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Intra-firm Mobility, Innovation Types and Engineers? Performance

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Abstract

We investigate the effects of engineers? intra-firm mobility on a social network, and the relationship between engineers? social network and their performance in the companies. Our data are obtained from two valuable questionnaires with large number of respondents. Our main results suggest that, engineers? intra-firm mobility will promote to form engineers? social network, while mismatched or improper job reallocation will be negatively associated with the range of the social network. A network with wider range will play important role in the performance of the engineers.

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Abstract

In this paper, we investigate the effects of engineers' intra-firm mobility on a social network, and the relationship between engineers' social network and their performance in the companies. Our data are obtained from two valuable questionnaires with a large number of respondents. Our main results suggest that, engineers' intra-firm mobility will promote the formation of the engineers' social network, while mismatched or improper job reallocation will be negatively associated with the range of the social network. A network with a wider range will play an important role in the performance of the engineers.

1. Introduction

It is often indicated that intra-firm mobility (or lateral transfers) combined with vertical promotion is important to form a career ladder through which each employee acquires different but related skills (Koike, 1988). Job rotation is said to be done methodically in Japanese firms, and it is widely used for training of employees, especially training of young engineers (Kusunoki and Numagami, 1997). Employees within a section rotate their job responsibility so that those within a rotation cycle are capable of performing multiple tasks. Most large Japanese firms routinely transfer employees to different sections/departments (Kusunoki and Numagami, 1997, Ariga, Brunello, and Ohkusa, 1999, and Ariga, 2006).

One of the reasons behind the observed intra-firm mobility or job rotation routine may be that the innovation management corresponding to its type of innovation has to employ this kind of mechanism to be able to utilize the existing tacit knowledge assets residing in individuals for company's innovation success.

Nonaka (1994) characterizes two types of knowledge, explicit and tacit, which are said to have critical implications for the case of knowledge flow. As described by Nonaka et al (2000), and Hall and Andriani (2002), explicit knowledge can embodied in a code or a language and can be communicated, processed, transmitted and stored relatively easily. It can be shared in the form of data, scientific formulae, manuals and suchlike. In contrast, tacit knowledge is personal and hard to formalize. It is rooted in action, procedures, commitment, values and emotion etc. Tacit knowledge is not codified, and not communicated in a language. It is acquired by sharing experiences, by observation and imitation. Therefore, transfer of tacit knowledge is optimally supported by interactions between individuals (Argote and Ingram, 2000).

Firms use a variety of mechanisms to enhance interactions between workers or engineers, and thus enable tacit knowledge transfer. These mechanisms not only provide workers or engineers with hands-on experience, but also alter the informal social network of the firm. When a worker or engineer rotates into a new department, he or she interacts with and forms some ties with workers in the new department. Some of these ties persist as the worker or engineer rotates back to his or her own department. This increases the number of inter-department ties, and enhances the resilience of the organization's overall social network. Consequently, it improves the performance of the organization (Burt, 1992, and Boone and Ganeshan, 2008).

On the other hand, corresponding to different type of innovations, or different stages of the innovation processes, transfer of tacit knowledge may play different roles for innovation success.

Along with the OECD Oslo Manual (2005), innovation success can be defined by four components: product innovation, process innovation, marketing innovation and organizational innovation. Among these four components, product and process innovations are closely related to the concept of technology or innovation management. The former refers to an innovation that introduces a good or service that is new or significantly improved regarding its characteristics or intended uses, the latter is related to the implementation of a new or significantly improved production or delivery method. Process innovations can be intended to decrease unit costs of production or delivery, and to increase quality. At the same time, a marketing innovation is the implementation of a new marketing method involving significant changes in product design or packaging, product placement, product promotion or pricing, while an organizational innovation refers to a new organizational method in the firm's business practices, workplace organization or external relations.

Different types of innovation may react to the impact of tacit knowledge transfer on innovation success in different ways. Alwis et al (2004) argued that, in early phases of the innovation process (idea discovery and generation), the degree of intangibility is high, so the significance of tacit knowledge in the early phases of the innovation process plays a more important role. However, Alwis et al (2004) also indicated that, problems which occur within the scope of the innovation process are often too complex to be solved only on an analytical basis. Decisions made within in each phase of the innovation process all rely heavily on tacit knowledge "know-how"; thus, tacit knowledge may play an important role in all stages of the innovation process.

On the other hand, some studies have suggested that intra-firm mobility or lateral transfers do not always benefit in improving workers or engineers' multiple skills nor enhance the promotion probability. Devereux (2000) analyzes the impact of negative demand shocks on task assignments in the context of the specific human capital model. He finds that the negative demand shocks induce reallocation of workers to tasks that require less skill in order to retain senior workers with larger amounts of specific human capital. This line of reasoning suggests that the workers with shorter tenure (and hence smaller amount of specific human capital) are more likely to be transferred to accommodate shifts in demand across different units of a firm. By employing a dataset derived from personnel files of a large manufacturing firm in Japan, Ariga (2006) showed that, transfer across offices in different locations by and of itself has a significantly negative impact on future promotion. His reading of this result is that the firm uses relocation as a device to reshuffle a slack labor force, especially when workers are relocated to functionally similar but geographically different units. As a result, not all mobility within a firm is a good signal.

In this paper, we investigate the effects of engineers' intra-firm mobility on forming a social network, and the relationship between the engineers' social network and their performance in the companies. We utilize the data obtained from two valuable questionnaires with a large number of respondents, which were developed and conducted by Japanese Electrical Electronic & Information Union (JEIU) in 2008, and by a federation of labor unions of the group companies of a large automobile company (FLU) in 2012 respectively.

Our main results suggest that, engineers' intra-firm mobility will promote the formation of an engineers' social network. However, if the job reallocation creates a job mismatch or improper job assignment to the engineers, mobility between different areas of responsibility will be negatively associated with the range of the social network. On the other hand, a network with a wider range is positively associated with better performance of the engineers when the performance is evaluated by the speed of promotion, output of work and income of the engineers.

The rest of the paper is organized as the follows. Section 2 describes our data source, presents preliminary analysis results, and develops our hypotheses for empirical analysis. Section 3 discusses the methodology, co-variables and estimated results. And Section 4 concludes.

2. Data and Hypotheses

2.1 Data Sources

The data used in this paper come from two larger questionnaires, which were developed and conducted by the Japanese Electrical Electronic & Information Union (JEIU) in 2008, and by a federation of labor unions of Japanese automobile companies (FLU) in 2012 respectively. The former includes 35 individual questions for both full time engineers and managers, and the latter consists of 49 questions for engineers, and 54 questions for managers. Both questionnaires are designed to ascertain how each company approaches the training of its engineers, as well as their evaluation and compensation, reflecting the changing and growing need for cutting-edge technological expertise in the increasingly competitive environment faced by representative Japanese companies in electrical and electronic, and automobile industries.

With regards to the questionnaire of the JEIU, there were about 4200 responses by the engineers and managers employed in 63 Japanese electrical and electronic equipment companies. In that of the FLU, there were about 1800 responses covering the engineers and managers in 34 automobile manufactures.

Our sample is selected from the valid responses for approximately 6000 individual responses in the two questionnaires, including the following information: (1) background information (i.e., sex, age, education, recruitment type, years of service at the present company, and the salary of previous year); (2) current and experienced areas of responsibility (i.e., survey/planning, development/design, production technology and quality management, technology management/patent management, information processing/software development, sales/technical services and the like.); (3) performance (i.e., number of patent applications, amount of patent-related remuneration, number of technical reports, presentation, and published papers inside or outside company); (4) source of information and idea about present work (i.e., exchange of opinions and ideas with individuals only at the same workplace, at the same company or outside of the company); (5) quickness of promotion valuated by respondents themselves; (6) ability and quality as a engineer evaluated by the respondents themselves; (7) environment of the company and workplace.

2.2 Intra-firm Mobility and Social Network

In this paper, intra-firm mobility is measured by using a dummy, ***Move***, which is set to equal unit if the respondent has experienced different areas of responsibility at the present company, and zero otherwise[1]. Table 1 summarizes the intra-firm mobility related to different age groups and different current areas of responsibility. It is clear that the share of respondents who have experienced intra-firm mobility varies across ages and current areas. That share also varies across the two industries, say, electrical and electronic, and automobile manufactures. Generally speaking, intra-firm mobility occurs more often for people who are currently in charge of "surveys/planning", "technology and patent management" and "sales/technical services" areas, while it is relatively rare for the people in the areas of "development/design" and "information process/software development". On the other hand, intra-firm mobility frequency seems higher for managers, compared with engineers, and people in electrical and electronic manufactures, compared with automobile manufacturers.

The two questionnaires also ask respondents to answer "how far does the exchange of

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[1] Although the respondent may experience moving between jobs in the same area, or move two or more times between two particular different areas, we cannot identify those based on the questionnaires of the JEIU. That is why we have chosen to focus on whether a move across different areas happens or not.

opinions and conversation about your work extend?" We classified the answers for this question into four rank groups, i.e., "None in particular", "Only with peoples in the same workplace", "Only with peoples in the same company", and "with people outside the company". These kinds of networks or boundaries for the networks may be informal. However, the networks with fewer internal boundaries or a wider range will experience more frequent, rapid and richer knowledge transfers, comprised of both tacit and explicit knowledge (Boone and Ganeshan, 2008).

Tables 2, 3, and 4 report shares of respondents related to ranges of the communication networks with different age groups and current areas. Both in electric and electronic, and automobile manufacturers, most of the engineers and managers shared their opinions and ideas with people outside of workplaces or outside of companies. However, quite a number of people make their communication boundaries within the same workplace or even have nobody to talk to about work. They account for roughly 35% of total respondents in the area of "information process/software development", and 15-20% in the other areas.

2.3 Hypotheses

As we discussed in the section of introduction, tacit knowledge transfer is tightly linked to individuals and their personal experiences. Thus, intra-firm mobility or lateral transfers will enable tacit knowledge transfer by enhancing interactions between engineers to promote the formation of the informal social network of the firm and raise its quality as well. A network with fewer internal boundaries or a wider range will convey richer knowledge transfer.

At the same time, the degree to which a person is connected to others in a social network has been associated with his or her performance and promotion (Burt, 1992, and Sparrowe et al., 2001).

Thus, we can expect that intra-firm mobility or lateral transfers would be critical to form a social network, especially to form an informal social network, which consequently provides a benefit in transfer of tacit knowledge, and improves the engineers' performance in the firm.

These considerations lead to our first and second hypotheses.

Hypothesis I. Intra-firm mobility of engineers both in Japanese electric and electronic, and automobile manufactures will promote the formation of their social network and improve quality of the network.

Hypothesis II. A network with fewer boundaries and a wider range is positively associated with better performance of the engineers.

Innovation process can be generally defined by product innovation, process innovation, marketing innovation and organizational innovation. It is made clear that innovation management corresponding to its type of innovation has to employ different mechanisms to be able to utilize the existing tacit knowledge assets for each stage of innovation. Surprisingly little is known about the role that tacit knowledge plays in each stage of innovation, which may be due to too complex problems faced on how to define the scope of the innovation process.

In this paper, we attempt to figure out what role tacit knowledge transfer plays in the different stages of the innovation process. Since we think that the intra-firm mobility is an efficient mechanism for tacit knowledge transfer, we develop our third hypothesis as follows,

Hypothesis III. The effects of intra-firm mobility on forming a social network may be different across the stages of innovation process.

As indicated by Ariga (2006), intra-firm mobility or lateral transfer may have different implications and consequences from those "planned" moves as a step within the long progression along the career ladder. Especially this transfer is induced by organizational change, say, job destructions within a firm driven primarily by "demand disturbances". If the newly assigned job after displacement is not a suitable one from the viewpoint of career progression, transfers induced by the job destructions are likely to have negative impact on the current and future productivity of transferred workers.

From this we formulated our last hypothesis.

Hypothesis IV. Job mismatching or improper job reallocation of engineers will be negatively associated with forming a social network. Consequently, it is negatively associated with the performance of the engineers.

3. Econometrical Analysis

3.1 Methodology and Co-variables

To determine whether the social network is associated with intra-firm mobility across different areas of responsibility, we utilize the following simple regression equation,

$$Network = f(Move, Mismatch \times Move, Sex, Service\ year,$$
$$Education, Recruitment, Manager, PersonalityComm) \quad (1)$$

where ***Network*** is calculated by using the four rank groups discussed in Section 2, to represent the individual's social network held by the respondents. ***Move*** refers to intra-firm mobility as discussed in Section 2 as well. We include ***Mismatch*** in the regression to represent whether the reallocation is thought improper or not by the engineer or manager[2]. ***Mismatch*** is set to equal one if the respondent thinks his or her current job allocation improper, zero otherwise. We also use a series of co-variables to grasp the background of the engineer or manager, which includes ***Sex***, ***Service year***, ***Education***, ***Manager*** and ***Recruitment***. ***Manager*** and ***Recruitment*** are dummy variables, which are set to equal unit if the respondent is a manager, or if he or she was recruited after some work experience in other companies.

Next, we attempt to build a proxy variable to represent the degree to which the respondent possesses ability in communication and external negotiation. We run our first factor analysis on the question of "Do you regard yourself as possessing sufficiently the following abilities and qualities?" both in the JEIU and the FLU, and get three factors, i.e., ability to grasp and solve problems, leadership, and ability to communicate and negotiate. We then use the score of the third factor as the values for

[2] The questionnaire of the JEIU provided information about whether the current job allocation is mismatched or not for the respondent. However, that is not the case for the FLU. We use the answer for question, "Do you feel our current work is worthwhile?" in the FLU as a counterpart for that in the JEIU. That is, if the respondent did not think the current work worthwhile, he or she is then classified into the group in which the current job allocation is thought mismatched for the respondents.

PersonalityComm in equation (1).

With regard to the relationship between a social network and the performance of the respondents, three types of dependent variables are considered to predict the effects of a social network on the performance of the respondents. ***SpeedProm***, an ordinal variable is utilized to represent how fast the respondent thinks he or she should have been promoted compared with a similar cohort, with the same year of recruitment and the same occupation. ***OutputPatent*** and ***OutputReport*** are two proxy variables measured by running our second factor analysis on the respondents' results of their work as an engineer over the past three years. The former shows the factor involving number of patent applications and related rewards, and the latter is associated with factor comprised of items such as technique reports, and paper presentation within or outside the company. Lastly, ***Salary***, the income of respondents, is also applied to the regression between the social network and the performance. Thus, we define the regression equation as the following,

$$\begin{aligned} &Performance(i.e., SpeedProm, OutputPatent, OutputReport, Salary) \\ &\quad = f(Network, Sex, Service\ year, Education, \\ &\qquad Recruitment, Manager, PersonalityAll) \end{aligned} \tag{2}$$

where ***PersonalityAll*** is the sum of the scores of the three factors in the first factor analysis.

One challenge of estimating the equation (2) is that ***Network*** may be endogenous. This problem may arise due to the causal effect of performance on a social network, or due to the existence of unobservable variables in equation (1), that is correlated with unobservable variables in equation (2). Neglecting the potential endogenous problem in equation (2) may result in biased and inconsistent estimators. To deal with this issue, we employ ***Move***, ***Mismatch*** and the scores of a factor analysis on the items related to the environment of the company and workplace in the JEIU and FLU as instrument variables, and implement a two-stages least squares (2SLS) estimation on the regression of ***Network*** on the performance[3].

Lastly, in order to test whether the type of innovation plays any role in tacit knowledge transfer, we classify the current areas of responsibility into three types of innovation, i.e., product innovation that includes the area of "Development/designing"; process innovation that includes the area of "Production technology management"; and organization and marketing innovation that includes all other areas, such "Technology and patent management", "Sales/technology service", and suchlike.

The descriptive statistics of all co-variables are described in Appendix Table 1 and their correlation coefficients are summarized in Appendix Table 2.

3.2 Estimated Results

Table 5 presents the ordinal logit estimates for the effects of the intra-firm mobility on the range of the social network.

Before introducing the estimated results for ***Move*** and ***Mismatch***, let us briefly give attention to the estimates related to the background of the engineers. The coefficients of ***PersonalityComm***, ability of engineers' communication and external negotiation, and ***Manager***, a dummy for managers, suggest strongly significant and positive effects on the range of the social network for almost all types of innovations, while those of ***Service year*** and ***Education*** are significantly positive mainly in the areas related to product innovations in the JEIU as well as in the FLU. The estimated coefficients of

[3] To save the space, we do not present the results of our three factor analysis in this paper. The results are available upon requests.

Recruitment, a dummy for mid-career recruitment are failed against the null hypothesis in all types of innovations. Interestingly, the coefficient of ***Sex*** in Column 9 reveals significantly negative, implying that female engineers in the area related to organization and marketing innovation in the JEIU, may have a wider social network[4].

The coefficients of ***Move***, a proxy variable for intra-firm mobility show significantly positive in the areas of product innovation, and organization and marketing innovation as well, whereas they are insignificant in the area of process innovation. These results support our first hypothesis. That is, intra-firm mobility will promote the formation of the engineers' social network. The evidence, however, is not observed in the areas of process innovation.

On the other hand, the estimate of ***Mismatch×Move*** shows significantly negative in the case of organization and marketing innovation in the sample of FLU, suggesting that, in that case, job mismatching or improper job reallocation of engineers will be negatively associated with forming a social network, as assumed by our fourth hypothesis.

We then turn to the estimated results for the effects of the network on the performance of the engineers. Tables 6, 7, 8 and 9 summarize the ordinal logit estimates and OLS estimates respectively for the regression of ***Network*** on the performance, where the dependent variables include ***SpeedProm***, an ordered variable for how fast the engineers have been promoted, ***OutputPatent*** and ***OutputReport***, the scores of the factor analysis on output of work for the engineers, and ***Salary***, the income of the previous year of the engineers obtained respectively. The variables related to the background of the engineers, such as ***Sex***, ***Service year***, ***Education***, ***Recruitment***, and

[4] Note that, ***Sex*** is measured by a unit for male engineers and zero for female.

Manager are used to control the influence of those variables on the performances. We also include ***PersonalityAll***, a sum of the scores of the factor analysis on the ability and quality of the respondents as engineers, in the regressions.

The ordinal logit estimates of Network in Table 6, indicate that, in the area of product innovation, there is a significant and positive association between ***Network*** and ***SpeedProm***. This relationship can be confirmed in the samples of both JEIU and FLU. The OLS estimates in Table 7 show that, in the JEIU and FLU, a significant and positive relationship between ***Network*** and ***OutputPatent*** exists not only in the area of product innovation but also in that of organization and marketing innovation. The estimated results of Table 8, however, suggest that, only in the sample of JEIU, ***Network*** can be recognized to play a positive role on the performance when it is measured by ***OutputReport***. Moreover, that is observed in all areas of the innovations in the JEIU, while in the sample of FLU, only the estimate in the area of organization and marketing innovation is significant. The estimated results of the regression of ***Network*** on ***Salary*** in Table 9 seems to be somewhat mixed. The estimates are significantly positive in the areas of product innovation, and organization and marketing innovation for the sample of JEIU, while for the sample of FLU, only the estimate in the area of process innovation is significant.

Those results partially support our second hypothesis: "A network with fewer boundaries and a wider range is positively associated with better performance of the engineers". Furthermore, the network in product innovation seems to play more important role in the engineers' performance.

Tables 10, 11, 12, and 13 present the 2SLS estimates of the regression of ***Network*** on performances. The tests for the overidentifying restriction in those tables suggest that, the instruments used in the regressions are valid in most of the cases[5]. After controlling the endogenous issue, the coefficient of ***Network*** turns out to be insignificant in a few of the cases, such as that of the regression of ***Network*** on ***OutputPatent*** in the area of product innovation, and that on ***OutputReport*** in the area of process innovation for the sample of JEIU. It seems, however, that there are no substantial changes in our main findings obtained from Tables 6, 7, 8, and 9.

[5] ***Move***, ***Mismatch***, the scores of three factors for factor analysis on environment of company and workplace, and all explanatory variable except of ***Network***, used in the regression (2) are employed as instrument variables in the 2SLS estimations.

4. Conclusions

In this paper, we investigated the effects of engineers' intra-firm mobility on forming a social network, and the relationship between the engineers' social network and their performance in the companies.

Our sample was built based on two valuable questionnaires with a large number of respondents, which were developed and conducted by the Japanese Electrical Electronic & Information Union (JEIU) in 2008, and by a federation of labor unions of the group companies of a large Japanese automobile company (FLU) in 2012.

Our main results are as follows.

(1) Engineers' intra-firm mobility will promote the formation of an engineers' social network. However, if the job reallocation is mismatched or improper to the engineers, mobility between different areas of responsibility will be negatively associated with the range of the social network.

(2) A network with a wider range is positively associated with better performance of the engineers when the performance is proxied by the speed of promotion, output of work, and income of the engineers.

(3) Compared with those in other types of innovations, the intra-firm mobility of the engineers in the area of product innovation seemed to play a more important role in the forming of a social network. Thus, the network possessed by those in product innovation consequently benefits more in transfer of tacit knowledge and results in better performance for them in the company.

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Table 1. Shares of respondents who have experienced moving between jobs in different areas

	Total sample			JEIU		TAGU	
	total	engineer	Manager				
Age							
below 29 years old	20.6%	20.6%	---	23.9%	(646)	12.5%	(388)
between 30 and 39 years old	33.3%	33.1%	39.6%	38.6%	(2215)	16.2%	(814)
between 40 and 49 years old	50.6%	49.0%	52.8%	55.4%	(1235)	36.2%	(473)
over 50 years old	62.3%	60.9%	62.8%	72.2%	(144)	50.4%	(126)
Current Area of Responsibility							
surveys/planning	73.6%	71.1%	83.3%	94.3%	(88)	41.1%	(69)
development/design	29.2%	25.9%	45.5%	33.3%	(2739)	17.5%	(1124)
production technology management	46.0%	44.3%	54.7%	56.0%	(645)	27.2%	(442)
technology and patent management	76.1%	67.3%	97.5%	86.9%	(84)	59.3%	(62)
information process/software development	44.9%	42.4%	60.7%	46.7%	(403)	22.6%	(36)
sales/technical services	60.0%	59.9%	60.7%	61.6%	(164)	36.4%	(13)
others	64.3%	57.8%	89.5%	63.6%	(140)	66.7%	(56)

Note: The values in parenthesis refer to the number of respondents.

Table 2. Range of network for exchange of opinions in total sample

	Total sample				
	none	within workplace	within company	outside company	total
Age					
below 29 years old	6.8%	23.6%	41.8%	27.8%	100.0%
between 30 and 39 years old	5.8%	16.8%	43.3%	34.2%	100.0%
between 40 and 49 years old	5.6%	10.5%	40.5%	43.4%	100.0%
over 50 years old	1.9%	6.7%	37.1%	54.3%	100.0%
Current Area of Responsibility					
surveys/planning	3.3%	15.7%	40.5%	40.5%	100.0%
development/design	5.5%	15.0%	40.5%	39.0%	100.0%
production Technology management	5.1%	13.7%	47.3%	34.0%	100.0%
technology and patent management	4.8%	15.9%	44.8%	34.5%	100.0%
information process/software development	10.2%	24.9%	39.0%	25.9%	100.0%
sales/technical services	7.3%	12.4%	42.4%	37.9%	100.0%
others	5.7%	21.4%	46.4%	26.6%	100.0%

Table 3. Range of network for exchange of opinions in electrical and electronic manufacturers

	JEIU				
	none	**within workplace**	**within company**	**outside company**	**total**
Age					
below than 29 years old	10.0%	26.6%	42.7%	20.6%	100.0%
between 30 and 39 years old	7.7%	18.6%	47.1%	26.5%	100.0%
between 40 and 49 years old	7.6%	11.4%	45.0%	36.0%	100.0%
over 50 years old	2.8%	6.4%	36.9%	53.9%	100.0%
Current Area of Responsibility					
surveys/planning	6.0%	15.5%	44.0%	34.5%	100.0%
development/design	7.4%	17.1%	44.3%	31.2%	100.0%
production Technology management	8.1%	14.4%	53.5%	24.0%	100.0%
technology and patent management	8.4%	13.3%	48.2%	30.1%	100.0%
information process/software development	10.8%	25.2%	40.3%	23.7%	100.0%
sales/technical services	7.9%	12.2%	45.1%	34.8%	100.0%
others	6.6%	21.3%	47.1%	25.0%	100.0%

Table 4. Range of network for exchange of opinions in automobile manufacturers

	TAGU				
	none	within workplace	within company	Outside company	total
Age					
below than 29 years old	1.5%	18.8%	40.2%	39.4%	100.0%
between 30 and 39 years old	0.6%	11.8%	33.0%	54.5%	100.0%
between 40 and 49 years old	0.4%	8.2%	29.0%	62.4%	100.0%
over 50 years old	0.8%	7.1%	37.3%	54.8%	100.0%
Current Area of Responsibility					
surveys/planning	0.0%	15.9%	36.2%	47.8%	100.0%
development/design	0.7%	10.2%	31.5%	57.6%	100.0%
production Technology management	0.7%	12.7%	38.5%	48.2%	100.0%
technology and patent management	0.0%	19.4%	40.3%	40.3%	100.0%
information process/software development	2.8%	22.2%	25.0%	50.0%	100.0%
sales/technical services	0.0%	15.4%	7.7%	76.9%	100.0%
others	3.6%	21.4%	44.6%	30.4%	100.0%

Table 5. Ordinal Logit estimates for the effects of intra-firm mobility on network

Variable	Total Sample				JEIU				FLU			
	All	Product	Process	Organization and marketing	All	product	Process	Organization and marketing	All	Product	Process	Organization and marketing
Move	0.224***	0.285***	0.106	0.410***	0.160**	0.230***	0.042	0.384**	0.437***	0.418*	0.289	1.032***
	(3.43)	(3.32)	(0.76)	(2.89)	(2.38)	(2.64)	(0.27)	(2.49)	(2.68)	(1.89)	(0.95)	(2.64)
Mismatch×Move	-0.170*	-0.195*	-0.185	-0.144	-0.091	-0.096	-0.296	0.017	-0.346*	-0.348	-0.043	-0.987**
	(-1.79)	(-1.76)	(-0.93)	(-0.65)	(-0.85)	(-0.81)	(-1.14)	(0.07)	(-1.84)	(-1.50)	(-0.14)	(-2.44)
Sex	-0.231	0.275	-0.009	-0.824***	-0.262	0.346	0.084	-0.889***	-0.014	-0.009	-0.022	0.463
	(-1.31)	(0.95)	(-0.02)	(-3.68)	(-1.36)	(1.04)	(0.20)	(-4.23)	(-0.03)	(-0.02)	(-0.02)	(0.47)
Service Year	0.050***	0.040***	0.061**	0.043	0.037***	0.035*	0.081**	0.004	0.062***	0.048**	0.042	0.070
	(3.91)	(2.68)	(2.29)	(1.28)	(2.87)	(1.85)	(2.12)	(0.13)	(2.65)	(2.04)	(1.01)	(1.09)
(Service Year)^2	-0.001	-0.001	-0.002	-0.002	-0.001*	0.000	-0.003**	0.000	-0.002***	-0.001	-0.001	-0.004***
	(-2.98)	(-1.14)	(-2.65)	(-1.40)	(-1.64)	(-0.55)	(-2.45)	(0.36)	(-2.61)	(-1.27)	(-1.01)	(-2.79)
Education	0.093***	0.142***	-0.003	-0.056	0.072**	0.129***	-0.027	-0.103	0.164***	0.189*	0.065	0.095
	(3.28)	(3.42)	(-0.05)	(-0.83)	(2.16)	(2.98)	(-0.35)	(-1.31)	(2.94)	(1.64)	(0.70)	(0.49)
Recruitment	0.060	0.081	0.192	-0.019	0.017	0.057	0.263	-0.148	0.027	0.072	0.129	-0.339
	(0.62)	(0.75)	(0.88)	(-0.09)	(0.15)	(0.39)	(0.82)	(-0.51)	(0.16)	(0.42)	(0.37)	(-0.92)
PersonalityComm	0.494***	0.425***	0.621***	0.595***	0.473***	0.414***	0.582***	0.591***	0.585***	0.462***	0.790***	0.774***
	(15.44)	(11.11)	(9.94)	(9.65)	(14.55)	(10.12)	(8.31)	(10.32)	(6.00)	(4.76)	(5.43)	(2.77)
Manager	0.760***	0.784***	0.813***	0.576***	0.874***	0.914***	1.128***	0.531***	0.504***	0.412*	0.441	1.256***
	(8.75)	(6.42)	(4.17)	(2.75)	(8.67)	(6.79)	(3.98)	(2.53)	(2.81)	(1.92)	(1.54)	(4.86)
No. of Obs.	5527	3536	947	1044	4077	2614	614	849	1450	922	333	195
R^2	0.068	0.071	0.076	0.068	0.045	0.045	0.050	0.063	0.044	0.037	0.048	0.115

Note: (1) The values in parentheses are t-statistics.

(2) "*", "**", and "***" refer to statistical significance at 10%, 5% and 1% level.

(3) The standard errors are measured by using cluster of firms.

Table 6. Ordinal Logit estimates for the effects of network on promotion

	Total sample				JEIU				FLU			
Variable	All areas	Product	Process	Organization and marketing	All areas	Product	Process	Organization and marketing	All areas	Product	Process	Organization and marketing
Network	0.111***	0.155***	0.150*	-0.037	0.094***	0.140***	0.177	-0.089	0.139***	0.186**	0.061	0.162
	(4.67)	(4.14)	(1.89)	(-0.59)	(3.32)	(3.13)	(1.60)	(-1.25)	(2.92)	(2.32)	(0.81)	(1.19)
Sex	-0.248**	-0.244***	-0.006	-0.435**	-0.262**	-0.262***	0.056	-0.464**	-0.171	-0.164	-0.321	-0.299
	(-2.23)	(-2.62)	(-0.01)	(-2.13)	(-2.09)	(-2.56)	(0.09)	(-2.09)	(-0.76)	(-0.78)	(-0.27)	(-1.26)
Service Year	-0.081***	-0.060***	-0.095***	-0.098***	-0.087***	-0.073***	-0.086***	-0.108***	-0.083***	-0.045	-0.101***	-0.106***
	(-6.07)	(-3.65)	(-4.16)	(-4.22)	(-5.57)	(-4.27)	(-2.93)	(-3.51)	(-3.29)	(-1.32)	(-2.71)	(-3.28)
(Service Year)^2	-0.001***	-0.002***	0.000	0.000	-0.001	-0.002***	0.000	0.000	-0.001*	-0.003***	0.000	-0.001
	(-2.68)	(-3.80)	(-0.21)	(-0.56)	(-1.38)	(-2.31)	(-0.30)	(0.28)	(-1.92)	(-3.06)	(-0.12)	(-0.56)
Education	-0.184***	-0.069	-0.259***	-0.322***	-0.169***	-0.052	-0.263**	-0.296***	-0.225***	-0.093	-0.295	-0.411***
	(-4.36)	(-1.21)	(-2.91)	(-3.89)	(-3.16)	(-0.79)	(-2.52)	(-2.82)	(-3.22)	(-0.78)	(-1.51)	(-3.21)
Recruitment	-0.852***	-0.833***	-1.239***	-0.588***	-0.947***	-1.033***	-1.181***	-0.664**	-0.838***	-0.724**	-1.407***	-0.596**
	(-5.60)	(-3.91)	(-6.11)	(-3.05)	(-7.93)	(-6.53)	(-4.21)	(-2.42)	(-3.24)	(-2.09)	(-4.88)	(-2.47)
PersonalityAll	0.169***	0.173***	0.144***	0.180***	0.168***	0.171***	0.127**	0.196***	0.168***	0.183***	0.207***	0.021
	(11.63)	(9.68)	(3.40)	(7.20)	(9.73)	(8.42)	(2.39)	(8.55)	(6.78)	(5.05)	(3.30)	(0.18)
Manager	2.041***	2.339***	1.753***	1.686***	2.202***	2.444***	2.210***	1.790***	1.748***	2.153***	1.286***	1.144**
	(15.71)	(15.93)	(6.36)	(8.87)	(17.53)	(15.11)	(6.47)	(9.15)	(7.05)	(7.21)	(4.12)	(2.20)
No. of Obs.	5477	3499	944	1034	4061	2606	611	844	1416	893	333	190
R^2	0.071	0.081	0.062	0.065	0.075	0.084	0.069	0.069	0.063	0.079	0.057	0.066

Note: (1) the values in parentheses are t-statisitcs.

(2) "a", "b", and "c" refer to statistical significance at 10%, 5% and 1% level.

(3) The standard errors are measured by using cluster of firms.

Table 7. OLS estimates for the effects of network on output related to patents

Variable	Total sample				JEIU				FLU			
	All	Product	Process	Organization and marketing	All	Product	Process	Organization and marketing	All	Product	Process	Organization and marketing
Network	0.097***	0.112***	0.018	0.090***	0.105***	0.126***	0.016	0.081***	0.058***	0.041*	0.021	0.176**
	(8.78)	(8.05)	(1.16)	(4.44)	(9.41)	(9.43)	(1.26)	(3.79)	(2.62)	(1.67)	(0.44)	(2.46)
Sex	0.082**	0.133*	-0.030	0.012	0.101**	0.172**	-0.029**	0.014	-0.052	-0.070	-0.004	-0.034
	(2.00)	(1.86)	(-1.62)	(0.27)	(2.20)	(2.05)	(-2.19)	(0.33)	(-1.01)	(-1.07)	(-0.04)	(-0.25)
Service Year	0.006*	-0.003	0.010**	0.015	0.004	-0.004	0.003	0.018	0.018***	0.006	0.022**	0.016
	(1.76)	(-0.40)	(2.14)	(1.62)	(0.79)	(-0.48)	(0.52)	(1.45)	(2.91)	(0.65)	(2.53)	(1.04)
(Service Year)^2	0.000	0.000*	0.000**	0.000	0.000	0.001*	0.000	0.000	0.000**	0.000	-0.001**	0.000
	(0.20)	(1.79)	(-2.14)	(-1.13)	(0.95)	(1.69)	(-0.45)	(-0.89)	(-2.56)	(0.20)	(-2.53)	(-0.90)
Education	0.100***	0.108***	0.026**	0.110***	0.119***	0.136***	0.016	0.130***	0.036**	0.015	0.040*	0.059
	(5.96)	(4.17)	(2.45)	(3.15)	(5.65)	(4.25)	(1.38)	(2.88)	(2.10)	(0.52)	(1.83)	(1.24)
Recruitment	0.020	0.008	-0.033	0.114*	0.041	0.001	-0.033	0.201**	-0.044	-0.035	-0.042	-0.103*
	(0.80)	(0.27)	(-1.36)	(1.75)	(1.05)	(0.01)	(-1.21)	(2.27)	(-1.58)	(-0.83)	(-0.87)	(-1.76)
PersonalityAll	0.015***	0.021***	0.013**	0.001	0.013**	0.019**	0.009	0.000	0.021**	0.024	0.027*	-0.010
	(3.21)	(2.89)	(2.43)	(0.17)	(2.55)	(2.48)	(1.62)	(-0.04)	(2.11)	(1.55)	(1.86)	(-0.66)
Manager	0.204***	0.239***	0.099*	0.119	0.261***	0.284***	0.152**	0.182	0.059	0.115	0.021	-0.212
	(3.38)	(2.83)	(1.68)	(1.33)	(3.52)	(2.70)	(2.29)	(1.58)	(0.64)	(0.89)	(0.24)	(-1.48)
No. of Obs.	5205	3303	912	990	3867	2463	592	812	1338	840	320	178
R^2	0.042	0.045	0.051	0.050	0.051	0.054	0.065	0.058	0.023	0.025	0.038	0.111

Note: (1) the values in parentheses are t-statisitcs.

(2) "*", "**", and "***" refer to statistical significance at 10%, 5% and 1% level.

(3) The standard errors are measured by using cluster of firms.

Table 8. OLS estimates for the effects of network on output related to technical reports

	Total sample				JEIU				FLU			
Variable	All	Product	Process	Organization and marketing	All	Product	Process	Organization and marketing	All	Product	Process	Organization and marketing
Network	0.071***	0.080***	0.022**	0.054***	0.082***	0.096***	0.025**	0.054***	0.028	0.014	0.010	0.074**
	(7.39)	(6.45)	(2.47)	(4.31)	(8.27)	(8.10)	(2.11)	(3.71)	(1.61)	(0.57)	(0.73)	(2.18)
Sex	0.020	0.035	-0.045***	0.016	0.019	0.047	-0.051***	0.018	0.017	-0.024	0.013	-0.003
	(0.83)	(0.89)	(-2.94)	(0.42)	(0.69)	(0.95)	(-3.04)	(0.49)	(0.71)	(-0.78)	(0.48)	(-0.04)
Service Year	0.008**	0.008	0.006**	0.012	0.009*	0.008	0.009**	0.015	0.011***	0.010	0.004**	0.008
	(2.38)	(1.42)	(2.31)	(1.47)	(1.70)	(1.10)	(2.11)	(1.33)	(2.68)	(1.00)	(2.32)	(1.41)
(Service Year)^2	0.000	0.000	0.000***	0.000	0.000	0.000	0.000**	0.000	0.000*	0.000	0.000*	0.000
	(-1.26)	(-0.66)	(-2.33)	(-0.92)	(-0.92)	(-0.55)	(-2.30)	(-0.84)	(-1.87)	(-0.47)	(-1.92)	(-0.65)
Education	0.095***	0.088***	0.024***	0.100***	0.104***	0.095***	0.026***	0.115**	0.065***	0.062***	0.020	0.060***
	(9.30)	(7.64)	(3.04)	(2.93)	(8.64)	(6.82)	(2.71)	(2.51)	(3.98)	(2.79)	(1.58)	(3.33)
Recruitment	-0.008	-0.032	-0.019	0.081*	0.012	-0.015	-0.026	0.129**	-0.031	-0.051	0.000	-0.012
	(-0.28)	(-0.83)	(-1.32)	(1.73)	(0.27)	(-0.22)	(-1.09)	(2.05)	(-0.93)	(-1.11)	(0.00)	(-0.29)
PersonalityAll	0.017***	0.024***	0.010***	0.002	0.014***	0.021***	0.010**	0.003	0.032***	0.043***	0.009***	-0.009*
	(3.82)	(4.37)	(2.85)	(0.37)	(2.96)	(3.43)	(2.25)	(0.36)	(2.88)	(3.39)	(3.06)	(-1.77)
Manager	0.121***	0.170**	0.042	0.016	0.110	0.138	0.054	0.021	0.131**	0.230***	0.026	-0.049
	(2.34)	(2.11)	(1.32)	(0.24)	(1.54)	(1.28)	(0.90)	(0.25)	(2.47)	(2.78)	(1.00)	(-0.92)
No. of Obs.	5205	3303	912	990	3867	2463	592	812	1338	840	320	178
R^2	0.049	0.049	0.056	0.038	0.052	0.051	0.064	0.037	0.046	0.055	0.042	0.122

Note: (1) the values in parentheses are t-statisitcs.

(2) "*", "**", and "***" refer to statistical significance at 10%, 5% and 1% level.

(3) The standard errors are measured by using cluster of firms.

Table 9. Ordinal Logit estimates for the effects of network on salary

	Total sample				JEIU				FLU			
Variable	All	Product	Process	Organization and marketing	All	Product	Process	Organization and marketing	All	Product	Process	Organization and marketing
Network	0.091***	0.063	0.061	0.145***	0.090***	0.083**	0.005	0.122**	0.171**	0.083	0.263*	0.182
	(2.92)	(1.61)	(0.90)	(2.58)	(2.81)	(2.36)	(0.06)	(2.02)	(2.13)	(0.73)	(1.87)	(0.92)
Sex	-0.988***	-0.728***	-1.979***	-1.217***	-0.938***	-0.620***	-1.892***	-1.229***	-1.433***	-1.493***	-2.241**	-1.249
	(-8.12)	(-5.57)	(-4.15)	(-4.44)	(-6.82)	(-4.79)	(-4.03)	(-4.56)	(-4.64)	(-3.81)	(-2.13)	(-1.60)
Service Year	0.344***	0.374***	0.313***	0.307***	0.330***	0.384***	0.286***	0.250***	0.367***	0.333***	0.367***	0.479***
	(16.05)	(15.03)	(6.84)	(7.62)	(12.95)	(13.24)	(4.37)	(7.22)	(9.58)	(7.05)	(5.80)	(6.51)
(Service Year)^2	-0.005***	-0.005***	-0.004***	-0.005***	-0.004***	-0.006***	-0.003	-0.003***	-0.005***	-0.004***	-0.005***	-0.009***
	(-8.25)	(-7.48)	(-3.05)	(-3.75)	(-6.49)	(-6.78)	(-1.58)	(-3.24)	(-5.43)	(-2.92)	(-3.35)	(-4.35)
Education	0.799***	0.811***	0.798***	0.651***	0.780***	0.795***	0.761***	0.618***	0.941***	0.930***	0.947***	0.891***
	(16.33)	(13.31)	(12.39)	(8.29)	(13.50)	(12.38)	(10.24)	(6.17)	(9.03)	(7.44)	(6.47)	(5.19)
Recruitment	0.898***	1.163***	0.781***	0.381**	0.736***	1.202***	0.532	0.072	1.299***	1.313***	1.229***	1.549***
	(9.09)	(7.65)	(3.05)	(2.24)	(5.45)	(6.17)	(1.36)	(0.37)	(7.55)	(5.56)	(3.12)	(5.35)
PersonalityAll	0.172***	0.164***	0.218***	0.157***	0.162***	0.145***	0.218***	0.171***	0.244***	0.275***	0.202***	0.205**
	(11.86)	(8.97)	(6.16)	(5.23)	(14.70)	(10.43)	(5.17)	(5.11)	(4.16)	(4.51)	(3.64)	(2.09)
Manager	1.884***	1.834***	1.641***	2.179***	1.882***	1.824***	1.822***	1.931***	1.915***	1.899***	1.463***	3.434***
	(7.53)	(7.00)	(4.67)	(6.78)	(5.19)	(4.75)	(2.71)	(5.93)	(6.80)	(7.78)	(4.61)	(5.55)
No. of Obs.	5535	3542	948	1045	4084	2620	614	850	1451	922	334	195
R^2	0.184	0.192	0.172	0.177	0.173	0.186	0.149	0.163	0.227	0.224	0.222	0.294

Note:
(1) the values in parentheses are t-statisitcs.
(2) "*", "**", and "***" refer to statistical significance at 10%, 5% and 1% level.
(3) The standard errors are measured by using cluster of firms.

Table 10. 2SLS Estimates for the effects of network on promotion

Variable	JEIU All	JEIU Product	JEIU Process	JEIU Organization and marketing	FLU All	FLU Product	FLU Process	FLU Organization and marketing
Network	1.633	1.339*	1.272	-1.022*	0.705**	0.767**	0.345	0.341
	(1.53)	(1.66)	(1.21)	(-1.84)	(2.42)	(2.03)	(0.86)	(0.92)
Sex	0.026	-0.264	-0.080	-0.634**	-0.055	-0.063	-0.186	-0.103
	(0.16)	(-1.45)	(-0.25)	(-2.29)	(-0.34)	(-0.33)	(-0.43)	(-0.58)
Service Year	-0.055***	-0.045***	-0.074**	-0.050**	-0.049***	-0.035*	-0.050**	-0.058**
	(-3.56)	(-3.00)	(-2.25)	(-2.62)	(-3.65)	(-1.83)	(-2.32)	(-2.40)
$(\text{Service Year})^2$	0.000	0.000	0.001	0.000	0.000	-0.001	0.000	0.000
	(0.31)	(-0.81)	(1.04)	(0.58)	(-0.41)	(-1.54)	(-0.27)	(0.45)
Education	-0.080***	-0.063	-0.064	-0.182***	-0.126***	-0.089	-0.152**	-0.177***
	(-2.60)	(-1.41)	(-0.98)	(-3.00)	(-3.34)	(-1.49)	(-2.33)	(-3.14)
Recruitment	-0.354***	-0.436***	-0.578***	-0.420**	-0.370***	-0.293***	-0.781***	-0.181
	(-3.22)	(-3.97)	(-2.86)	(-2.45)	(-5.33)	(-3.37)	(-5.52)	(-1.12)
PersonalityAll	-0.058	-0.023	-0.064	0.184***	0.021	0.032	0.060	-0.023
	(-0.65)	(-0.37)	(-0.57)	(3.35)	(0.76)	(1.09)	(1.11)	(-0.44)
Manager	0.354	0.475	0.482	1.004***	0.645***	0.793***	0.649***	0.311
	(0.94)	(1.53)	(1.03)	(5.53)	(6.21)	(6.21)	(3.74)	(1.12)
No. of Obs.	4054	2600	611	843	1401	883	331	187
P values of test for overidentifying	0.056	0.103	0.631	0.118	0.053	0.253	0.470	0.060

Note: (1) the values in parentheses are t-statisitcs.
(2) "*", "**", and "***" refer to statistical significance at 10%, 5% and 1% level.
(3) Move, Mismatch×Move, and the scores of three factors for factor analysis on environment of company and workplace are used as instrument variables.

Table 11. 2SLS Estimates for the effects of network on output related to patents

Variable	JEIU				FLU			
	All	Product	Process	Organization and marketing	All	Product	Process	Organization and marketing
Network	0.180	0.219	0.057	0.334*	0.302***	0.307***	0.073	0.474***
	(0.76)	(0.48)	(0.38)	(1.89)	(4.52)	(3.55)	(1.05)	(2.58)
Sex	-0.060	-0.100	-0.006	0.056	0.046	0.037	-0.055**	0.192**
	(-1.10)	(-1.00)	(-0.05)	(0.23)	(1.19)	(0.58)	(-2.56)	(2.22)
Service Year	0.015*	0.002	0.021**	0.011	0.006	0.007	0.008**	0.014
	(1.78)	(0.13)	(2.25)	(0.72)	(1.14)	(0.75)	(2.33)	(1.16)
(Service Year)^2	0.000	0.000	-0.001***	0.000	0.000	0.000	0.000**	0.000
	(-1.35)	(0.47)	(-2.71)	(0.00)	(-0.70)	(-0.51)	(-2.45)	(-0.87)
Education	0.026	-0.003	0.037*	0.055	0.101***	0.086***	0.027***	0.139***
	(0.96)	(-0.05)	(1.70)	(1.33)	(7.56)	(4.46)	(2.75)	(2.67)
Recruitment	-0.047	-0.040	-0.047	-0.091	0.017	-0.018	-0.026	0.170*
	(-1.37)	(-0.74)	(-0.93)	(-1.17)	(0.43)	(-0.31)	(-0.81)	(1.97)
PersonalityAll	0.011	0.013	0.025	-0.024	-0.005	0.005	0.004	-0.036*
	(0.62)	(0.50)	(1.07)	(-1.04)	(-0.67)	(0.64)	(0.56)	(-1.65)
Manager	0.034	0.080	0.023	-0.301*	0.033	0.061	0.042	-0.068
	(0.35)	(0.51)	(0.26)	(-1.89)	(0.57)	(0.74)	(0.87)	(-0.71)
No. of Obs.	1324	830	318	176	3800	2417	586	797
P values of test for overidentifying	0.578	0.631	0.085	0.182	0.116	0.159	0.067	0.763

Note: (1) the values in parentheses are t-statistics.
(2) "*", "**", and "***" refer to statistical significance at 10%, 5% and 1% level.
(3) Move, Mismatch×Move, and the scores of three factors for factor analysis on environment of company and workplace are used as instrument variables.

Table 12. 2SLS Estimates for the effects of network on output related to technical reports

Variable	JEIU All	JEIU Product	JEIU Process	JEIU Organization and marketing	FLU All	FLU Product	FLU Process	FLU Organization and marketing
Network	0.302***	0.307***	0.073	0.474***	0.058	0.165	0.065	-0.060
	(4.52)	(3.55)	(1.05)	(2.58)	(0.25)	(0.47)	(0.85)	(-0.73)
Sex	0.046	0.037	-0.055**	0.192	0.019	-0.042	0.010	-0.076
	(1.19)	(0.58)	(-2.56)	(2.22)	(0.35)	(-0.47)	(0.42)	(-1.15)
Service Year	0.006	0.007	0.008**	0.014	0.011*	0.007	0.003	0.010*
	(1.14)	(0.75)	(2.33)	(1.16)	(1.86)	(0.65)	(1.05)	(1.87)
(Service Year)^2	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	(-0.70)	(-0.51)	(-2.45)	(-0.87)	(-1.42)	(-0.29)	(-0.55)	(-1.50)
Education	0.101***	0.086***	0.027***	0.139***	0.062***	0.048	0.017	0.060***
	(7.56)	(4.46)	(2.75)	(2.67)	(2.91)	(1.14)	(1.56)	(3.98)
Recruitment	0.017	-0.018	-0.026	0.170*	-0.030	-0.051	-0.006	-0.018
	(0.43)	(-0.31)	(-0.81)	(1.97)	(-1.20)	(-1.28)	(-0.26)	(-0.41)
PersonalityAll	-0.005	0.005	0.004	-0.036*	0.031	0.034	0.004	0.006
	(-0.67)	(0.64)	(0.56)	(-1.65)	(1.36)	(1.27)	(0.40)	(0.54)
Manager	0.033	0.061	0.042	-0.068	0.123**	0.205**	0.023	-0.005
	(0.57)	(0.74)	(0.87)	(-0.71)	(2.32)	(2.60)	(0.83)	(-0.08)
No. of Obs.	3800	2417	586	797	1324	830	318	176
P values of test for overidentifying	0.116	0.159	0.067	0.762	0.900	0.969	0.063	0.424

Note: (1) the values in parentheses are t-statisitcs.
(2) "*", "**", and "***" refer to statistical significance at 10%, 5% and 1% level.
(3) Move, Mismatch×Move, and the scores of three factors for factor analysis on environment of company and workplace are used as instrument variables.

Table 13. 2SLS Estimates for the effects of network on salary

	JEIU				FLU			
Variable	All	Product	Process	Organization and marketing	All	Product	Process	Organization and marketing
Network	0.253	0.458**	-0.237	-0.017	1.259***	-0.434	1.940***	1.247**
	(1.50)	(2.26)	(-0.58)	(-0.04)	(2.66)	(-0.73)	(2.87)	(2.05)
Sex	-0.849***	-0.639***	-1.596***	-1.103***	-0.877***	-1.079***	-0.914***	-0.572
	(-6.21)	(-3.45)	(-2.70)	(-4.21)	(-2.99)	(-2.99)	(-3.92)	(-0.91)
Service Year	0.255***	0.285***	0.232***	0.210***	0.208***	0.225***	0.185***	0.253***
	(19.97)	(17.09)	(6.32)	(8.60)	(9.21)	(7.83)	(3.99)	(4.93)
$(\text{Service Year})^2$	-0.004***	-0.004***	-0.003**	-0.003***	-0.002***	-0.003***	-0.002	-0.004**
	(-7.91)	(-7.15)	(-2.19)	(-3.42)	(-3.56)	(-2.97)	(-1.35)	(-2.36)
Education	0.560***	0.526***	0.589***	0.446***	0.550***	0.633***	0.589***	0.540***
	(18.88)	(13.04)	(8.70)	(5.65)	(9.15)	(7.50)	(5.48)	(4.82)
Recruitment	0.620***	0.889***	0.611**	0.133	0.830***	0.850***	0.641**	0.938***
	(5.69)	(5.78)	(2.55)	(0.65)	(7.48)	(6.70)	(2.30)	(3.79)
PersonalityAll	0.120***	0.092***	0.206***	0.153***	0.081*	0.219***	-0.042	0.018
	(6.75)	(4.29)	(3.77)	(3.49)	(1.82)	(4.70)	(-0.45)	(0.22)
Manager	1.125***	0.964***	1.238***	1.347***	1.804***	2.007***	1.386***	2.494***
	(9.14)	(6.03)	(3.59)	(5.78)	(10.62)	(9.82)	(4.54)	(5.29)
No. of Obs.	4003	2567	606	830	1436	912	332	192
P values of test for overidentifying	0.026	0.076	0.038	0.041	0.000	0.000	0.247	0.196

Note: (1) the values in parentheses are t-statisitcs.

(2) "*", "**", and "***" refer to statistical significance at 10%, 5% and 1% level.

(3) Move, Mismatch×Move, and the scores of three factors for factor analysis on environment of company and workplace are used as instrument variables.

Appendix Table 1. Descriptive Statistics

Variable	No. of Obs.	Mean	Std. Dev.	Min	Max
Network	5491	3.095	0.862	1.000	4.000
Sex	5566	0.035	0.184	0.000	1.000
Education	5563	3.051	1.011	1.000	5.000
Recruitment	5565	0.107	0.309	0.000	1.000
Service year	5546	13.245	7.661	0.750	44.000
Move	5568	0.483	0.500	0.000	1.000
Mismatch	5555	0.343	0.475	0.000	1.000
PersonalitySolv	5472	0.045	0.939	-2.953	2.267
PersonalityLead	5472	0.043	0.933	-2.522	2.480
PersonalityComm	5472	0.040	0.892	-2.730	2.163
SpeedProm	5503	2.728	0.916	1.000	5.000
OutputPatent	5249	0.004	0.864	-0.215	35.758
OutputReprot	5249	0.007	0.634	-0.376	19.124
Salary	5568	5.665	2.024	1.000	11.000

Appendix Table 2. Correlation Coefficients of Co-variables

		1	2	3	4	5	6	7	8	9	10	11	12	13	14
1	Network	1.000													
2	Sex	-0.069	1.000												
3	Education	0.020	-0.030	1.000											
4	Recruitment	0.044	-0.017	-0.060	1.000										
5	Service year	0.118	-0.071	-0.477	-0.157	1.000									
6	Move	0.128	-0.024	-0.146	0.059	0.262	1.000								
7	Mismatch	-0.048	-0.005	-0.083	0.048	0.011	0.073	1.000							
8	PersonalitySolv	0.119	-0.082	-0.005	-0.055	0.237	0.027	-0.161	1.000						
9	PersonalityLead	0.150	-0.063	-0.063	-0.045	0.284	0.061	-0.163	0.792	1.000					
10	PersonalityComm	0.137	-0.024	-0.038	-0.062	0.186	0.026	-0.153	0.761	0.854	1.000				
11	SpeedProm	0.103	-0.032	0.105	-0.066	-0.119	-0.027	-0.116	0.158	0.188	0.185	1.000			
12	OutputPatent	0.127	-0.004	0.083	-0.009	0.070	0.035	-0.028	0.075	0.091	0.065	0.041	1.000		
13	OutputReprot	0.130	-0.020	0.130	-0.019	0.029	0.014	-0.051	0.103	0.098	0.066	0.058	0.676	1.000	
14	Salary	0.193	-0.158	0.006	-0.010	0.596	0.151	-0.089	0.366	0.385	0.298	0.145	0.129	0.154	1.000