

Is Education a Signal on the Russian Labour Market?

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LLMS Seminar

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2 Literature Review

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Motivation

Higher education is very popular in Russia.

Some people try to get two and three higher degrees.

- Do we really invest in **human capital** while study **or** just get credentials hoping to use them as **signals** about our innate productivity?
- Is it possible to estimate the **return to** the educational **signals**?

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Notes

Screening is the process of investigation or gathering information about something.

Potential worker in the hiring process could **signal** about his productivity with the use of certificates of education.

The process of obtaining information on the productivity through supervision of signals about education we call screening.

Hypotheses

Brown and Sessions (1999):

The *strong screening hypothesis (SSH)*

- productivity is **immutable** with schooling
- education is used as a signal of innate productivity

The *weak screening hypothesis (WSH)*

- education may **augment** inherent productivity
- the primary role of education is to signal about the productivity

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It is rational to expect, that

- education increases person's productivity and could play a role of signal about the productivity,
- the returns to educational signals and human capital should be the same, if the labour market is in equilibrium.

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Literature Review

- **Stigler (1962)**

The more information — the closer worker's marginal product to the maximum.

- **Spence (1972, 1973, 1974)**

The employee considers education as acquisition of signal about his abilities.

Literature Review

- **Arrow (1973)**

- theoretical model where education is a filter
- employer assigns wages corresponded to the average productivity of the employees with respective education

- **Taubman and Wales (1973)**

- level of education is a cheap instrument of screening
- the return to education in the unscreened group of employees was considerably less than in the group subjected to screening (NBER-TH data)

- **Riley (1975, 1979)**

- firms in different extent pay attention to screening (theoretical models)
- in some specialities the employees used to be screened (the Current Population Survey)

Literature Review

- **Wolpin (1977)**
 - self-employed workers as unscreened group
 - persons who do not suppose to signal about their productivity are less educated (NBER-TH data)
- **Psacharopoulos (1979)**
 - screening should be more evident in state sector
 - curves in axes income–tenure should approach each other with tenure increasing
- **Liu and Wong (1982)**
 - samples divided according to the job tenure and general labour market experience
 - the decreasing return to education with tenure is the evidence of screening via certificates

Literature Review

- **Wolpin (1977)** and **Kawaguchi (2003)**

The self-employed are more able as evidenced by their higher lifetime earnings.

Literature Review

- **Clark (2000)**

- the Russia Longitudinal Monitoring Survey (RLMS-HSE) data (1994–1996 and 1998 years)

- ideas of Wolpin (1977), Psacharopoulos (1979) Liu and Wong (1982)

Literature Review

- Clark (2000)

OLS and the standard Heckman (1979) bivariate approach estimates on samples of **state** and **private** sectors (Mincerian earnings functions, Mincer and Polachek (1974)):

$$\ln w = \alpha + \beta S + \gamma_1 \text{Exp} + \gamma_2 \text{Exp}^2 + \gamma_3 \text{Male} + \varepsilon, \quad (1)$$

$$\begin{aligned} \ln w = \alpha + \beta S + \gamma_1 \text{Exp} + \gamma_2 \text{Exp}^2 + \gamma_3 \text{Male} + \\ + \gamma_4 \text{Hours} + \gamma_5 \text{Tenure} + \gamma_6 \text{Tenure}^2 + \varepsilon, \end{aligned} \quad (2)$$

where $\ln w$ is logarithm of monthly wages, S is years of schooling, Exp is experience, Male is gender dummy variable, Hours is hours of work, Tenure is years of tenure.

Literature Review

- **Clark (2000)**

Return to education in **private** sector were greater than in the **state** one.

Literature Review

- **Clark (2000)**

- insignificant slope coefficients of schooling in the **entrepreneurs'** earnings functions and significant coefficients in the **employees'** equations
- small sample of entrepreneurs (61-75 observations)

Literature Review

- Clark (2000)

Mincerian earnings functions in the form:

$$\begin{aligned} \ln w = & \alpha_0 + \alpha_1 C_1 + \alpha_2 C_2 + \alpha_3 C_3 + \alpha_4 C_4 + \alpha_5 C_5 + \\ & + \alpha_6 \textit{State} + \alpha_7 \textit{Hours} + \alpha_8 \textit{Exp} + \alpha_9 \textit{Exp}^2 + \varepsilon, \end{aligned} \quad (3)$$

$$\begin{aligned} \ln w = & \alpha_0 + \alpha_1 C_1 + \alpha_2 C_2 + \alpha_3 C_3 + \alpha_4 C_4 + \alpha_5 C_5 + \\ & + \alpha_6 \textit{State} + \alpha_7 \textit{Hours} + \varepsilon, \end{aligned} \quad (4)$$

on samples of the **employees** with different years spent on the same firm (tenure) and experiences (0–2, 1–3, and so on, and 0–4, 2–6, and so on, respectively),

where C_1 – C_5 are binary variables correspond to the levels of education.

Literature Review

- **Clark (2000)**

- The returns to the levels of education were not stable due to the differences in the samples, but, in average, they were significant for the university level.
- The effects tended to lose significance after approximately 8–10 year of tenure and 10–14 years of experience.
- Author comes to the conclusion of rejecting SSH.



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Methodology

Mincerian earnings function:

$$\ln y = \alpha + S\beta + R\gamma + \epsilon,$$

where

y is logarithm of monthly earnings,

α is intercept term,

S equals to years of schooling or set of dummy variables indicating level of education (the last is concerned with “sheepskin” effect: Layard and Psacharopoulos (1974); Liu and Wong (1982); Hungerford and Solon (1987)),

β is private return to education,

R is vector of explanatory and control variables,

γ is vector of parameters,

ϵ_j is an error term.

Methodology

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compare β in screened and unscreened groups.

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β s in equations for unscreened groups of respondents (**self-employed** workers) are **insignificant**,

β is **significant** for the screened group (**employees**).

◀ **Econometric & Ideological Problems** ▶



Methodology

Mincerian earnings function:

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The *weak* screening hypothesis (WSH)

- education may **augment** inherent productivity
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β s are **significant** in each screened and unscreened groups (**employees** and **self-employed** workers),

β s in equations for unscreened groups of respondents (**self-employed** workers) are expected to be **smaller**, than in the screened group (employees).
◀ **Why?** ▶

Methodology

Mincerian earnings function:

$$\ln y = \alpha + S\beta + R\gamma + \epsilon,$$

consider dynamics of β with time spent on the same firm.

Educational **signals** should be significant in the hiring process and **decrease** with time spent on the same firm.

◀ *Is education ideal sorting device?* ▶

Empirical Framework

Gorodnichenko and Sabirianova Peter (2005):

Basic Mincerian earnings functions, OLS

Panel A: Russia

	1985	1990	1996	1998	2000	2002
Schooling (adjusted years)	0.028 ^{***} (0.003)	0.039 ^{***} (0.004)	0.081 ^{***} (0.007)	0.091 ^{***} (0.006)	0.093 ^{***} (0.007)	0.092 ^{***} (0.006)
Experience (years)	0.019 ^{***} (0.003)	0.027 ^{***} (0.003)	0.014 ^{***} (0.005)	0.029 ^{***} (0.005)	0.045 ^{***} (0.005)	0.030 ^{***} (0.005)
Experience ² /1000	-0.378 ^{***} (0.055)	-0.554 ^{***} (0.072)	-0.335 ^{***} (0.119)	-0.629 ^{***} (0.108)	-0.991 ^{***} (0.129)	-0.724 ^{***} (0.119)
Female	-0.424 ^{***} (0.016)	-0.401 ^{***} (0.020)	-0.473 ^{***} (0.030)	-0.530 ^{***} (0.027)	-0.520 ^{***} (0.030)	-0.473 ^{***} (0.026)
Capital	0.011 (0.044)	0.095 (0.058)	0.614 ^{***} (0.060)	0.537 ^{***} (0.061)	0.634 ^{***} (0.082)	0.630 ^{***} (0.053)
<i>N</i>	4111	3776	3497	3332	3169	3341
<i>R</i> ²	0.19	0.15	0.13	0.17	0.15	0.18

Empirical Framework

Gorodnichenko and Sabirianova Peter (2005):

Sensitivity analysis of the estimated returns to schooling

Panel A: Russia

	1985	1990	1996	1998	2000	2002
Without survey weights	0.027 (0.003)	0.039 (0.004)	0.081 (0.007)	0.094 (0.006)	0.097 (0.007)	0.096 (0.006)
Without restrictions on age	0.027 (0.003)	0.037 (0.004)	0.077 (0.006)	0.083 (0.006)	0.086 (0.006)	0.089 (0.006)
	[4220]	[3964]	[3676]	[3537]	[3374]	[3531]
Schooling (actual years)			0.068 (0.006)	0.078 (0.005)	0.080 (0.006)	0.080 (0.005)
			[3469]	[3298]	[3159]	[3310]
With wages actually received last month			0.065 (0.008)	0.090 (0.009)	0.092 (0.008)	0.086 (0.007)
			[2445]	[2326]	[2649]	[2906]
With log of hourly wage rate			0.085 (0.007)	0.097 (0.006)	0.102 (0.007)	0.101 (0.006)
			[3061]	[3281]	[3090]	[3297]
With industry dummies	0.032 (0.003)	0.042 (0.004)	0.079 (0.006)	0.091 (0.006)	0.093 (0.007)	
	[3982]	[3679]	[3477]	[3316]	[3132]	
With district fixed effects	0.023 (0.003)	0.030 (0.004)	0.063 (0.006)	0.069 (0.005)	0.073 (0.006)	0.074 (0.005)

Empirical Framework

Gorodnichenko and Sabirianova Peter (2005):

Panel B: Ukraine

	1986	1991	1997	1998	2000	2002
Without survey weights	0.031 (0.003)	0.039 (0.004)	0.037 (0.005)	0.039 (0.005)	0.036 (0.005)	0.046 (0.005)
Without restrictions on age	0.034 (0.004) [4192]	0.039 (0.005) [3564]	0.040 (0.005) [3073]	0.040 (0.005) [2945]	0.035 (0.004) [3099]	0.046 (0.004) [3494]
Schooling (actual years)			0.041 (0.005) [2914]	0.046 (0.006) [2779]	0.047 (0.005) [2890]	0.055 (0.005) [3245]
With wages actually received last month						0.049 (0.005) [3066]
With log of hourly wage rate						0.052 (0.005) [2968]
With wages actually received over the last six months						0.048 (0.005) [2570]
Based on IV estimation	0.072 (0.010) [3764]	0.092 (0.014) [3193]	0.088 (0.014) [2722]	0.103 (0.014) [2604]	0.112 (0.014) [2731]	0.121 (0.013) [3058]
With parents' background	0.031 (0.004) [3766]	0.034 (0.005) [3196]	0.031 (0.005) [2736]	0.031 (0.005) [2615]	0.028 (0.005) [2746]	0.038 (0.005) [3061]



Empirical Framework

- sample selection bias
- endogeneity of education

Empirical Framework

GMM-Heckit estimates (Wooldridge, 2002, p. 568–569):

- The **number of children** in the family, person's **age**, **spouse's monthly earnings** and all exogenous variables of the main equation with **spouse's education** instead of the person's education are used in the **labour force participation** equation.
- The **number of children** in the family, person's **age**, **spouse's monthly earnings** along with **spouse's education** and **nonselection hazard**¹ are used as **instruments** in **GMM** estimator of the main equation.

¹ The nonselection hazard is $\frac{f(z\hat{\delta})}{1-F(z\hat{\delta})}$, where z is vector of explanatory variables in the labour force participation equation, $\hat{\delta}$ is vector of estimates of the corresponding parameters, f and F are standard normal pdf and CDF, respectively.



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Data

RLMS-HSE (1994–2009)

- annual survey (except of 1997 and 1999) with representative sample of population of the Russian Federation
- 88% of respondents in sample were interviewed in October–November

NOBUS (2003)

- representative data for the Russian Federation and at regional level for 47 out of 89 subjects of the Russian Federation
- more that 99% of respondents were interviewed in May–June

Federal State Statistics Service

- regional consumer price indexes
- pecuniary values in 1994 roubles for the RLMS-HSE data

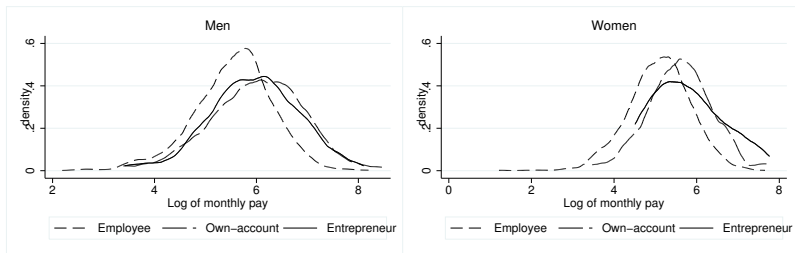
Means of selected variables

RLMS-HSE (1994–2009)	Men			Women		
	Empl-ee	Own-acc.	Entrep.	Employee	Own-acc.	Entrep.
Log of monthly pay	5.549 (0.005)	5.982 (0.029)	5.845 (0.031)	5.156 (0.005)	5.537 (0.032)	5.623 (0.037)
Schooling (years)	12.797 (0.016)	13.430 (0.068)	14.050 (0.088)	13.350 (0.015)	13.555 (0.073)	14.385 (0.101)
Secondary vocational education	0.214 (0.002)	0.305 (0.012)	0.198 (0.011)	0.358 (0.002)	0.473 (0.015)	0.407 (0.018)
Higher education	0.226 (0.002)	0.270 (0.012)	0.426 (0.014)	0.294 (0.002)	0.258 (0.014)	0.425 (0.018)
Sample size, log of monthly pay	31079	1110	1078	36225	826	655
Sample size, other variables	33244	1362	1260	38331	1039	744
Sample size, log of mon.pay, 2003	2166	100	80	2632	88	44
NOBUS (2003)	Employee	Self-employed		Employee	Self-employed	
Log of monthly pay	8.057 (0.005)	7.474 (0.094)		7.722 (0.005)	7.304 (0.100)	
Secondary vocational education	0.303 (0.003)	0.272 (0.010)		0.375 (0.003)	0.344 (0.013)	
Incomplete higher education	0.033 (0.001)	0.032 (0.004)		0.039 (0.001)	0.049 (0.006)	
Higher education	0.184 (0.003)	0.218 (0.009)		0.243 (0.003)	0.193 (0.011)	
Sample size, log of monthly pay	22174	175		24581	116	
Sample size, other variables	23035	1939		25308	1361	

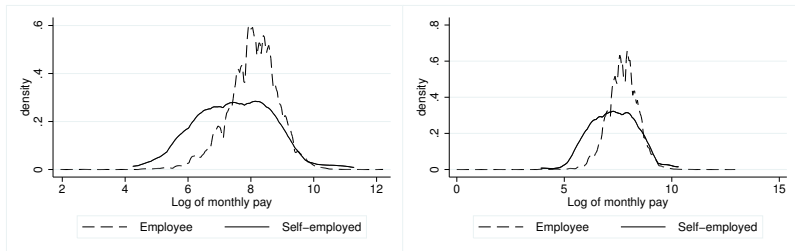
Standard errors of means are in parentheses.

Kernel density estimates of log of monthly earnings in 2003

RLMS-HSE

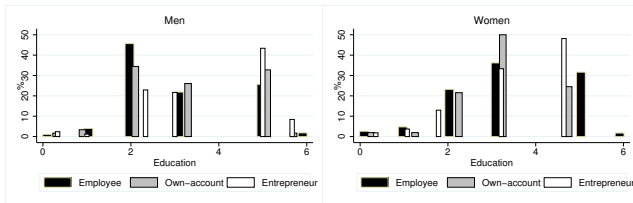


NOBUS

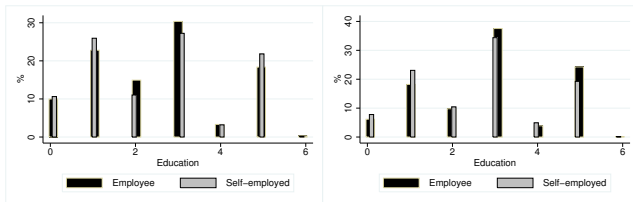


Histograms of education in 2003

RLMS-HSE



NOBUS



0 — Incomplete secondary, primary and no primary education; 1 — Secondary education; 2 — Primary vocational education; 3 — Secondary vocational education; 4 — Incomplete higher education (NOBUS); 5 — Higher education; 6 — Postgraduate higher education.



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Employee vs. Self-employed

Earnings functions for men, OLS estimates on the RLMS-HSE data

	1996		1998		2000	
	Employee	Self-empl.	Employee	Self-empl.	Employee	Self-empl.
Schooling (years)	0.052*** (0.008)	0.075 (0.054)	0.047*** (0.007)	0.028 (0.050)	0.044*** (0.007)	0.044 (0.036)
Experience (years)	-0.011* (0.006)	-0.059 (0.041)	0.003 (0.005)	0.057 (0.052)	0.007 (0.005)	-0.003 (0.031)
Experience ² /100	0.011 (0.014)	0.182 (0.121)	-0.022** (0.011)	-0.173 (0.151)	-0.030*** (0.012)	-0.014 (0.091)
City	0.677*** (0.051)	1.023*** (0.300)	0.642*** (0.042)	0.277 (0.273)	0.631*** (0.044)	-0.011 (0.225)
Constant	4.181*** (0.110)	4.407*** (0.723)	3.881*** (0.092)	4.474*** (0.810)	4.052*** (0.101)	5.118*** (0.526)
Observations	1706	45	1651	50	1790	97
Adj. R ²	0.142	0.233	0.175	-0.033	0.142	-0.019
F	71.7	4.3	88.5	0.6	75.0	0.6
	2003		2006		2009	
	Employee	Self-empl.	Employee	Self-empl.	Employee	Self-empl.
Schooling (years)	0.041*** (0.006)	0.068** (0.027)	0.049*** (0.005)	0.069*** (0.022)	0.032*** (0.006)	-0.015 (0.039)
Experience (years)	0.006 (0.004)	0.058** (0.028)	0.018*** (0.004)	0.034 (0.021)	0.023*** (0.004)	0.081** (0.038)
Experience ² /100	-0.028*** (0.010)	-0.223*** (0.083)	-0.056*** (0.008)	-0.102* (0.057)	-0.057*** (0.011)	-0.209** (0.099)
City	0.547*** (0.035)	0.426** (0.172)	0.343*** (0.030)	0.576*** (0.139)	0.284*** (0.036)	-0.146 (0.222)
Constant	4.623*** (0.082)	4.547*** (0.399)	4.917*** (0.070)	4.615*** (0.332)	5.174*** (0.087)	5.740*** (0.606)
Observations	2164	138	2721	162	2790	145
Adj. R ²	0.149	0.136	0.110	0.162	0.045	0.011
F	95.9	6.4	85.1	8.8	34.2	1.4

Standard errors are in parentheses.

* $p < .1$, ** $p < .05$, *** $p < .01$

Employee vs. Self-employed

Earnings functions for men, Heckit estimates, RLMS-HSE I

	1996	1998	2000	2003	2006	2009
Schooling (years)	0.040*** (0.008)	0.041*** (0.007)	0.041*** (0.007)	0.043*** (0.006)	0.044*** (0.005)	0.036*** (0.006)
Experience (years)	-0.018*** (0.006)	-0.007 (0.005)	-0.006 (0.005)	-0.006 (0.005)	0.008* (0.004)	0.011** (0.005)
Experience ² /100	0.053*** (0.015)	0.007 (0.013)	0.006 (0.013)	0.003 (0.013)	-0.028*** (0.010)	-0.011 (0.013)
City	0.659*** (0.057)	0.629*** (0.048)	0.570*** (0.049)	0.485*** (0.043)	0.360*** (0.036)	0.125*** (0.044)
Constant	4.519*** (0.121)	4.169*** (0.107)	4.368*** (0.111)	4.864*** (0.102)	5.175*** (0.084)	5.449*** (0.099)
<i>LF Participation</i>						
Spouse's schooling	0.041*** (0.012)	0.047*** (0.012)	0.060*** (0.012)	0.074*** (0.012)	0.069*** (0.011)	0.051*** (0.009)
Experience (years)	-0.092*** (0.014)	-0.080*** (0.014)	-0.074*** (0.013)	-0.024** (0.011)	-0.031*** (0.011)	-0.043*** (0.010)
Experience ² /100	0.112*** (0.026)	0.119*** (0.026)	0.104*** (0.027)	0.047* (0.025)	0.080*** (0.023)	0.085*** (0.022)
City	0.154* (0.083)	0.358*** (0.081)	0.474*** (0.076)	0.456*** (0.072)	0.477*** (0.066)	0.387*** (0.063)
Age	0.269*** (0.028)	0.259*** (0.027)	0.220*** (0.026)	0.225*** (0.024)	0.199*** (0.021)	0.161*** (0.018)
Age ² /100	-0.309*** (0.030)	-0.316*** (0.030)	-0.275*** (0.029)	-0.298*** (0.027)	-0.276*** (0.024)	-0.210*** (0.020)
Number of children 0-2	0.161	-0.019	0.009	0.132	0.258**	0.048

Employee vs. Self-employed

Earnings functions for men, Heckit estimates, RLMS-HSE II

	(0.156)	(0.141)	(0.137)	(0.128)	(0.120)	(0.095)
Number of children 3–6	-0.069	-0.033	-0.034	-0.141	0.011	0.141
	(0.102)	(0.111)	(0.109)	(0.098)	(0.095)	(0.091)
Number of children 7–17	0.002	-0.066	-0.050	-0.157***	-0.154***	-0.153***
	(0.055)	(0.055)	(0.054)	(0.049)	(0.050)	(0.044)
Log of spouse's mon.pay	0.022	0.011	0.008	0.050***	0.037**	0.014
	(0.017)	(0.018)	(0.020)	(0.018)	(0.016)	(0.014)
Constant	-3.880***	-3.743***	-3.178***	-3.963***	-3.203***	-2.233***
	(0.565)	(0.523)	(0.527)	(0.480)	(0.435)	(0.376)
atanh ρ	-0.880***	-0.419***	-0.424***	-0.493***	-0.576***	-1.434***
	(0.118)	(0.140)	(0.123)	(0.122)	(0.096)	(0.078)
In σ	-0.010	-0.251***	-0.194***	-0.289***	-0.334***	-0.023
	(0.024)	(0.024)	(0.023)	(0.022)	(0.019)	(0.017)
Observations	1945	1979	2145	2365	2893	2793
Censored observations	483	530	566	584	650	481
χ^2	197.6	238.6	198.9	219.1	202.9	62.0
Significance of χ^2	0.000	0.000	0.000	0.000	0.000	0.000

Standard errors are in parentheses.

* $p < .1$, ** $p < .05$, *** $p < .01$

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Earnings functions for men, GMM-Heckit estimates, RLMS-HSE

	1996		1998		2000	
	Employee	Self-empl.	Employee	Self-empl.	Employee	Self-empl.
Schooling (years)	0.066*** (0.021)	0.105 (0.117)	0.073*** (0.017)	0.016 (0.038)	0.070*** (0.022)	0.142 (0.102)
Experience (years)	-0.015** (0.006)	0.074 (0.059)	-0.010* (0.005)	0.081* (0.043)	-0.005 (0.006)	-0.039 (0.026)
Experience ² /100	0.032* (0.017)	-0.132 (0.173)	0.015 (0.013)	-0.323*** (0.116)	0.008 (0.014)	0.048 (0.090)
City	0.658*** (0.067)	1.074*** (0.238)	0.588*** (0.051)	0.421 (0.257)	0.556*** (0.057)	-0.014 (0.240)
Nonselection hazard	-0.332* (0.176)	-6.333** (2.851)	-0.278** (0.140)	1.656 (1.655)	-0.360** (0.169)	0.484 (1.277)
Constant	4.103*** (0.275)	4.134** (1.694)	3.780*** (0.227)	4.539*** (0.610)	3.988*** (0.299)	3.958*** (1.525)
Observations	1371	31	1353	38	1466	69
χ^2	243	69	303	20	275	10
	2003		2006		2009	
	Employee	Self-empl.	Employee	Self-empl.	Employee	Self-empl.
Schooling (years)	0.032* (0.016)	0.156** (0.075)	0.056*** (0.015)	-0.058 (0.072)	0.027 (0.018)	-0.137 (0.103)
Experience (years)	-0.010* (0.005)	0.027 (0.028)	0.003 (0.004)	0.027 (0.024)	0.011** (0.005)	0.084 (0.051)
Experience ² /100	0.017 (0.013)	-0.094 (0.080)	-0.011 (0.011)	-0.041 (0.068)	-0.022* (0.013)	-0.158 (0.137)
City	0.488*** (0.049)	0.146 (0.243)	0.277*** (0.043)	0.594** (0.269)	0.216*** (0.047)	-0.130 (0.365)
Nonselection hazard	-0.446*** (0.102)	-1.152 (0.793)	-0.557*** (0.089)	-1.061 (0.733)	-0.566*** (0.138)	-1.759 (1.106)
Constant	5.034*** (0.224)	3.896*** (1.088)	5.127*** (0.197)	6.590*** (0.961)	5.504*** (0.251)	7.588*** (1.217)
Observations	1625	94	2077	105	2138	102
χ^2	266	24	265	30	109	12

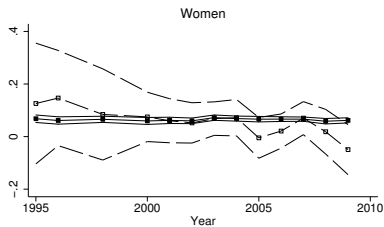
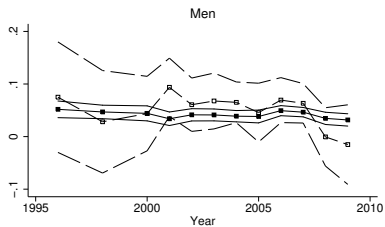
Robust standard errors are in parentheses.

* $p < .1$, ** $p < .05$, *** $p < .01$

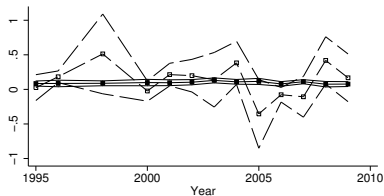
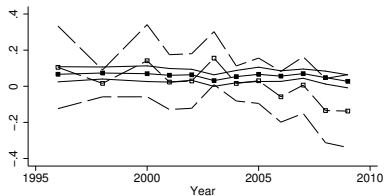
Employee vs. Self-employed

Private return to years of schooling (RLMS-HSE)

OLS



GMM-Heckit



—■— Employee - - - ■ - - Self-Employed

— 95% conf. int. - - - 95% conf. int.

Employee vs. Self-employed

Earnings functions for men, GMM-Heckit estimates, RLMS-HSE

	1996		1998		2000	
	Employee	Self-empl.	Employee	Self-empl.	Employee	Self-empl.
Higher and postgrad. ed.	0.378*** (0.132)	0.383 (0.295)	0.348*** (0.101)	0.312 (0.240)	0.398*** (0.126)	0.877** (0.395)
Experience (years)	-0.013** (0.006)	0.074 (0.056)	-0.008 (0.006)	0.059 (0.048)	-0.007 (0.006)	-0.051* (0.029)
Experience ² /100	0.033** (0.017)	-0.190 (0.159)	0.018 (0.016)	-0.264** (0.128)	0.020 (0.016)	0.083 (0.086)
City	0.669*** (0.066)	1.255*** (0.166)	0.606*** (0.056)	0.274 (0.309)	0.532*** (0.063)	0.251 (0.261)
Nonselection hazard	-0.528*** (0.157)	-4.256* (2.513)	-0.472*** (0.157)	1.684 (1.876)	-0.518*** (0.168)	0.123 (0.610)
Constant	4.861*** (0.080)	5.249*** (0.316)	4.634*** (0.080)	4.773*** (0.435)	4.845*** (0.088)	5.438*** (0.332)
Observations	1363	31	1138	32	1206	61
χ^2	250	86	245	16	224	22
	2003		2006		2009	
	Employee	Self-empl.	Employee	Self-empl.	Employee	Self-empl.
Higher and postgrad. ed.	0.333*** (0.096)	0.790* (0.429)	0.466*** (0.087)	0.281 (0.223)	0.200* (0.103)	-0.098 (0.503)
Experience (years)	-0.012** (0.006)	0.060** (0.029)	0.005 (0.004)	0.034* (0.020)	0.012** (0.005)	0.071* (0.041)
Experience ² /100	0.027* (0.014)	-0.161** (0.080)	-0.015 (0.011)	-0.054 (0.054)	-0.022* (0.013)	-0.109 (0.101)
City	0.501*** (0.051)	0.488* (0.263)	0.291*** (0.042)	0.359* (0.193)	0.220*** (0.044)	-0.313 (0.228)
Nonselection hazard	-0.506*** (0.109)	-0.845* (0.461)	-0.588*** (0.089)	-1.330** (0.534)	-0.607*** (0.135)	-1.829** (0.853)
Constant	5.371*** (0.076)	5.100*** (0.458)	5.747*** (0.063)	5.831*** (0.281)	5.823*** (0.074)	5.901*** (0.500)
Observations	1355	81	1902	97	2134	102
χ^2	248	211	281	38	118	16

Robust standard errors are in parentheses.

* $p < .1$, ** $p < .05$, *** $p < .01$

Employee vs. Self-employed

Earnings functions for women, GMM-Heckit estimates, RLMS-HSE

	1996		1998		2000	
	Employee	Self-empl.	Employee	Self-empl.	Employee	Self-empl.
Higher and postgrad. ed.	0.468*** (0.133)	-0.043 (0.199)	0.522*** (0.105)	0.572* (0.318)	0.470*** (0.117)	-0.095 (0.313)
Experience (years)	-0.017** (0.007)	0.037 (0.046)	-0.008 (0.008)	-0.092* (0.051)	-0.012 (0.009)	0.069* (0.040)
Experience ² /100	0.079*** (0.021)	-0.178 (0.147)	0.055** (0.025)	0.303 (0.218)	0.066** (0.028)	-0.305* (0.156)
City	0.438*** (0.056)	0.950*** (0.270)	0.380*** (0.047)	-1.023** (0.441)	0.368*** (0.052)	0.039 (0.211)
Nonselection hazard	-0.728*** (0.144)	0.578 (0.760)	-0.812*** (0.116)	-3.178 (2.021)	-0.739*** (0.144)	1.028 (0.778)
Constant	4.559*** (0.078)	4.816*** (0.476)	4.218*** (0.090)	6.875*** (0.634)	4.378*** (0.105)	4.839*** (0.360)
Observations	1239	18	1105	22	1089	31
χ^2	163	148	205	52	169	10
	2003		2006		2009	
	Employee	Self-empl.	Employee	Self-empl.	Employee	Self-empl.
Higher and postgrad. ed.	0.809*** (0.103)	-0.031 (0.492)	0.555*** (0.085)	-0.007 (0.349)	0.449*** (0.096)	-0.583 (0.549)
Experience (years)	-0.017** (0.008)	-0.044 (0.040)	-0.005 (0.005)	0.084*** (0.029)	0.014** (0.006)	0.018 (0.046)
Experience ² /100	0.072*** (0.022)	0.223* (0.118)	0.025* (0.014)	-0.167** (0.073)	-0.018 (0.015)	-0.167 (0.125)
City	0.286*** (0.048)	-0.076 (0.193)	0.315*** (0.039)	0.067 (0.258)	0.163*** (0.043)	0.353 (0.298)
Nonselection hazard	-0.754*** (0.132)	-2.538*** (0.678)	-0.448*** (0.073)	-0.923 (0.643)	-0.515*** (0.091)	2.071** (0.886)
Constant	4.854*** (0.093)	6.346*** (0.469)	5.189*** (0.070)	5.060*** (0.467)	5.367*** (0.075)	5.206*** (0.562)
Observations	1305	45	1720	53	1972	55
χ^2	244	23	254	32	160	18

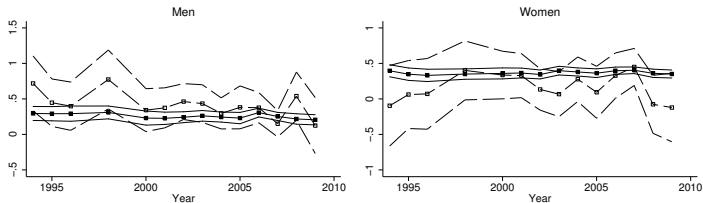
Robust standard errors are in parentheses.

* $p < .1$, ** $p < .05$, *** $p < .01$

Employee vs. Self-employed

Private return to higher education (RLMS-HSE)

OLS



GMM-Hekit



Base category is all levels below than higher education.

Employee vs. Self-employed

Heckit estimates of earnings functions on the NOBUS data I

	Men		Women	
	Employee	Self-employed	Employee	Self-employed
Secondary education	0.152*** (0.027)	-0.381 (0.434)	0.109*** (0.030)	0.260 (0.526)
Primary vocational education	0.243*** (0.028)	0.166 (0.536)	0.177*** (0.032)	0.337 (0.606)
Secondary vocational ed.	0.333*** (0.026)	0.018 (0.443)	0.277*** (0.028)	0.532 (0.511)
Incomplete higher education	0.437*** (0.047)	0.206 (0.634)	0.546*** (0.042)	-0.391 (0.879)
Higher education	0.565*** (0.028)	0.369 (0.467)	0.599*** (0.029)	0.737 (0.555)
Postgraduate higher education	0.639*** (0.121)	.	1.055*** (0.158)	.
1 ≤ Experience < 3	0.280*** (0.100)	1.108** (0.532)	0.068 (0.056)	0.280 (0.560)
3 ≤ Experience < 5	0.369*** (0.095)	0.183 (0.558)	0.054 (0.055)	-0.426 (0.776)
5 ≤ Experience < 10	0.459*** (0.090)	0.389 (0.367)	0.136*** (0.052)	0.060 (0.484)
10 ≤ Experience	0.486*** (0.088)	.	0.176*** (0.050)	.
City	0.571*** (0.016)	0.721*** (0.236)	0.408*** (0.015)	1.095*** (0.329)
Constant	7.029***	7.469***	7.170***	6.040***

Employee vs. Self-employed

Heckit estimates of earnings functions on the NOBUS data II

	(0.091)	(1.104)	(0.057)	(2.221)
<i>Labour Force Participation</i>				
Spouse's secondary education	0.084 (0.058)	-0.006 (0.270)	0.231*** (0.039)	0.111 (0.301)
Spouse's primary vocational ed.	0.113* (0.066)	0.221 (0.298)	0.243*** (0.043)	0.601** (0.275)
Spouse's secondary vocat.ed.	0.085 (0.055)	0.106 (0.252)	0.218*** (0.038)	0.412 (0.266)
Spouse's incomplete higher ed.	0.159 (0.105)	0.016 (0.494)	0.269*** (0.074)	0.694* (0.408)
Spouse's higher education	0.091 (0.060)	0.411 (0.272)	0.193*** (0.042)	0.376 (0.291)
Spouse's postgrad. higher ed.	0.448 (0.448)	1.843** (0.893)	-0.071 (0.174)	-4.140 (1.4e+04)
City	0.052 (0.033)	0.079 (0.127)	-0.102*** (0.029)	-0.158 (0.155)
Age	0.078*** (0.010)	0.057 (0.048)	0.176*** (0.007)	0.129*** (0.048)
Age ² /100	-0.130*** (0.011)	-0.109** (0.055)	-0.226*** (0.009)	-0.164*** (0.058)
Number of children 0–2 years	0.057 (0.074)	0.022 (0.263)	-0.658*** (0.035)	-0.144 (0.237)
Number of children 3–6 years	-0.036 (0.050)	-0.882*** (0.324)	-0.125*** (0.030)	-0.205 (0.223)
Number of children 7–17 years	-0.028	0.023	-0.107***	-0.022

Employee vs. Self-employed

Heckit estimates of earnings functions on the NOBUS data III

	(0.020)	(0.080)	(0.016)	(0.089)
Log of spouse's earnings	0.442***	-0.100	0.316***	-0.029
	(0.018)	(0.090)	(0.015)	(0.102)
Constant	-3.076***	-1.256	-4.931***	-4.534***
	(0.271)	(1.173)	(0.176)	(1.256)
$\operatorname{atanh} \rho$	-1.095***	-0.299	-1.080***	0.187
	(0.032)	(0.522)	(0.033)	(1.139)
$\ln \sigma$	-0.274***	-0.096	-0.293***	-0.283
	(0.008)	(0.138)	(0.009)	(0.206)
Observations	13577	1714	15442	3548
Censored observations	1633	1633	3505	3505
χ^2	2351.8	26.7	2008.5	30.2
Significance of χ^2	0.000	0.002	0.000	0.000

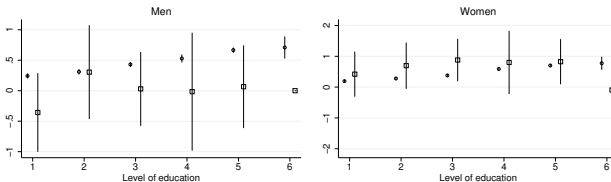
Standard errors are in parentheses.

* $p < .1$, ** $p < .05$, *** $p < .01$

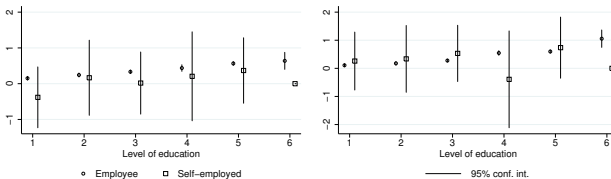
Employee vs. Self-employed

Private return to education (NOBUS)

OLS



Heckit



1 — Secondary education; 2 — Primary vocational education; 3 — Secondary vocational education; 4 — Incomplete higher education; 5 — Higher education; 6 — Postgraduate higher education.

Does tenure matter?

Does tenure matter?

Interaction of education and within-firm experience:

$$\ln y = \alpha + \beta S + \delta \textit{tenure} \times S + R\gamma + \varepsilon,$$

tenure is years spent on the same firm.

Does tenure matter?

Earnings functions for male employees (RLMS-HSE)

	1996		1998		2000	
	OLS	GMM-Hec.	OLS	GMM-Hec.	OLS	GMM-Hec.
Schooling (years)	0.051*** (0.008)	0.075*** (0.028)	0.044*** (0.007)	0.082*** (0.022)	0.043*** (0.007)	0.072*** (0.027)
Tenure×Schooling/100	0.009 (0.022)	-0.072 (0.103)	-0.011 (0.019)	-0.189** (0.095)	0.011 (0.018)	0.020 (0.097)
Experience (years)	-0.011* (0.006)	-0.006 (0.012)	0.001 (0.006)	0.018 (0.013)	0.007 (0.005)	-0.008 (0.009)
Experience ² /100	0.011 (0.013)	0.021 (0.023)	-0.017 (0.012)	-0.024 (0.021)	-0.030*** (0.011)	0.015 (0.019)
City	0.675*** (0.055)	0.652*** (0.067)	0.688*** (0.049)	0.656*** (0.059)	0.631*** (0.047)	0.544*** (0.061)
Nonselection hazard		-0.375** (0.183)		-0.376** (0.150)		-0.378* (0.221)
Constant	4.192*** (0.111)	4.001*** (0.354)	3.953*** (0.106)	3.614*** (0.291)	4.063*** (0.104)	3.972*** (0.365)
Observations	1703	1365	1284	1031	1788	1344
χ^2		242		279		246
	2003		2006		2009	
	OLS	GMM-Hec.	OLS	GMM-Hec.	OLS	GMM-Hec.
Schooling (years)	0.040*** (0.006)	0.055** (0.023)	0.049*** (0.005)	0.091*** (0.020)	0.028*** (0.006)	0.063** (0.026)
Tenure×Schooling/100	0.015 (0.014)	-0.075 (0.087)	0.003 (0.013)	-0.148 (0.098)	0.031* (0.017)	-0.198 (0.133)
Experience (years)	0.005 (0.004)	-0.003 (0.009)	0.018*** (0.004)	0.017* (0.009)	0.020*** (0.005)	0.027** (0.012)
Experience ² /100	-0.028*** (0.009)	0.007 (0.018)	-0.055*** (0.008)	-0.032** (0.016)	-0.054*** (0.011)	-0.042** (0.019)
City	0.549*** (0.039)	0.506*** (0.051)	0.344*** (0.033)	0.267*** (0.045)	0.286*** (0.036)	0.223*** (0.048)
Nonselection hazard		-0.329* (0.170)		-0.433*** (0.138)		-0.398* (0.210)
Constant	4.635*** (0.084)	4.681*** (0.334)	4.920*** (0.073)	4.648*** (0.273)	5.217*** (0.093)	5.021*** (0.376)
Observations	2160	1503	2717	1991	2777	2125
χ^2		257		269		111

Robust standard errors are in parentheses.

* $p < .1$, ** $p < .05$, *** $p < .01$

Does tenure matter?

Earnings functions for female employees (RLMS-HSE)

	1996		1998		2000	
	OLS	GMM-Hec.	OLS	GMM-Hec.	OLS	GMM-Hec.
Schooling (years)	0.056*** (0.008)	0.045 (0.030)	0.057*** (0.007)	0.038 (0.027)	0.053*** (0.007)	0.060** (0.027)
Tenure×Schooling/100	0.026 (0.018)	0.238* (0.137)	0.051*** (0.018)	0.380*** (0.121)	0.054*** (0.016)	0.142 (0.098)
Experience (years)	-0.010* (0.005)	-0.045*** (0.017)	0.007 (0.005)	-0.055*** (0.016)	0.016*** (0.005)	-0.030** (0.015)
Experience ² /100	0.012 (0.012)	0.118*** (0.030)	-0.029** (0.012)	0.104*** (0.030)	-0.048*** (0.012)	0.090*** (0.032)
City	0.440*** (0.045)	0.434*** (0.058)	0.417*** (0.040)	0.393*** (0.055)	0.421*** (0.039)	0.352*** (0.054)
Nonselection hazard		-0.619*** (0.153)		-0.745*** (0.133)		-0.872*** (0.155)
Constant	3.843*** (0.105)	4.083*** (0.396)	3.350*** (0.104)	3.881*** (0.361)	3.459*** (0.105)	3.784*** (0.372)
Observations	1927	1236	1585	978	2023	1136
χ^2		161		157		174
	2003		2006		2009	
	OLS	GMM-Hec.	OLS	GMM-Hec.	OLS	GMM-Hec.
Schooling (years)	0.068*** (0.005)	0.118*** (0.023)	0.063*** (0.005)	0.082*** (0.019)	0.057*** (0.005)	0.075*** (0.023)
Tenure×Schooling/100	0.031** (0.012)	0.174** (0.074)	0.026** (0.010)	0.060 (0.092)	0.036*** (0.012)	0.111 (0.119)
Experience (years)	0.013*** (0.004)	-0.039*** (0.013)	0.012*** (0.003)	-0.009 (0.011)	0.019*** (0.004)	0.011 (0.014)
Experience ² /100	-0.032*** (0.009)	0.102*** (0.028)	-0.040*** (0.008)	0.027 (0.017)	-0.049*** (0.009)	-0.013 (0.022)
City	0.394*** (0.032)	0.257*** (0.051)	0.322*** (0.029)	0.295*** (0.040)	0.208*** (0.030)	0.151*** (0.044)
Nonselection hazard		-0.841*** (0.156)		-0.541*** (0.108)		-0.532*** (0.142)
Constant	3.768*** (0.083)	3.592*** (0.334)	4.285*** (0.076)	4.272*** (0.283)	4.487*** (0.080)	4.487*** (0.359)
Observations	2628	1355	3254	1769	3389	1968
χ^2		237		250		161

Robust standard errors are in parentheses.

* $p < .1$, ** $p < .05$, *** $p < .01$



Does tenure matter?

Earnings functions for male employees (RLMS-HSE)

	1996		1998		2000	
	OLS	GMM-Hec.	OLS	GMM-Hec.	OLS	GMM-Hec.
Higher & Postgr. ed.	0.319*** (0.066)	1.078*** (0.395)	0.309*** (0.064)	0.751** (0.318)	0.246*** (0.059)	0.249 (0.310)
Tenure × Higher & Post.	-0.003 (0.005)	-0.063* (0.034)	-0.003 (0.005)	-0.040 (0.025)	-0.002 (0.005)	0.017 (0.032)
Experience (years)	-0.009 (0.006)	0.005 (0.011)	0.001 (0.006)	0.009 (0.010)	0.005 (0.006)	-0.010 (0.008)
Experience ² /100	0.004 (0.013)	0.001 (0.027)	-0.021 (0.014)	-0.014 (0.022)	-0.027** (0.012)	0.029 (0.022)
City	0.697*** (0.056)	0.631*** (0.071)	0.684*** (0.052)	0.656*** (0.062)	0.644*** (0.050)	0.528*** (0.063)
Nonselection hazard		-0.450** (0.200)		-0.373** (0.173)		-0.633*** (0.238)
Constant	4.751*** (0.064)	4.689*** (0.129)	4.455*** (0.066)	4.462*** (0.131)	4.592*** (0.066)	4.902*** (0.131)
Observations	1694	1360	1137	931	1549	1206
Adj. R ²	0.137	0.063	0.188	0.153	0.136	0.148
F	51.8		49.4		45.5	
χ ²		233		231		224

	2003		2006		2009	
	OLS	GMM-Hec.	OLS	GMM-Hec.	OLS	GMM-Hec.
Higher & Postgr. ed.	0.251*** (0.044)	0.761*** (0.285)	0.297*** (0.039)	0.576** (0.228)	0.169*** (0.050)	0.334 (0.238)
Tenure × Higher & Post.	0.001 (0.003)	-0.043 (0.027)	0.001 (0.003)	-0.013 (0.025)	0.005 (0.004)	-0.013 (0.025)
Experience (years)	0.004 (0.004)	-0.006 (0.007)	0.019*** (0.004)	0.007 (0.006)	0.022*** (0.004)	0.013** (0.006)
Experience ² /100	-0.022** (0.010)	0.019 (0.016)	-0.058*** (0.009)	-0.019 (0.013)	-0.057*** (0.011)	-0.023* (0.013)
City	0.592*** (0.042)	0.528*** (0.057)	0.373*** (0.034)	0.297*** (0.045)	0.294*** (0.036)	0.221*** (0.045)
Nonselection hazard		-0.255 (0.199)		-0.539*** (0.128)		-0.564*** (0.149)
Constant	5.093*** (0.051)	5.190*** (0.142)	5.475*** (0.043)	5.709*** (0.103)	5.546*** (0.046)	5.788*** (0.098)
Observations	1860	1354	2519	1899	2774	2123
Adj. R ²	0.158	0.107	0.112	0.132	0.047	0.046
F	57.7		55.4		25.5	
χ ²		237		280		118

Robust standard errors are in parentheses.

* $p < .1$, ** $p < .05$, *** $p < .01$



Does tenure matter?

Earnings functions for female employees (RLMS-HSE)

	1996		1998		2000	
	OLS	GMM-Hec.	OLS	GMM-Hec.	OLS	GMM-Hec.
Higher & Postgr. ed.	0.341*** (0.059)	0.385 (0.263)	0.349*** (0.058)	0.244 (0.379)	0.325*** (0.053)	0.027 (0.263)
Tenure × Higher & Post.	-0.001 (0.004)	0.008 (0.026)	0.000 (0.003)	0.028 (0.034)	0.003 (0.003)	0.046* (0.023)
Experience (years)	-0.004 (0.005)	-0.019** (0.009)	0.015*** (0.006)	-0.010 (0.011)	0.020*** (0.005)	-0.032*** (0.012)
Experience ² /100	-0.003 (0.012)	0.082*** (0.023)	-0.045*** (0.014)	0.040 (0.028)	-0.053*** (0.013)	0.109*** (0.033)
City	0.462*** (0.045)	0.444*** (0.056)	0.439*** (0.042)	0.397*** (0.051)	0.446*** (0.040)	0.370*** (0.053)
Nonselection hazard		-0.736*** (0.146)		-0.733*** (0.154)		-0.950*** (0.166)
Constant	4.469*** (0.052)	4.582*** (0.097)	3.977*** (0.057)	4.269*** (0.149)	4.052*** (0.052)	4.614*** (0.141)
Observations	1924	1233	1504	949	1878	1089
Adj. R ²	0.089	0.111	0.124	0.132	0.115	0.088
F	39.2		43.8		48.3	
χ ²		160		159		169

	2003		2006		2009	
	OLS	GMM-Hec.	OLS	GMM-Hec.	OLS	GMM-Hec.
Higher & Postgr. ed.	0.371*** (0.041)	0.411* (0.212)	0.370*** (0.037)	-0.092 (0.315)	0.292*** (0.041)	0.440 (0.270)
Tenure × Higher & Post.	0.003 (0.002)	0.038** (0.018)	0.003 (0.002)	0.066** (0.033)	0.006** (0.003)	0.001 (0.025)
Experience (years)	0.015*** (0.004)	-0.038*** (0.011)	0.013*** (0.003)	-0.029** (0.013)	0.021*** (0.004)	0.013 (0.010)
Experience ² /100	-0.037*** (0.010)	0.121*** (0.028)	-0.042*** (0.008)	0.063*** (0.024)	-0.050*** (0.009)	-0.018 (0.019)
City	0.423*** (0.034)	0.259*** (0.050)	0.338*** (0.029)	0.296*** (0.043)	0.218*** (0.030)	0.159*** (0.043)
Nonselection hazard		-1.071*** (0.181)		-0.948*** (0.196)		-0.522*** (0.132)
Constant	4.562*** (0.043)	5.167*** (0.145)	5.033*** (0.038)	5.632*** (0.191)	5.199*** (0.040)	5.379*** (0.141)
Observations	2413	1302	3099	1719	3388	1967
Adj. R ²	0.135	0.094	0.125	0.004	0.073	0.078
F	74.9		90.1		53.0	
χ ²		236		218		161

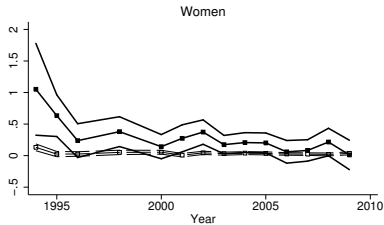
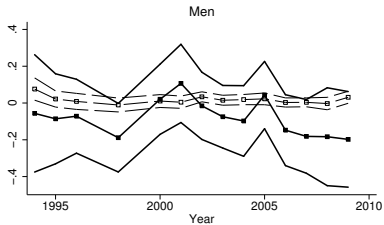
Robust standard errors are in parentheses.

* $p < .1$, ** $p < .05$, *** $p < .01$

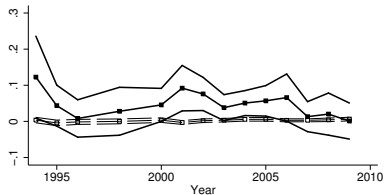
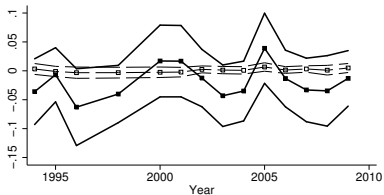
Does tenure matter?

Slope coefficients of interaction terms (RLMS-HSE)

Slope of schooling with tenure interaction



Slope of higher and postgr. ed. with tenure interaction

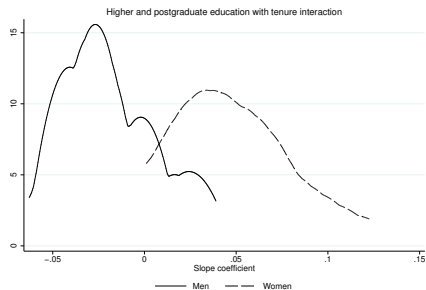
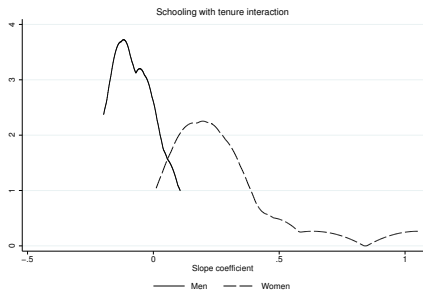


—■— GMM-Heckit - - - □ - - OLS

— 95% conf. int. - - - 95% conf. int.

Does tenure matter?

Distributions of GMM-Heckit estimates of slope coefficients of interaction terms (RLMS-HSE)



Thank you !

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