5131	0.374***
receipt sickness benefits, $t-1$			−0.2921	0.229
marital status: single, $t-1$			0.5249	0.154***
children age ≤ 17 living at home, $t-1$			−0.2012	0.034***
receipt SE start-up support, $t-3$			0.9673	0.147***
[13] year dummies (p-value)	0.0000		0.0000	
[6] education dummies (p-value)	—		0.0000	
[14] industry dummies (p-value)	—		0.0000	
[7] region dummies (p-value)	—		0.0000	

Notes: Sample description: see Table 1. Asterisks indicate significance levels: *** 1% or less, ** 5% or less, * 1% or less. All specifications include an overall constant term.

Table 4b: Insurance Choice and Transitions from Self-employment to Unemployment (Bivariate Random Effects Probits) — Unemployment Incidence

variable	Simple Specification coeff.	std. error	Main Specification coeff.	std. error
UI fund member, $t-1$	0.1309	0.062**	0.1599	0.057***
age	0.2661	0.193	0.2441	0.177
age squared/100	-0.6445	0.397	-0.6996	0.362*
age cubed/1000	0.0630	0.029**	0.0618	0.027**
cohort/10	-1.1025	1.243	-1.7855	1.134
cohort squared/100	0.4148	0.226*	0.3907	0.196**
cohort cubed/10000	-0.3126	0.165*	-0.2933	0.143**
regional unemployment rate$\times 10, t-1$			-0.3763	0.219*
age spouse/100, $t-1$			0.1049	0.284
spouse does not work, $t-1$			0.1387	0.046***
total income spouse, $t-1$ [100kDKK]			-0.1658	0.032***
income from self-employment, $t-3$ [mDKK]			-0.8226	0.090***
had negative income from SE, $t-3$			-0.0017	0.071
wealth, $t-1$ [mDKK]			-0.0755	0.014***
experience [100 years] as wage earner, $t-3$			0.0469	0.238
receipt sickness benefits, $t-1$			0.4625	0.176***
marital status: single, $t-1$			0.2155	0.134
children age ≤ 17 living at home, $t-1$			-0.0634	0.035*
receipt SE start-up support, $t-3$			0.3306	0.080***
[13] year dummies (p-value)	0.0000		0.0000	
[6] education dummies (p-value)	—		0.0000	
[14] industry dummies (p-value)	—		0.0000	
[7] region dummies (p-value)	—		0.0522	
ρ	0.1610	0.045***	0.1594	0.041***
ρ_η	0.3365	0.037***	0.3466	0.050***
σ_{η_1}	3.4885	0.029***	2.8760	0.031***
σ_{η_2}	0.9149	0.707	0.5810	0.115***
Log-likelihood	$-33,077.6$		$-31,969.6$	

Notes: Sample description: see Table 1. Asterisks indicate significance levels: *** 1% or less, ** 5% or less, * 1% or less. All specifications include an overall constant term.

Table 5: Sensitivity Analyses

Variation	UI fund member, $t-1$ coeff.	std.err.	NT	N	log-lik.
univariate model, main specification (Table 2)	0.5031	0.036***	86,092	13,434	−7,482.5
— univariate fixed effects logit†	0.5511	0.127***	8,234	1,358	−1,185.8
bivariate model, simple specification (Table 4b)	0.1309	0.062**	86,092	13,434	−33,077.6
— age & cohort dummies	0.1393	0.062**	86,092	13,434	−32,749.0
— same, but fixed effects LPM-IV	0.0475	0.025*	86,092	13,434	
bivariate model, main specification (Table 4b)	0.1599	0.057***	86,092	13,434	−31,969.6
— unempl. status as depend. var.	0.1886	0.068***	86,066	13,431	−30,103.1
— education/year-spec. unempl. rate	0.1586	0.057***	86,092	13,434	−31,951.1
— industry/year-spec. bankruptcy rate	0.1579	0.061***	76,529	12,479	−27,922.0
— interact with declining industries dummy	0.1465	0.059**	86,092	13,434	−31,961.8
— excl. income & wealth variables	0.1682	0.058***	86,092	13,434	−32,037.5
— more lags in regressors	0.1783	0.057***	86,092	13,434	−31,838.6
— sample conditioned on 1 year self-empl.	0.1249	0.038***	127,120	19,753	−54,010.2
— initial conditions	0.1684	0.058***	79,118	12,759	−29,288.1

Notes: This Table reports the estimated coefficient of interest (on the insurance dummy) in the equation of unemployment incidence, when the specification of model assumptions are being changed compared to the main results in Tables 2 and 4b. Full results are available on request. Asterisks indicate significance levels: *** 1% or less, ** 5% or less, * 1% or less. †Logit coefficient and standard error estimates rescaled with $\sqrt{3}/\pi$.

Table 6: Average Predicted Probabilities (Percentages)

	Data	Model			
		Simple Spec.		Main Spec.	
Variable	incidence	$\hat{P}_{jit}$	$\hat{I}^{0.5}_{jit}$	$\hat{P}_{jit}$	$\hat{I}^{0.5}_{jit}$
insured	65.43	64.23	90.05	65.69	79.98
unemployed	1.94	2.66	0.00	2.20	0.01

Note: This Table shows incidence of insurance and unemployment in the data, and, per model, the mean predicted probability $\hat{P}_{jit}$ and the mean of the indicator $\hat{I}^{0.5}_{jit} \equiv \hat{P}_{jit} \geq 0.5$.

Table 7: Bivariate Distributions (Percentages)

	Data		Simple Spec.		Main Spec.	
			unemployed			
insured	no	yes	no	yes	no	yes
no	34.31	0.26	34.56	0.02	34.32	0.25
yes	63.75	1.68	63.50	1.93	63.74	1.70

Note: This Table shows the classification of observations in 2 dimensions. The model predictions (from Tables 4a and 4b) are based on an indicator comparable to that in Table 6, *after* matching the marginal distributions of $\hat{I}^{\tau_j}_{jit}$ to the data (i.e., we shift τ_j until $\hat{I}^{\tau_j}_{jit}$ equals the numbers in column 1 of Table 6.)

A Identification and Minimum Set of Assumptions

In the model we can identify the impact of insurance status on subsequent unemployment non-parametrically, under the assumption that the errors are additively separable, and that time, age and cohort effects enter additively. To illustrate this point let us assume a model where insurance and unemployment status are determined (non-parametrically) by age, cohort and time and by the eligibility status e. Let $y_{c,a,t}$ be insurance status for an individual belonging to birth cohort c, aged a in year t. We assume that insurance status can be described as

$$E(y_{c,a,t}) = \alpha_c + \delta_a + \tau_t + \beta e_{c,a,t}, \quad c = 1,\ldots,C,\ a = 1,\ldots,\ A, t = 1,\ldots,T \tag{A.1}$$

where $\alpha_c$is a set of cohort dummies, δ_a a set of age dummies and τ_t a set of time dummies. These three sets of dummies are not separately identified due to the collinearity of cohort, age and time. However, our goal is not to identify these three sets of dummies but to show that the impact of the eligibility incentive with a minimal set of assumptions on cohort, age and time effects. Let us consider four birth cohorts 1941, 1946, 1951 and 1956 and four years 1981, 1982, 1991 and 1992. The table below shows age and the eligibility incentive e

	1981		1982		1991		1992	
	age	e	age	e	age	e	age	e
Cohort 1931	50	1	51	1				
Cohort 1936	45	0	46	0				
Cohort 1941					50	1	51	1
Cohort 1946					45	0	46	1

The impact of the eligibility incentive can be identified from a difference-in-difference-in-difference type of estimation. From (A.1) we can see that

$$\beta = E(\Delta y_{1946,46,1992} - \Delta y_{1941,51,1992} - \Delta y_{1936,46,1982} + \Delta y_{1931,51,1982}),$$

where $\Delta y_{c,a,t} = y_{c,a,t} - y_{c,a-1,t-1}$. The identification relies on the fact that for different cohorts the incentive kicks in at different ages and different years. Empirically, the model can be estimated as a linear probability model, by running a regression of insurance and unemployment on a whole set of cohort, age and time dummies as well as on the eligibility dummy.[28] This identification can be done entirely from repeated cross sections. If we want to exploit the panel aspect of the data we should replace the cohort specific effects with individual specific effects. The model is still identified from a difference-in-difference-in-difference approach and the cohort dummies should be replaced by individual fixed effects.

We can non-parametrically identify the impact of insurance on subsequent unemployment. This follows by a general result on discrete endogenous variables with discrete instruments (see, for instance, Blundell and Powell (2003)). In our application, we implement this by IV estimation in a linear probability model where eligibility is used as an instrument.

[28]Due to collinearity we can include $T-1$ time dummies, $C-1$ cohort dummies and $A-1$ age dummies. Furthermore we will have to reduce the number of dummies by one because of the linear relation $age = cohort - year$.

B Additional Material

B.1 Model

This appendix supplies a few core derivatives whose signs are discussed in the text. It may be useful to partition the set of parameters into the following:

- exogenous risk, θ
- cost of effort, λ
- preference, income, and insurance parameters,

$$M = \{Y^0, Y^E, A, B, P, \gamma, \} \tag{B.2}$$

In addition, we define the following symbols for reference:

$$\begin{aligned} a &= u(Y^0 + Y^E, 0) - u(Y^0 + Y^E - P, 0) > 0 \\ b &= u(Y^0 + Y^E - P, 0) - u(Y^0 + B - P, \gamma) \lesseqgtr 0 \\ c &= u(Y^0 + B - P, \gamma) - u(Y^0 + A, \gamma) > 0 \\ d &= u(Y^0 + Y^E, 0) - u(Y^0 + A, \gamma) \equiv a + b + c \lesseqgtr 0. \end{aligned}$$

Owing to our assumption that $Y^E - P > B - P > A$, these magnitudes can be read off from Figure B.1. Note that $d > b$. We also may want to interpret b and d as functions of various income, preference, and insurance parameters, and define for reference

$$b = b(Y^0, Y^E, B, P, \gamma) \tag{B.3}$$

$$d = d(Y^0, Y^E, A, \gamma). \tag{B.4}$$

B.1.1 Derivatives of Effort

The derivatives of optimal effort with respect to some parameter can be calculated, assuming an interior solution, by relying on implicit differentiation. We may distinguish between effort when insured ($e^{\star I}$) and uninsured ($e^{\star 0}$).

Exogenous Risk

$$\frac{\mathrm{d}e^{\star I}}{\mathrm{d}\theta} = -\frac{\pi_{e\theta}}{\pi_{ee}} = \frac{\mathrm{d}e^{\star 0}}{\mathrm{d}\theta} < 0$$

which is independent of whether the agent is insured or not. The sign follows from the assumption $\pi_{e\theta} > 0$. See Figure B.2 for an illustration of that assumption.

Cost of Effort

$$\frac{\mathrm{d}e^{\star I}}{\mathrm{d}\lambda} = -\frac{1}{\pi_{ee}} \cdot \frac{1}{b} \leq 0 \qquad \text{and} \qquad \frac{\mathrm{d}e^{\star 0}}{\mathrm{d}\lambda} = -\frac{1}{\pi_{ee}} \cdot \frac{1}{d} \leq 0.$$

For $b > 0$ and $d > 0$, respectively, effort decreases with effort cost. For $b < 0$ and $d < 0$, respectively, effort will not react to effort cost since optimal effort is already zero.

Preference, Income, and Insurance Parameters Let $\mu \in M$ where M is defined in (B.2). Then,

$$\begin{aligned}\frac{\mathrm{d}e^{\star I}}{\mathrm{d}\mu} &= \frac{1}{\pi_{ee}} \cdot \frac{\lambda}{[b(\cdot)]^2} \cdot b_\mu \\ \frac{\mathrm{d}e^{\star 0}}{\mathrm{d}\mu} &= \frac{1}{\pi_{ee}} \cdot \frac{\lambda}{[d(\cdot)]^2} \cdot d_\mu\end{aligned}$$

Where $b(\cdot)$ and $d(\cdot)$ are defined through (B.3) and (B.4). The sign of these derivatives equals the sign of b_μ and d_μ, respectively, since $\pi_{ee} > 0$ by assumption.

Derivatives at a corner solution are zero.

Earnings

$$\frac{\partial b}{\partial Y^E} = u_1(Y^0 + Y^E - P, 0) > 0$$

and

$$\frac{\partial d}{\partial Y^E} = u_1(Y^0 + Y^E, 0) > 0.$$

Insured or not, labor income increases effort.

Nonlabor Income Analogously, we find

$$\frac{\partial b}{\partial Y^0} = \overbrace{[u_1(Y^0 + Y^E - P, 0) - u_1(Y^0 + B - P, \gamma)]}^{\kappa_1} < 0$$

and

$$\frac{\partial d}{\partial Y^0} = \underbrace{[u_1(Y^0 + Y^E, 0) - u_1(Y^0 + A, \gamma)]}_{\kappa_0} < 0$$

both follow from the concavity of the utility function and from our assumptions on the relative sizes of income components: effort decreases with sufficient fall-back resources, irrespective of insurance status.

Social Assistance

$$\frac{\partial b}{\partial A} = 0 \quad \text{and} \quad \frac{\partial d}{\partial A} = -u_1(Y^0 + A, \gamma) < 0$$

Increasing the outside option is irrelevant for those that are insured, but decreases effort for those that are not.

UI Benefits

$$\frac{\partial b}{\partial B} = -u_1(Y^0 + B - P, \gamma) < 0 \quad \text{and} \quad \frac{\partial d}{\partial B} = 0$$

Increasing UI benefits is detrimental for effort for those that are insured and does not affect those that are not.

UI Premium

$$\frac{\partial b}{\partial P} = u_1(Y^0 + B - P, \gamma) - u_1(Y^0 + Y^E - P, 0) > 0 \quad \text{and} \quad \frac{\partial d}{\partial P} = 0.$$

Higher premiums encourage provision of effort, whereas they are irrelevant for behavior of uninsured people.

Preferences for Leisure

$$\frac{\partial b}{\partial \gamma} = -u_2(Y^0 + B - P, \gamma) < 0 \quad \text{and} \quad \frac{\partial d}{\partial \gamma} = -u_2(Y^0 + A, \gamma) < 0.$$

B.1.2 Insurance

In this section, we study how insurance choice depends on variation in various parameters.

Exogenous Risk From (4) follows

$$\frac{\partial D}{\partial \theta} = (a+c) \cdot \pi_\theta(\theta, e^{\star 0}) + \left[b \cdot \left(\pi_\theta(\theta, e^{\star 0}) - \pi_\theta(\theta, e^{\star I})\right)\right] \geq 0.$$

If $b < 0$ and $d < 0$ then $e^{\star I} = e^{\star 0} = 0$ and $\pi(\theta, e^{\star I}) = \pi(\theta, e^{\star 0}) = 1$. It then follows that $\pi_\theta(\theta, 0) = 0$. The expression above reduces to $\partial D / \partial \theta = 0$. In the case where $b < 0$ and $d > 0$ we have $e^{\star I} = 0$ and $\pi(\theta, e^{\star I}) = 1$. It then follows that $\pi_\theta(\theta, 0) = 0$.

$$\begin{aligned}
\frac{\partial D}{\partial \theta} &= (a+c) \cdot \pi_\theta(\theta, e^{\star 0}) + \left[b \cdot \left(\pi_\theta(\theta, e^{\star 0})\right)\right] \\
&= (a+b+c) \cdot \pi_\theta(\theta, e^{\star 0}) \\
&= d \cdot \pi_\theta(\theta, e^{\star 0}) > 0.
\end{aligned}$$

Cost of Effort

$$\frac{\partial D}{\partial \lambda} = -(e^{\star I} - e^{\star 0}) > 0$$

due to (1).

Preference, Income, and Insurance Parameters For $\mu \in M$ (see (B.2)),

$$\frac{\partial D}{\partial \mu} = a_\mu (\pi^{\star 0} - 1) + c_\mu \cdot \pi^{\star 0} + b_\mu \cdot \underbrace{(\pi^{\star 0} - \pi^{\star I})}_{\leq 0}.$$

Earnings The derivative is

$$\frac{\partial D}{\partial Y^E} = (1 - \pi^{\star I}) \cdot u_1(Y^0 + Y^E - P, 0) - (1 - \pi^{\star 0}) \cdot u_1(Y^0 + Y^E, 0)$$

which we rewrite slightly as

$$\frac{\partial D}{\partial Y^E} = (1 - \pi^{\star I}) \cdot \alpha_1 - (1 - \pi^{\star 0}) \cdot \alpha_0 \tag{B.5}$$

where we have introduced the symbols $\alpha_1 \equiv u_1(Y^E + Y^0 - P, 0)$ and $\alpha_0 = u_1(Y^E + Y^0, 0)$. Note that $\alpha_1 \geq \alpha_0$ (due to concavity). It is apparent that the derivative is not easily signed since we know from (1) and $\pi_e < 0$ that $\pi^{\star 0} \leq \pi^{\star I}$. That means that the association of a large α_1 with a small probability may or may not weigh up against the association of a relatively smaller α_0 with a larger weight.

We can rewrite (B.5) as

$$\frac{\partial D}{\partial Y^E} = \underbrace{(1 - \pi^{\star 0}) \cdot [\alpha_1 - \alpha_0]}_{>0} + \underbrace{[\pi^{\star 0} - \pi^{\star I}] \cdot \alpha_1}_{\leq 0}$$

In the (near) absence of an insurance effect on effort ('moral hazard'), $\pi^{\star I} \approx \pi^{\star 0}$, the derivative is positive and richer people (in terms of own income) are more likely to insure themselves.

There is a second aspect of interest. This concerns behavior when UI benefits get large relative to earnings. In particular, effort taking will be diminished, and instead taking out insurance becomes more likely.

If $Y^E \to B^+$ and $e^{\star I} \to 0$, and hence

$$\begin{aligned} D &\to u(B+Y^0-P,\gamma)-(1-\pi^{\star 0})\cdot u(B+Y^0,0)-\pi^{\star 0}\cdot u(A+Y^0,\gamma)+\lambda e^{\star 0} \\ &\geq u(B+Y^0-P,\gamma)-(1-\pi^{\star 0})\cdot u(B+Y^0,\gamma)-\pi^{\star 0}\cdot u(A+Y^0,\gamma)+\lambda e^{\star 0} \end{aligned}$$

By using Jensen's inequality we get that

$$\begin{aligned} u(B+Y^0-P,\gamma)-(1-\pi^{\star 0})\cdot u(B+Y^0,\gamma)-\pi^{\star 0}\cdot u(A+Y^0,\gamma)+\lambda e^{\star 0} &\geq \\ u(B+Y^0-P,\gamma)-u((1-\pi^{\star 0})(B+Y^0)+\pi^{\star 0}(A+Y^0),\gamma)+\lambda e^{\star 0} &= \\ u(B+Y^0-P,\gamma)-u(B+Y^0-\pi^{\star 0}(B-A),\gamma)+\lambda e^{\star 0} & \end{aligned}$$

The last expression is positive if $P < \pi(\theta, e^{\star 0})\cdot(B-A)$. This means that if the premium is small then agents with an income $Y^E \to B^+$ will chose to insure themselves.[29]

Nonlabor Income

$$\begin{aligned} \frac{\partial D}{\partial Y^0} = &\Big((1-\pi^{\star I})\cdot u_1(Y^0+Y^E-P,0)+\pi^{\star I}\cdot u_1(Y^0+B-P,\gamma)\Big)- \\ &\Big((1-\pi^{\star 0})\cdot u_1(Y^0+Y^E,0)+\pi^{\star 0}\cdot u_1(Y^0+A,\gamma)\Big). \end{aligned}$$

Rewriting leaves

$$\frac{\partial D}{\partial Y^0} = \underbrace{[\alpha_1-\alpha_0]}_{<0} + \underbrace{\pi^{\star 0}\cdot\kappa_0}_{<0} - \underbrace{\pi^{\star I}\cdot\kappa_1}_{<0}$$

where α_1, α_0, κ_1 and κ_0 have been defined before. Again, the derivative cannot be signed in general. If we assume no moral hazard, then

$$\frac{\partial D}{\partial Y^0} \approx \underbrace{[\alpha_1-\alpha_0]}_{<0} + \underbrace{\pi^{\star 0}\cdot(\kappa_0-\kappa_1)}_{<0} < 0.$$

That is, income other than earnings decreases insurance demand.

Social Assistance

$$\frac{\partial D}{\partial A} = -\pi^{\star 0}\cdot u_1(Y^0+A,\gamma) < 0.$$

UI Benefits

$$\frac{\partial D}{\partial B} = \pi^{\star I}\cdot u_1(Y^0+B-P,\gamma) > 0.$$

UI Premium

$$\frac{\partial D}{\partial P} = -(1-\pi^{\star I})\cdot u_1(Y^0+Y^E-P,0)-\pi^{\star I}\cdot u_1(Y^0+B-P,\gamma) < 0.$$

Preferences for Leisure

$$\frac{\partial D}{\partial \gamma} = \pi^{\star I}\cdot u_2(Y^0+B-P,\gamma)-\pi^{\star 0}\cdot u_2(Y^0+A,\gamma) > 0.$$

[29] If the UI premium is actuarially fair then $P = \pi(\theta, e^{\star 0})\cdot(B-A)$.

B.2 Additional Figures

Figure B.1: Utility of Consumption

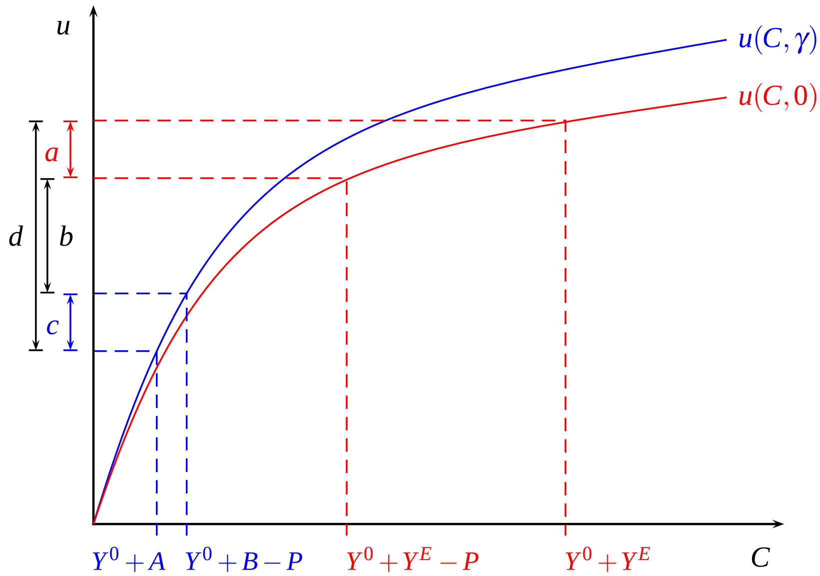


Figure B.2: Probability of Unemployment