資料５－１

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Flexible labor and innovation performance of R&D-oriented start-ups in Japan

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Backgrounds

- Debate: whether labor market is flexible enough?
- Support argument:
  - Flexibility allows firms to adapt to changing demand conditions, e.g. environment shocks
  - Flexibility contributes to employment as well as allows for higher economic growth and higher productivity growth (e.g. OCED job study, 1994; Nicoletti and Scarpetta, 2003)
- Counterargument:
  - Fair protection against dismissal
  - Longer-term commitments and loyalty

Japanese labor market

- Since 1990s, a shift from senority wage and lifetime employment to more flexible labor market while non-regular workers are used.
- Currently using dual labor market model (flexicurity)but different from those in EU countries such as Denmark
  - Compared to permanent employees, lower payment, lower social security and lower protection from dismissal
- Flexible labor is used for economizing labor costs. Non-regular employees are common in low-tech sectors.

Forms of flexible labor contracts

- Numerical flexibilty
  - Adjustment of labor intake, the number of workers from external labor market
  - Achieve by hire temporary workers, part-timers, dispatched workers or easy hiring and firing
- Functional flexibility
  - Adjustment of internal labor market, such as job rotation within a firm
- Wage flexibility
  - Wage levels are not decided collectively and there are more differences between the wages of workers, e.g. performance-based pay

Aim of our paper

- Builds on previous firm-level analysis on flexible labor and innovation from EU countries
- Focus on R&D-oriented start-ups (typically firms are categorized to schumpeter I regime)
- Focus on numerical flexibility (empirical results using EU firm-level data are rather mixed)
- Within a Japanese context where flexicurity (dual labor market model) is implemented.
  - Whether there is an additional effect of flexible labor than its role of cost saving?

Numerical flexibility might favor innovation

- ***Walrasian* view**
  - Difficult and expensive firing of redundant personnel frustrates labour-saving process innovations
  - With easier firing, shifting labour from old and declining industries to innovative activities is easier
  - Easier firing enhances the inflow of 'fresh blood' (i.e. of people with novel ideas and networks)
  - The (latent) threat of easy firing reduces shirking
  - Firms can more easily replace weak people by better personnel

Numerical flexibility might damage innovation

- ***Schumpeterian* view**
  - Principal argument: Flexible 'hire & fire' reduces loyalty and commitment. With easier firing, shifting labour from old and declining industries to innovative activities is easier
  - Lower investment in manpower training as pay-back periods become shorter.
  - Personnel have fewer incentives to invest in firm specific knowledge (e.g. safety instructions)
  - A larger personnel turnover weakens the 'historical memory' of organizations and the 'learning organization'.
  - Tacit knowledge for incremental innovation is in favour of continuity in labor relations, thus internal labor market (‘functional flexibility’) is preferred than via external labor market (‘numerical flexibility’)
  - People threatened by easy firing have incentives not to reveal knowledge relevant to labor-saving process innovation
  - Easy firing will change power relations in firms.

Numerical flexibility as an important means for start-ups to innovate?

- Schumpeter I model
  - 'Entrepreneurial model': new firm foundation (e.g. in ICT, biotechnology); inventor-entrepreneur ('Garage business').
  - Countries with more labor flexibility (e.g. Anglo-Saxon countries) perform better on Schumpeter I regime
  - Most start-ups are categorized as firms in Schumpeter I regime
- Resource-based view
  - Limited human capital, efficiently manage human resources is key to success
  - Flexibility allows start-ups having relatively greater freedom of capital interests to set the terms of utilization of labor
  - Flexible labor might be critical for start-ups due to the liabilities of newness and size
- Thus, we assume ‘numerical flexibility positively → innovation of start-ups’

Data

- **Original questionnaire survey data for Japanese start-ups**
  - Repeated annual surveys from 2008 to 2011 in 4 waves
  - First survey in November 2008 sent to 13,582 firms in manufacturing and software sectors incorporated between Jan. 2007 and August 2008
    - Target firms obtained from a company database compiled by Tokyo Shoko Research (TSR)
  - Questions on founder's personal characteristics, firm characteristics at start-up, finance, employment, R&D and innovation, firm performance etc
  - Obtained a panel of 514 firms (931 observations)

Key variables

- Innovation performance
  - Technological innovation (no distinguish between innovativeness and imitativeness) ; *INN*
    - Number of product/process innovations
  - Patent (representing newness) ; *PAT*
    - Number of patent applications
- Numerical flexibility
  - External labor turnover for regular workers; *TURN*
    - Number of hired and retired workers between periods *t* and *t*+1, divided by total number of workers at period *t*
  - Share of temporary workers (including part-time and fixed-term employees); *TEMP*
  - Share of dispatched workers (employees hired from agency); *DISP*

Other variables

- *SIZE;* Logarithm of the number of employees (incl. the president)
- *AGE;* Logarithm of the number of months after the foundation
- *B2C;* Dummy variable: 1 if B to C industry, 0 otherwise
- *RD;* Logarithm of annual amount of research and development expenditures
- *PROFIT;* Dummy variable: 1 if the business is profitable, 0 otherwise
- *COMP;* 5-point Likert scale for perceived competitive pressure (1 less competitive ～ 5 fairly competitive)
- *IND;* Dummy variable: 1 if independnet start-ups, 0 otherwise
- Other controls
  - High-tech dummy (categolized based on R&D intensity),
  - Year dummies

Descriptive statistics

Variable	Obs	Mean	Std.Dev.	Min	Max
(Dependent variable)					
INN	931	1.491	6.125	0	100
PAT	903	0.402	3.360	0	68
(Independent variable)					
TURN	931	0.277	0.948	0	18
TEMP	931	0.134	0.229	0	0.946
DISP	931	0.013	0.076	0	0.833
SIZE	931	1.128	0.965	0	5.994
AGE	931	3.048	0.650	1.386	4.060
B2C	931	0.063	0.244	0	1
RD	931	2.888	2.795	0	12.388
PROFIT	931	0.519	0.500	0	1
COMP	931	2.766	1.366	0	5
IND	931	0.871	0.335	0	1

Econometric methods

- Negative binomial regression model
  - Dependent variables are count data
- Alternative methods for robustness checks
  - Zero-inflated negative binomial model for excess number of zeros
  - Seemingly unrelated regression (SUR)

Estimation results: full sample

Variable	*INN*	*PAT*
TURN	-0.074	0.665**
	(0.060)	(0.287)
TEMP	0.857***	-2.126***
	(0.324)	(0.818)
DISP	2.561***	1.764
	(0.780)	(1.754)
RD	0.242***	0.364***
	(0.025)	(0.060)
SIZE	0.150	0.299
	(0.092)	(0.206)
AGE	0.618***	-1.134**
	(0.234)	(0.516)
B2C	0.511*	-0.051
	(0.290)	(0.668)
PROFIT	-0.352**	-0.458
	(0.141)	(0.305)
COMP	0.047	0.126
	(0.051)	(0.108)
IND	0.685***	1.583***
	(0.225)	(0.523)
HIGHTECH	-0.838***	-0.221
	(0.158)	(0.345)
Constant term	-3.411***	-0.028
	(0.940)	(1.999)
Year dummies	Yes	Yes
ln(α)	1.036***	2.273***
	(0.084)	(0.139)
Log likelihood	-1259.438	-478.386
Pseudo R^2	0.067	0.076
Observations	931	903

Discussion: full sample results

- External labor turnover
  - *Positive* (*TURN*) on patent applications (*PAT*).
    - By hiring people flexibly, start-ups may be able to absorb with novel ideas and extend networks.
    - The (latent) threat of easy firing may reduce shirking.
  - Insignificant for technological innovations (*INN*)

Discussion: full sample results (cont.)

- Flexible labor
  - *Positive* (*TEMP*, *DISP*) on technological innovations (*INN*)
  - *Negative* (*TEMP*) on patent applications (*PAT*).
    - Non-regular workers are only used to conduct routines that produce output that does not require much knowledge especially novel knowledge.
    - Technological innovation (*INN*) may not necessarily capture the real innovativeness, because product/process innovations include incremental innovations as well as radical innovations.
    - In contrast, patents (*PAT*) require novel knowledge.
    - Therefore, we found a positive effect on *INN* but a negative effect on *PAT* .

Estimation results: sub-samples

	High-tech		Low-tech	
Variable	*INN*	*PAT*	*INN*	*PAT*
TURN	-0.027	0.635*	-0.605	0.062
	(0.062)	(0.347)	(0.434)	(0.271)
TEMP	0.615	-2.753**	1.315**	-0.752
	(0.383)	(1.212)	(0.527)	(0.974)
DISP	-1.292	0.873	5.149***	6.040**
	(1.098)	(2.117)	(1.508)	(2.589)
RD	0.218***	0.372***	0.243***	0.395***
	(0.028)	(0.078)	(0.048)	(0.090)
SIZE	0.315***	0.500*	-0.340*	-0.514*
	(0.101)	(0.271)	(0.178)	(0.307)
AGE	0.610**	-1.478**	0.659	0.298
	(0.254)	(0.673)	(0.464)	(0.699)
B2C	0.460	-0.045	0.140	-0.126
	(0.366)	(1.109)	(0.491)	(0.712)
PROFIT	-0.312**	-0.344	-0.207	-0.026
	(0.153)	(0.398)	(0.290)	(0.460)
COMP	0.230***	0.195	-0.284***	0.045
	(0.057)	(0.141)	(0.098)	(0.175)
IND	0.650**	1.456**	0.385	1.596**
	(0.267)	(0.706)	(0.430)	(0.750)
Constant term	-4.980***	0.232	-1.733	-4.203
	(1.046)	(2.586)	(1.849)	(2.789)
Year dummies	Yes	Yes	Yes	Yes
ln(α)	0.723***	2.374***	1.141***	1.225***
	(0.118)	(0.162)	(0.135)	(0.359)
Log likelihood	-795.628	-338.205	-437.500	-127.145
Pseudo R^2	0.079	0.082	0.071	0.113
Observations	651	631	280	272

Discussion: sub-sample results

- External labor turnover
  - *Positive* (*TURN*) on patent applications (*PAT*) only for ***high- tech sectors***.
    - People with novel ideas and networks may be particularly important in high-tech sectors, but less important in low-tech sectors, while
- Flexible labor
  - *Positive* (*TEMP*, *DISP*) on technological innovations (*INN*) only for ***low-tech sectors***
  - *Positive* (*DISP*) on patent applications (*PAT*) for ***low-tech sectors***.
    - Flexible labor is important for innovation only in low-tech sectors

Summary of the findings

- *External labor turnover* increases the number of patent applications (representing newness), particularly in high-tech sectors.
- *Flexible labor* increases the number of technological innovations (not necessarily representing newness) in low-tech sectors.
- But, while *flexible labor* decreases the number of patent applications in high-tech sectors, it increases in low-tech sectors.

Implications

- Encouraging external labor turnover is a significant means for boosting innovation performance, especially in high-tech sectors.
- Flexible labor is only important in low-tech sectors, but relatively unimportant for innovation in high-tech sectors.
- Therefore, from an economic policy perspective, promoting labor mobility for regular workers may contribute to achieving innovation and thus economic growth.
  - This supports the 3rd arrow of Abenomics?