FRIEDRICH-ALEXANDER
UNIVERSITÄT
ERLANGEN-NÜRNBERG

Institute for Employment Research

The Research Institute of the Federal Employment Agency

IAB

Estimating the latent effect of unemployment benefits on unemployment duration

Dynamics of Low Wage, Low Pay and Transfer Receipt
November 15, 2013
Nuremberg

Simon Lo
Gesine Stephan
Ralf A. Wilke

Motivation

Effects of unemployment benefits

- Reservation wages increase with generosity of unemployment benefit system (Moffitt/Nicholson 1982, Mortensen 1970)
- Spikes in outflow rates may occur during times of benefit exhaustion (Mortensen 1977, van den Berg 1990, Boone/van Ours 2009)

Competing risks

- Generosity of the benefit system may affect **competing risks** differently (for instance, a less generous system may induce workers to take up a low wage job earlier instead of further searching for a better paid one)
- **Competing risks are probably not independent from each other**, which complicates identification of marginal distributions of latent failure times

Heterogeneous groups

- Generosity of benefit system affects **heterogeneous groups** differently
- In particular, low wage workers may receive complementary unemployment assistance, moderating the effects of the unemployment benefit system

Contribution of this paper

Competing risks	• Consider five different exit states from unemployment • In detail: Recall, low-wage full-time job, other full-time job, subsidized self-employment, unknown and other
Econometrics	• Application of a recently developed **regression model for the Copula Graphic Estimator** for dependent competing risks (Lo/Wilke 2013) • Operates under fewer ad-hoc assumptions than are commonly applied • Estimation of **bounds for the marginal distribution functions** of failure times for all risks
Identification	• Natural experiment (cut in benefit duration) • Difference-in-differences approach
Heterogeneous groups	• Previous low-wage earners (up to 2/3 of the national medium wage) • Previous non low-wage earners

Related empirical literature

Competing risks

- Leaving unemployment or finding a new job:
  Card/Chetty/Weber 2007, Boone/van Ours 2009, Fitzenberger/Wilke 2010
- Local or distant job: Arntz/Lo/Wilke 2010
  Local job finding, migration, or subsidized employment: Arntz/Wilke 2009
- Recall or new job: Alba-Ramirez/Arranz/Monoz-Bullón 2007
- Open-ended/fixed-term/part-time/government-provided work, self-employment, or labor force-withdrawal: Portugal/Addison 2008

Heterogeneous groups

- Low-wage and other men and women: Arntz/Wilke 2009
- High-skilled single and married males, less-skilled males: Arntz/Lo/Wilke 2010

Institutional background

German system of unemployment compensation

Unemployment benefits (ALG I)	• **Insurance contributions** by workers and firms (no experience rating) • Level: **Depends on former wage**, replacement rate of 60 / 67 percent of previous wage • Entitlement length: Depends on employment history
Unemployment assistance (ALG II)	• **Means tested assistance** for needy job-seekers and their households • **Tax-funded** • Level: Since 2005 **not dependent** on former wage • Entitlement length: Unlimited
Active labor market programs	• Further training, wages subsidies, job creation schemes … • **Subsidized self-employment**: Previous two instruments were merged into a new one since August 2006, which required a remaining unemployment benefit claim of at least 90 days

2006 reform of unemployment benefit durations

Age group	Maximum entitlement length		
		2/2006 until	
	until 1/2006	12/2007	Reduction
<45	12	12	0
45-46	18	12	6
47-51	22	12	10
52-54	26	12	14
55-56	26	18	8
>56	32	18	14

We will compare those of age 40-44 and those of age 45-46

We do not consider older groups because of

- a change in the inflow rate after the reform
- early retirement is unlikely for employees aged <47

Previous results regarding reform effects on inflows in unemployment

Anticipation (11/2005 - 1/2006)	
Basis	0.2
Age group 45-46	16.3**
Age group 47-51	19.9**
Age group 52-54	52.4**
Age group 55-56	53.1**
Age group >56	117.7**
Post-reform (since 2/2006)	
Basis	-25.4**
Age group 45-46	-2.1
Age group 47-51	-1.1
Age group 52-54	-11.9**
Age group 55-56	-9.4**
Age group >56	-22.3**
N of individuals	389235

→ Exclude anticipation period from analysis

→ 2006 reform had no significant impact on post-reform unemployment inflows of workers aged 45-51

**) $\alpha = 0.01$
Relative marginal effects
Source: Dlugosz/Stephan/Wilke (2013)

Data

Sample

Data set	25-percent-sample from the **Integrated Employment Biographies** V8.01 (times of employment, unemployment, job search, program participation)
Sample	• **Entries into unemployment 2004 to 2008, age 40-46**, maximum entitlement length at the beginning of the unemployment spell under the pre-reform regulations, last job full-time (around 60.000 observations) • Excluded: Females, construction sector, anticipation period (10/2005 – 2/2006)
Unemployment	• Definition: Registered unemployed and/or unemployment benefit recipient and/or participant in active labor market program - excepted subsidized employment or self-employment and long training • Duration censored at 2 years
RHS variables	Individual characteristics (education, family status, nationality), labor market history of last 7 years, characteristics last job (daily wage rate, status, sectoral affiliation, firm size), federal state, unemployment rate

Column percent and number of observations

	Low-wage men				Non low-wage men			
	Age 40-44		Age 45-46		Age 40-44		Age 45-46	
	Pre	Post	Pre	Post	Pre	Post	Pre	Post
Recall	0.18	0.15	0.20	0.15	0.10	0.07	0.09	0.06
Low-wage full time	**0.32**	**0.34**	**0.33**	**0.35**	0.13	0.11	0.12	0.12
Other full time	0.11	0.14	0.10	0.12	**0.38**	**0.42**	**0.38**	**0.40**
Subsidized self-employment	0.08	0.08	0.07	0.08	0.15	0.16	0.15	0.15
Unknown and other	0.19	0.20	0.17	0.21	0.16	0.19	0.17	0.22
-- Part-time	0.02	0.03	0.02	0.04	0.02	0.01	0.02	0.01
-- Long training	0.02	0.04	0.02	0.04	0.03	0.05	0.04	0.05
-- Secondary labor market	0.04	0.02	0.03	0.02	0.01	0.004	0.01	0.01
-- Unknown	0.11	0.11	0.10	0.11	0.11	0.13	0.11	0.15
Censored	0.12	0.10	0.12	0.10	0.07	0.04	0.09	0.05
N of observations	7,134	5,126	1,817	1,346	19,148	15,051	5,740	4,526

Means of selected right-hand side variables

	Low-wage men					Non low-wage men				
		Age 40-44		Age 45-46			Age 40-44		Age 45-46	
	All	Pre	Post	Pre	Post	All	Pre	Post	Pre	Post
Low education (0/1)	0.08	0.07	0.09	0.06	0.08	0.04	0.04	0.04	0.03	0.05
Vocational training or Abitur (0/1)	0.87	0.88	0.86	0.89	0.86	0.76	0.76	0.75	0.77	0.76
University (0/1)	0.05	0.04	0.05	0.05	0.05	0.20	0.20	0.21	0.20	0.20
Married (0/1)	0.55	0.55	0.51	0.61	0.56	0.63	0.63	0.59	0.68	0.65
Non-German (0/1)	0.18	0.17	0.21	0.15	0.17	0.12	0.12	0.13	0.11	0.13
Years of employment	5.52	5.40	5.45	5.90	5.89	6.24	6.17	6.21	6.40	6.48
Years of tenure at last employer	3.21	3.10	3.10	3.66	3.66	3.58	3.48	3.54	3.78	3.87
Years of unemployment	0.71	0.68	0.89	0.44	0.60	0.28	0.30	0.33	0.20	0.18
Past recall (0/1)	0.19	0.19	0.20	0.20	0.19	0.14	0.14	0.14	0.15	0.14
Daily wage rate	43.30	43.40	43.00	43.75	43.23	95.62	92.71	98.69	94.18	99.55
Manufacturing (0/1)	0.21	0.23	0.18	0.23	0.19	0.36	0.38	0.33	0.39	0.36
Hotels and restaurants (0/1)	0.09	0.08	0.11	0.07	0.09	0.02	0.01	0.02	0.01	0.02
Temporary agency sector (0/1)	0.11	0.12	0.11	0.12	0.08	0.02	0.02	0.02	0.02	0.02
N of observations	15423	7134	5126	1817	1346	44465	19148	15051	5740	4526

Econometric strategy

Identification

Natural experiment

- Treatment group of age 45-46, control group of age 40-44
- Pre-reform (1/2004-1/2006), post-reform (2/2006-12/2008)

Difference-in-difference

- **Compare group-specific differences in competing risks j to exit unemployment between time periods**:

$$DiD_j = (F_j^{45\text{-}46,\ post\ -reform} - F_j^{40\text{-}44,\ post\text{-}reform}) - (F_j^{45\text{-}46,\ pre\text{-}reform} - F_j^{40\text{-}44,\ pre\text{-}reform}),$$

where $F_j(t) = Pr(T_j \leq t)$ is the marginal distribution function of risk j

- Identifying (untestable) assumption: Trends in failure times would have been the same for both age groups in the absence of the reform

Challenge

Identify marginal distributions of latent durations in the presence of competing risks

Competing risks

Basics

- $(T_1, \ldots T_J)$ = latent duration times of risks j = 1 …J
- Observed: $T = \min_j\{T_j\}$ and destination state r
- $Q_j(t) = Pr(T_j \leq t, j = r)$ = cumulative incidence of risk j
- $S(t) = Pr(T_1 > t, \ldots, T_J > t)$ = joint survival function at t (or survival of the minimum)
- $S_j(t) = Pr(T_j > t) = 1 - F_j(t)$ = marginal survival function of risk j

Problem

- **Unknown dependence structure between risks**: Marginal distributions of latent failure times $S_j(t)$ cannot be identified from observed risks (Cox 1962)
- S(t) and $Q_j(t)$ are identified, but $Q_j(t)$ does not have a causal interpretation (ignores exits due to other risks, does not attain 1 as t goes to infinity)

Proposed approaches

- Consider cumulative incidence functions (weak assumptions, medical research)
- Assume semi-parametric hazard rate (ad hoc specification, econometrics)
- **Assume dependence structure** (Zheng/Klein 1995)

Relationships

(1) Dependence Structure (Copula)

(2) Marginal Distributions $F_j(t)$

(3) Joint survival function $S(t)$, cumulative incidence functions $Q_j(t)$

(1) + (2) generate (3)

(3) does not identify (1) + (2)

Cox and Kaplan-Meier assume independence

(Mixed) proportional hazard models assume (1) and impose functional form on $F_j(t)$

The Copula Graphic Estimator

Copula (= link) function

Joint distribution of the ranks of the duration variables, which **describes the dependence structure of failure times** for all competing risks
$C(f_1, \ldots f_J) = Pr(f_1 \leq F_1, \ldots f_J \leq F_J)$

Idea of the Copula Graphic Estimator

- Dependence structure between risks (copula) and marginal distributions $F_j(t)$ generate $S(t)$ and $Q_j(t)$
- Identify $S_1(t_1) \ldots S_J(t_J)$, using $S(t)$ and $Q_1(t_1) \ldots Q_J(t_J)$ for a known or assumed copula (solving an equation system)

Literature

- Proposed for model with 2 dependent risks by Zheng/Klein (1995).
- Extended to model with more than 2 dependent risks when copula is Archimedean by Lo/Wilke (2010), using a risk-pooling approach
- **Extended to regression model** by Lo/Wilke (2013)

A regression model for the Copula Graphic Estimator

General approach

- Closed form expression of $S_j(t;x)$ as a function of $Q_j(t;x)$ and the copula
- Two-stage estimation procedure

Estimation

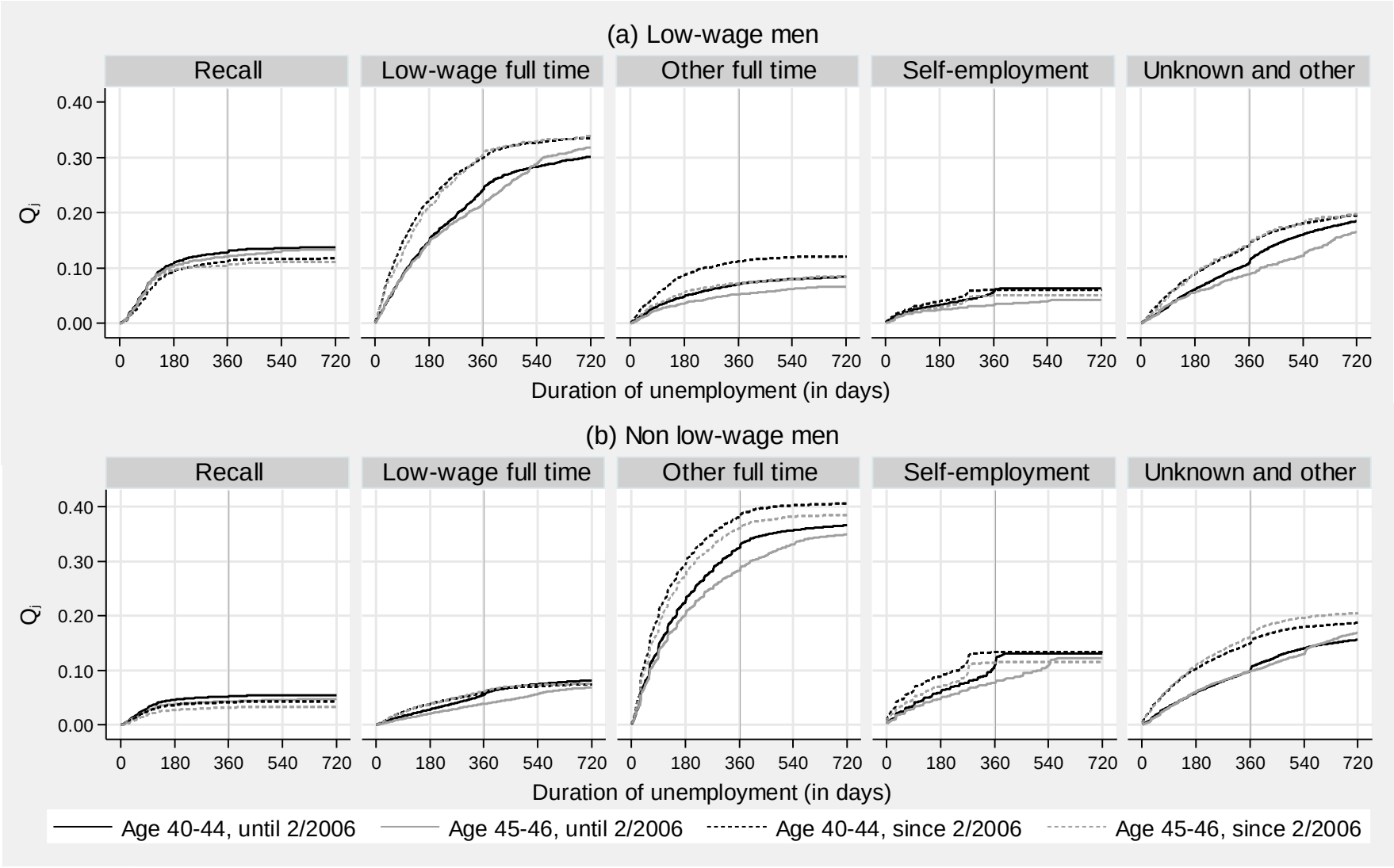
- **First stage**: Estimate proportional hazard model for $Q_j(t;x)$ (Fine/Gray 1999, *stcrreg*)
- **Second stage**: Use first stage results to estimate $S_j(t;x)$ under the assumption of the Frank copula, computing a grid for the support of the copula dependence parameter
- **Obtain bounds** for $S_j(t;x)$ by taking the min and max over all values of the dependence parameter

This paper

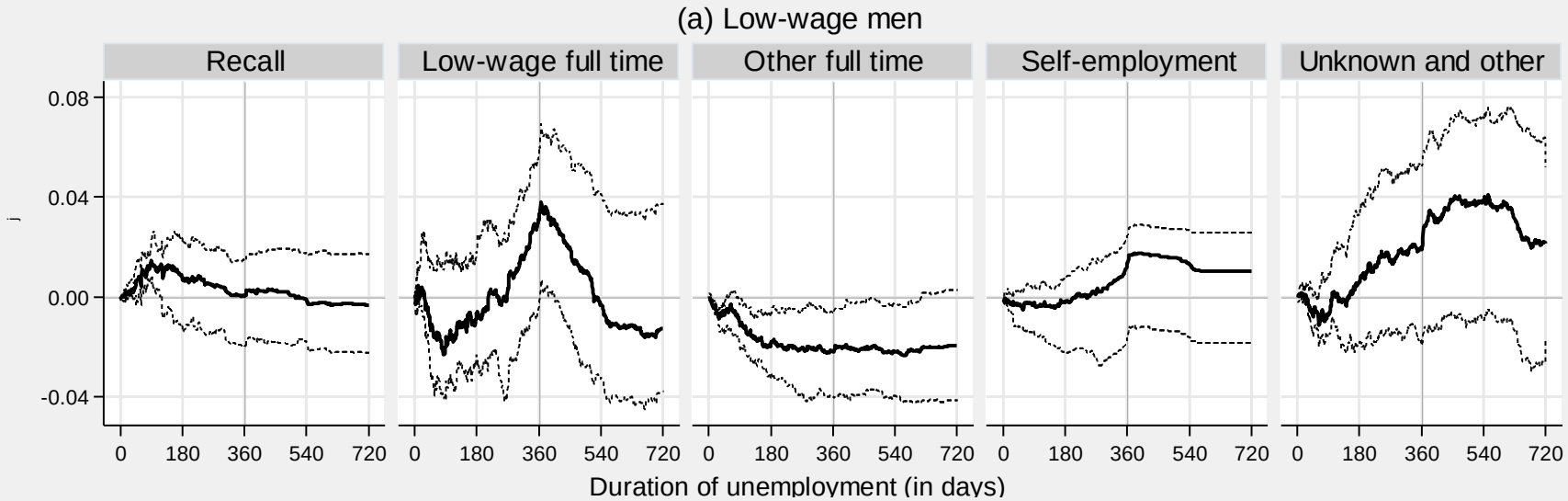
- Presentation of bounds for the difference-in-differences estimator for $F_j(t;x) = 1 - S_j(t;x) = Pr(T_j \leq t| x)$, where x is the sample mean in our application
- Assumption: Copula does not depend on time periods or age groups
- In the first step we estimate 5*4*2 = 40 cumulative incidence curves

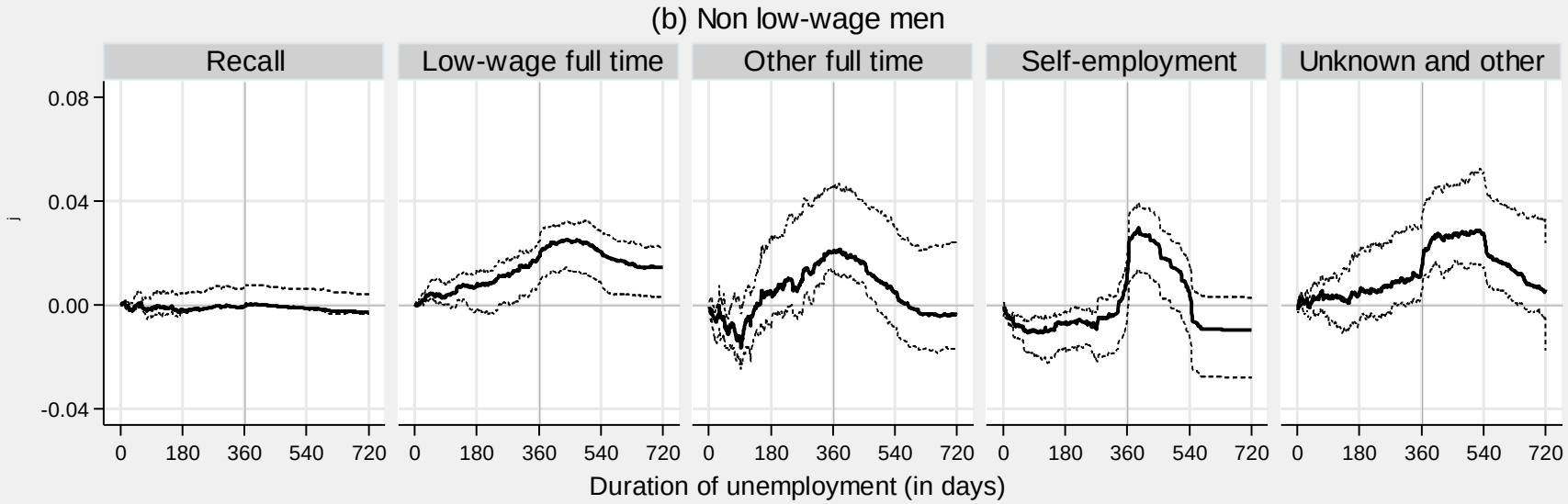
Empirical results: Cumulative incidence

Cumulative incidence curves



DiD estimator for cumulative incidence curves





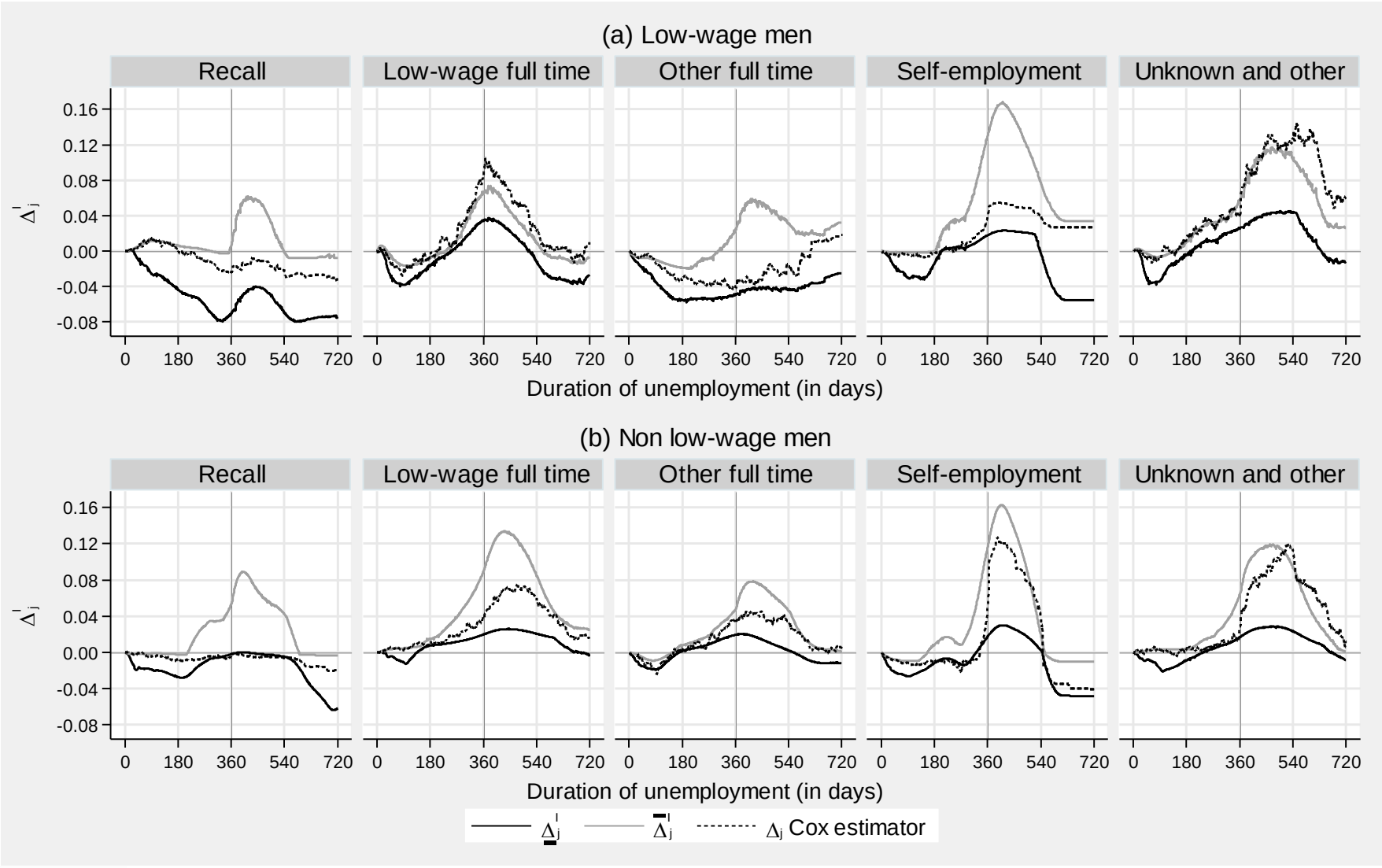
Prediction at variable means of respective sample, 95-percent-CI (bootstrapping)

Empirical results: Copula Graphic Estimator Regression

Example for one of the 40 first stage estimates (excerpt)

Risk to enter non low-wage job	Low-wage men							
	Age 40-44				Age 45-46			
Selected variables	Pre		Post		Pre		Post	
Vocational training or Abitur	1.927	**	2.404	**	2.509	*	1.433	
University	2.901	**	2.351	**	2.467		1.587	
Married	1.415	**	1.357	**	1.412	*	1.175	
Non-German	0.767	*	0.757	*	0.958		0.540	*
Years of employment	1.156	**	1.069		1.025		1.131	
Years of tenure at last employer	0.885	**	0.890	**	0.937		0.861	**
Years of unemployment	0.917		0.916		0.559	**	0.702	*
Past recall	0.905		0.988		0.836		0.612	
Daily wage rate	1.030	**	1.026	**	1.030	**	1.022	*
Hotels and restaurants	0.623	*	0.601	**	0.583		1.035	
Temporary agency sector	0.795		1.207		0.785		0.606	
N of observations	7134		5126		1817		1346	
N of failures	770		708		188		163	

DiD estimator of bounds for the reform effects on marginal distributions



Robustness checks

Specification	Variations of **sample and unemployment definition** obtained very similar results: • Excluding a longer time period around the reform (8/2005 to 4/2006) • Including the anticipation period • Using a wider definition of unemployment, interpreting also times in an unknown destination as unemployment • Taking those of age 47 to 51 as the treatment group
Uncertainty	Estimation of standard errors using a **bootstrap** for an example: Shows that uncertainty due to random sampling does not play an important role
Copula assumption	Re-estimation of model **without assumption** that copula is independent of time periods and age groups: Results in much wider bounds

Conclusions

Cut in unemployment benefit duration affected unemployment exits

Strategy of the paper

Exploit a natural experiment to identify bounds on the marginal distribution functions for different **competing risks to leave unemployment**, using large administrative data and applying a Copula Graphic Estimator Regression model

Main results

In Germany, shorter benefit durations since 2006 induced in particular **previous non low-wage workers**

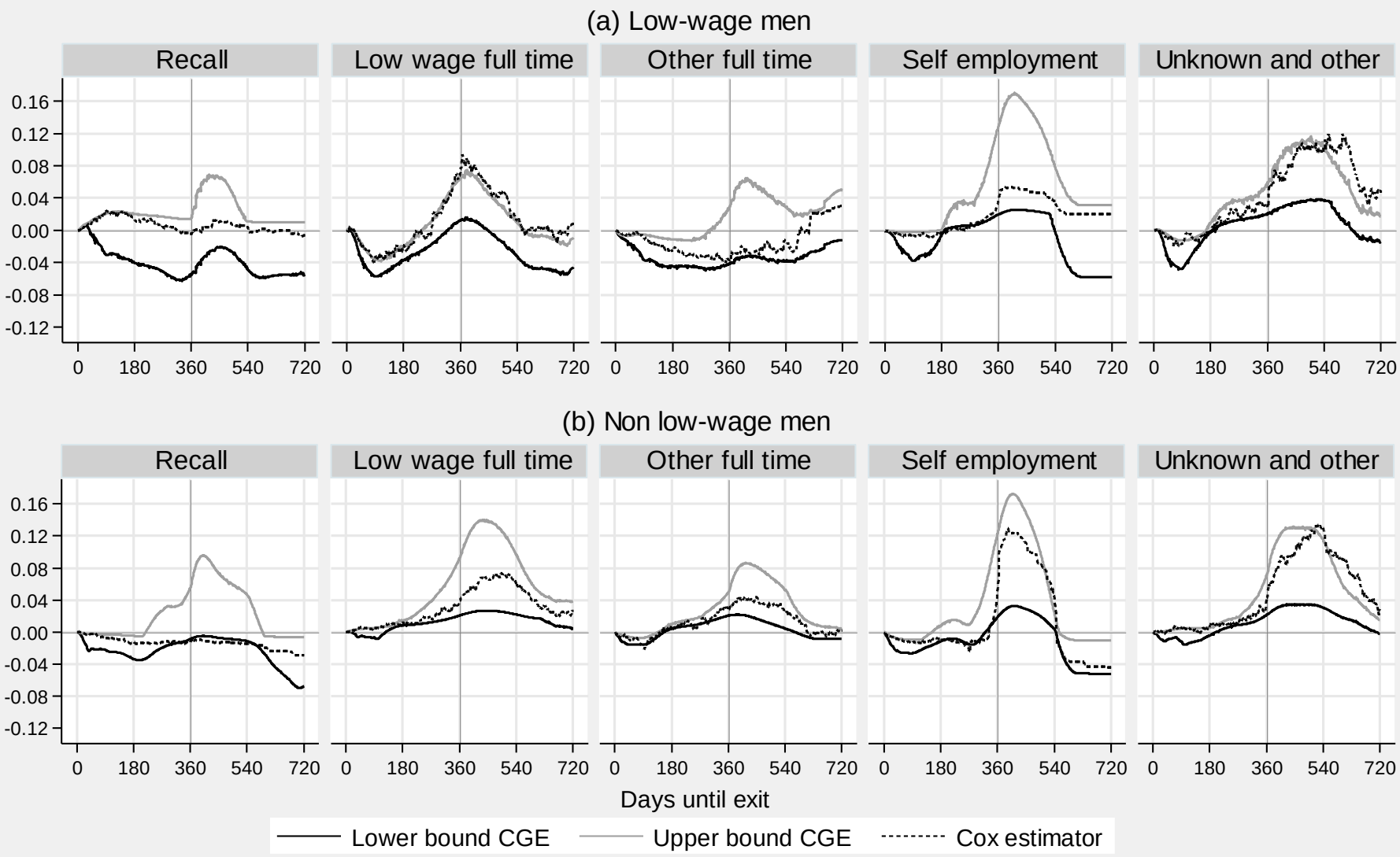
- **to take up a low-wage or other full time job earlier**
- **to enter subsidized self-employment earlier**

Policy conclusions

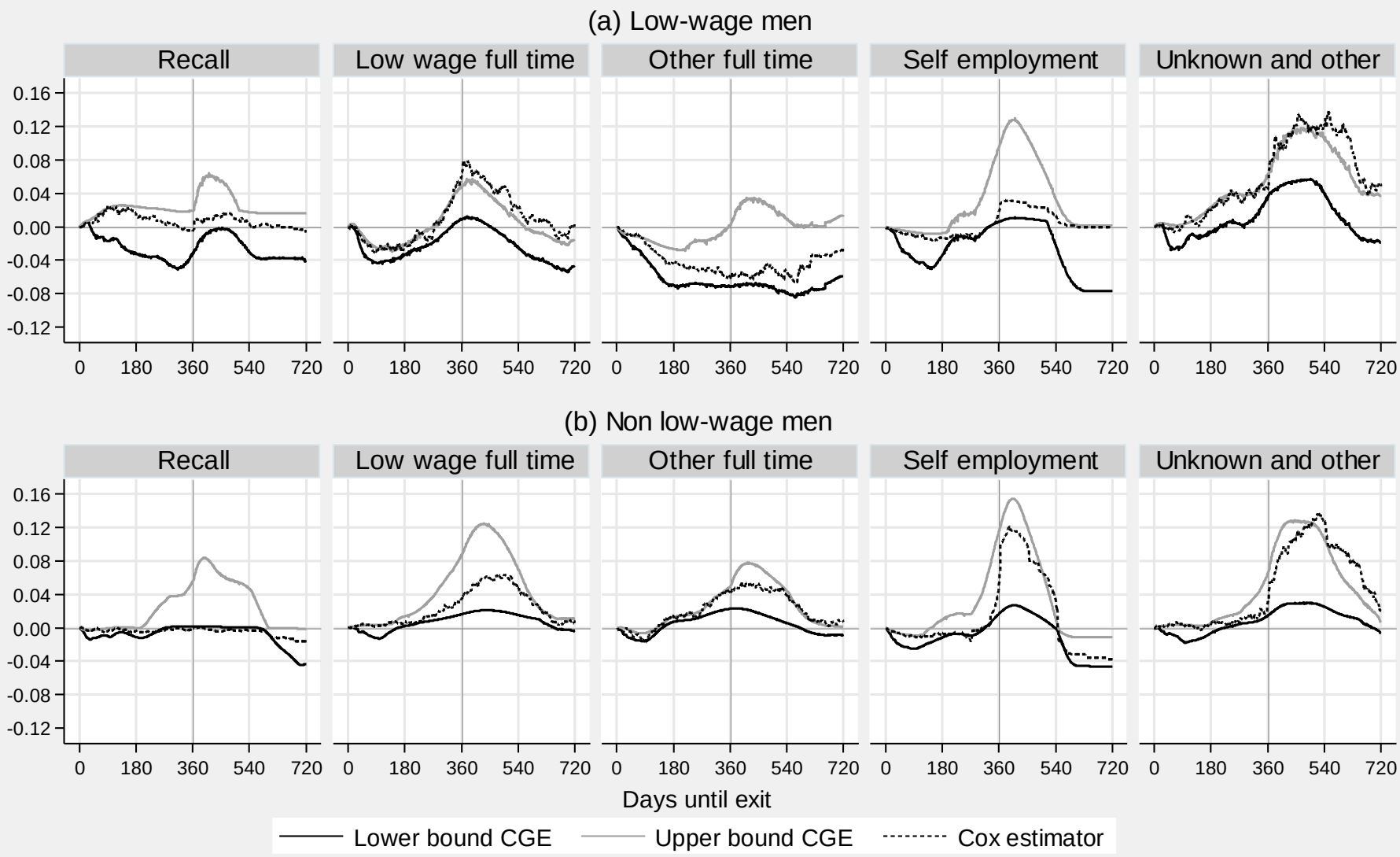
- Reform was successful in the sense that it **affected exit behavior** from unemployment (but: reform had partly been withdrawn in 2008)
- Results fit very well into the recent discussion that the decrease in unemployment in Germany during the last years is mainly the result of a **rising low-wage sector**

Appendix I

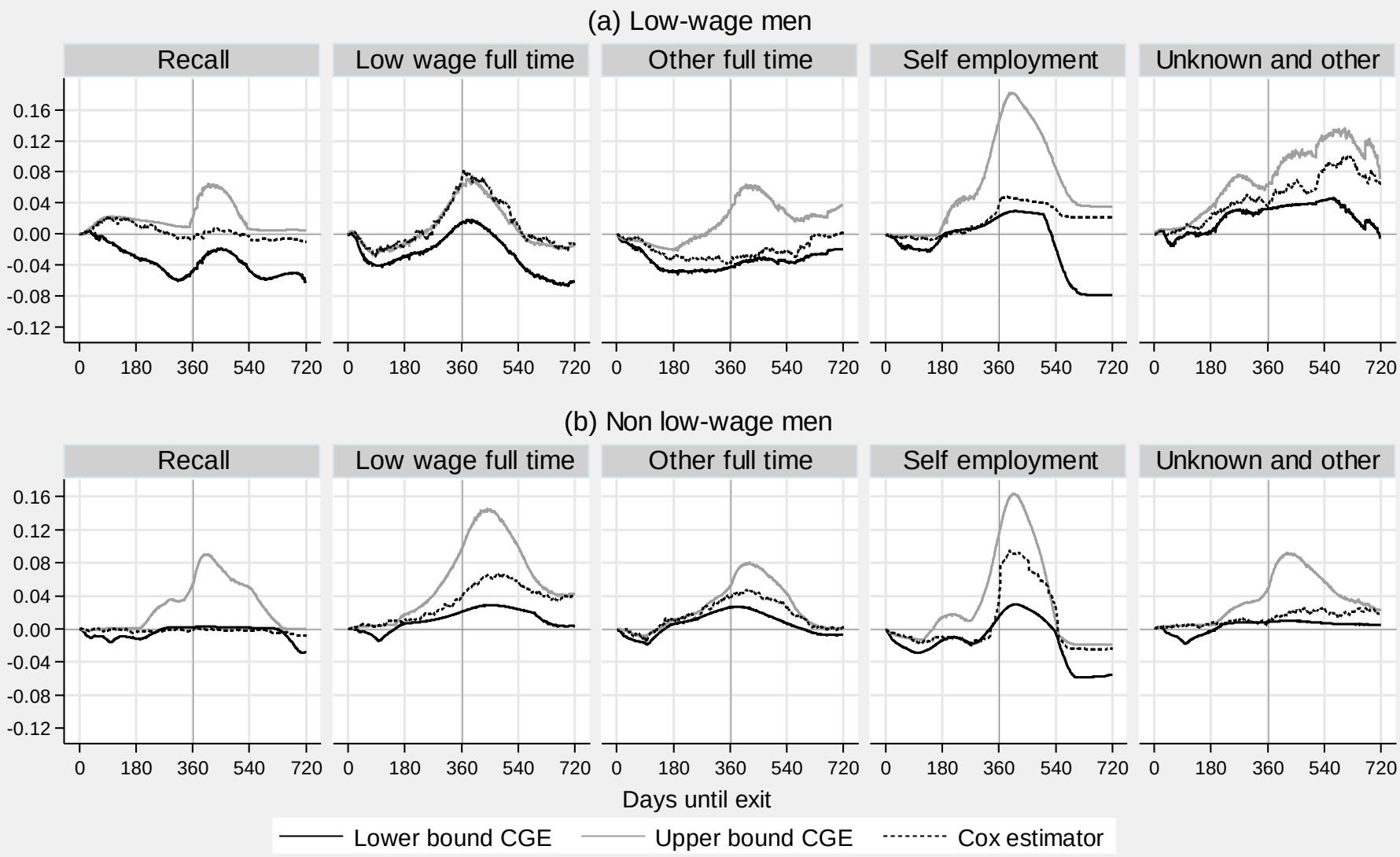
Excluding extended anticipation period 8/2005 to 4/2006



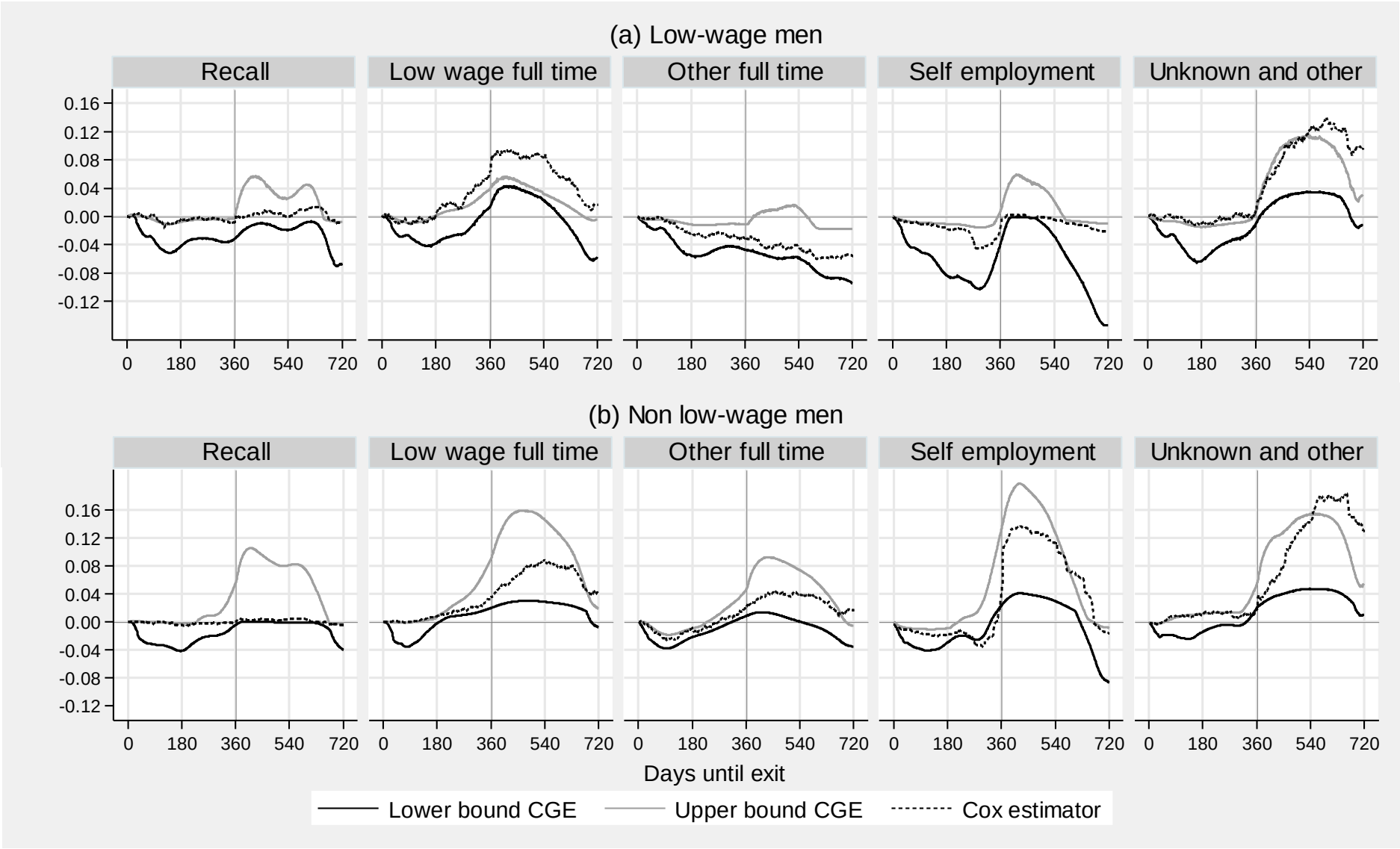
Anticipation period of reform not excluded



Wider definition of unemployment

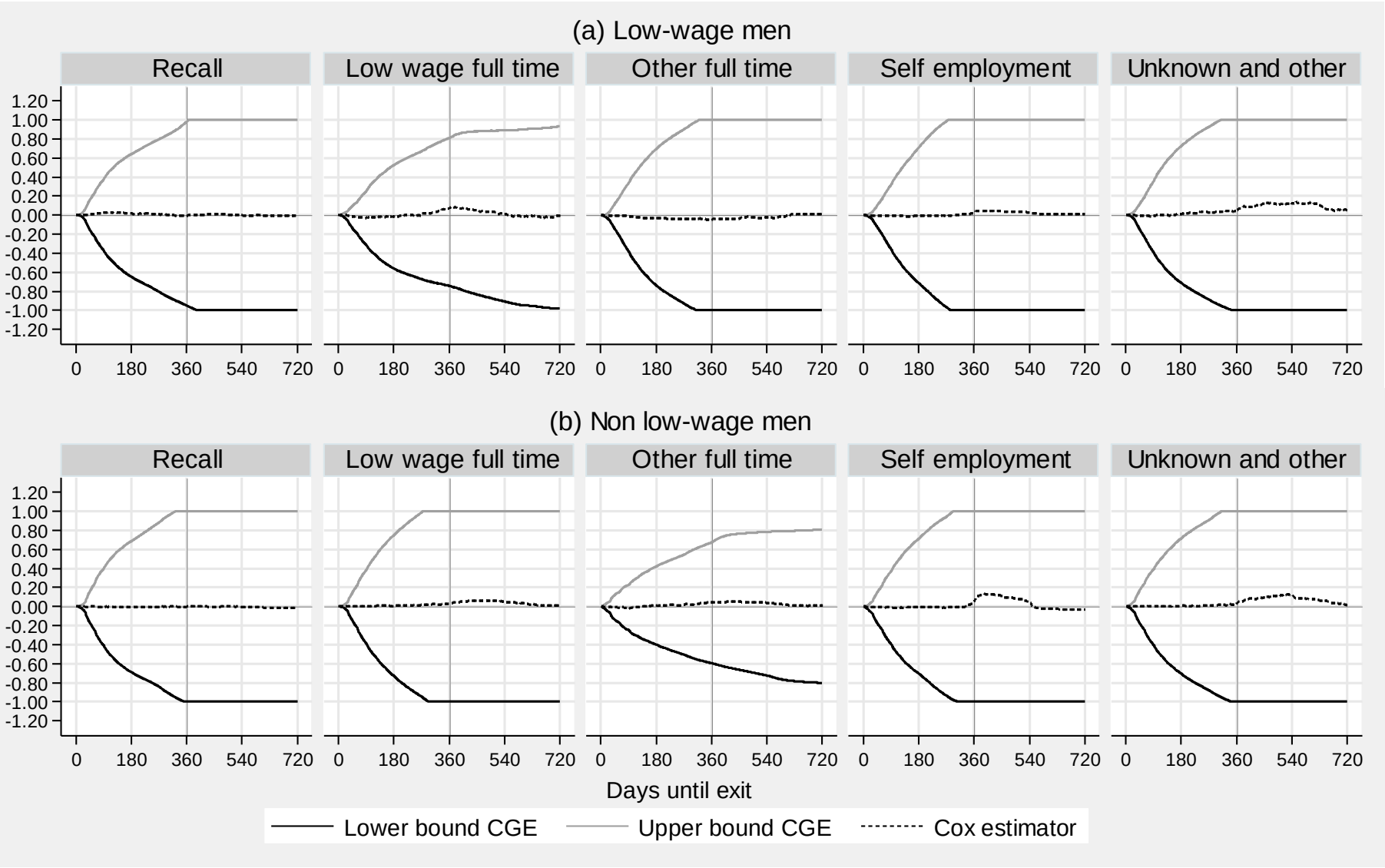


Age group 47-51 as treatment group

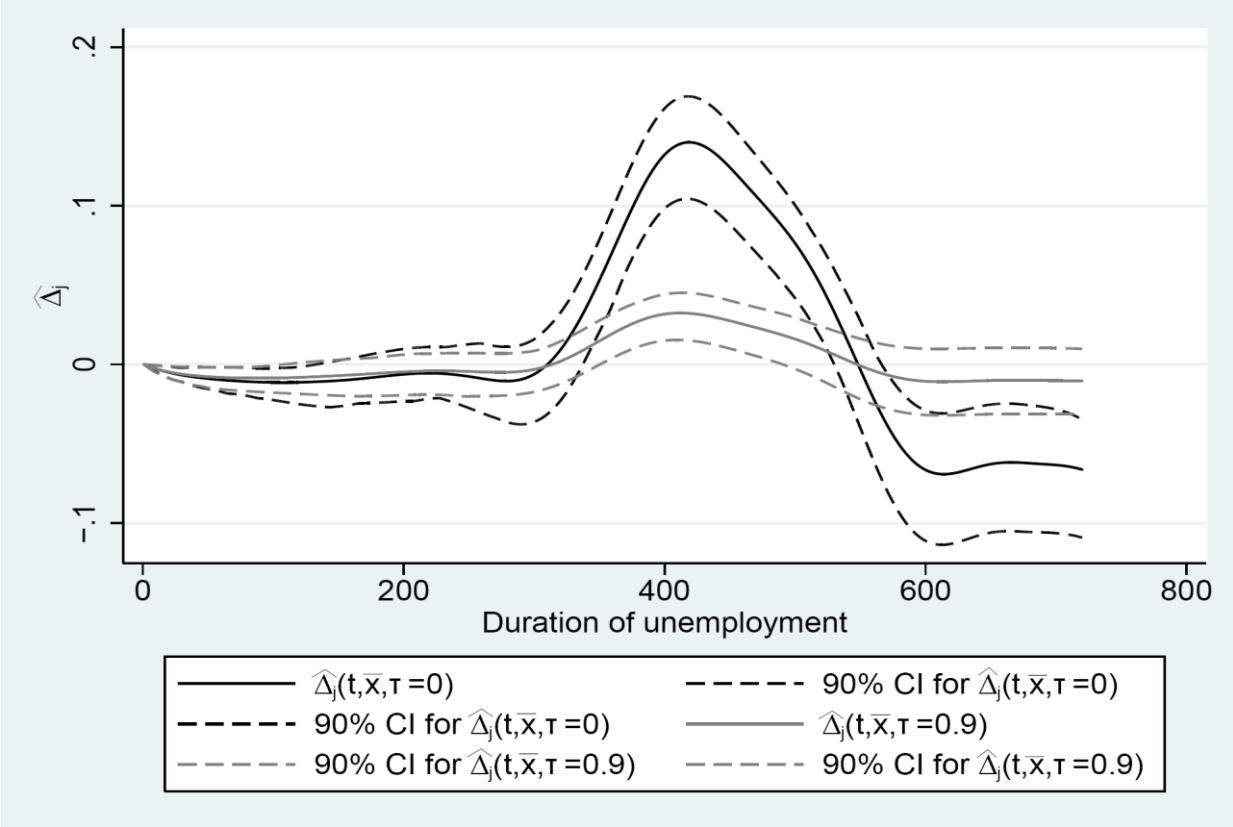


Prediction at variable means of respective sample

Relaxing assumption that copula does not depend on time period or age



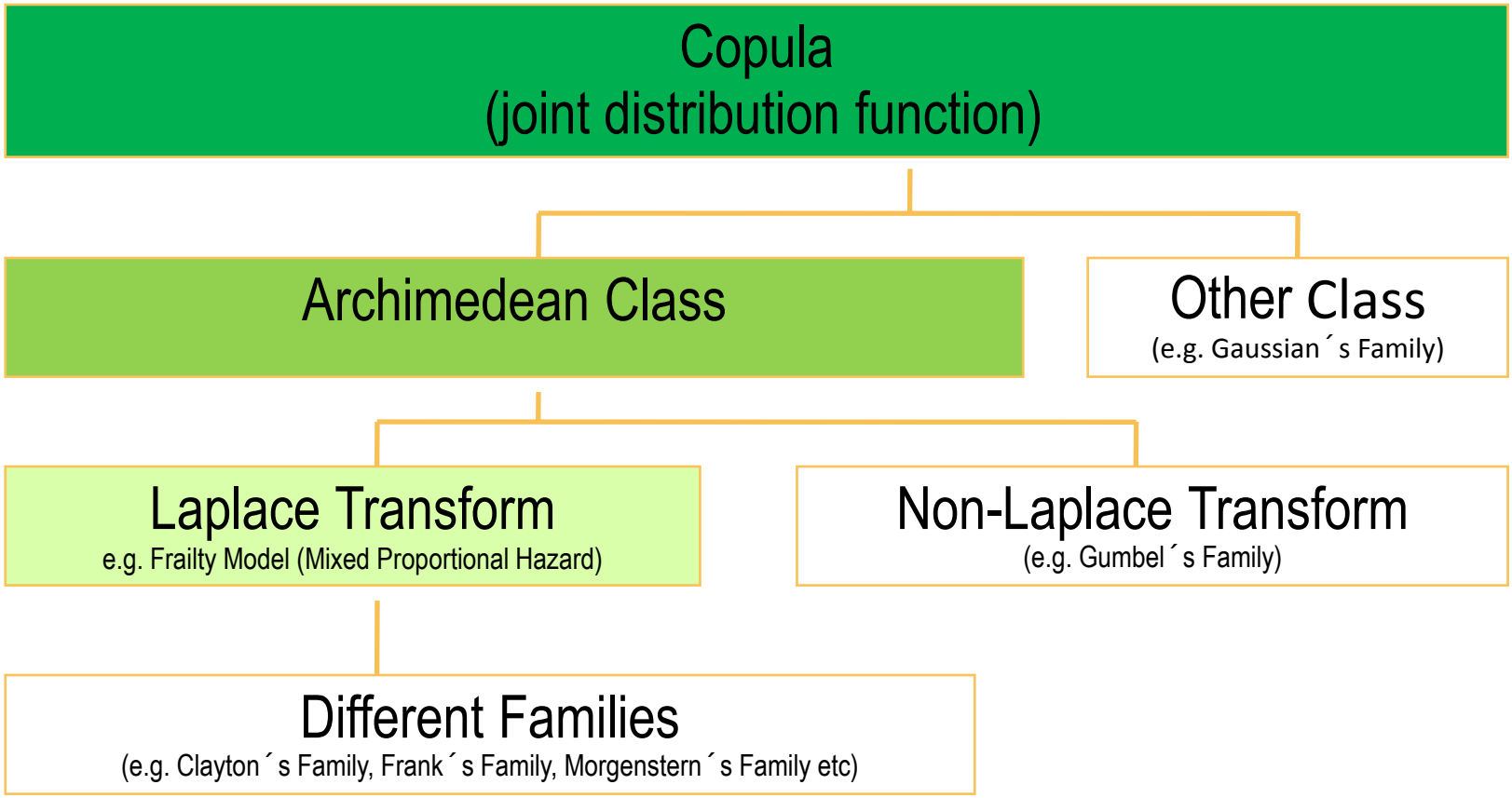
Partial identification vs. random sampling



90% bootstrap CI for risk self-employment, non low-wage

Appendix II

Families of Copula Functions



Estimation of the reform effect on latent durations

- Identification of the reform effect,
  with T as the reform period dummy and G as the reform group dummy :

$$\begin{aligned}\Delta_j(t;\bar{\mathbf{x}}) &= F_j(t;T=1,G=1,\bar{\mathbf{x}}) - F_j(t;T=0,G=1,\bar{\mathbf{x}}) \\ &\quad - (F_j(t;T=1,G=0,\bar{\mathbf{x}}) - F_j(t;T=0,G=0,\bar{\mathbf{x}}))\end{aligned}$$

- Semi-parametric model for the sub-distribution hazards (Fine/Gray 1999), with

$$\begin{aligned}\phi_j(t;\mathbf{x}) &= \lim_{\Delta t\to 0}\frac{1}{\Delta t}P(t\le T\le t+\Delta t,\delta=j;\ T\ge t\cup(T\le t\cap\delta\neq j),\mathbf{x}) \\ &= -d\log\{1-Q_j(t;\mathbf{x})\}/dt,\end{aligned}$$

- Estimation for pre-/post-reform, control/treatment group at sample mean

Assumption of the Frank copula

- F is not identified as the dependence structure (τ) is unknown;
  we assume a one parameter Frank copula with generator function ξ

$$\tilde{F}_j(t;\mathbf{x},\tau) = 1-\xi_\tau^{-1}\left[-\int_0^t \xi_\tau'(1-\sum_{j=1}^{5} Q_j(u;\mathbf{x}))Q_j'(u;\mathbf{x})du\right]$$

- For this reason we compute for a grid on the support of τ
  and determine a lower and upper bound for the treatment effect

$$\begin{aligned}\tilde{\Delta}_j(t;\bar{\mathbf{x}},\tau) = \; = \; & \tilde{F}_j(t;T=1,G=1,\bar{\mathbf{x}},\tau)-\tilde{F}_j(t;T=0,G=1,\bar{\mathbf{x}},\tau)\\ & -\left(\tilde{F}_j(t;T=1,G=0,\bar{\mathbf{x}},\tau)-\tilde{F}_j(t;T=0,G=0,\bar{\mathbf{x}},\tau)\right)\end{aligned}$$

$$\begin{aligned}\underline{\Delta}_j(t;\bar{\mathbf{x}}) &= \min_\tau \tilde{\Delta}_j(t;\bar{\mathbf{x}},\tau)\\ \overline{\Delta}_j(t;\bar{\mathbf{x}}) &= \max_\tau \tilde{\Delta}_j(t;\bar{\mathbf{x}},\tau)\end{aligned}$$

: