The Effect of Manager Education on Firm Growth

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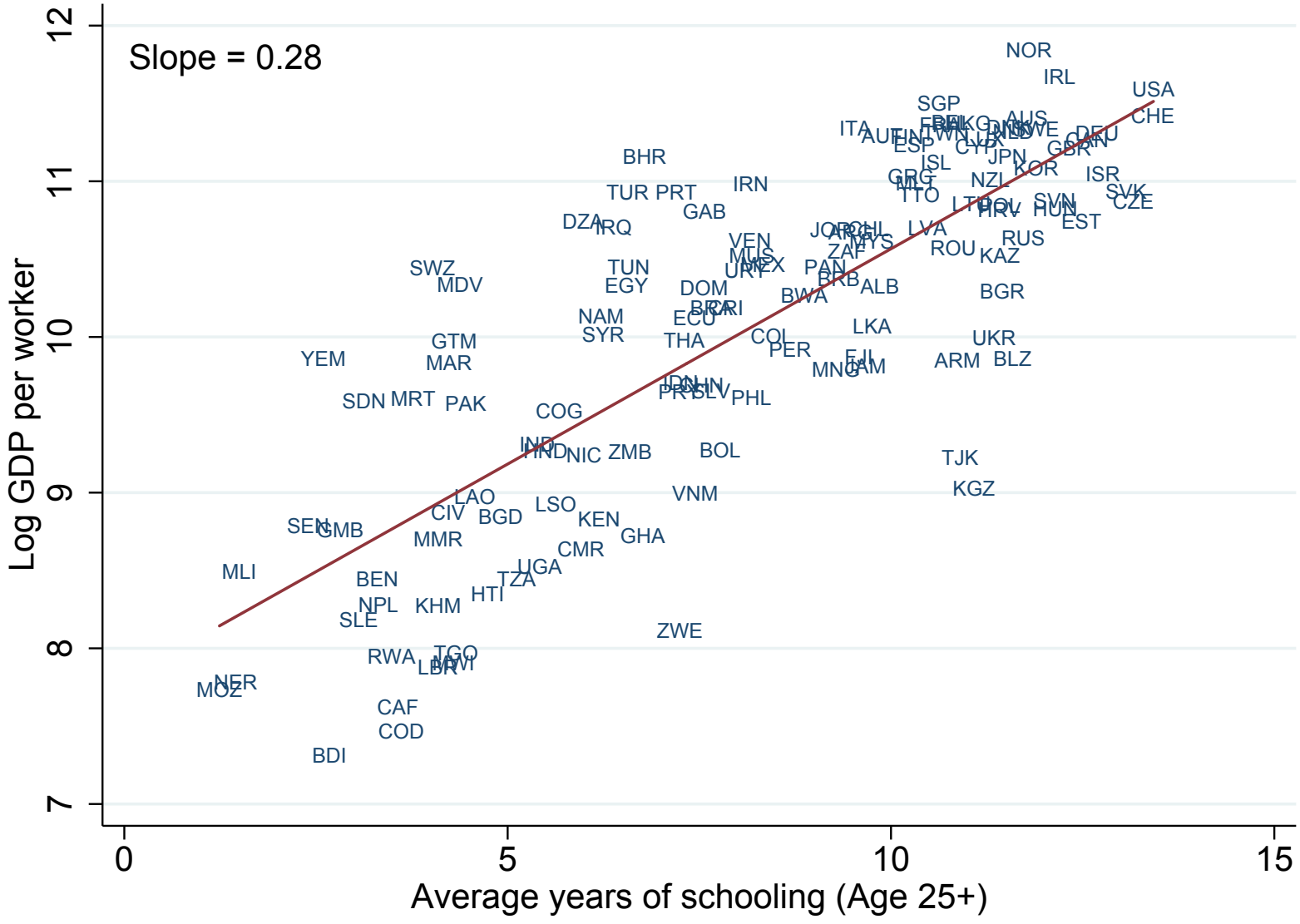
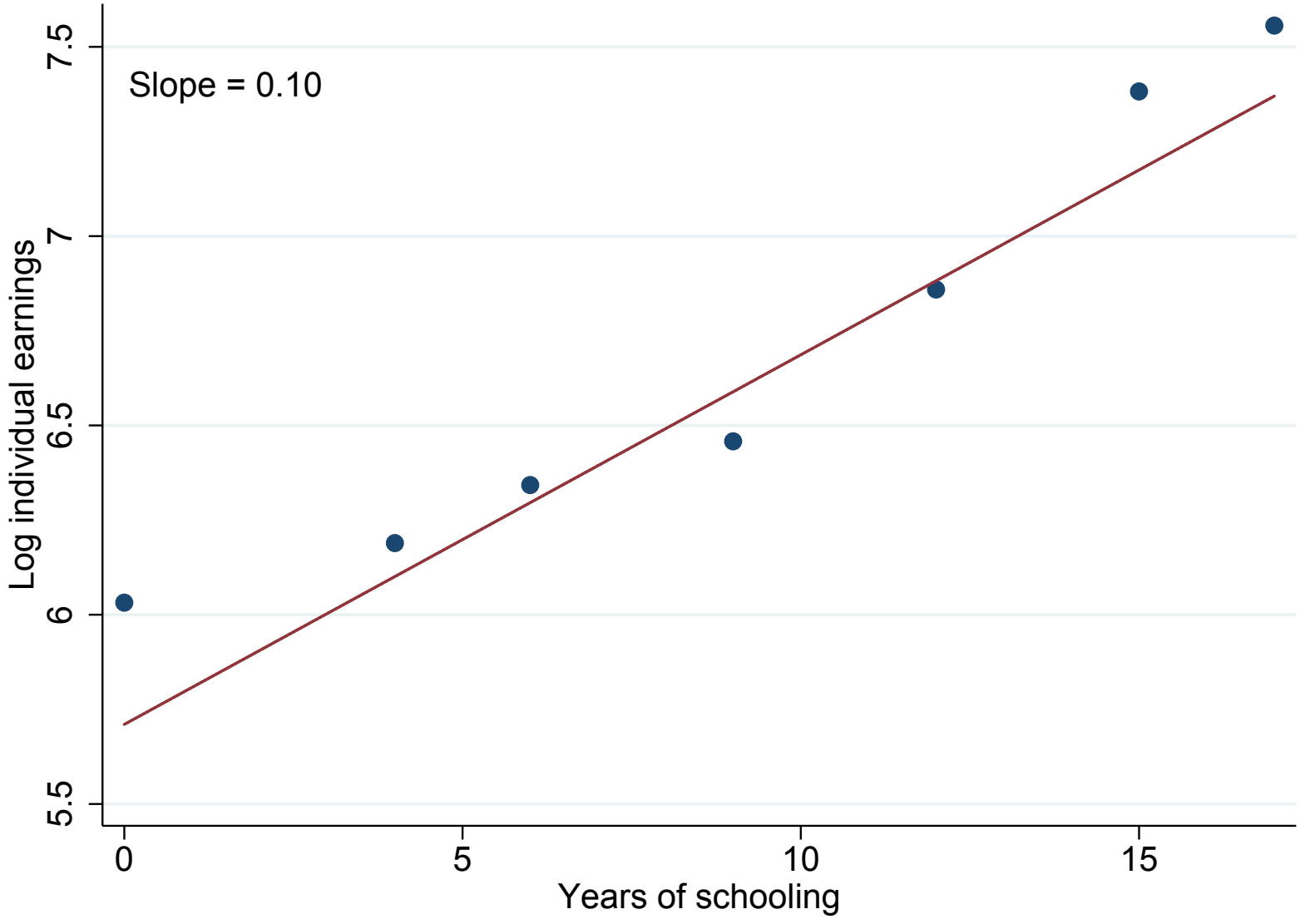
Education and Aggregate Income Across Countries

2010



Education and Individual Earnings in Portugal

2009



Two Views on the Aggregate Effect of Education

1. Aggregate effect $\approx$ individual effect
   - Cross-country coefficient biased upward by omitted technology differences
     Klenow and Rodriguez-Clare (1997), Hall and Jones (1999)
   - Holding technology constant, the two effects should be equal
   - Prevailing view in development accounting (e.g. Caselli, 2005)

2. Aggregate effect $>$ individual effect
   - Cross-country coefficient reflects human capital externalities, not technology
     Lucas (1988)
   - Technology differences do play key role, but are themselves driven by education
     Nelson and Phelps (1966), Romer (1990)

Technology and the Education of Managers

- *"We suggest that [...] production management is a function requiring adaptation to change and that the more educated a manager is, the quicker will he be to introduce new techniques of production"*

  Nelson and Phelps (1966)

- Macro implication: economic *growth* increases with the *level* of human capital

- Benhabib and Spiegel (1994) find support for this prediction across countries
  - But subject to similar concerns with omitted variables, reverse causation

    Bils and Klenow (2000), Krueger and Lindahl (2000)

This Paper

- Develop firm-level analog of prediction studied by Benhabib and Spiegel (1994)
  - If manager education is a driver of technology, then it increases firm growth
- Test it using administrative data on universe of firms and workers in Portugal
  - Firm growth increases strongly with manager education in cross-section
  - Analyze event studies of management changes $\rightarrow$ find similar effect
  - Develop strategy to account for omitted ability $\rightarrow$ effect remains stable
- Explore aggregate implications (preliminary)
  - Calculate effect on aggregate output of moving from the distribution of manager education in Portugal to that in the U.S.

Outline

1. Data
2. Findings
3. Aggregate Implications

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Data: Quadros de Pessoal

- Administrative matched employer-employee data on the universe of employer firms and employees in Portugal, 1995-2009
  - Occupational codes that identify managers directly
  - No size thresholds and includes the firm's founding year

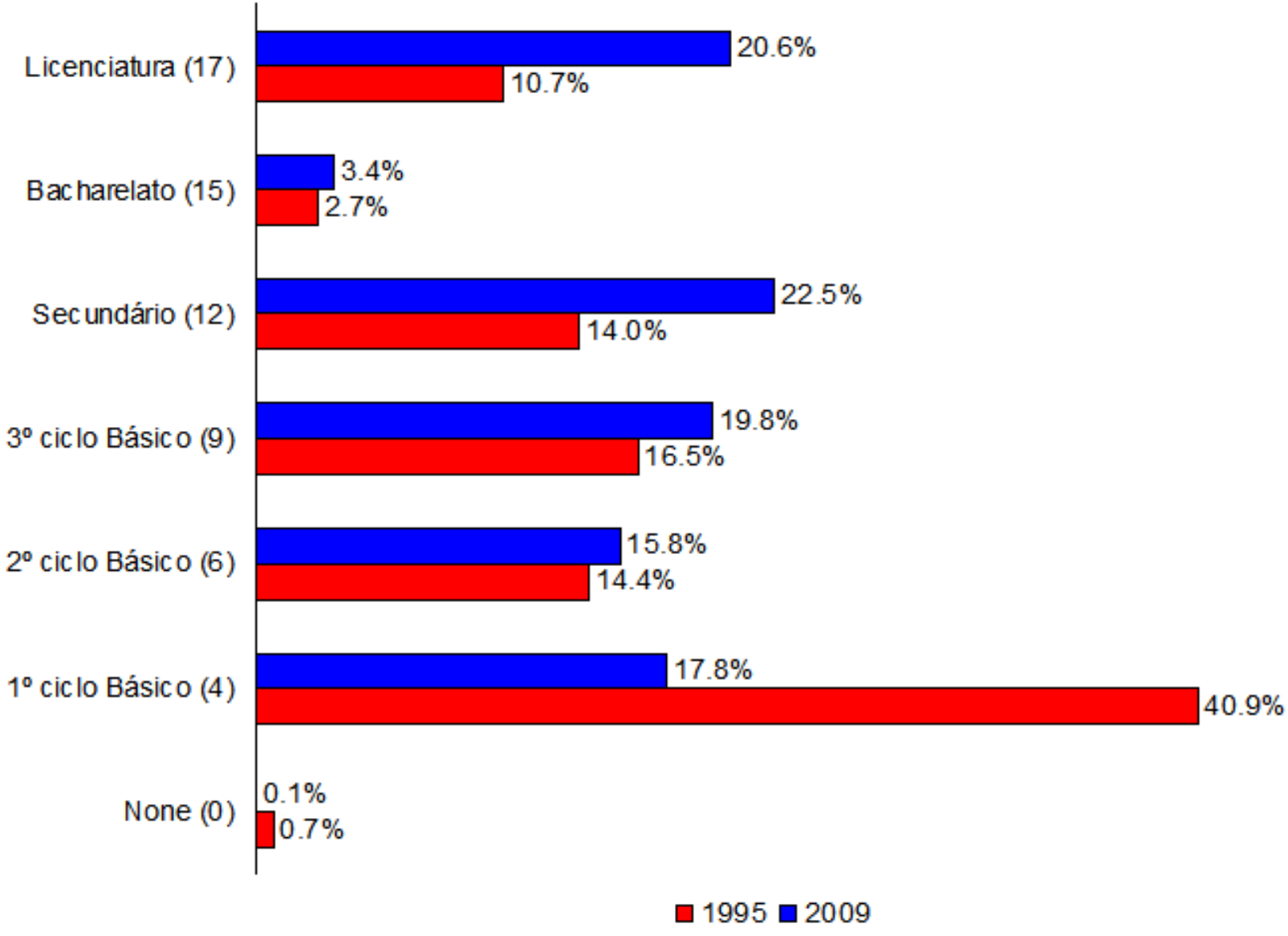
- Key variables
  - Firm growth: annual employment growth rate, winsorized at 99th percentile
  - Manager education: average years of schooling from no schooling to college
  - Controls: firm age and size, manager age, non-manager education and age and number of managers

- Sample: 1.8 million observations and 359,000 firms

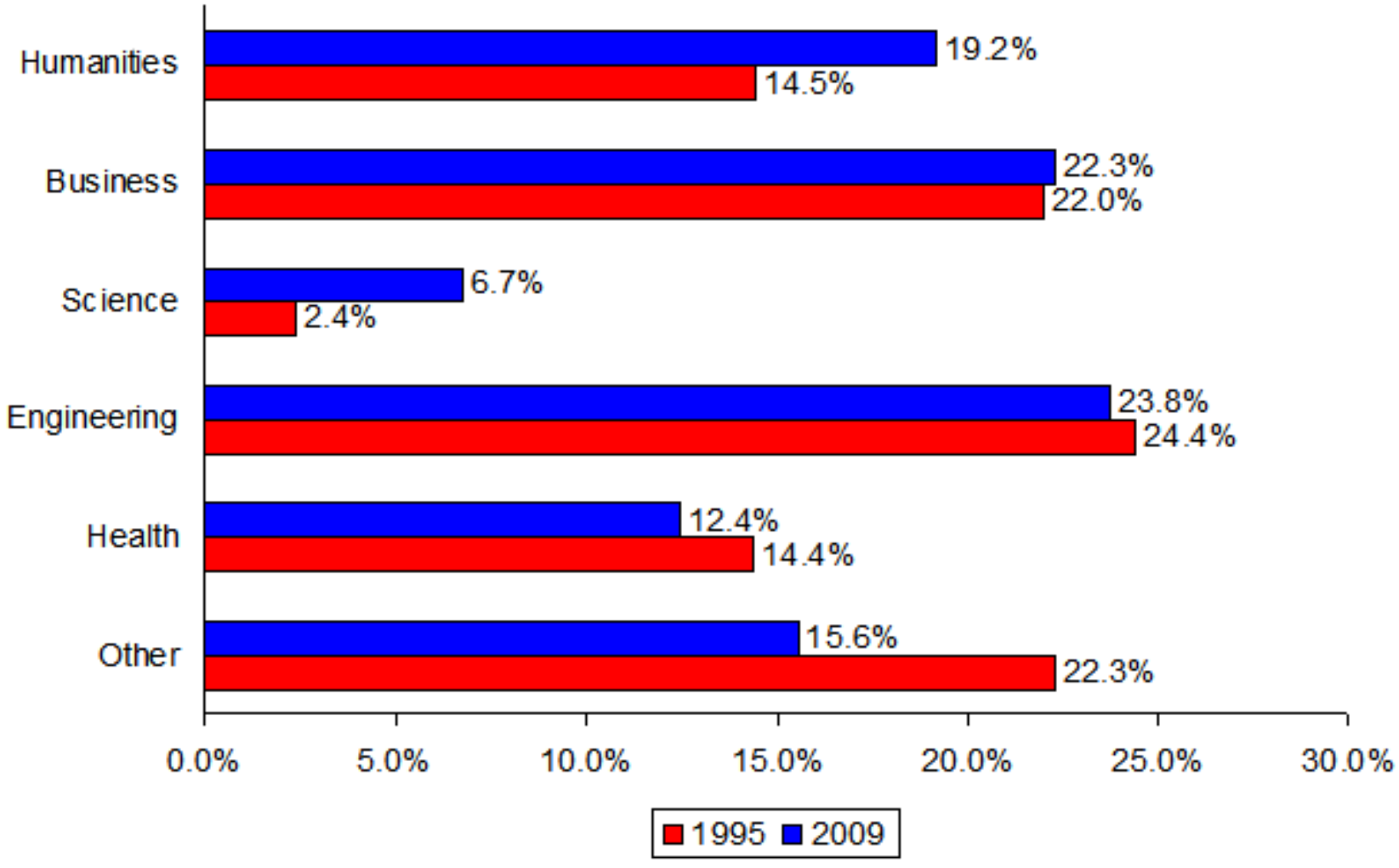
Manager Definition

- Conceptually: top decision makers
- Occupational codes include a hierarchy of managerial titles: "General Manager", "Operations Manager", etc
- Take worker(s) with highest managerial title reported; 63% of firm-years and 79% of employment
  - If no managerial title reported, take firm's owner(s); 7% of firm-years and 3% of employment
  - If no owners reported, assign previous or following year's managers, if still or already present; 4% of firm-years and 5% of employment
- In total, cover 74% of firm-years and 87% of employment in the data
- Findings robust to alternative procedures (e.g. all managerial titles, only step one)

Managers by Education Level



College-Educated Managers by Field



Summary Statistics

	Mean	SD	P10	P50	P90
Firm Growth (p.p.)	1.37	31.27	-33.33	0.00	33.33
Number of Workers	13.82	84.58	2.00	5.00	22.00
Number of Managers	1.52	1.67	1.00	1.00	2.00
Manager Education	8.69	4.33	4.00	9.00	17.00
Non-Manager Education	7.56	3.03	4.00	6.96	12.00
Manager Age	44.92	10.32	32.00	44.50	59.00
Non-Manager Age	35.74	8.50	25.25	35.00	46.94
Firm Age	12.39	12.35	2.00	9.00	27.00

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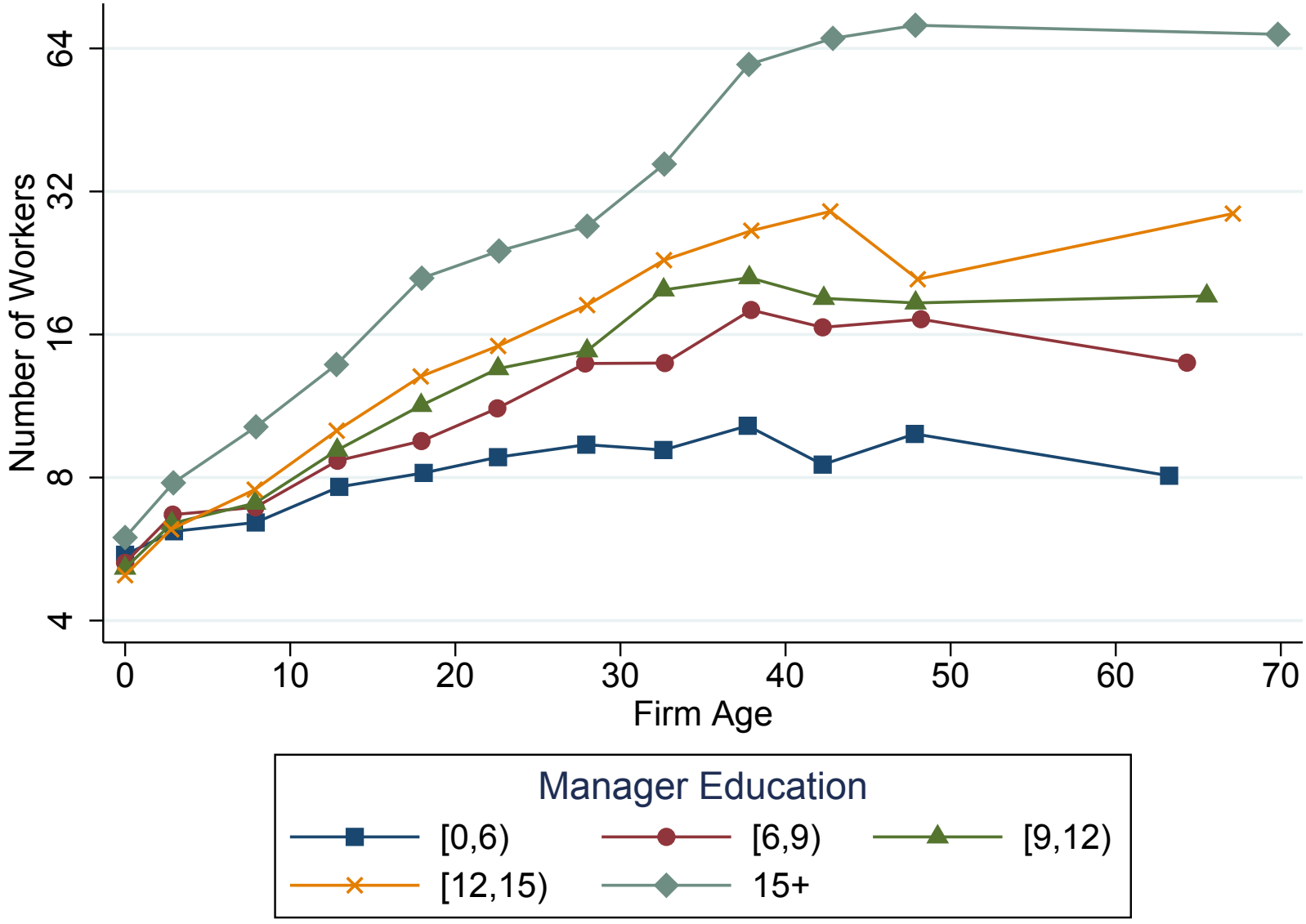
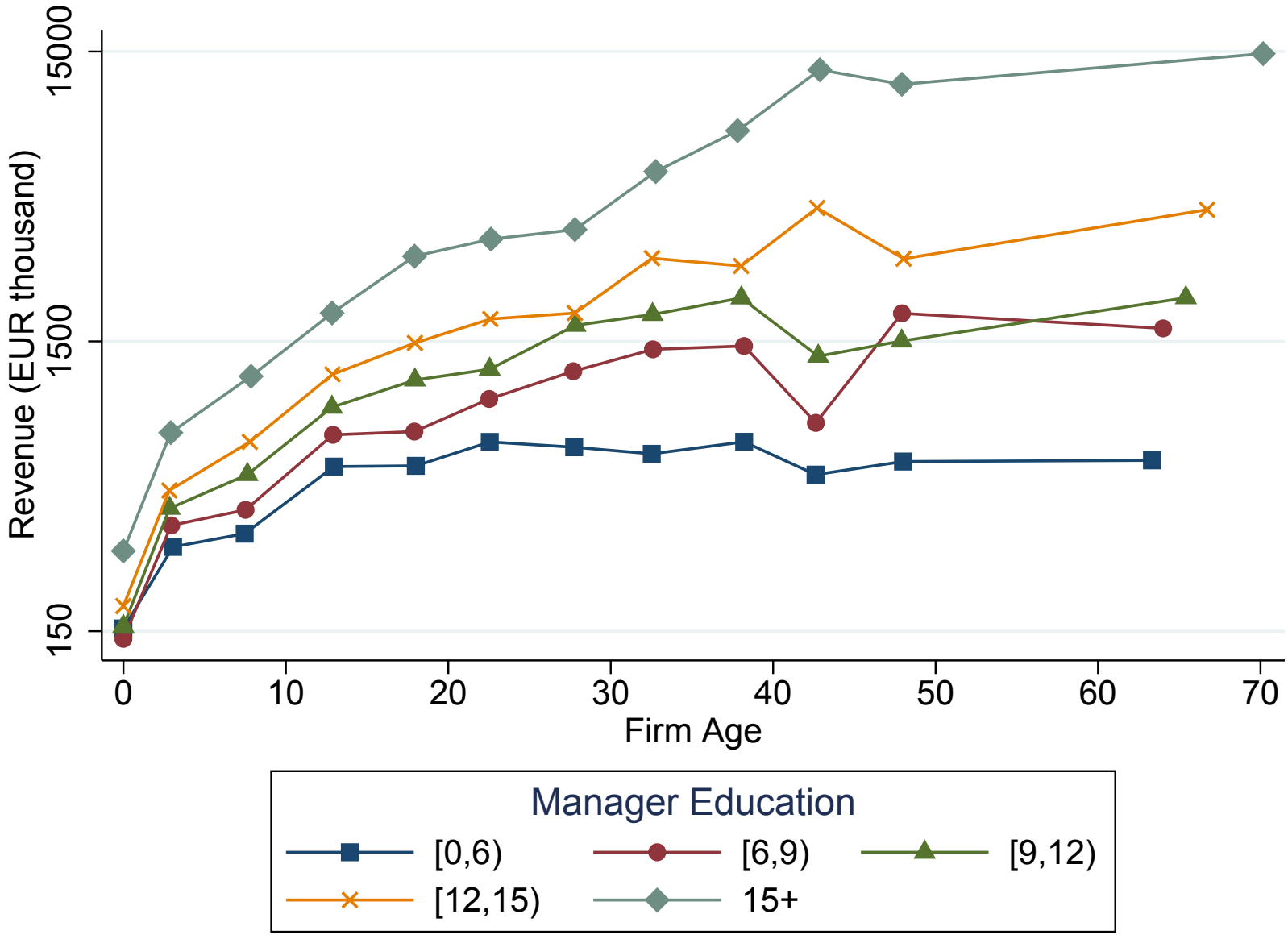
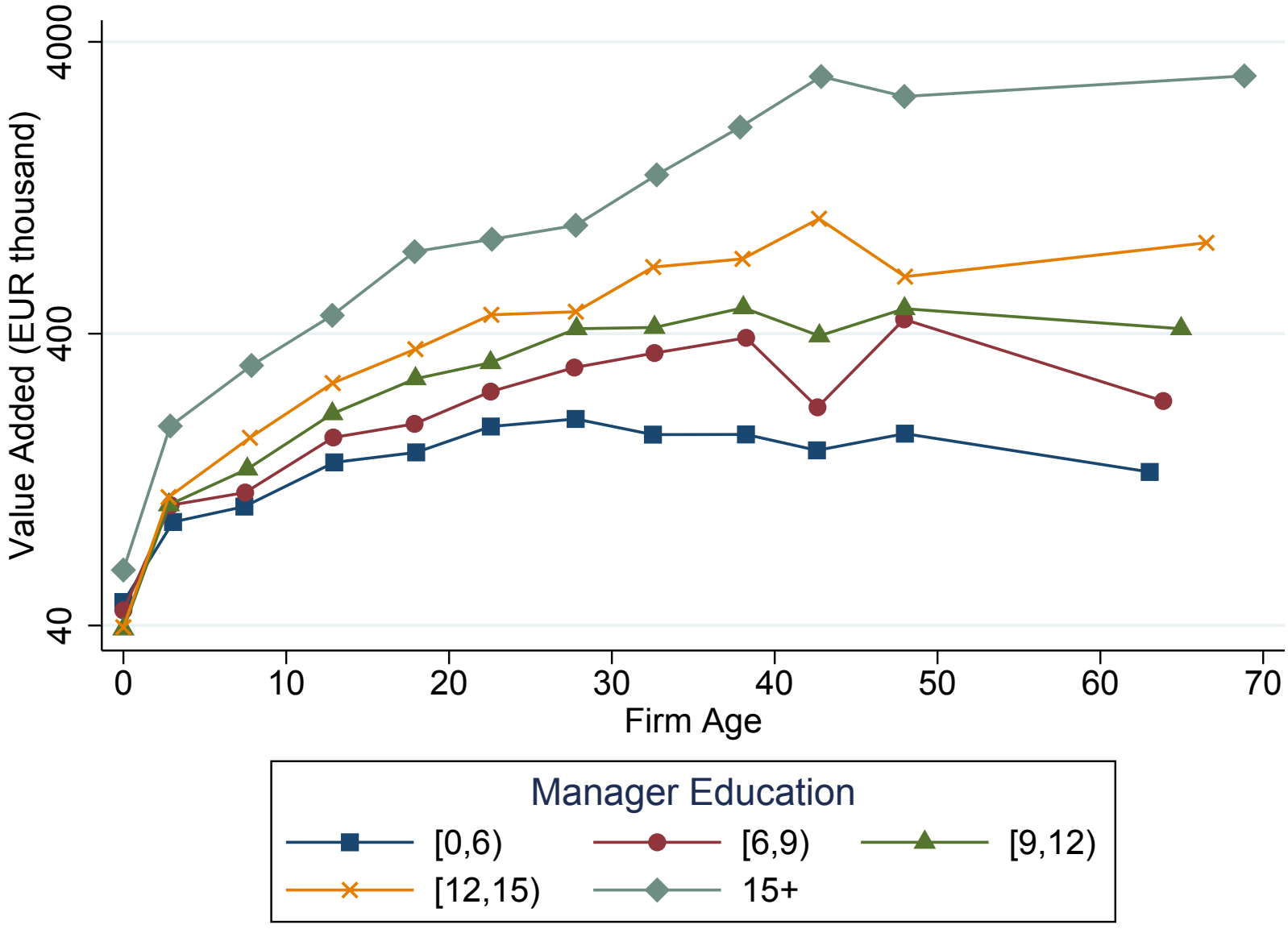
Firm Size by Manager Education, 2009 Cross-Section



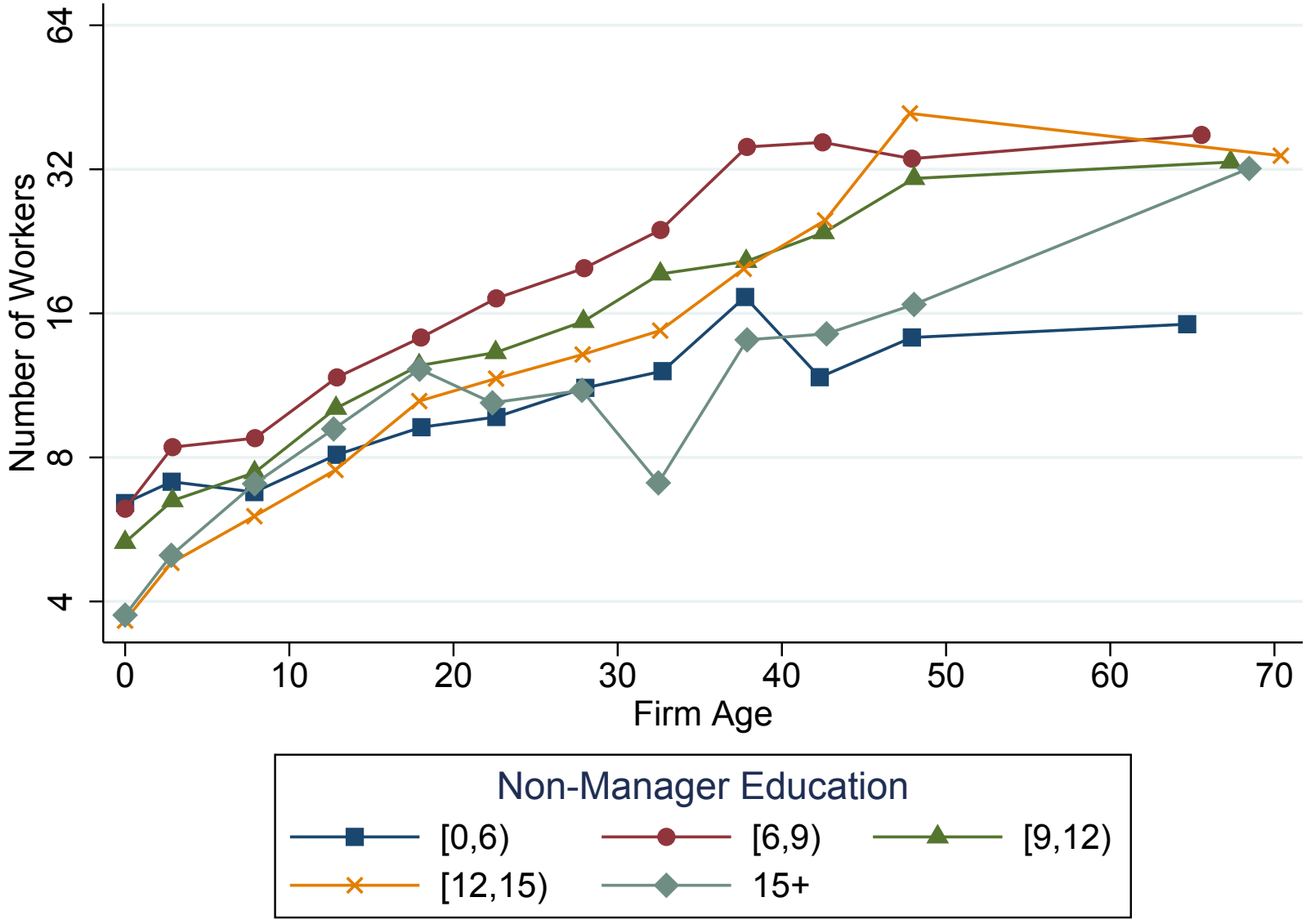
Firm Revenue by Manager Education, 2009 Cross-Section



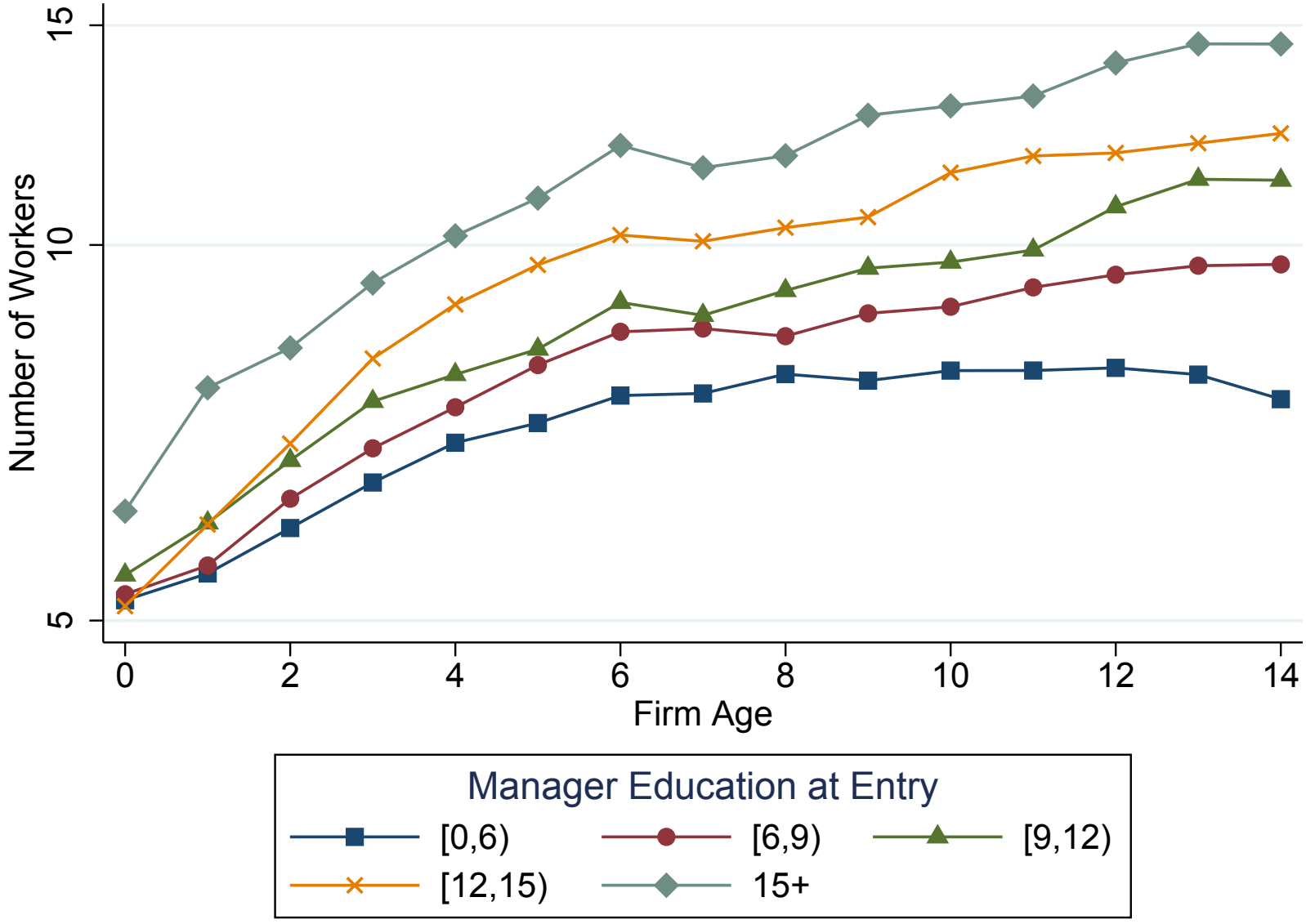
Value Added by Manager Education, 2009 Cross-Section



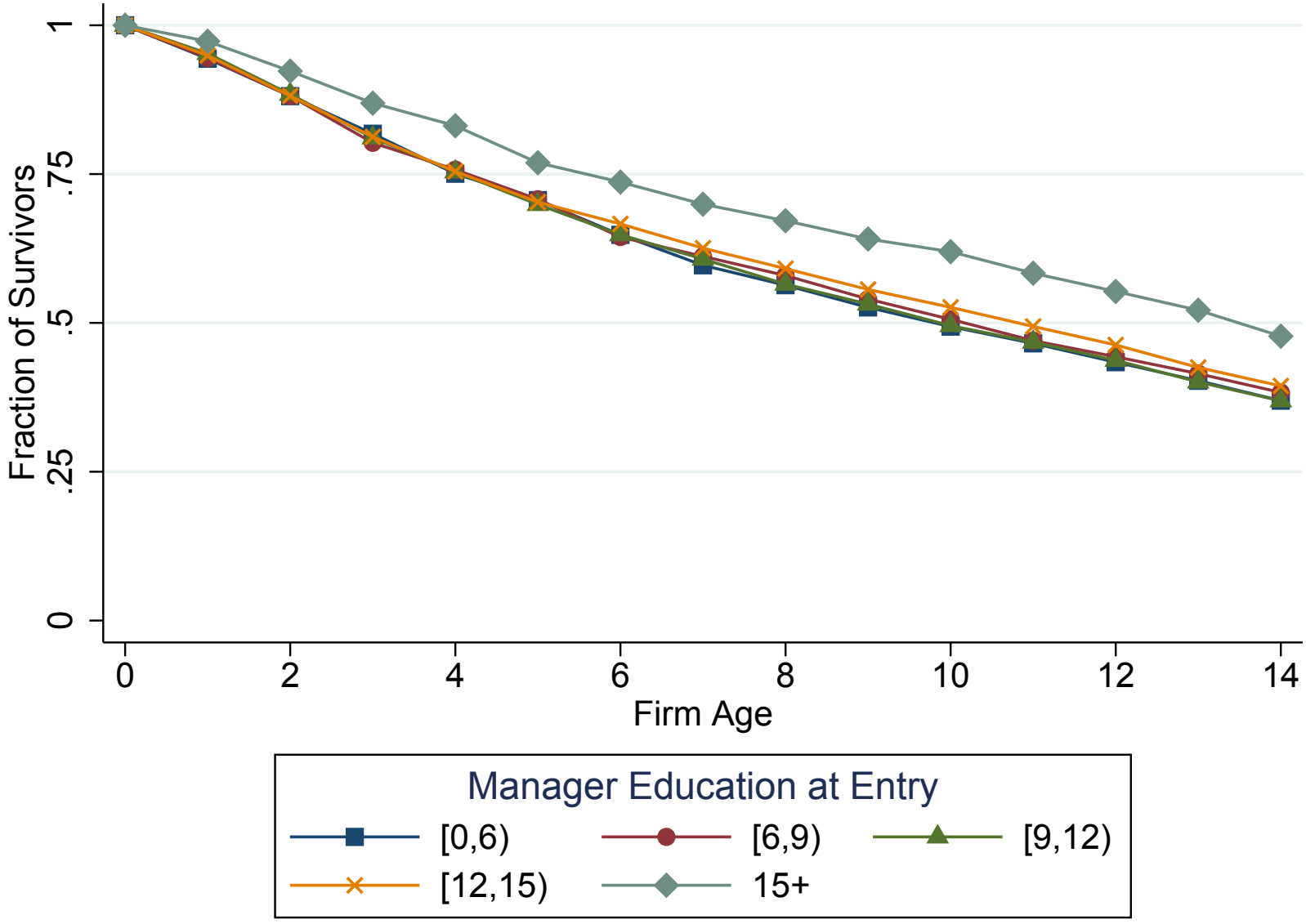
Firm Size by Non-Manager Education, 2009 Cross-Section



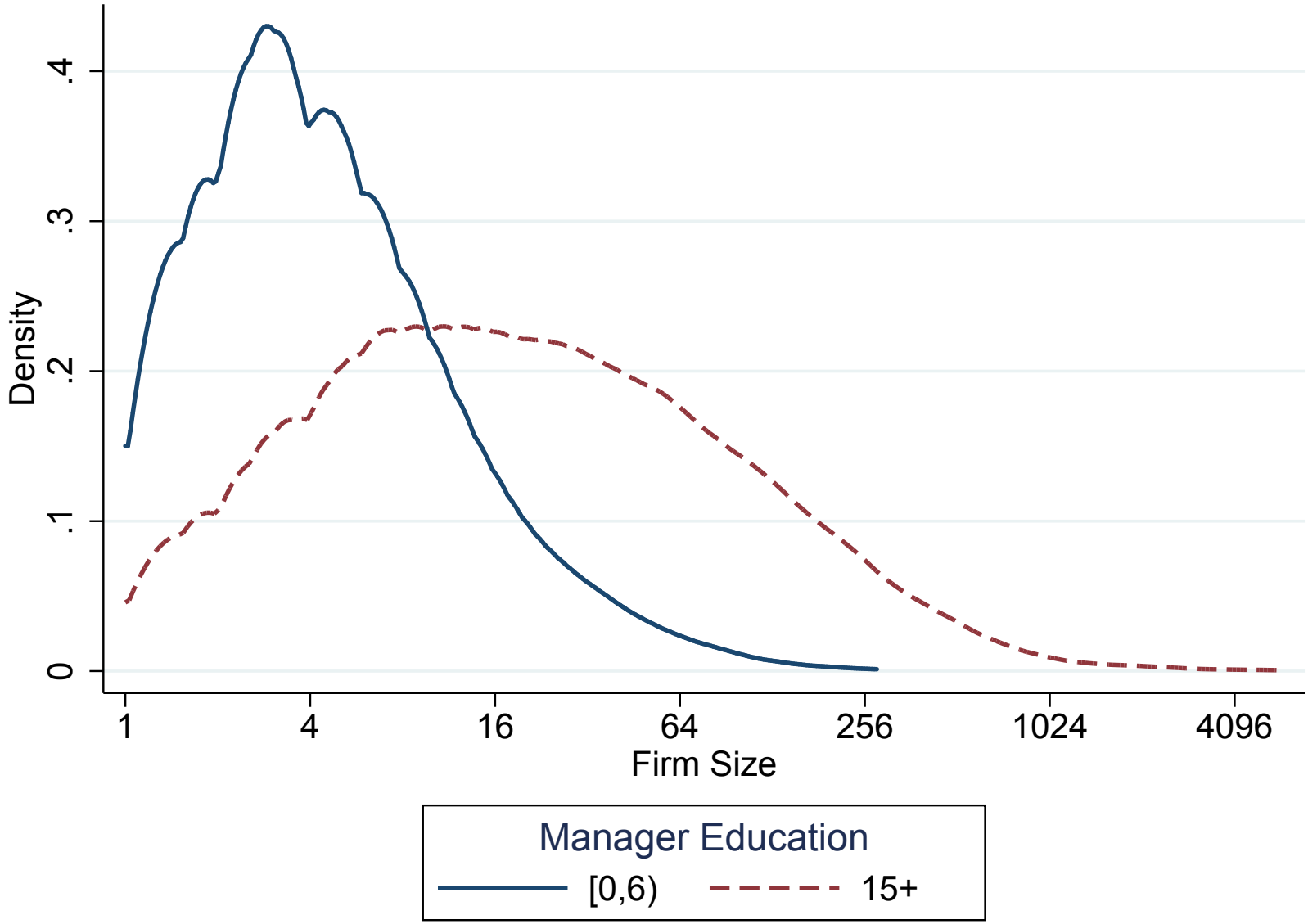
Firm Size by Manager Education, 1995 Cohort Survivors



Fraction of Survivors by Manager Education, 1995 Cohort



Firm Size Distribution, Firms Aged 30+ in 2009 Cross-Section

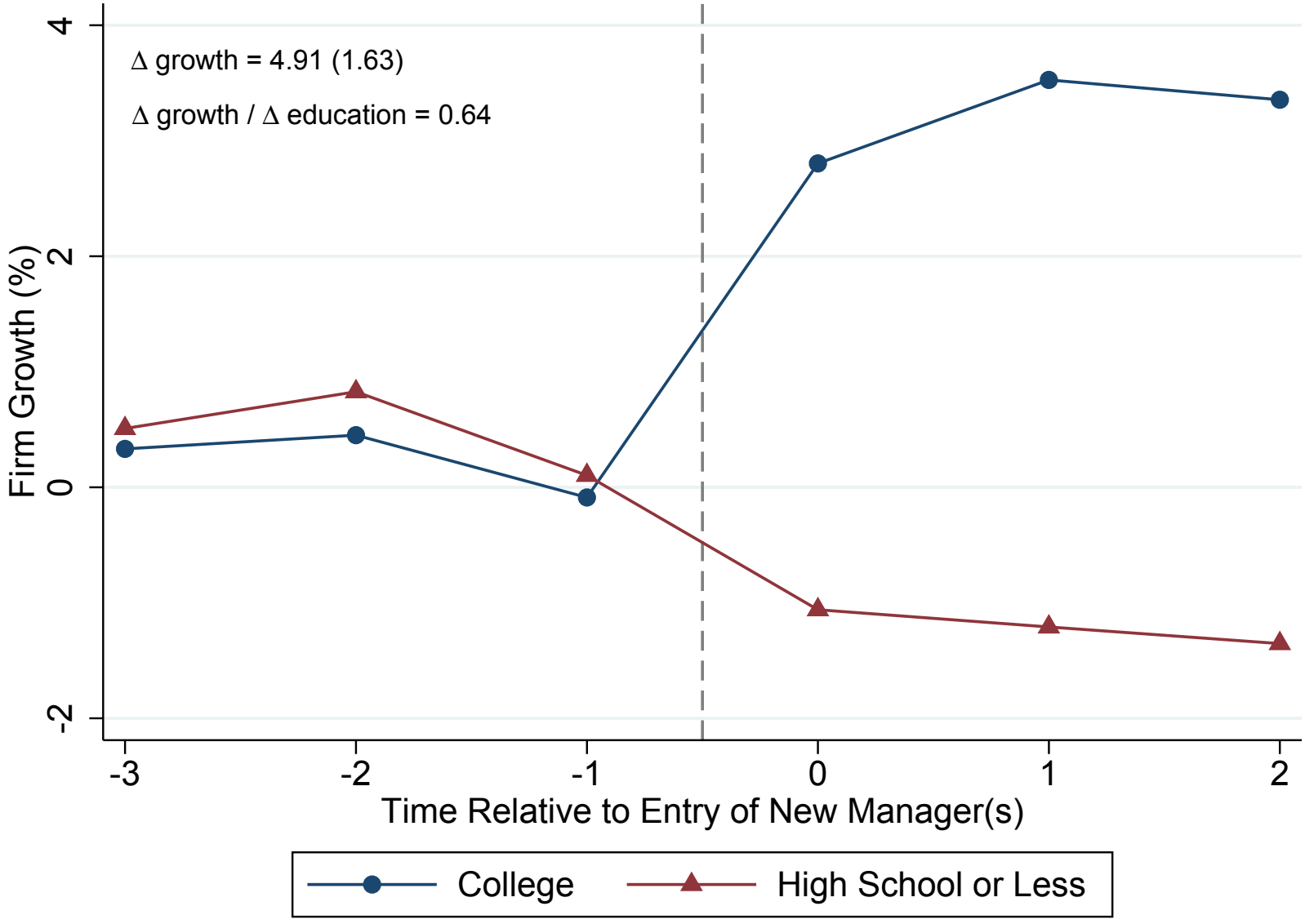


Event Studies of Management Changes

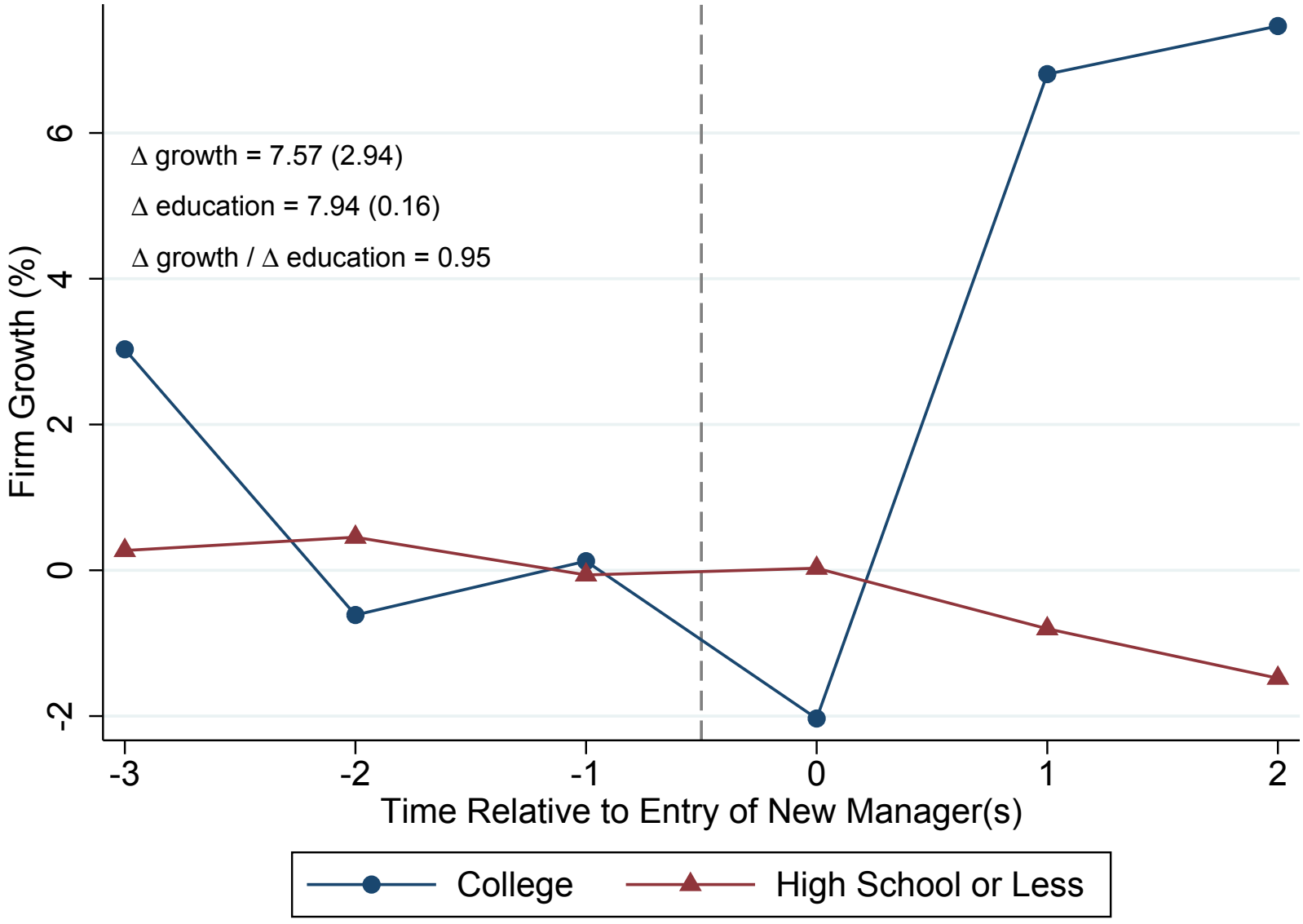
1. Firms that **switch to** college educated managers vs firms that switch to managers with high school or less
   - Assumption: parallel growth trends
   - Examine graphical evidence on growth pre-trends
   - Restrict to owner-managed firms (likely to be family successions)
   - Placebo tests with changes in other occupations

2. Firms that **lose** college educated managers vs firms that lose managers with high school or less
   - Focus on losses where managers leave the sample permanently before age 55
   - Likely to have left the labor force for exogenous reasons, e.g. death or disability
   - Sanity check: over half of losses can be accounted for by expected deaths alone

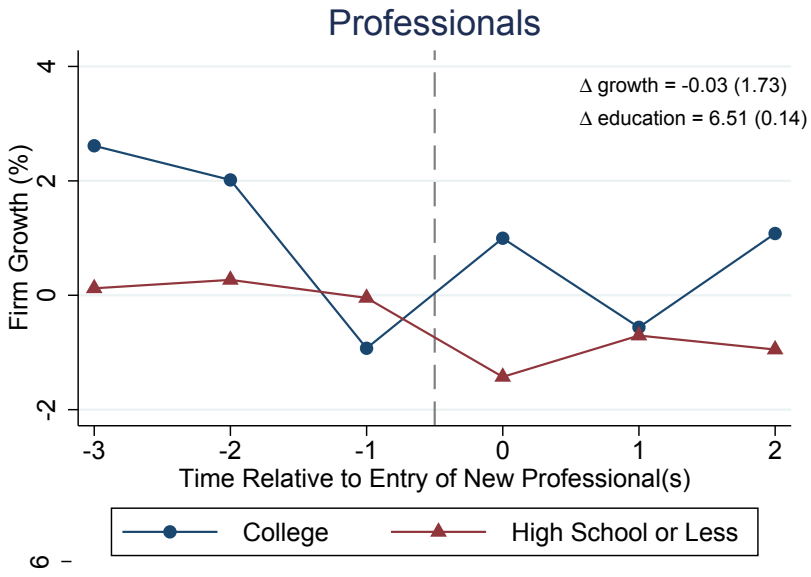
Design 1: Effect on Firm Growth

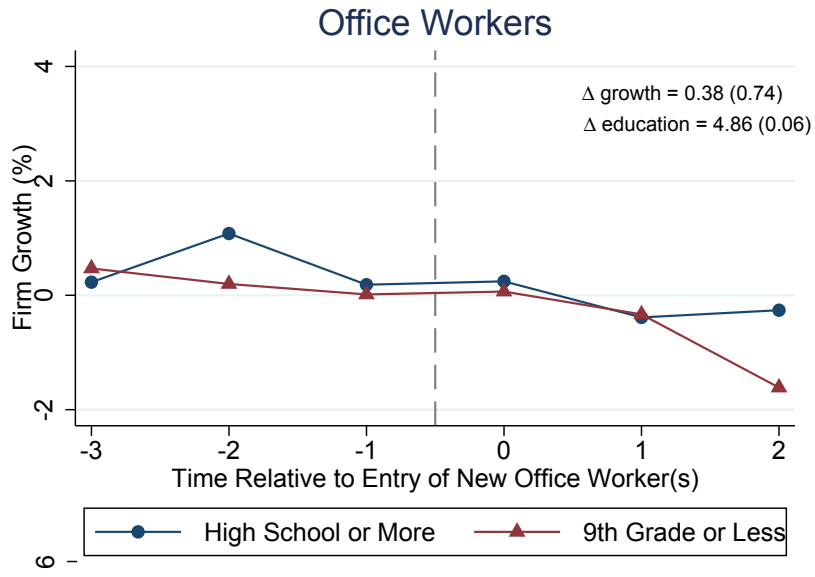


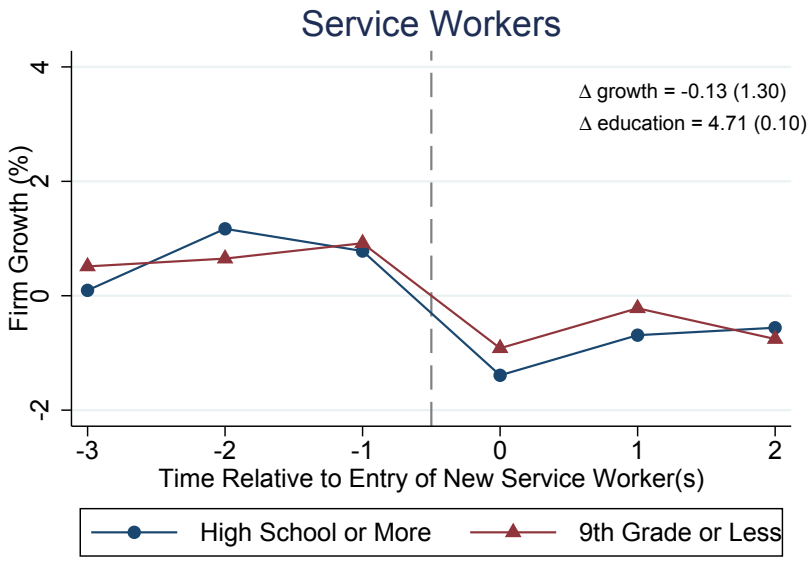
Design 1: Owner-Managed Before and After Change

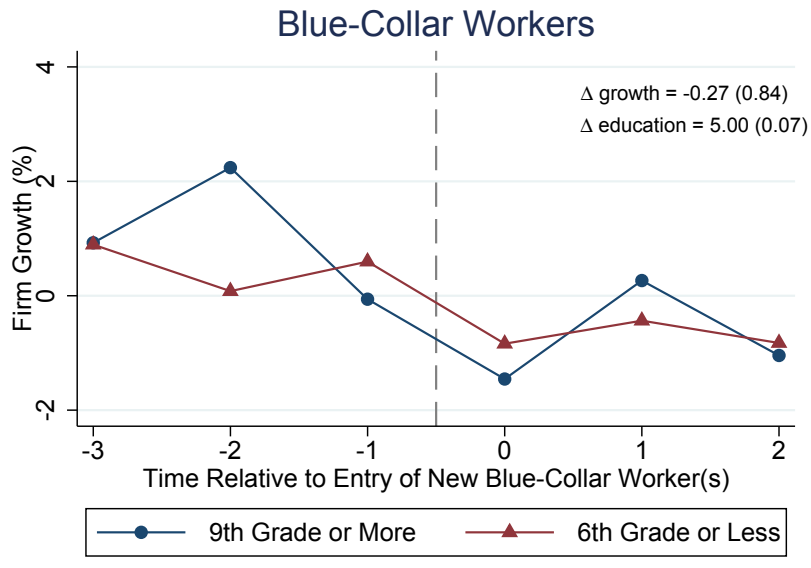


Design 1: Changes in Other Occupations

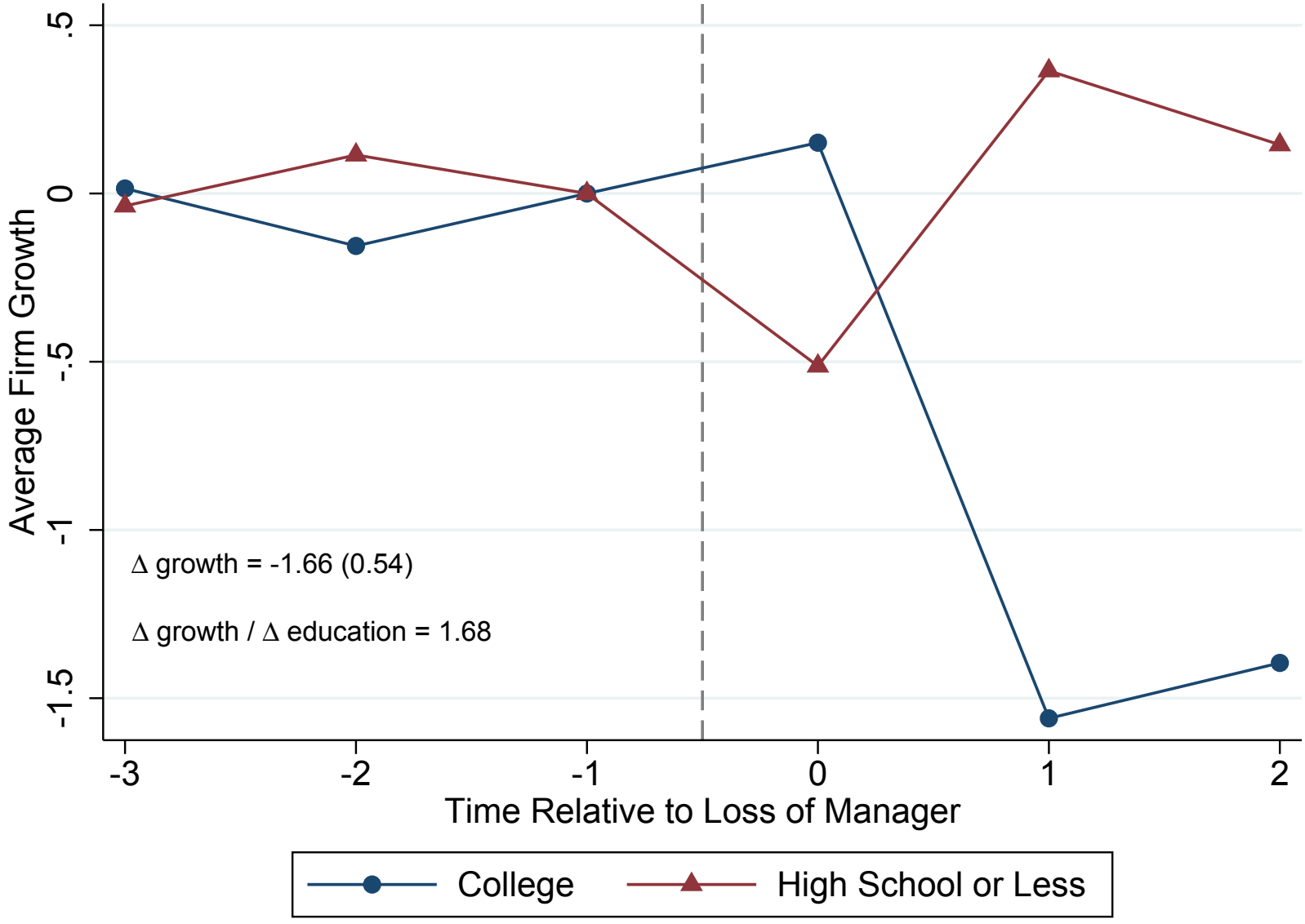








Design 2: Effect on Firm Growth



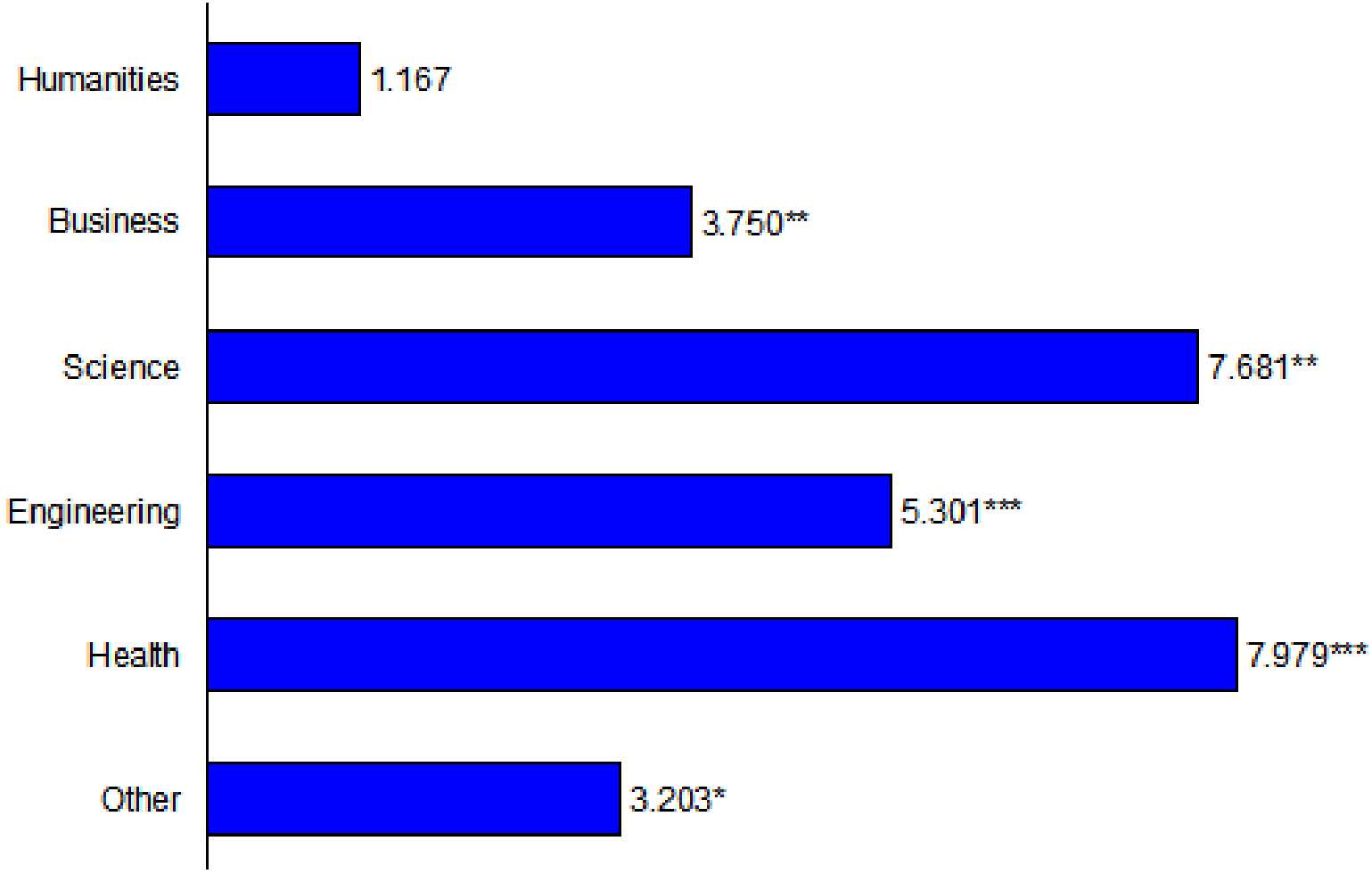
Full Sample Extension

$$\Delta g_{jt} = \alpha_0 + \alpha_1 \Delta s_{jt} + \theta \mathbf{X}_{jt} + \delta_t + \varepsilon_{jt}$$

	1-year Δ	3-year Δ	By level	Owner Ed.	Revenue
	(1)	(2)	(3)	(4)	(5)
Manager Education	0.409***	0.387***		0.498***	0.664***
	(0.120)	(0.099)		(0.171)	(0.247)
Owner Education				-0.044	
				(0.080)	
Relative to [0,6):					
[6,9)			2.199*		
			(1.170)		
[9,12)			2.624**		
			(1.291)		
[12,15)			2.733**		
			(1.365)		
15+			6.466***		
			(1.558)		
Observations	659457	659457	659457	480515	489542
Number of Firms	206215	206215	206215	166058	177900

Effect by Field of College Degree

Relative to not having a college degree:



Can Estimates Account for Cross-Sectional Differences?

Relative firm size, college vs primary-school manager

Firm Age Bin	Simulation	Data	Sim/Data
1 to 5	1.22	1.26	97
6 to 10	1.48	1.59	93
11 to 15	1.80	1.81	99
16 to 20	2.20	2.57	86
21 to 25	2.63	2.72	97
26 to 30	3.24	2.88	113
31 to 35	3.88	4.00	97
36 to 40	4.74	5.76	82
41 to 45	5.71	7.89	72
46 to 50	7.04	7.25	97

Income in Other Occupations as Proxy for Ability

- Suppose firm growth is given by

$$g_{jt} = \alpha_0 + \alpha_1 s_{jt} + \alpha_2 a_{jt} + \varepsilon_{jt} \tag{1}$$

- Results could be biased by omitted ability a_{jt}
- Assume the manager's outside option working as a non-manager is given by

$$\ln w_{jt} = \beta_0 + \beta_1 \beta_1 s_{jt} + \beta_2 a_{jt} \tag{2}$$

- Then solving (2) for a_{jt} and plugging into (1)

$$g_{jt} = \alpha_0 - \frac{\alpha_2 \beta_0}{\beta_2} + (\alpha_1 - \frac{\alpha_2}{\beta_2}\beta_1 \frac{\alpha_2}{\beta_2}\beta_1 \frac{\alpha_2}{\beta_2}\beta_1 \frac{\alpha_2}{\beta_2}\beta_1) s_{jt} + \frac{\alpha_2}{\beta_2}\frac{\alpha_2}{\beta_2} \ln w_{jt} + \varepsilon_{jt} \tag{3}$$

Income in Other Occupations as Proxy for Ability

- Assumptions
  - Ability measured by a scalar a_{jt}
  - $\frac{\alpha_1}{\alpha_2} \neq \frac{\beta_1}{\beta_2}$, i.e. relative importance of schooling and ability differs in management and other occupations

- Implement using a sample of managers observed in other occupations before becoming managers
  - Use last observed income as non-manager, residualized on year and experience dummies (same results using average)

- Also examine robustness to other measures of ability and experience
  - Age
  - Management and industry experience
  - Number of prior occupations (Lazear, 2005)
  - Tenure at firm

Education vs Other Manager Characteristics

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Education	**0.51*****	0.45***	0.46***	0.51***	0.53***	0.49***	0.50***	0.47***	0.39***
	(0.04)	(0.04)	(0.04)	(0.04)	(0.04)	(0.04)	(0.04)	(0.04)	(0.04)
Log Outside Option		1.07***							1.30***
		(0.22)							(0.22)
Bias-corrected Education		**0.53*****							**0.49*****
(Return to Education=7%)		(0.04)							(0.04)
Age			-0.08***					-0.09***	-0.11***
			(0.02)					(0.02)	(0.02)
Management Experience				0.26**				-0.15	-0.14
				(0.11)				(0.13)	(0.13)
Industry Experience					0.75***			0.74***	0.75***
					(0.07)			(0.07)	(0.07)
Prior Occupations						0.73***		0.43***	0.31*
						(0.14)		(0.17)	(0.17)
Tenure at Firm							-0.09***	-0.01	-0.01
							(0.03)	(0.03)	(0.03)
Observations	476432	476432	476432	476432	476432	476432	476432	476432	476432
Number of Firms	132085	132085	132085	132085	132085	132085	132085	132085	132085

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Implications for Aggregate Output

- What does estimated effect imply for aggregate output?
- Present a simple model of heterogeneous firms based on Hsieh and Klenow (2014) where manager education drives firm-level technology
- In equilibrium, aggregate technology (TFP) is a function of the distribution of manager education and firm age
- Use estimated effect to calibrate model and calculate the effect of changes in manager education on TFP

Moving to U.S. Distribution of Manager Education

- Use data from Global Entrepreneurship Monitor to measure distribution of manager education in Portugal and U.S. (10 vs 14 average years of schooling)
- Assume distribution of firm age is independent of manager education, and equal to the overall distribution in Portugal
- Results
  - Moving from distribution in Portugal to that of U.S. would increase TFP by 33%
  - Accounting for increased physical capital accumulation, output per capita would rise by 54%, half of the difference between the two countries

Conclusion

- Findings
  - If education drives technology adoption, then aggregate return to education exceeds individual return
  - Micro-level test: does firm growth increase with manager education?
  - Find strong support using administrative data on the universe of firms and workers in Portugal
  - Magnitude suggests manager education can account for large differences in aggregate output

- Implications
  - Good news: investment in education has a higher return than implied by individual earnings
  - Bad news: the return takes a very long time to fully materialize