Wage Determination in High-tech Start-ups – Does it Differ for Academic Spin-offs?

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Motivation and research question

- High-tech start-ups play an important role in the commercialisation of new technologies and services.
- Academic spin-offs are a vehicle to commercialise research results generated at universities and other scientific institutions.
- Academic spin-offs exhibit better innovation performance than otherwise created firms.
- Academic spin-offs are frequently not found to perform better in terms employment growth.
- Academic spin-offs require a high-skilled labour force to commercialise research results from academia.

Research question

Do spin-offs pay higher wages than other high-tech start-ups in order to attract high-skilled employees?

Literature review

- Wage differentials between newly-founded and established firms.
  Brown and Medoff 2003, Brixy et al. 2007
- Wage differentials and innovation activities
  Bogliacino 2008, Walewski 2009, Pianta and Tancioni 2006
- Innovation output of academic spin-offs
  Toole and Czarnitzki 2006
- Employment growth of academic spin-offs
  Colombo and Piva 2005, Cantner and Goethner 2011, Egeln et al. 2007
- Survival of academic spin-offs
  Egeln et al. 2007, Cantner and Goethner 2011

Linked Employer-Employee Data Set (I)

Employer data: ZEW High-tech Start-up Survey

- High-tech firms founded in the period from 1998 to 2005
- Random sample stratified by start-up year and high-tech sector (manufacturing, technology-intensive services, software)
- Computer-aided telephone interviews (CATI) conducted in 2007
- Net sample: 3,017 firms
- Average length of an interview: 30 minutes

Employee data: Employment Statistics of the Fed. Employment Agency

- Person-specific data on all employees subject to social insurance contributions reported by the employing establishment
- Data on socio-demographic characteristics (age, gender, professional qualification) and employment related characteristics (start and end date of employment, gross earnings)

Linked Employer-Employee Data Set (II)

- Match of high-tech start-ups founded in the period from 2003 to 2005
- Record matching via firm names and addresses
- 947 of the firms surveyed could be matched to one or more establishments.
- In case of more than one establishment, establishment data are aggregated to firm level.
- From 2003 to 2008, a total of 11,861 employees subject to social insurance contributions worked in these 947 firms.
- Data on part time and full time employees
- Employment spells of an entire year and shorter periods

Identification of academic spin-offs

1. Did the entrepreneur study at a university or does she/he currently study?

2. After finishing her/his education, did the entrepreneur work at a university or at another scientific institution?

3. I will read out several factors that might have been relevant for the formation of your firm. Please tell me whether these factors were “indispensible”, “of great importance”, “of minor or no importance.”

   - Specific skills that the entrepreneur has acquired during her/his activities at the scientific institution.

   - New scientific methods or techniques which the entrepreneur has acquired during her/his activities at the scientific institution.

   - Results of the entrepreneur‘s own research activities at the scientific institutions, for instance, the development of a new product or services.

(The wording of questions was adapted to start-up established by scientists, graduates or students.)

Definition of academic spin-offs

Transfer spin-off

At least one of the founders was involved in producing new research results or scientific methods that were indispensable to the creation of the firm.

Competence spin-off

Specific skills, which at least one of the founders acquired during the time at the public research institute, must have been indispensable to the creation of the firm.

Table 1: Number and share of academic spin-offs

	no spin-off		transfer spin-offs		competence spin-offs	
	#	% [a]	#	% [a]	#	% [a]
All high-tech start-ups	1,324	86.1	102	6.8	121	7.1
Matched firms in LEE data	719	87.5	59	6.3	66	6.3

[a] Population-weighted shares.
Source: ZEW High-tech Start-up Survey.

Table 2: Employees in academic spin-offs in 2006

	No spin-offs	spin-offs
Number of employees (at the end of 2006)		
Mean	9.33	9.09
Median	5	6
Level of education (mean share of person days in %)		
Employees with university degree	20.9	32.1
Employees with vocational training	57.4	38.8
Trainees	5.3	5.5
Employees without a degree	11.6	18.9
Employment status (mean share of person days in %)		
Trainees	5.1	5.0
Full time employees	54.4	55.2
Part time employees	4.2	6.8
“Mini jobs”	36.3	33.0

Source: ZEW High-tech Start-up Survey, employment statistics.

Table 3: Gross salaries in 2006 by employment status in €

	no spin-offs	spin-offs
Trainee	6,435	5,183
Full time	29,167	32,605
Part time	11,435	15,490
“Mini job”	4,201	3,958

Source: Employment statistic.

Table 4: Gross salaries in 2006 by level of education in € (full time employees only)

	no spin-offs	spin-offs
No degree	24,999	26,780
Vocational training	27,408	27,809
University degree	38,126	43,654

Source: Employment statistic.

Econometric approach

- Unit of analysis: person-year, calculated by aggregating all employment spells of an employee in the start-up examined in year *t*
- Endogenous variable: mean daily wages employee *i* earned in year *t*
- Estimation method: random-effects GLS regression
  pooled OLS regression
- Standard errors clustered by employee *i*

Vector of exogenous variables (I)

Employee data

- Age, age squared
- Gender (1 = male)
- Citizenship (1 = German, 0 = foreigner)
- Level of education (no degree, vocational training, university degree)
- Long-term unemployment before entering the start-up (1/0)
- Employment status (full time, part time, trainee, “mini job”)
- Job tenure (in days)
- Occupation in start-up (21 occupational categories)

Vector of exogenous variables (II)

Employer data

- Transfer spin-off, competence spin-off
- Interaction terms between spin-off categories and level of education
- Firm size (in person-days)
- Team foundation (1/0)
- Firm age (in years)
- R&D activities (none, occasionally, continuously)
- Share of employees with university degree (in person-days)
- Share of trainees in workforce (in person-days)
- Entrepreneur with university degree (1/0)
- Entrepreneur with industry experience in the sector of start-up (1/0)
- Start-up from Eastern Germany (1/0)
- Sector (cutting-edge manufacturing, high-tech manufacturing, software, technology-oriented services)

Table 5: Estimation results of random effects GLS regression

	Coefficient	Robust stand. error	
Age	0.508	0.003	***
Age squared	-0.001	0.000	***
Gender (1 = male)	-0.269	0.012	***
Citizenship (1 = German, 0 = Foreigner)	-0.015	0.017	
Level of education			
University degree	0.102	0.017	***
Vocational training	0.049	0.015	***
Reference: no degree			
Former long-term unemployment	-0.265	0.025	***
Employment status			
"Mini job"	-1.758	0.187	***
Part time	-0.670	0.044	***
Trainee	-0.974	0.034	***
Reference: Full time			
Job tenure	0.028	0.003	***
Occupation in start-up (21 occupational categories)	*included*		

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	Coefficient	Robust stand. error	
Transfer spin-off	0.098	0.043	**
Competence spin-off	-0.039	0.051	
Interaction terms			
Transfer s-o * vocational training	-0.088	0.050	*
Transfer s-o * university degree	-0.015	0.052	
Competence s-o * vocational training	0.042	0.059	
Competence s-o * university degree	-0.004	0.070	
Firm size (in person-days)	0.045	0.004	***
Team foundation (1/0)	0.046	0.010	***
Firm age (in years)	0.005	0.002	**
R&D activities			
Continuously	0.058	0.012	***
Occasionally	0.037	0.011	***
Reference: no R&D activities			
Share of employees with university degree	0.180	0.019	***
Share of trainees in workforce	-0.132	0.041	***
Entrepreneur with university degree (1/0)	0.132	0.012	***
Entrepreneur with industry experience (1/0)	0.063	0.012	***
Start-up from Eastern Germany	-0.249	0.011	***
Sector			
High-tech manufacturing	0.090	0.012	***
Software	0.052	0.019	***
Technology-oriented services	0.032	0.015	**
Reference. Cutting-edge manufacturing			
Integer	2.746	0.069	***
σ_u	0.440		
σ_e	0.236		
Number of observations	29,456		
Number of groups (employees)	11,861		
R^2 within	0.435		
between	0.808		
overall	0.799		

Table 6: Average marginal effects of spin-off variables on daily wages

	Marginal effect	Stand. error	
Transfer spin-offs	0.044	0.019	**
Competence spin-offs	-0.016	0.022	
Transfer spin-offs			
No degree	0.098	0.043	**
Vocational training	0.010	0.027	
University degree	0.083	0.027	***
Competence spin-offs			
No degree	-0.039	0.051	
Vocational training	0.003	0.029	
University degree	-0.043	0.046	

Source: ZEW High-tech Start-up Survey, employment statistics, own estimation.

Conclusions

- Transfer spin-offs pay higher wages than otherwise created firms.
- Transfer spin-offs show positive wage differentials for university graduates and employees without a formal qualification but not for employees with a vocational training.
- Wages paid by competence spin-offs do not differ from those paid by non spin-offs.
- Even if transfer spin-offs do not create more jobs than other start-ups, they have a positive effect on the labour market since they offer comparatively well-paid jobs.

Thank you for your attention!