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*Determinants of Employee Salary Growth in Shanghai: An Analysis of Formal Education, On-the-job Training, and Adult Education with a Three-level Model**

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Using survey data from 2,206 employees in Shanghai, China, in 1998, this study estimates the effects of three forms of human capital development on employee salary growth; namely, formal education, on-the-job training provided by employers, and adult education pursued by employees outside their firms. Using a hierarchical linear model, the analysis estimates employee salary growth over a period of five years during the economic transition from 1992 to 1995 due to (a) temporal factors, (b) individual-level characteristics, and (c) firm-level characteristics. This study finds that (a) pre-job formal education is positively associated with salary only at the initial data-collection time, (b) the experience of employees in

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coping with change in the workplace, on-the-job training, and long-term adult education is associated with salary growth; (c) the capacity of firms to cope with the transition had a significant impact on employee salary growth; and (d) the technical proficiency level of employees is not associated with salary growth.

Introduction

Promoting economic growth by improving the quality of the workforce through education has attracted the attention of education policy makers in China. This is because human capital theory suggests that education raises the productivity of workers by imparting useful knowledge and skills, hence raising the workers' future income by increasing their lifetime earnings.[1] Over the past forty years, numerous studies have been conducted in the developed countries on the rates of return to education (RORE); most studies show that formal schooling is crucial in explaining variations of wages.[2] Comparative studies, conducted in some less-developed countries, advocate the expansion of formal education.[3]

Nevertheless, some researchers have noted concomitant issues arising from formal education expansion, which raise doubts about the formal system's effectiveness in meeting the goals of development. It has been cautioned that over-education may result in a loss of production.[4] Others believe that raising the educational level of the population may increase inequalities in income distribution[5] and intensify the mismatch between the supply of more-educated prospective employees and the demand for employees with advanced technical skills.[6] In the case of developing countries, vocational education increases worker productivity only in some instances.[7] Furthermore, there are doubts about the effectiveness of vocational and technical education in preparing youth for destined occupations.[8] Bennell questions the research practice of applying RORE in less developed countries.[9] He notes that RORE models developed in developed countries ignore the fact that many economic activities in the less developed countries are carried out in different economic conditions. In such a case, study results point education policy-making in the wrong direction, paying insufficient attention to local preconditions and experiences.[10]

While formal education has expanded rapidly across countries, a large portion of human capital accumulation in the form of adult education and training for working adults actually takes place both inside and outside the workplace. In the developed countries, adult education development in

recent years has focused on a strengthening of vocational training, especially on-the-job training, to meet the needs for skill development across all occupational strata in the global economy.[11] Studies in some developing countries find that a mix of education and training is available for skill acquisition and there are multiple paths to skill development for a given occupation.[12] A study of firms in Shenzhen shows that both firm-provided on-the-job training (OJT) and adult education and training (AET) paid for by employees offer substantial means to develop job skills.[13] A similar survey was conducted in Shanghai in 1998. It was found that during a period of five years, 60% of the sampled employees received OJT, and 38% attended AET outside of the firm, paying for the courses themselves.[14] Among the 38% who attended AET, 25.6% attended long-term programmes for additional educational qualifications and 12.1% attended short-term job-related training programmes.

Historically, Shanghai has been the industrial and commercial centre of China. In the 1990s, the city underwent a restructuring of its economy in order to speed up growth. A few distinct changes are noteworth. For instance, in addition to the typical state-owned and collective firms, firms with other ownership forms became prominent employers. These included newly emerging economic entities such as joint ventures with firms from Hong Kong, Taiwan, Macau, and foreign countries, and local private firms, corporations, etc. These firms have claimed a larger share of output than the state-owned and collective firms and continue to show higher production efficiency.[15] For instance, in 1997 the newly emerged firms utilized 34% of the labour force in Shanghai, while the state-owned and collective firms utilized 35% and 31% respectively. However, output per worker in the last two types of firms was only about 57% and 39% of that in the former firms. Multiple forms of ownership have created a competitive market, resulting in labour mobility within and between types of firms. The newly emerged firms have been among the first to introduce market economy management practices to cope with changes due to transition. Their products are of a better quality and more varieties. Manufacturing firms in Shanghai have also introduced advanced technology in the auto, electronics, oil-refinery, iron and steel, and power plant equipment industries.[16] A diversified tertiary sector is growing rapidly. New occupations require that employees acquire different knowledge, skills, and attitudes/values.

Confronted by these challenges, there has been a need for firms to rebuild their competitive edge. In addition to expanding formal education,

Shanghai has turned to OJT and AET as alternatives to improve the quality of its workforce. Employers provide OJT in the expectation that it will upgrade the job skills of their employees. Local education and training centres as well as university evening programmes provide short-term training and degree programmes for adults.

Given that education and training for working adults have expanded rapidly, both in terms of variety and level of participation, it is important that they be included in estimations of returns to education. It is interesting to examine in what ways OJT and self-financed AET are contributing to an improvement in job-related skills. Shanghai was chosen as an example of the transformation of China's planned economy to a market-oriented economy. It thus provides a proper setting for studying human capital development during this transition. By employing a three-level hierarchical linear model, this study incorporates both individual and firm-level factors to estimate their impact on employees' salary trajectories over a period of five years from 1992 to 1997. The remainder of this paper is divided into five sections. The next section provides a framework to understand human capital development during economic transition. The third section presents the data sets for analysis. This is followed by a discussion of the three-level analytic method. The fifth section examines the empirical results. Finally, the concluding section discusses policy implications.

A Framework for Human Capital Development During Economic Transition

Becker suggests that education or training raise the productivity of workers by imparting useful knowledge and skills.[17] Other arguments provide different explanations of how education and training are related to worker productivity. One is based on the argument that the higher earnings of educated workers simply reflect their superior ability acquired during the process of education, rather than their skills and knowledge. Spence argues that education is used as a market signal to indicate the potential productivity of workers.[18] Thurow maintains that productivity is characteristic of jobs rather than of workers; employers use education credentials to select workers because more educated workers can be trained for specific jobs more quickly and at a lower cost.[19] Schultz suggests that education enhances an individual's abilities to deal with disequilibria resulting from changing economic conditions. These include the ability to perceive a

given disequilibrium, to analyze information, and to reallocate resources.[20] However, Knox notes that over the adult life span discrepancies in proficiency may occur.[21] Proficiency is defined as "the capability to perform satisfactorily if given the opportunity"; this performance involves some combination of knowledge, skills, and attitudes (KSA).[22]

Another school argues that production conditions are complementary to the utilization of human capital. Recently, Hall and Jones noted that differences in capital accumulation and output per worker are fundamentally related to differences in social infrastructure across countries.[23] This includes differences in the institutions and government policies that determine the economic environment within which individuals accumulate skills and firms accumulate capital and produce output. Their analysis of data covering 127 countries supports this argument. Levin argues that the organization of production, such as the extent of discretion, participation in decision-making, responsibility sharing, and information available to employees, affects employees' utilization of their ability to act in work.[24] Levin and Kelley suggest that education can improve productivity only if complementary inputs exist, which include training, contract terms, and management practices;[25] they point out that economists have overestimated the payoffs resulting from increased education while they have ignored the complementary inputs and production conditions. Tsang found that a mismatch of worker characteristics, such as over-education, caused dissatisfaction among workers and this was associated with a loss of over 8% in the US$57 billion output of the dominant player in the US telecommunications industry, AT&T, in 1981.[26] Xiao also found that management has promoted the transfer of training in the workplace in Shenzhen, China.[27]

In a study of the large demand for learning in the workplace in Shenzhen, Xiao argues that economic reform, an open market, and new technologies have resulted in qualitative changes in the workplace.[28] The organization of production, management practices, and physical capital that formerly worked well in the planned economy have now become obsolete. The critical point is that quality changes create discrepancies between the firms' new status quo of operation and the employees' current competency level, and between the employees' current competency level and the expected competency for operating in the changing workplace. It is obvious that it is impossible to rely only on pre-work education to deal with the discrepancies in proficiency that occurs in an adult's working life. OJT and AET have thus become alternative ways to upgrade the KSA of the workforce.

The competitiveness of a firm, especially in a market economy, depends on its stock of physical and human capital as well as on the uniqueness of its management practices that can bring the firm's capacity into full play. Each firm has a unique organizational culture[29] and firm-contextual activities require a specific KSA. Rational firms provide specific OJT to build up their human capital to match their physical capital, thus raising their marginal productivity. OJT, while upgrading the KSA of employees, also develops shared values and ways of working together to strengthen the firm's unique competitiveness in the market economy. Therefore, in-firm training, as opposed to general education, can compensate for the peculiarities of the internal market and the increasingly complex technological demands of the workplace. By upgrading firm-specific human capital, the competency of employees is re-established.

Unprecedentedly, individual employees are now able to change their jobs if they find better opportunities to realize their personal potential or they may be dismissed if their job performance is not up to an expected level over time. They are cognizant of the increased discrepany between changes in the firm and their KSA. They thus engage in learning, either to remain competent in their current jobs or to change to new jobs. When firm-provided training does not fulfil the employees' personal expectations, AET outside their firms becomes an option. AET, therefore, meets the specific needs of individuals and assists them in adapting to the increasingly complex technology and social demands. By participating in AET, employees can close the gap between their competency level and their expectations.

Employers and employees look to OJT and AET and disengage themselves from obsolete KSA in order to regain job competency. It is argued that in economic transition, OJT and AET are means of readjusting to changes and of maintaining competency in production; both firms and employees are involved in an equilibrating process to maintain competitiveness.

Instead of focusing on the end-results of earnings in relation to education, this study attempts to examine the process of how types of education and training are associated with skill development and productivity in a firm context. The task of measuring changes in productivity or earnings then is thus complicated, as education and training for working adults take place in more heterogeneous forms during one's working life. In addition, employees nested in a given firm act according to the distinct conditions of production.

The Mincerian method has been commonly used to estimate RORE with regard to formal education in the earning function equation.[30] However, focusing on the end-result of earnings does not make allowances for the endogeneity of training decisions in a workplace setting, changes in earnings, as well as the partitioning of individual and organizational impacts. An estimation of human capital effects is in fact complicated by the existence of different types of human capital.[31] By using a three-level hierarchical linear growth model, this study incorporates changes in salary over time, as well as individual and firm-level factors to estimate their impact on salary growth. The three-level hierarchical linear growth model retains equations and data sets at three levels of analysis; namely, within-individual growth, the individual level and the firm level. In order to facilitate the discussion, I will present the data sets prior to discussing the methodology.

The Survey and Data Sets

Data used for the analysis are from a reverse tracer study conducted in Shanghai in early 1998. The reverse tracer study begins with their current job positions; it then seeks to identify each major alternative education and training route pursued by employees to reach their current destinations over the previous years. Two questionnaires were distributed to collect the data. The employee questionnaire consisted of four groups of questions: (a) the employee's formal education; (b) OJT provided by firms or line ministry bureaucracies; (c) AET courses that employees attended outside of the firm; and (d) demographic information, job position, technical proficiency level, and salary. The employee questionnaire was designed to allow respondents to recall their experience over a period of five years. The survey was conducted in January 1998, and information on OJT and AET was obtained for the five-year period from 1992 to 1997. The firm questionnaire collected information on sector, size, ownership, sales, investment in training, productivity, etc.

A stratified random sampling[32] was used to select 61 firms to participate. In each firm, one to two intact work groups/production lines on the floor were sampled to obtain a vertical sample, which consisted of all the personnel at a work site. This sampling method permits one examine the personnel structure of the firms. Altogether, 8,700 employees were sampled, about 0.12% of the workforce in the manufacturing and service sectors.[33] Out of the 8,700 employees surveyed, 6,320 returned the

questionnaires, corresponding to a 73% response rate. Those who did not respond were those who did not bring the questionnaire to the firm on the collection day and those who did not complete it. Among the returned questionnaires, the collective firms were under-represented. Weights were then applied to the sample in order to arrive at a representative sample of the workforce. For the analysis of the three-level model, 2,606 individual cases were used, after deleting cases that contained missing values in any of the variables, with an average of 50 cases in each firm. One firm was dropped from the analysis because there were fewer than 12 employees.

In the following, the variables at each level are associated with the theoretical arguments discussed in the previous section. Hypotheses are proposed to facilitate the building up of a three-level model and to later test the empirical results. Descriptions of the temporal variables that reflect employee change over time are presented in Table 1. Descriptions of individual and firm-level variables are presented in Table 2 and Table 3, respectively.

Level 1 within Individual Temporal Variables

OBSERVATIONS is the number of years that elapsed from the beginning of 1992 to the year when data were retrospectively collected for salary and the job's technical proficiency level. The initial data-point time, the beginning of 1992, is coded as 0, the second time point, the end of 1995, is coded as 3, and the third time point, the end of 1997, is coded as 5.

SALARY refers to the log monthly salary in 1997 prices in the analysis. SALARY information was collected for the same time points as OBSERVATIONS and adjusted to inflation with 1997 prices. Salary in Shanghai very much reflects the traditional salary scheme in the Chinese payroll system, especially in the state-owned and collective firms. It is a lump sum, and not associated with one's performance, unlike that in Shenzhen, which has reformed its salary system.[34]

Shanghai is in the process of transforming into a market economy. Due to the rapid increase in the cost of living, many firms give "bonuses" to their employees, primarily in proportion to salary in order to offset inflation. The bonuses do not reflect the employees' work efforts. The government does not approve of such practices, and therefore, the bonuses are referred as "grey income." In this study, firms did not make public the amount of "grey income." Therefore, salary data in the analysis does not include "grey income."[35]

Table 1. Descriptions of Level 1 Variables

Variable	Definition	Mean	Std Dev	Min.	Max.	N
OBSERVATIONS: Years elapsed between observation time points						
	beginning of 1992	0.00	0.00	0.00	0.00	2606
	end of 1995	3.00	0.00	3.00	3.00	2606
	end of 1997	5.00	0.00	5.00	5.00	2606
SALARY: Salary observations in 1997 prices (RMB)						
	beginning of 1992	1015.18	528.69	100.00	3002.67	2606
	end of 1995	1063.93	474.50	131.40	3180.45	2606
	end of 1997	1078.72	466.93	152.58	3200.00	2606
RANK: Technical rank in position						
	beginning of 1992	0.00	0.00	0.00	0.00	2606
	end of 1995	0.15	0.36	0.00	1.00	2606
	end of 1997	0.42	0.82	0.00	2.00	2606

RANK refers to advancement in an employee's proficiency ranking in the job position from a previous observation time point. It is used as a reference for salary decisions. RANK at the initial observation is coded as 0; RANK at the second time point is the change in ranking between the first and second observations; and at the third time point it is the change in ranking between the first and third observations. One advancement in proficiency ranking is coded as 1 and two as 2. If there is no change in proficiency ranking, RANK is coded as 0. Note that a performance assessment is not formally conducted in firms in Shanghai. Decisions about one's advancement are largely up to the discretion of cadre managers and can be influenced by non-technical factors. It is hypothesized that over time an individual's salary will increase and proficiency will improve.

Individual Variables as Level 2 Models Predictors

SEX is a dummy. A male employee is coded as 1 and a female is coded as 0. An gendered pattern of job mobility is observed in Shanghai.[36] Gender is expected to be associated with salary growth. *AGE* is measured in years and coded into four groups for analysis purposes. *MARITAL* reveals whether or not an employee is married. A "one family-two system" strategy has been observed in Shanghai;[37] I also note such a practice in certain types of training received,[38] thus it is expected that marital status will have an effect on salary. Work experience in years is a proxy for learning-by-

doing in the Mincerian method. It is included in this study and is coded as a dummy variable *WEXP*. Those who had work experience prior to 1992 are coded as 1; those who joined their firm in 1992 and later are coded as 0.

CHANGE refers to a major technological change experienced by an employee over the five years. In the study, about 55.8% of the sampled employees experienced changes, which occurred due to: (a) the production of new products or the provision of new services; (b) the use of advanced production technology; (c) the reorganization of production and reform; and (d) a change to a new position within the firm. These changes occurred because of the firms' efforts to upgrade their physical capital, and to reorient production in order to improve competitiveness in the market. Change is coded as 0 if a person did not experience any change, 1 if he/she experienced change once, 2 if he/she experienced two to four changes, and 3 if he/she experienced five or more changes. Technological changes are qualitative changes that involve substantial learning. It is hypothesized that employers value such occasions and relate them to salary increases.

ED_YEAR is coded as the actual numbers of years of education that an employee received. Formal education is also put into seven dummy variables to test the effects of the Chinese government's education reform. Three types of vocational and technical education curricula, in technical workers' schools, vocational/technical schools, and specialized secondary schools, have expanded rapidly since the mid-1980s. This aims to facilitate the nationwide restructuring of upper-secondary schools from a mono-academic general study curriculum to a mix of at least 50% or more of vocational and technical studies.[39] It is assumed that such schools provide young people with skills for prospective jobs. This study tests the economic assumption that vocational and technical education is related to one's proficiency and that employers value technically capable personnel in salary decisions.

TRAINING refers to OJT received by employees. Firms provide up to 8 types of training.[40] In the analysis, TRAINING is coded as the actual amount of training that an employee received during the last five years.

AET_SHORT, a dummy variable refers to short-term job-related AET programmes that an employee attended. Such training may last for a few days of concentrated study or for two weeks to three months, with two to three events every week. Employees attend AET programmes outside their firms at nearby adult education centres. At the completion of such training adult learners may or may not be awarded a certificate.

Table 2. Descriptions of Level 2 Variables (N = 2,606)

Variable	Definition	Coding	%
SEX	Sex		
	female	0	41.8
	male	1	58.2
AGE	Age group		
	16–25	0	2.8
	26–35	1	31.8
	36–45	2	45.2
	46 and above	3	20.2
MARITAL	Marital status		
	no	0	10.3
	yes	1	89.7
WKEXP	Had work experience before the current job		
	no	0	5.1
	yes	1	94.9
CHANGE	Extent of technical changes experienced in the job		
	none	0	44.2
	once	1	24.2
	2 to 4 times	2	22
	5 times or more	3	9.6
ED_YEAR	Educational attainment in years		
	6 years or less	6	0.9
	9 years	9	34.9
	12 years	12	39.6
	13 years	13	12.4
	14 years	14	5.6
	16 years	16	6.7
Education	Education by type (dummy)		
ED_LSGE	lower secondary and less	1, 0	35.8
ED_USGE (reference)	upper secondary general education	1, 0	24.4
ED_TWS	technical worker school	1, 0	12.2
ED_VTE	vocational/technical education	1, 0	2.9
ED_SSS	specialized secondary school	1, 0	12.4
ED_JC	junior college	1, 0	5.6
ED_UN	university or more	1, 0	6.7
TRAINING	Amount of on-the-job training		
	none	0	31.7
	once	1	28.8
	twice	2	17.7
	three times	3	11.7
	four times	4	5.9
	five times	5	2.5
	six times	6	1.2
	seven times	7	0.4
AET programmes	Adult education and training (dummy)		
AET_SHORT (reference)	yes	1, 0	11.3
AET_LONG	yes	1, 0	32.2

AET_LONG, coded as a dummy, refers to long-term AET programmes. At the completion of such programmes one earns a diploma at the secondary education level or a degree at the post-secondary level. The period of study usually lasts for about two to three years. Employees attend these programmes three to four times a week in the evenings or over the weekends at an AET centres or at a university/college. In total, 43.5% of the sampled employees took part in AET programmes. In the analysis, AET_SHORT is a reference group. It is argued that OJT and AET are adopted as strategies to upgrade employee KSA, thus building up competence. It is hypothesized that OJT and AET improve one's proficiency and relate positively to firms' salary decisions.

Firm-level Variables for Level 3 Models [41]

SECTOR is a dummy variable, with 0 for those in manufacturing and 1 for those in the service sector. *SIZE* refers to firm size, which is coded in an ordinal manner. In Shenzhen, firm size has been found to be associated with the firm's capacity to provide OJT.[42] In Japan it was associated with firm's capacity to invest in physical capital,[43] with small firms being less able to do so. Firm size is included to test the firm's capabilities during transition. *LVTRNFEE* refers to the average annual expenses on OJT per employee in 1995, 1996, and 1997. About 26.2% of the firms surveyed did not spend any money on OJT. RMB 50 is used as a discretionary grouping to code firms into ordinal groups. Whether or not employees receive OJT reflects the impact of the firm's human resource strategies at the individual level; this variable reveals information about the firm's efforts and capacity to build up their competitiveness during transition.

Ownership includes six types. State-owned firms and collective firms are conventional firms in a planned economy. Co-operatives are firms that collaborate on certain projects using part of the mother-company's resources. These firms may be dissolved when the project is completed or if it does not make any profits. Or they may later become permanent entities if business is successful and stable. Corporate firms are newly emerged public firms that have shares on the stock market or among certain stakeholders. The study also distinguishes between firms with investment from foreign countries and firms with investment from Hong Kong, Macau, and Taiwan. Both types of firm include joint ventures and sole proprietorships. These two types of firm have brought market economy-oriented ideas and practices to Shanghai's newly opened market.

They are more competitive during the transition. In the analysis, they are used as the reference group.

LVOFFJOB refers to the proportion of employees who become

Table 3. Descriptions of Level 3 Variables (60 firms)

Variable	Definition	Code	Percentage
SECTOR	Economic sector		
	manufacturing	0	82.0
	service	1	18.0
SIZE	Size of firm		
	fewer than 300 employees	0	9.8
	301 to 800 employees	1	14.8
	over 800 employees	2	75.4
LVTRNFEE	Per employee training expense (in 1997 RMB prices)		
	none	0	26.2
	1–49	1	9.8
	50–99	2	13.1
	100–149	3	18.0
	150–199	4	14.8
	200–249	5	6.6
	250 and more	6	11.5
Ownership	Types of ownership of firms (dummy)		
OWN-COOP	co-operatives	1, 0	1.6
OWN_CLCT (reference)	collective	1, 0	14.8
OWN_CORP	corporate	1, 0	14.8
OWN_FGJN	foreign	1, 0	14.8
OWN_HKJT	Hong Kong, Macau, and Taiwan	1, 0	3.3
OWN-STAT	state-owned	1, 0	50.3
LVOFFJOB	Number of employees off-job		
	no off-job employees	0	39.3
	up to 5% of total employees	1	30.6
	up to 10% of total employees	2	6.5
	up to 15% of total employees	3	9.9
	more than 16% of total employees	4	4.9
LVPRFS	Number of professionals in total employees		
	no professionals	0	10.5
	1–5% of total employees	1	56.2
	up to 10% of total employees	2	17.3
	up to 15% of total employees	3	8.8
	more than 16% of total employees	4	7.0

off-job-employees (*xiagang gongren*), those who are not given job tasks because they are incompetent and/or surplus.[44] It is coded in an ordinal manner, with the amount of every additional 5% as an arbitrary grouping. This variable is an indicator of a firm's well-being during the economic transition. *LVPRFS* refers to the proportion of professionals in the firm. It is postulated that hiring more well-trained professionals will increase productivity,[45] and hypothesized that hiring more professionals is a human resource strategy associated with the competitiveness of the firm. LVPRFS is coded in the same way as LVOFFJOB.

Measuring Salary Growth with a Three-level Model

The data sets present a portrait of the structural context of firms. For instance, hiring and salary growth are decisions made by the firms, affected by firm characteristics, as well as by individual characteristics such as those brought to the firm (e.g., formal schooling) or characteristics developed while working (e.g., acquiring skills through OJT). As an employee is nested in a firm, the firm characteristics, inputs and strategies, which define the resources and context, will either limit or promote his/her potential. An aggregation bias can occur when the analysis focuses on the end-results and does not allow for partitioning effects due to factors nested at different structural level in a firm.

Recent advances in statistics with reference to hierarchical linear models (HLM) offer an integrated approach for studying determinants of growth in an organized structure.[46] They facilitate a decomposition of any observed relationship between variables into different level components. HLM incorporates a unique random effect for each organization unit and the variability in these random effects is taken into account to estimate standard errors. HLM also resolves the problem of heterogeneity by estimating a separate set of regression coefficients for each organization unit and then modelling variations among units in their sets of coefficients. The other advantage of HLM is that it accommodates multiple time-point observations of an individual over time. This study of determinants of salary growth employs an analysis at three levels: (a) salary observations at three time points over time, (b) employee factors, and (c) firm factors.

At Level 1 (L1), the within-individual level, such variables as employee salary growth within a span of a maximum of five years at three observations and gains in an individual's technical proficiency level at

corresponding observation points are examined. It is assumed that Y_{tij}, the observed log salary at time *t* for employee *i*, is a function of a systematic growth curve plus random error. The L1 Model is:

$$Y_{tij} = \pi_{0ij} + \pi_{1ij}\,(\text{OBSERVATION})_{tij} + \pi_{2ij}\,(\text{RANK}) + e_{tij} \qquad (1)$$

where

Y_{tij} is the outcome variable of the log monthly salary at time *t* for employee *i* nested in firm *j*;

$(\text{OBSERVATIONS})_{tij}$ is the observation occasion at time *t* (t =1, 2, 3); it is 0 at the beginning of 1992, 3 at the end of 1995, and 5 at the end of 1997;

$(\text{RANK})_{tij}$ refers to gains in employees' technical proficiency level due to improved job performance from the previous observation time-point;

π_{0ij} is the initial salary for employee *ij*, that is, the expected salary at the beginning of 1992 when OBSERVATIONS is coded as 0;

π_{1ij} is the average annual salary growth rate for employee *ij* during the five-year period;

π_{2ij} is the parameter of a gain in the employee's technical proficiency associated with salary growth during the period of five years;

e_{tij} is the error, which is independent, with a mean of zero and normally distributed with a common variance s^2.

Equation 1 is the assumption that the growth parameters vary across employees over time. At Level 2 (L2), the parameters of L1 become outcome variables. The L2 model represents the growth variation due to individual factors as:

$$\pi_{pij} = \beta_{p0j} + \sum_{q=1}^{Qp} \beta_{pqj}\, X_{qij} + r_{pij} \qquad (2)$$

β_{p0j} is the intercept term for firm *j* in modelling the employee effect π_{pij};

X_{qij} is a measured characteristic of the individual employee *i* in firm *j* (see Table 2).

β_{pqj} represents the effect of X_{qij} on the *p*th growth parameter; and

r_{pij} is a random effect with a mean of zero. The set of $P + 1$ random effects for employee *i* are assumed multivariate normally distributed with full covariance matrix, T, dimensioned $(P + 1) \times (P + 1)$.

At Level 3 (L3), each L2 parameter (i.e., each β_{pqj} coefficient) becomes an outcome variable and may be predicted by some firm-level characteristics as,

$$\beta_{pqj} = \gamma_{pq0} + \sum_{s=1}^{S_{pq}} \gamma_{pqs} W_{sj} + u_{pqj} \quad (3)$$

where

γ_{pq0} is the intercept term in the firm-level model for β_{pqj};

W_{sj} is a firm characteristic used as a predictor for the firm effect on β_{pqj} (note that each β_{pqj} may have a unique set of the L3 predictor, W_{sj}, s = 1, …, S_{pq});

γ_{pqs} is the corresponding L3 coefficient that represents the direction and strength of association between firm characteristic W_{sj} and β_{pqj}; and

u_{pqj} is a L3 random effect that represents the deviation of firm j's coefficient, β_{pqj}, from its predicted value based on a firm-level model.

Note that for each firm there are $\Sigma^{P}_{p=0}(Q_p + 1)$ equations in the L3 model. The residuals from these equations are assumed multivariate normally distributed. Each is assumed to have a mean of zero, some variance, and covariance among all pairs of elements.

Empirical Results

The results are presented in three groups. First, analysis of salary growth over time as an unconditional model is conducted, in which the variance is left random in the L2 model and L3 model. Thereafter follows an explanatory model that allows for an estimation of the separate effects of employee characteristic variables on employee initial salary, the annual salary growth rate, and the technical rank of the position. Finally, the L3 model estimates the explanatory effects of the firm characteristic variables on individual variables, thus defining salary growth over years, and on the technical rank in the firm context.

Unconditional Model

Employees mature in performance and their salaries tend to increase over time. The L1 model (see Equation 1) estimates salary growth of an employee over time. There are no predictions in the L2 and L3 models on salary growth. This unconditional model provides empirical evidence to determine a proper specification of the individual growth equation and baseline statistics to later evaluate the effects of subsequent L2 and L3 models.[47] The unconditional models can partition variability in the individual growth parameters into L2 and L3 components:

Level 2 Model,

$$\pi_{0ij} = \beta_{00j} + r_{0ij} \quad (2.0a)$$

$$\pi_{1ij} = \beta_{10j} + r_{1ij} \quad (2.1a)$$

$$\pi_{2ij} = \beta_{20j} \quad (2.2a)$$

and the Level 3 Model,

$$\beta_{00j} = \gamma_{000} + u_{00j} \quad (3.00a)$$

$$\beta_{10j} = \gamma_{100} + u_{10j} \quad (3.10a)$$

$$\beta_{20j} = \gamma_{200} + u_{20j} \quad (3.40a)$$

where L1 coefficients, π_{pij}, become the outcome variables in the L2 Model, and L2 coefficients, β_{pqj}, become the outcome variables in the L3 Model. β_{00j} is the mean salary within firm *j* at the initial observation time, while γ_{000} is the grand mean salary of 2,606 employees in 60 firms at the initial observation time. β_{10j} is the mean annual growth rate of salary within firm *j*, while γ_{100} is the grand mean growth rate for all employees; and β_{20j} is the mean rate of advancement in technical proficiency ranking within firm *j*, while γ_{200} is the grand mean rate of advancement in technical ranking of 2,606 employees over five years.

Because there are only three occasions for these temporal variables, variance at the individual level can only allow *t*-1 random variance for freedom in calculation; in this case, only two L2 random effects, r_{0ij} and r_{1ij} with variances $\tau_{\pi 00j}$ and $\tau_{\pi 11j}$, respectively, and with a covariance of $\tau_{\pi 01j}$. Level 2 random effects represent the deviation of employee *ij*'s coefficients (π_{pij}) from their predicted value based on the individual level model. In the L3 model, there are three random effects, u_{00j}, u_{10j}, and u_{20j}, which represent the deviation of firm *j*'s coefficients (β_{pqj}) from the grand means γ_{pqs}. These random effects are normally distributed with a mean of 0 and variance τ_{β}.

Table 4 presents both the fixed and random effects of salary growth. The fixed effects, as presented in the top panel, indicate a strong positive salary growth trajectory. The estimated salary parameter (γ_{000} = 6.821747) represents the true average salary of employees at the first time-point of observation (thereafter mean salary), about RMB 917.59. It is significantly different from that at the second and third observation times. For five sequential years, the annual salary growth appears to exhibit a positive growth trend. The coefficient (γ_{100}) predicts an annual growth of 3%

over a five-year period. In contrast, the estimation (γ_{200}) shows that an advance in one's technical proficiency ranking has no effect on salary. This indicates that the salary system in Shanghai firms does not relate an employee's technical performance to pay. This is not surprising, because I noted in field trips to firms that salary decisions were not based on performance assessment. Determinants of salary growth can be largely based on the discretional decisions of leaders as was the case in the planned economy. But this is not the case in Shenzhen.[48]

Table 4. Unconditional Model of Salary Growth

The outcome variable: Log monthly salary in 1997 RMB prices

Fixed Effect	Standard Coefficient	Error	Approx. T-ratio	d.f.	P-value
For average initial salary INTRCPT1 π_{0ij}					
For INTRCPT2 β_{00j}					
INTRCPT3, γ_{000}	6.821747	0.029328	232.603	59	0.000
For Average salary growth rate INTRCPT1 π_{1ij}					
For INTRCPT2, β_{10j}					
INTRCPT3, γ_{100}	0.030251	0.005642	5.362	59	0.000
For RANK slope INTRCEPT1 π_{2ij}					
For INTRCPT2 β_{20j}					
INTRCPT3, γ_{200}	0.000259	0.007405	0.035	59	0.972

Random Effect	Variance Component	df	Chi-square	P-value
Level 1				
Temporal variation, e_{tij}	0.03613			
Level 2 (employee within firm)				
Ind. initial salary, r_{0ij}	0.19201	2546	9299.16480	0.000
Ind. Salary growth rate, r_{1ij}	0.00519	2546	5410.75927	0.000
Level 3 (between firm)				
Firm mean initial salary, u_{00j}	0.04292	55	575.34258	0.000
Firm mean salary growth rate, u_{10j}	0.00157	55	462.21277	0.000
Firm RANK rate, u_{20j}	0.00065	55	74.66002	0.040

Reliability estimate

Random L1 coefficient	Reliability estimate	Random L2 coefficient	Reliability estimate
INTRCPT1, π_0	0.816	INTRCPT1/INTRCPT2, β_{00}	0.849
OBSV, π_1	0.601	OBSV/INTRCPT2, β_{10}	0.838
		RANK/INTRCPT2, β_{20}	0.201

Estimates of the random effects appear in the middle panel of Table 4, which separate the variance into the temporal (within-individual over time), and then the employee initial salary and the mean growth rate into within-firm and between-firm components. The χ^2 statistics accompanying these variances indicate that there is not much variation in RANK left to explain. However, there is significant variation within firms (i.e., r_{0ij}, and r_{1ij}) and between firms (i.e., u_{00j}, and u_{10j}) in the initial salary as well as annual growth among employees within firms (i.e., π_{0ij}, and π_{1ij}) and between firms (i.e., β_{00j}, and β_{10j}). Analysis at L2 should proceed to explain these variances.

With multi-wave data, the correlation of the true initial status and true change can be obtained with more consistency than with a simple two points comparison.[49] For the salary data, the estimated correlation between initial salary status and the true annual growth rate was –0.842.[50] Employees whose initial salary was lower at the first observation tend to have a much steeper growth slope over the next four years than those whose initial salaries was higher. These results suggest a true negative relation, which tends to equalize salary in the long run, and models the egalitarian compensation practices in the planned economy, considering that technical ranking is not related to salary growth.

Table 4 shows that the reliability of the initial salary intercept is 0.816, based on an average of 50 employees in each firm, and 0.601 for the annual salary increase slope, based on the three temporal observations. Though there are only three observations, the annual salary slope appears fairly reliable. The reliability of the initial salary intercept (i.e., 0.849) and the annual increase rate intercept (i.e., 0.838) at the firm level are also very reliable; but the reliability of the job position technical ranking (i.e., 0.201) is very low due to the fact that RANK did not vary much from person to person and or vary from firm to firm.[51]

Conditional L2 Model with Individual Characteristics as Predictors

Now, the L1 model being the same as in Equation 1, the parameters in the L1 model become outcome variables in the L2 Model, and their variability will be predicted by the employee characteristic variables. The specific L2. b1 model is:

$$\begin{aligned}\pi_{0ij} = {} & \beta_{00j} + \beta_{01j}\,(\text{SEX})_{ij} + \beta_{02j}\,(\text{AGE})_{ij} + \beta_{03j}\,(\text{MARITAL})_{ij} + \\ & \beta_{04j}\,(\text{ED\_LSGEP})_{ij} + \beta_{05j}\,(\text{ED-TWS})_{ij} + \beta_{06j}\,(\text{ED-VTS})_{ij} + \\ & \beta_{07j}\,(\text{ED-SSS})_{ij} + \beta_{08j}\,(\text{ED-JC})_{ij} + \beta_{09j}\,(\text{ED-UN})_{ij} + r_{0ij} \quad (2.0\text{b}1)\end{aligned}$$

$$\pi_{1ij} = \beta_{10j} + \beta_{11j}\,(\text{SEX})_{ij} + \beta_{12j}\,(\text{AGE})_{ij} + \beta_{13j}\,(\text{MARITAL})_{ij} + \beta_{14j}\,(\text{ED\_LSGEP})_{ij} + \beta_{15j}\,(\text{ED-TWS})_{ij} + \beta_{16j}\,(\text{ED-VTS})_{ij} + \beta_{17j}\,(\text{ED-SSS})_{ij} + \beta_{18j}\,(\text{ED-JC})_{ij} + \beta_{19j}\,(\text{ED-UN})_{ij} + r_{1ij} \quad (2.1b1)$$

$$\pi_{2ij} = \beta_{20\,j} \quad (2.2b1).$$

As discussed in the data section, the economic assumption about vocational and technical education in preparing the skilled workforce has resulted in a nationwide secondary education restructuring since 1985, having streamed 50 to 60% of the enrollment in vocational/technical education studies. The analysis at L2 pays attention to types of education.

It is hypothesized that type of education is associated with initial salary (π_{0ij}) and with salary growth (π_{1ij}) because employers appreciate skills cultivated by certain types of formal education. Employees with upper secondary general education are set as a reference group. As the coefficient of RANK does not show any association with SALARY growth, there is no hypothesis about it. Here, the L3 model remains unpredicted.

Table 5 presents the empirical results. Compared with upper secondary general education, no types of secondary education show an advantage or a disadvantage in terms of SALARY at the initial data-collection point. Nor do the coefficients of types of education indicate any difference in salary growth, except for employees with four years of university education or more. The coefficient (γ_{190}) indicates a predicted annual increment slope of 2.1% for university graduates. These results show that types of education at secondary level do not have an effect on decisions, at hiring or salary growth over time. These findings are consistent with those generated from a similar analysis of employees in Shenzhen.[52] I conclude that, though expected by policy makers in China, employers in Shanghai do not favour KSA obtained through secondary vocational and technical education over that obtained through general education.

Final L2 Model and the Conditional L3 Model with Firm Characteristics as Predictors

As the type of secondary education did not show any impact on SALARY, another L2 model was set up to test the effects of education in years, technical change, on-the-job training, work experience, and adult education on salary growth. The L1 model remains the same as in Equation 1, the L2.b2 model is specified as:

Table 5. Effects of Individual Characteristics on Salary Growth

The outcome variable: Log monthly salary in 1997 RMB prices					
Fixed Effect	Coefficient	Standard Error	T-ratio	Approx. d.f.	P-value
Model for average initial salary, π_{0ij}					
Mean individual initial salary, β_{00j}					
INTRCEPT, γ_{000}	6.467126	0.047840	135.182	59	0.000
SEX, β_{01j}					
INTRCEPT, γ_{010}	0.064906	0.019671	3.300	2596	0.001
AGE, β_{02j}					
INTRCEPT, γ_{020}	0.161494	0.013933	11.591	2596	0.000
MARITAL, β_{03j}					
INTRCEPT, γ_{030}	0.037379	0.031301	1.194	2596	0.233
ED_LSGEP, β_{04j}					
INTRCEPT, γ_{040}	–0.046435	0.025159	–1.846	2596	0.064
ED_TWS, β_{05j}					
INTRCEPT, γ_{050}	–0.022507	0.031083	–0.724	2596	0.469
ED_VTS, β_{06j}					
INTRCEPT, γ_{060}	–0.018850	0.062015	–0.304	2596	0.761
ED_SSS, β_{07j}					
INTRCEPT, γ_{070}	0.028685	0.034130	0.840	2596	0.401
ED_JC, β_{08j}					
INTRCEPT, γ_{080}	0.024089	0.043197	0.558	2596	0.577
ED_UN, β_{09j}					
INTRCEPT, γ_{090}	0.061812	0.042259	1.463	2596	0.143
Model for average salary growth rate, π_{1ij}					
Average initial salary growth rate, β_{10j}					
INTRCEPT, γ_{100}	0.066574	0.009038	7.366	59	0.000
SEX, β_{11j}					
INTRCEPT, γ_{110}	0.000718	0.003841	0.187	2596	0.852
AGE, β_{12j}					
INTRCEPT, γ_{120}	–0.018324	0.002722	–6.732	2596	0.000
MARITAL, β_{13j}					
INTRCEPT, γ_{130}	–0.008201	0.006157	–1.332	2596	0.183
ED_LSGEP, β_{14j}					
INTRCEPT, γ_{140}	0.003484	0.004909	0.710	2596	0.478
ED_TWS, β_{15j}					
INTRCEPT, γ_{150}	0.000939	0.006197	0.152	2596	0.880
ED_VTS, β_{16j}					
INTRCEPT, γ_{160}	–0.005083	0.011988	–0.424	2596	0.671
ED_SSS, β_{17j}					
INTRCEPT, γ_{170}	0.001450	0.006605	0.220	2596	0.826
ED_JC, β_{18j}					
INTRCEPT, γ_{180}	0.008325	0.008454	0.985	2596	0.325
ED_UN, β_{19j}					
INTRCEPT, γ_{190}	0.021308	0.008234	2.588	2596	0.010
Model for average RANK rate, π_{2ij}					
Average RANK rate, β_{20j}					
INTRCEPT, γ_{200}	–0.002837	0.007123	–0.398	59	0.692

$$\pi_{0ij} = \beta_{00j} + \beta_{01j}\,(\text{SEX})_{ij} + \beta_{02j}\,(\text{AGE})_{ij} + \beta_{03j}\,(\text{MARITAL})_{ij} + \beta_{04j}\,(\text{ED\_YEAR})_{ij} + \beta_{05j}\,(\text{WKEXP})_{ij} + r_{0ij} \quad (2.0b2)$$

$$\pi_{1ij} = \beta_{10\,j} + \beta_{11j}\,(\text{SEX})_{ij} + \beta_{12j}\,(\text{AGE})_{ij} + \beta_{13j}\,(\text{MARITAL})_{ij} + \beta_{14j}\,(\text{ED-YEAR})_{ij} + \beta_{15j}\,(\text{CHANGE})_{ij} + \beta_{16j}\,(\text{TRAINING})_{ij} + \beta_{17j}\,(\text{WKEXP})_{ij} + \beta_{18j}\,(\text{AE\_LONG})_{ij} + r_{1ij} \quad (2.1b2)$$

$$\pi_{2ij} = \beta_{20\,j} \quad (2.2b2).$$

In addition, firm variables are used to predict six L2 parameters and to test the hypotheses as discussed in the data section:[53]

$$\beta_{00j} = \gamma_{000} + \gamma_{001}\,(\text{LVOFFJOB})_j + u_{00\,j} \quad (3.00c)$$

$$\beta_{04\,j} = \gamma_{040} + \gamma_{041}\,(\text{LVPRFS})_j + \gamma_{042}(\text{OWN\_COOP})_j + \gamma_{043}\,(\text{OWN\_CORP})_j + \gamma_{044}\,(\text{OWN\_FGJN})_j + \gamma_{045}\,(\text{OWN\_HKJT})_j + \gamma_{046}\,(\text{OWN\_STAT})_j \quad (3.04c)$$

$$\beta_{10j} = \gamma_{100} + \gamma_{101}(\text{OWN\_COOP})_j + \gamma_{102}(\text{OWN\_CORP})_j + \gamma_{103}\,(\text{OWN\_FGJN})_j + \gamma_{104}\,(\text{OWN\_HKJT})_j + \gamma_{105}\,(\text{OWN\_STAT})_j + \gamma_{106}\,(\text{LVTRNFEE})_j + u_{10\,j} \quad (3.10c)$$

$$\beta_{15j} = \gamma_{150} + \gamma_{151}\,(\text{SECTOR})_j + \gamma_{152}\,(\text{SIZE})_j \quad (3.15c)$$

$$\beta_{16\,j} = \gamma_{160} + \gamma_{161}\,(\text{SECTOR})_j + \gamma_{162}\,(\text{SIZE})_j \quad (3.16c)$$

$$\beta_{16\,j} = \gamma_{180} + \gamma_{181}\,(\text{SECTOR})_j + \gamma_{182}\,(\text{SIZE})_j \quad (3.18c)$$

Table 6 presents estimates for testing the hypotheses on the final L2 model and L3 model as specified in the discussion on measurements in the data section. Let us look at the fixed effects of both the L2 predictors and L3 predictors on the L2 parameters. The salary coefficient remains positive and significant, but the magnitude is reduced with L2 and L3 predictors in the model. The estimate for the size of off-job-employees (γ_{001}) shows a negative association with the firm's ability to pay. That is, as the proportion of the firm's off-job-employees increases by every 5%, on-the-job workers receive 5% less salary. This seems to indicate that the "iron rice bowl" personnel policy adopted in the planned economy is now disappearing. Firms are being transformed into firm-based operational units and their competitiveness in the market affects their ability to pay.

Table 6. Effects of Firm Characteristics on Salary Growth

The outcome variable: Log monthly salary in 1997 RMB prices					
Fixed Effect	Coefficient	Standard Error	T-ratio	Approx. d.f.	P-value
Model for average initial salary, π_{0ij}					
Mean individual initial salary, β_{00j}					
INTRCPT, γ_{000}	6.219054	0.085717	72.553	58	0.000
LVOFFJOB, γ_{001}	–0.052589	0.021438	–2.453	58	0.017
SEX, β_{01j}					
INTRCPT, γ_{010}	0.065744	0.019617	3.351	2600	0.001
AGE, β_{02j}					
INTRCPT, γ_{020}	0.154524	0.013979	11.054	2600	0.000
MARITAL, β_{03j}					
INTRCPT, γ_{030}	0.021631	0.031507	0.687	2600	0.492
ED_YEAR, β_{04j}					
INTRCPT, γ_{040}	0.013936	0.005444	2.560	2600	0.011
LVPRFS, γ_{041}	0.000822	0.001400	0.587	2600	0.557
WKEXP, β_{05j}					
INTRCPT, γ_{050}	0.146989	0.044957	3.270	2600	0.001
Model for average salary growth rate, π_{1ij}					
Average initial salary growth rate, β_{10j}					
INTRCPT, γ_{100}	0.025690	0.019359	1.327	53	0.190
OWN_COOP, γ_{101}	0.000297	0.030371	0.010	53	0.992
OWN_CORP, γ_{102}	–0.008837	0.015292	–0.578	53	0.565
OWN_FGJN, γ_{103}	0.037827	0.017742	2.132	53	0.037
OWN_HKJT, γ_{104}	0.076628	0.026986	2.840	53	0.007
OWN_STAT, γ_{105}	0.020999	0.012463	1.685	53	0.097
LVTRNFEE, γ_{106}	0.005309	0.002230	2.380	53	0.021
SEX, β_{11j}					
INTRCPT, γ_{110}	0.000477	0.003849	0.124	2597	0.902
AGE, β_{12j}					
INTRCPT, γ_{120}	–0.016359	0.002750	–5.949	2597	0.000
MARITAL, β_{13j}					
INTRCPT, γ_{130}	–0.006550	0.006222	–1.053	2597	0.293
ED_YEAR, β_{14j}					
INTRCPT, γ_{140}	0.001223	0.000912	1.341	2597	0.180
CHANGE, β_{15j}					
INTRCPT, γ_{150}	0.005617	0.005475	1.026	2597	0.305
SECTOR, γ_{151}	0.002942	0.002574	1.143	2597	0.253
SIZE, γ_{152}	–0.001350	0.001886	–0.716	2597	0.474
TRAINING, β_{16j}					
INTRCPT, γ_{160}	0.009354	0.003671	2.548	2597	0.011
SECTOR, γ_{161}	–0.006119	0.001838	–3.330	2597	0.001
SIZE, γ_{162}	–0.001891	0.001267	–1.492	2597	0.136

Table 6. (Cont'd)

The outcome variable: Log monthly salary in 1997 prices					
Fixed Effect	Coefficient	Standard Error	T-ratio	Approx. d.f.	P-value
WKEXP, β_{17j}					
INTRCPT, γ_{170}	–0.013961	0.008806	–1.585	2597	0.113
AET_LONG, β_{18j}					
INTRCPT, γ_{180}	–0.010559	0.012582	–0.839	2597	0.402
SECTOR, γ_{181}	–0.002367	0.005623	–0.421	2597	0.673
SIZE, γ_{182}	0.006733	0.004289	1.570	2597	0.116
Model for average RANK rate, π_{2ij}					
Average RANK rate, β_{20j}					
INTRCPT, γ_{200}	–0.003210	0.006857	–0.468	59	0.641

Random Effect	Standard Deviation	Variance Component	df	Chi-square	P-value
Level 1					
Temporal variation, e_{tij}	0.18940	0.03587			
Level 2 (employees within firm)					
Ind. initial salary, r_{0ij}	0.41751	0.17431	2541	8490.03293	0.000
Ind. salary growth rate, r_{1ij}	0.07089	0.00502	2538	5870.77270	0.000
Level 3					
Firm mean initial salary, u_{00j}	0.21003	0.04411	54	630.93070	0.000
Firm mean salary growth rate, u_{10j}	0.03267	0.00107	49	339.01467	0.000
Firm RANK rate, u_{20j}	0.02006	0.00040	55	69.02646	0.097

SEX, AGE, ED_YEAR, and WKEXP show significantly positive effects on mean salary. Gender has an effect on mean salary; a male employee receives 6.6% (γ_{010}) more salary at the first data collection time-point. Gender discrimination exists in salary decisions, because other things being equal, male employees receive more than their female counterparts. The age coefficient ($\gamma_{020} = 0.154524$) shows that for every 10 year increase in age, an employee may receive about 15% more salary. This shows that seniority, a major factor in salary decisions in the planned economy, still has a strong effect on salary decisions. This contrasts with the results in Shenzhen, where age has no effect on either mean salary or salary growth.[54] Marital status (γ_{030}) does not appear to play a part in salary decisions. I assume that the gender difference is due to the practice of the "one family-two systems," whereby women take lower paying jobs and are placed at the disadvantaged end of the job queue when relocating in Shanghai.[55]

Years of formal education show a positive impact on mean salary, but with a magnitude of about 1.4% for every additional year of education. Seniority, at the same rate (15% for every 10 years older), has more of an effect on salary growth because years of formal education do not increase after one has left school. Regardless, the amount of education instead of the type of education is considered when deciding salary growth. Studies in Shanghai show that adult have been changing jobs during transition and that they may not take the same kind of jobs.[56] Therefore, in most cases type of education does not match jobs. The estimate for work experience ($\gamma_{050} = 0.146989$) shows that employers value the previous work experience of an employee, which often indicates his/her ability to perform and to learn on the job.

The estimate for the proportion of professionals in a firm (γ_{041}) shows no association with employees' educational attainments, and thus it does not affect the return to the employees' education. A descriptive analysis shows that among professionals in the surveyed sample, 36% had 15 or more years of education, 42.7% had only 13 years education, and 16.9% had only 9 years of education.[57] The findings from this study indicate that thus far the strategy of expanding higher education to train professionals has had no effect. This may be because firms have to keep off-job-employees and that those with higher educations cost more to hire so that they are not hired.

A key issue in the market transition debate is whether newly emerged firms, particularly firms with investment from outside the socialist system, recruit more educated employees who in turn make these firms more competitive. The estimation of returns to education across different ownership types (see Equation 3.04c) does not show any difference across firms (to save space, these parameters are not listed in Table 6). During the transition, all types of firms have tried to retain more educated employees. Therefore, this hypothesis is rejected.

The predicted annual salary growth rate (γ_{100}) for employees over five years is 2.6%, without considering the firm-level effects. Compared to the reference firms, firms with foreign investment give on average 3.8% higher annual salary increases to their employees (γ_{103}); and firms with investment from Hong Kong, Macau, and Taiwan give 7.7% higher (γ_{104}). There are no differences among other types of firms. It is not surprising that types of ownership are closely associated with capacity to allocate economic capital, which is one of the driving forces behind the economic reforms. This finding regarding the financial capacity of firms accords with the

calculation of government statistics that newly emerged firms are more competitive in the market-oriented economy (see the discussion in the Introduction). The firms' expenditures on OJT (γ_{106}) also show on average 0.5% higher annual salary growth for every 50 RMB that firms spend on OJT.

It is noted that with the firm-level predictors in the L3 model, the salary growth intercept ($\gamma_{100} = 0.025690$, $t = 1.327$, $p = 0.190$) is insignificant. This indicates that these firm-level predictors, types of ownership and ability to provide OJT, explain all of the other variance in the grand mean annual salary growth. These firm-level variables are powerful predictors of salary growth. We can conclude that the firms' financial status is a vital factor in determining annual salary growth.

Gender, marital status, and work experience do not show any statistical association with salary growth in models with or without the L3 predictors. The age coefficient (γ_{120}) indicates a predicted power in the opposite direction, which means that for every one year younger, employees will receive another 0.16% annual increment. This indicates a flattening increment slope of the salary growth rate as one becomes older.

It should be noted that years of education have an explanatory power on mean salary, but not on salary growth. This indicates that although employers may have considered level of education as a criterion in salary decisions in early years, they did not use it to determine salary increases in later years. This finding accords with that in the similar study in Shenzhen.[58] It supports the arguments of Spence and Thurow that education is used as a market signal to select workers for their potential productivity.[59]

It is most interesting to note that the estimate for technological changes (γ_{150}) predicts a salary increment. The variable of technological changes (γ_{150}) appeared significant ($t = 0.016$) when the L3 predictors (e.g. γ_{151}, γ_{152}) were not in the model. This indicates that for every major change that an employee experiences in the workplace, he/she eventually receives an increment of 0.56% in salary. This illustrates that specific experiences in coping with technological change are valued by employers. As suggested by our interviewees, such experience is "learning by doing and exploring when new things came up."[60] In comparison, an employee's work experience (γ_{170}) does not have an association with salary growth.

With the L3 predictors (e.g. γ_{151}, γ_{152}) in the model, γ_{150} is insignificant ($t = 0.305$), which means that the variance in technological changes is explained. However, the coefficients of sector (γ_{151}) and firm size (γ_{152})

show that it makes no difference whether one is in a firm in the manufacturing or in the service sector, nor does the size of the firm make any difference. My field trip showed that technological changes have been extensive in all types of firms. So I thus conclude that technological changes affect firms of all sizes in both sectors equally.

The estimate for OJT (γ_{160}) shows a 0.93% significant and positive increment on salary growth. For every time an employee received OJT, he or she eventually received a salary increase. This association of OJT with salary growth supports the hypothesis that employees in Shanghai deliberately use OJT to upgrade their KSA because employers associate OJT with salary decisions over time.

The coefficient of sector (γ_{161}) shows that firms in the manufacturing sector provide significantly more OJT to their employees than firms in the service sector. On average, employees in manufacturing are given a 0.9% increment in salary for every OJT that they receive; the average salary increase OJT for employees receiving in the service sector is estimated to be 0.3% ($\gamma_{160} - \gamma_{161}$). Firms of all sizes provide the same amount of OJT for their employees. After the L3 predictors are put into the model, the variance in OJT (γ_{160}) remains significant ($t = 0.011$).

Like the variable for technological change (γ_{150}), long-term AET appeared significant when the L3 predictors were not in the model ($\gamma_{180} = 0.007230$, t = 0.003). This finding indicates that employees who attended long-term AET (γ_{180}) have, on the average, received an annual 0.7% increment in salary as compared with those who attended short-term AET. This finding reflects the implementation of government policy that requires additional educational qualifications for promotion.[61] However, when the L3 variables SECTOR (γ_{181}), and SIZE (γ_{182}), are used to predict attendance in long-term AET programmes, the variance is explained. Nevertheless, being in a firm in manufacturing sector or service sector, and being in a large firm or a small firm do not have an impact on employees' decisions to attend AET programmes for additional educational qualifications. Attendance in an adult education programmes is very much an individual decision.

The lower panel of Table 6 shows that with the firm-level variables added into the L3 model, the corresponding χ^2 statistics accompanying the variance components among employees in firms (r_{0ij} and r_{1ij}) and among firms (u_{00j} and u_{10j}) still remain significant. This indicates that there is still significant variation in mean salary and mean annual salary growth among employees within firms as well as among firms.

Table 7 presents a comparison of the explanatory power of the three-level models. The first column illustrates random effects, the variance components while using the unconditional model. Column 2 illustrates the variance components after the employee characteristic variables are added to the L2 model. Column 3 shows the percentage of variance that is explained by the individual characteristic variables. For instance, the L2 model predicts 9.2% of the variance in the mean salary among employees within firms (r_{0ij}), and 2.7% of the variance in the salary growth slope (r_{1ij}). Column 4 lists variance after firm variables are added into the model. With the firm factors as predictors, more variance is explained at the firm level. In total, the three-level hierarchical linear model explains 9.2% of the variance in mean salary difference (r_{0ij}), and 3.3% of the variance in salary growth slope (r_{1ij}) among employees within firms. It explains 10.5% of the variance in the mean salary difference (u_{0ij}), and 32% of the variance in the salary growth slope (u_{1ij}) among firms.

HLM also allows us to detect the proportions of the variation existing among employees within firms and between firms. The panel at the bottom of Table 7 shows that for the baseline model, about 18% of the variance lies among firms in the salary at the initial observation point and 23% lies

Table 7. Comparison of Variance

Variance Component	Unconditional model (1)	Conditional with employee variables (2)	Variance explained (%) (3)	Conditional with firm variables (4)	Additional variance explained (%) (5)	Total variance explained (%) (6)
Level 1 (growth level) e_{ij}	0.03613	0.03586	0.7	0.03587	0.0	0.7
Level 2 (within firm)						
Initial salary r_{0ij}	0.19201	0.17432	9.2	0.17431	0.0	9.2
Growth slope r_{1ij}	0.00519	0.00505	2.7	0.00502	0.6	3.3
Level 3 (between firms)						
Firm mean salary u_{00j}	0.04292	0.04784	2.9	0.04411	7.8	10.5
Firm mean growth u_{10j}	0.00157	0.00145	7.6	0.00107	26.2	31.8
Firm RANK slope u_{20j}	0.00065	0.00044	32.3	0.00040	9.1	38.5
Variance among firms ($\tau_{\beta pp}/(\tau_{\beta pp} + \tau_{\pi pp})$)						
Initial salary	0.18	0.22		0.20		
Growth slope	0.23	0.22		0.18		

among firms in the growth rate. The rest of the variance lies among individual employees within firms.

Since the purpose of this study is to survey the educational and training histories of employees, it does not examine other personal characteristics developed through education and training, such as cognitive abilities or abilities associated with family background. Nor does this study examine workplace management factors (e.g., peer relations, supervisor support). This leaves much of variance unexplained both at the individual and the firm level. As the ability to deal with disequilibria and the involvement of employees in work decision-making are crucial to increase productivity,[62] future studies might explore these factors that reflect how individuals behave in order to improve productivity, thus explaining more variances at the individual level.

Concluding Discussion

This study analyzes the process how three forms of human capital development strategies contribute to salary growth over time. In the workplace, employees are nested in their firms; individual characteristics are promoted or constrained in some way as the firm makes production decisions. If one ignores this process in the estimation of rates of returns, such as if one considers only individual variables and pre-job characteristics, the human capital concept is flawed theoretically. This is because other alternatives that impart skills and knowledge in individuals and other complements in the workplace are neglected. The most important of these ignored conditions involves the process of how knowledge and skills learnt are transferred into productivity through many complementary and sufficient conditions in the context of a firm. The analysis in this study has attempted to uncover what is going on in the "black box" by revealing several important findings in the context of Shanghai, an economy in the process of transforming. I argue that qualitative changes in a transitional economy create disequilibria in the workplace. As changes accelerate and become a constant, OJT and AET serve as complementary strategies for re-equilibration, by upgrading human capital and matching changes in physical capital and management. OJT provided in the workplace strengthens a firm's capacities in a market economy, while AET suits an individual's expectations of the external market. Therefore, OJT and AET engage employees in the changing economic process and upgrade their human capital.

Summary of the Findings. The findings in this study support my argument and, at the same time, they bring to light several issues in utilizing human capital in firms. First, formal education has a significant impact on the employers' salary decisions in early years. However, employers consider the level of education, not the type of education. Additional years of formal education do not contribute to annual salary increases. It is perplexing that firms with a larger proportion of professionals do not hire those who are more educated. There is no statistical difference in returns to education across types of ownership forms. Second, experiencing technological changes in the transition plays a part in annual salary growth, as does employer-provided OJT. Employers also recognize long-term AET programmes. These findings suggest that employers consider that human resource strategies and intentional experiences contribute to adaptability to transition. Third, salary patterns reveal gender discrimination among employees, and seniority is still a very powerful factor contributing to salary decisions. Fifth, firms with investment from outside China's socialist system significantly outperformed other types of firms in transition in terms of providing salary increases to employees. Firms that spend significantly more on OJT continued to give annual salary increases to their employees. In contrast, firms with a large number of off-job-employees pay significantly less to their remaining employees. These findings suggest an advantage for those firms in terms of resources, such as financing, advanced technology, and experience in the market economy. Sixth, regarding economic sector and firm size, there is no difference in the extent to which employees experienced technology changes in the workplace. In other words, change has been so pervasive that employees in all firms in Shanghai have undergone similar experiences during the economic transition. Economic sector and firm size show no effect on an employee's decision to attend an AET programme outside the firm; this is an individual decision. However, firms in the manufacturing sector provided significantly more OJT for their employees, indicative of Shanghai's priority to restructure manufacturing to boost economic growth as a priority in transition. No wonder that employers provide OJT to upgrade the workforce at the same time as they replace their physical capital. Finally, a major finding is that an employee's technical proficiency level is not associated with his/her salary increases over time. This raises a concern.

A Comparison with Shenzhen. A HLM analysis was first carried out on a similar survey that collected information in Shenzhen from 1990 to

1996.[63] A brief comparison is presented here. Analysis of the Shanghai data accords with the findings of the effects of formal education on salary in the Shenzhen data. That is, formal education has an impact on salary at hiring time, but not on annual salary increases or on technical proficiency. However, in Shenzhen firm-provided OJT does not automatically account for annual salary growth. An employee's technical proficiency ranking is positively associated with salary growth. OJT contributes to salary growth through advance in firm-recognized technical proficiency, which are based on performance assessments. This indicates that firms in Shenzhen relate employees' job performance to salary. In contrast, the amount of OJT provided in firms in Shanghai automatically accounts for annual salary growth, and the employees' technical proficiency is not associated with salary growth. The comparison raises questions about firms' compensation policy in Shanghai.

In both cities, the experience of technological change in the workplace also constitutes as learning-by-doing and thus is associated with salary increases. Voluntary attendance at AET outside of the firm by individual employees is associated with annual salary growth in Shanghai, but not in Shenzhen. Firms in Shenzhen do not consider programmes that meet individual expectations to be a factor in salary increases. Manufacturing firms in Shenzhen, which are at forefront of the economic development, utilize OJT to match their human capital with their physical capital. Likewise, firms in Shanghai utilize the same strategy. This indicates that firms are rational in terms of utilizing OJT to keep abreast of changes in the workplace and to regain equilibrium in production. The Shenzhen study found that firms with more formalized management, such as firms with investment from outside the socialist system and state-owned/corporate firms, provide more OJT for their employees. In the analysis of the Shanghai data, firms with investment from outside socialist China have substantial ability to continue to give annual salary increases to employees.

Implications for Human Capital Development in Transition. The findings of this study suggest a number of relationships between education and training and productivity. First, the findings regarding formal education indicate that Chinese policy-makers made the false assumption that secondary vocational/technical education would prepare youth with occupational skills for future jobs. In fact, employers do not care much about the type of education.[64] Again, firms with more professionals do not recruit more employees with higher academic qualifications. This may also indicate that the Chinese policy-makers' assumption that higher education

prepares highly skilled professionals is not accepted by employers.[65] Either they do not have the financial capacity to pay more to so-called highly skilled professionals who have higher academic qualifications, or they use other options such as OJT and long-term AET to train their professionals with firm-required skills. These findings suggest a need to reconsider the nationwide educational reforms of secondary education and the expansion of higher education.

Instead, firms use OJT and AET programmes as strategies to upgrade their workforce and attendance in such programme are taken into consideration in salary increase decisions. However, it is problematic that employee performance is not associated with salary increase, and OJT and AET are not observed to be associated with improved job skills. In addition, my field study reveals that managers have no control over the content of training; OJT and AET providers have little contact with the workshop floor. That the compensation policy does not link employees' technical skills to salary suggests an important area for management improvement; human resource strategies and personnel management in the firms must be complementary so as to promote the transfer of human capital to production.

Types of ownership did not show any difference across firms in recruiting employees, regarding their education levels. However, this study indicates that the financial capacity of a firm has a significant impact on its ability to pay its employees and to cope with transition. Capable firms continue to give salary increases and invest in OJT, and to limit the number of off-job-employees. These are all measures to cope with the economic transition. With continued training, their employees become competitive and outperform those in other firms. In contrast, financially handicapped firms are disadvantaged in the market economy, especially the state-owned and the collective firms. Firm and government policies should focus on these issues.

The findings of this study illustrate that RORE is complicated by many factors in the process of production. A firm's capacity and its position in the market economy are seen as major factors in the individual salary growth trajectory during economic transition. Formal education has been a crucial factor in explaining workers' wages in numerous of studies of using conventional methods of RORE.[66] However, it shows a limited explanatory power in this study as well as in the similar Shenzhen study,[67] both of which differentiate workplace factors into individual and firm levels in the analysis.

Regarding productivity, Shanghai lags behind Shenzhen. This can be due to the fact that Shanghai began its economic transition a decade later than Shenzhen, and it has not yet been able to catch up with some of the reforms (e.g., performance assessment in firms) that would be sufficient conditions to improve the social infrastructure. Nevertheless, the findings from this study suggest it is necessary to address such issues as secondary education policy, the quality of OJT and AET programmes, and financial policy at the societal level and such issues as human resource management and compensation policies at the firm level. These are complementary conditions to improve productivity. It will be interesting to collect similar data in 5 or 10 years' time to reexamine the salary trajectory in Shanghai.

Notes

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32. The sample considered five factors: (a) manufacturing and service sectors; (b) major industries and trades; (c) firms of different types of ownership; (d) firms of different sizes; and (e) one to two intact work groups/production lines on the floor to obtain a vertical sample, which consisted of all the personnel at a work site. For detailed discussion on survey and analysis, please see Xiao (Note 28).
33. For details of the sampling methods and administration of the survey, see Xiao (Note 14 and 28).
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35. Without "grey income," the analysis underestimates the employees' total income from the firm. However, as it is given in proportion to salary, the salary used in the analysis without the "grey income" is still able to predict its relation with the other variables.
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40. The eight types of OJT include entry-job training, remedial training, skill-upgrading training, technological change training, management training,

certificate programmes, firm culture study, and other training. For a detailed discussion, see Xiao (Note 14).

41. One firm was excluded from the analysis because it has fewer than 12 employees. A labour/capital/technology-intensive variable was estimated in the model. Because it did not show any difference, it was dropped out of the estimation. I assumed that Shanghai is still at the initial stage of transition. A so-called labour/capital/technology-intensive factors do not have much of an effect because at this stage boosting the manufacturing sector is a strategy to promote economic growth in Shanghai.
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43. E. Daito, "Technology and Labor in a Dual Economy: from Natural Rubber to Synthetic Resin," in *Industrial Training and Technological Innovation: A Comparative and Historical Study*, edited by Howard F. Gospe (London and New York: Routledge, 1991), pp. 171–93.
44. In the planned economy, employees had a secure "iron rice bowl," for one's entire life. In the economic transition, firms still do not lay off redundant workers or fire incompetent workers. Instead, they stop assigning tasks to these employees and ask them to look for jobs elsewhere while keeping their personnel files in the firm and paying them a minimum monthly living allowance, about RMB 200 to 300, until they find a new job.
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47. Bryk and Raudenbush, ibid., p. 135.
48. Xiao (Note 28).
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50. HLM yields the maximum likelihood estimates for r (π_{0ij}, π_{1ij}). Under a linear individual growth model, this correlation is the correlation between π_{0ij}, and π_{1ij},

$$\hat{\rho}\,(\pi_{0ij},\, \pi_{1ij}\,) = \hat{\tau}_{\pi 01} / [\,\hat{\tau}_{\pi 00} + \hat{\tau}_{\pi 11}\,]^{1/2} \qquad (4)$$

51. It is important to examine the reliability of the ordinary least squares (OLS) estimate at the individual and firm levels, and the correlation among the growth parameters. The reliability of the L2 and L3 outcome variables will help ensure that the data can detect systematic relations between growth parameters and personal-level variables, and between personal and firm variables (Bryk and Raudenbush [Note 46], pp. 69, 137, 177–78). The reliabilities depend on two

factors: first, the degree to which the true underlying growth parameters vary from person to person and from firm to firm; and, second, the precision with which each person's and firm's regression equation is estimated. For each employee *ij* at L2,

$$\text{reliability } (\hat{\pi}_{0ij}) = \frac{\tau_\pi}{\tau_\pi / [\tau_\pi + \sigma^2/t_{jk}]} \quad (5)$$

is the reliability of the individual mean for use in discrimination among employees within the firm. For any firm *j* at L3,

$$\text{reliability } (\hat{\beta}_{00j}) = \frac{\tau_\beta}{\tau_\beta + \{\sum [\tau_\pi + \sigma^2/t_{jk}]^{-1}\}^{-1}}$$

is the reliability of the firm's sample mean as an estimate of its true mean. The averages of these reliabilities across employees and firms (Equation 6) provide summary measures of the reliability of the employee and firm means, respectively.

52. Xiao and Tsang (Note 13); Xiao (Note 28).
53. Due to limited space, empirical results for the the L2 model without the L3 variables are not presented in this paper, but are available from the author or on the web-site www.fed.cuhk.edu.hk.eap/people/xiaoj.html. Equations of those L2 parameters that are not undergoing estimation with L3 predictors are excluded from the text. They are L2 parameters β_{01j}, β_{02j}, β_{03j}, β_{05j}, β_{11j}, β_{12j}, β_{13j}, β_{14j}, β_{17}, and β_{20j} .
54. Xiao (Note 28), Table 5.
55. Davis (Note 36).
56. Davis, ibid.
57. Xiao (Note 14), Table 2.
58. Xiao (Note 28).
59. Spence (Note 18); Thurow (Note 19).
60. The research team took a field trip to confirm the preliminary quantitative findings and to conduct further enquiries. Fifteen employees in three selected firms were interviewed. One was state-owned, one was a collective, and one was a HK-Shanghai joint venture. Interviewees included both males and females, managers, technicians, front workers, salesmen, engineers, and R&D staff. The team also interviewed 10 staff in AET, both instructors and programme managers, at four training centres. One was affiliated with state-owned firm, one was an independent private training centre, one was a worker union-run centre, and the fourth was a district government-run community college.
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