Labor Market Experience and Returns to College Education in Fast Growing Economies

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Abstract

China's college admissions increased by five times between 1998 and 2009. While the college premium for young workers declined, that for senior workers increased in this period. In our general equilibrium model, a rising demand for skills (education and experience) explains both trends. A demand shock leads to an expansion in the elastic college enrollment, depressing the college premium for young workers. With an inelastic supply, experienced college graduates continue to enjoy a rising premium. Despite the low immediate premium, young individuals continue to flood into colleges because they foresee high lifetime returns. Simulations match empirical results well.

JEL Classifications: J24, J23, J31, I2
Keywords: Return to Labor Market Experience, Return to Higher Education, Lifetime Return to College Education, College Enrollment, China

Appendix For Online Publication

Appendix A. Proofs of Propositions

Proof of Proposition 1

By the definition of v (equation 5), we get $w_m = \frac{(1+k)(v+1+C)}{1+kw}$. Substituting it into the market clearing equation for m (equation 6), we get the following equation,

$$nB[\frac{(1+k)(v+1+C)}{1+kw}]^{-\sigma} \int_{(\frac{(1+k)(v+1+C)}{1+kw})^{1/\alpha}}^{w} (\delta^{\alpha})^{\sigma-1} dF(\delta) = \frac{1}{k+1} G(v). \quad (14)$$

We first show that v and w have a one-to-one functional relationship. Equation 14 provides a functional relationship between v and w. The left hand side is decreasing in v, but the right-hand side is increasing in v. When $v = 0$, the left hand side is positive, and the right-hand side is 0. When v is very large, such that $w_m^{1/\alpha} = (\frac{(1+k)(v+1+C)}{1+kw})^{1/\alpha} \geq w$, the left hand side is less than or equal to 0, and the right hand side is greater than 0. Therefore given w, the above equation has a unique solution; in other words, v and w have a one-to-one functional relationship.

We then show that w increases with v. Increasing w shifts the left hand side of equation 14 (demand) up. Therefore, the right hand side (supply) has to increase, and thus v needs to increase. Therefore $w = w^*(v)$ is an increasing function. We then substitute w by $w^*(v)$ into $w_h = \frac{(1+k)(v+1+C)}{1/w+k}$ to get $w_h = \frac{(1+k)(v+1+C)}{1/w^*(v)+k}$. This is an increasing function of v, denoted as $w_h^*(v)$. Substituting $w_h = w_h^*(v)$ and $w = w^*(v)$ into the clearing condition for h (equation 7), we get the following equation,

$$B(w_h^*(v))^{-\sigma}[n \int_{w^*(v)}^{\Delta} (\delta^{1+\alpha})^{\sigma-1} dF(\delta) + n_f (\Delta^{1+\alpha})^{\sigma-1}] = \frac{k}{k+1} G(v). \quad (15)$$

We next show that there is a unique solution for v. Given that $w_h^*(v)$ and $w^*(v)$ are increasing, the left hand side is decreasing in v; and it goes from a positive number at $v = 0$ to zero or a negative number when v is big (when $w^*(v) \geq \Delta$). In contrast, the right hand side is increasing from 0 to a positive number. Thus, a unique solution v exists.

We can then conclude that $w = w^*(v)$, $w_h = \frac{(1+k)(v+1+C)}{1/w+k}$, and $w_m = \frac{(1+k)(v+1+C)}{1+kw}$ each have a unique solution. Q.E.D.

Proof of Proposition 2

Given a sequence of college enrollment rates $\{g^t \equiv G(v^t)\}$, we will use Schauder's fixed point theorem by establishing a mapping between g^t to $g^{t\prime}$ to prove the Proposition. Specifically, from the enrollment path g^t, we can compute the evolution of L_m^t and L_h^t. Then, using the period-by-period demand and supply equations (equations 12 and 13), we can compute the wages w_m^t and w_h^t, from which we can compute v^t. Finally, we can get a new set of enrollment rates $g^{t\prime} = G(v^t)$, and establish the mapping from $\{g^t\}$ to $\{g^t\}'$.

We define a Banach space for all of the sequences bounded by $[0,1]$ with a sup norm. Clearly this space is compact and convex. The above-defined mapping can be easily shown to be a continuous self-mapping. Therefore we can use the Schauder Fixed Point Theorem to establish the existence of a fixed point such that $\{g^t\} = \{g^t\}'$.

Proposition 1 implies that any convergent equilibrium will converge to the unique steady state equilibrium derived in the previous section. Notationally, as t goes to ∞, $\{w_m^t, w_h^t, L_h^t, L_m^t, v^t\}$ converges to $\{w_m^s, w_h^s, L_h^s, L_m^s, v^s\}$, which satisfies equations 6 and 7. Q.E.D.

Proof of Proposition 3

We will first show that w increases with n_f by contradiction. Suppose not, if w decreases, then the left hand side of the market clearing equation for the medium-type workers (equation 14) will shift down, and thus the right hand side or v has to decrease to balance. Then, $w_h = \frac{(1+k)(v+1+C)}{1/w+k}$ also decreases, but this would violate the market clearing condition for h-type workers (equation 15). To see this, the left hand side of equation 15 increases from the previous equilibrium since w_h decreases, w decreases, and n_f increases, but the right hand side decreases from the previous equilibrium as v decreases. This is a contradiction, and therefore w must increase.

We next show that w_h increases with n_f. As w increases, the left hand side of equation 14 shifts up, so v also increases to balance the equation. Then $w_h = \frac{(1+k)(v+1+C)}{k+1/w}$ must increase too. So we have shown that w, v, and w_h all increase. Q.E.D.

Proof of Proposition 4

To analyze the change in w_m when n_f increases, we first need to sign dw_m/dw. We implicitly differentiate the demand equation for m (equation 6), which establishes a functional relationship between w and w_m. We already know that w increases with the arrival of high-productivity firms, therefore to sign dw_m, all we need to do is to sign dw/dw_m. Implicitly differentiating it, we can obtain an expression for dw_m/dw as follows,

$$nBw_m^{-\sigma-1}(-\sigma)\int_{w_m^{1/\alpha}}^{w} \delta^{\sigma-1}dF(\delta) + nBw_m^{-\sigma}(-w_m^{\sigma-1}f(w_m)) + nBw_m^{-\sigma}w^{\sigma-1}f(w)\frac{dw}{dw_m} = \frac{1}{k+1}G'(v)[\frac{1+kw}{1+k} + \frac{w_m k}{1+k}\frac{dw}{dw_m}].$$

After re-arranging and simplification, we get

$$\frac{dw}{dw_m} = \frac{-\sigma nBw_m^{-\sigma-1}\int_{w_m^{1/\alpha}}^{w}\delta^{\sigma-1}dF(\delta) - nBw_m^{-1}f(w_m) - \frac{1}{k+1}G\prime(v)\frac{kw_m}{1+k}}{\frac{1}{k+1}\frac{1+kw}{1+k}G\prime(v) - nBw_m^{-\sigma}w^{-\sigma-1}f(w)}.$$

By examining this expression, we know that when $G'(.)$ is sufficiently small, i.e., the supply is very elastic, $dw/dw_m > 0$. On the other hand, if $G'(.)$ is sufficiently large, i.e., the supply is very elastic, then $dw/dw_m < 0$.

Lemma 1 *In period by period demand/supply equations for* h*- and* m*-type workers, if both* L_h *and* L_m *decrease and one of them decreases strictly, then* w_m *and* w_h *increase strictly. (Conversely if both* L_h *and* L_m *increase, and one of them increases strictly, then* w_m *and* w_h *decrease strictly.)*

Proof: We prove by contradiction, using market clearing equations 12 and 13. If w_m decreases, then the left hand side of equation 12 increases, but the right hand side L_m decreases. Thus, w must decrease to keep the equation balance. Then, $w_h = w * w_m$ must also decrease. However, if w decreases, then equation 13 indicates that w_h must increase to be equal to L_h, which has decreased. This is a contradiction. Therefore, w_m must increase.

Similarly, to show that w_h increases, we also prove by contradiction. Suppose w_h decreases, then the left hand side of equation 13 increases, but the right hand side (L_h) decreases, which is a contradiction. Therefore, w_h must increase. Q.E.D.

Lemma 2 *Define* W_m *as the solution to the period by period demand and supply equations (12 and 13), given* L_m *and* L_h*. Then, the partial* $-\frac{\partial W_m}{\partial L_h}$ *is bounded from below.*

Proof: We first differentiate the market clearing equations for m-type (equation 12) and h-type workers (equation 13). More specifically, we denote function $M(.)$ as

$M(w_m, w_h) = nBw_m^{-\sigma} \int_{w_m^{1/\alpha}}^{w_h/w_m} (\delta^\alpha)^{\sigma-1} dF(\delta)$, and $H(.)$ as $H(w_m, w_h) = Bw_h^{-\sigma}[n \int_{w_h/w_m}^{\Delta} (\delta^{1+\alpha})^{\sigma-1} dF(\delta) + n_f(\Delta^{1+\alpha})^{\sigma-1}]$. Implicitly differentiating both equations on both sides by L_h, holding L_m constant, we have

$M_1 \frac{\partial w_m}{\partial L_h} + M_2 \frac{\partial w_h}{\partial L_h} = 0$, and $H_1 \frac{\partial w_m}{\partial L_h} + H_2 \frac{\partial w_h}{\partial L_h} = 1$.

Solving the above equations, we get $\frac{\partial W_m}{\partial L_h} = (H_1 - H_2 M_1/M_2)^{-1}$. As $M_1 < 0$, $M_2 > 0$, $H_1 < 0$ and $H_2 > 0$, then by Lemma 1, $\frac{\partial W_m}{\partial L_h} < 0$.

We know that the absolute values of M_1, M_2, H_1 and H_2 are bounded from below and above (by assumption, all wages are in the range of $[1, \Delta^{1+\alpha}]$, and $f(.) < \infty$). Therefore, the absolute value $H_1 - H_2 M_1/M_2$ is bounded from above, and hence the absolute value of $\frac{\partial W_m}{\partial L_h}$ is bounded from below.

Lemma 3 *If* $v^t > v^s$ *and both* L_m^t *and* L_h^t *converge from below, then*

$$\lim_{t\to\infty} \frac{L_h^s - L_h^t}{L_m^s - L_m^t} = \infty. \quad (16)$$

Proof: Expanding the recursive formula for L_h, we have $L_h^t = \sum_{j=1}^t \eta\mu^j L_m^{t-j}$, and hence $L_h^s - L_h^t = \sum_{j=1}^t \eta\mu^j (L_m^s - L_m^{t-j})$. We know that $L_m^s - L_m^t < \mu(1-\eta)(L_m^s - L_m^{t-1})$ for all t. This is because $L_m^s - L_m^t = \mu(1-\eta)(L_m^s - L_m^{t-1}) + (1-\mu)(G(v^s) - G(v^t))$, and $G(v^t) > G(v^s)$.

Recursively applying the above inequality, we have

$$L_m^s - L_m^{t-j} > \mu^{-j}(1-\eta)^{-j}(L_m^s - L_m^t) \quad (17)$$

Substitute this inequality into the expression for $L_h^s - L_h^t$, we get $L_h^s - L_h^t > (L_m^s - L_m^t) \sum_{j=1}^t (1-\eta)^{-j}$. Therefore $\frac{L_h^s - L_h^t}{L_m^s - L_m^t}$ will go to infinity as t goes to infinity. Q.E.D.

Proof of Proposition 5

We prove this by contradiction. If L_m never overshoots, i.e., $L_m^t \leq L_m^s$ for all t, then L_h also never overshoots ($L_h^t \leq L_h^s$ for all t). The inequality is strict, as long as $L_h^0 < L_h^s$ (this can be shown easily by an induction on equation 10). Since the demand for labor n_f^t will be a constant for a t large enough ($t > \tau$) by assumption, and the supply never overshoots ($L_m^t \leq L_m^s$ and $L_h^t < L_h^s$, for $t > \tau$), then by Lemma 1, the wages will be higher than the long term values for $t > \tau$, i.e., $w_m^t > w_m^s$, $w_h^t > w_h^s$, and $v^t > v^s$.

Next, we will show that this is not possible when $G'(.) > 0$. First, we will establish that given $L_m^{t+1} < L_m^s$ for all t, we have

$$\frac{G(v^{t-4}) - G(v^s)}{L_m^s - L_m^t} < \frac{\mu(1-\eta)}{1-\mu}. \tag{18}$$

This follows from simple algebra as, $L_m^{t+1} = (1-\mu)G(v^{t-4}) + \mu(1-\eta)L_m^t < L_m^s$. Re-arranging this, we get $(1-\mu)G(v^{t-4}) < L_m^s - \mu(1-\eta)L_m^t = \mu(1-\eta)(L_m^s - L_m^t) + (1-\mu+\mu\eta)L_m^s$. Given $(1-\mu+\mu\eta)L_m^s = (1-\mu)G(v^s)$, we have $G(v^{t-4}) - G(v^s) < \frac{\mu(1-\eta)}{1-\mu}(L_m^s - L_m^t)$.

Second, we know that $v^{t-4} - v^s > (1-\mu)\mu^4(1-\eta)^4(w_m^t - w_m^s)$. By the formula for v_t, for all $t > \tau$, $w_m^t > w_m^s$ and $w_h^t > w_h^s$.

Third, applying the mean value theorem, we have $w_m^t - w_m^s = (-\frac{\partial W_m}{\partial L_m})(L_m^s - L_m^t) + (-\frac{\partial W_m}{\partial L_h})(L_h^s - L_h^t)$, where W_m is the function that solves for w_m taking as given L_m and L_h in the period by period supply and demand equations. The partials are evaluated at some values in the range $(L_m^t,\ L_m^s)$ and $(L_h^t,\ L_h^s)$.

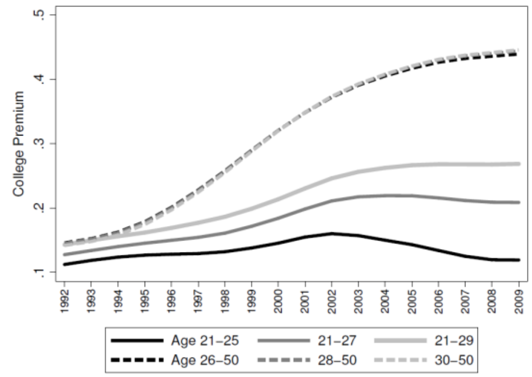
Combining the second and third steps, we have $v^{t-4} - v^s > (1-\mu)\mu^4(1-$

$\eta)^4[(-\frac{\partial W_m}{\partial L_m})(L_m^s - L_m^t) + (-\frac{\partial W_m}{\partial L_h})(L_h^s - L_h^t)]$. Again, applying the mean value theorem on $G(.)$, we get $G(v^{t-4}) - G(v^s) > G'(.)(1-\mu)\mu^4(1-\eta)^4[(-\frac{\partial W_m}{\partial L_m})(L_m^s - L_m^t) + (-\frac{\partial W_m}{\partial L_h})(L_h^s - L_h^t)]$. Dividing both sides by $L_m^s - L_m^t$, we have

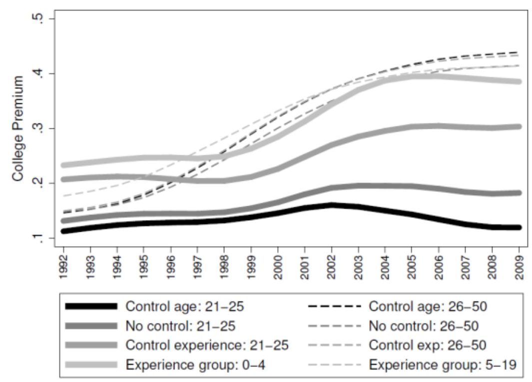
$$\frac{G(v^{t-4})-G(v^s)}{L_m^s - L_m^t} > G'(.)(1-\mu)\mu^4(1-\eta)^4[(-\frac{\partial W_m}{\partial L_m}) + (-\frac{\partial W_m}{\partial L_h})\frac{L_h^s - L_h^t}{L_m^s - L_m^t}]. \quad (19)$$

By Lemma 2, $-\frac{\partial W_m}{\partial L_h}$ is uniformly bounded from below, and by Lemma 3, $\frac{L_h^s - L_h^t}{L_m^s - L_m^t}$ goes to ∞. As long as $G'(.)(> 0)$ is evaluated near v_s, $\frac{G(v^{t-4})-G(v^s)}{L_m^s - L_m^t}$ will go to ∞. This contradicts to the first step where we have shown that $\frac{G(v^{t-4})-G(v^s)}{L_m^s - L_m^t} < \frac{\mu(1-\eta)}{1-\mu}$ for a t big enough. Therefore, L_m^t will overshoot. Q.E.D

Appendix B. Figures



(a) Different Age Cutoffs



(b) Different Estimation Specifications

Figure A1 *College Premiums for Different Cutoffs and Specifications*

Note: For panel a, the college premiums for the age groups are estimated by cross-sectional regressions for each age group for each year, with log earnings as the dependent variable and the college dummy, age, age square, gender, and province fixed effects as independent variables. For panel b, the first six legends refer to cross-sectional Mincer regressions for a given age group, while the last two legends refer to cross-sectional Mincer regressions for a given experience group. “Control age” means controlling for age and age square in the regression. “No control” means we do not control for age or experience. “Control experience” means controlling for experience and experience square in the Mincer regression. Mincer regressions for a given experience group also control for experience and experience square. We always control for gender and provincial fixed effects. The curves are smoothed using Lowess method with a bandwidth of 0.6.

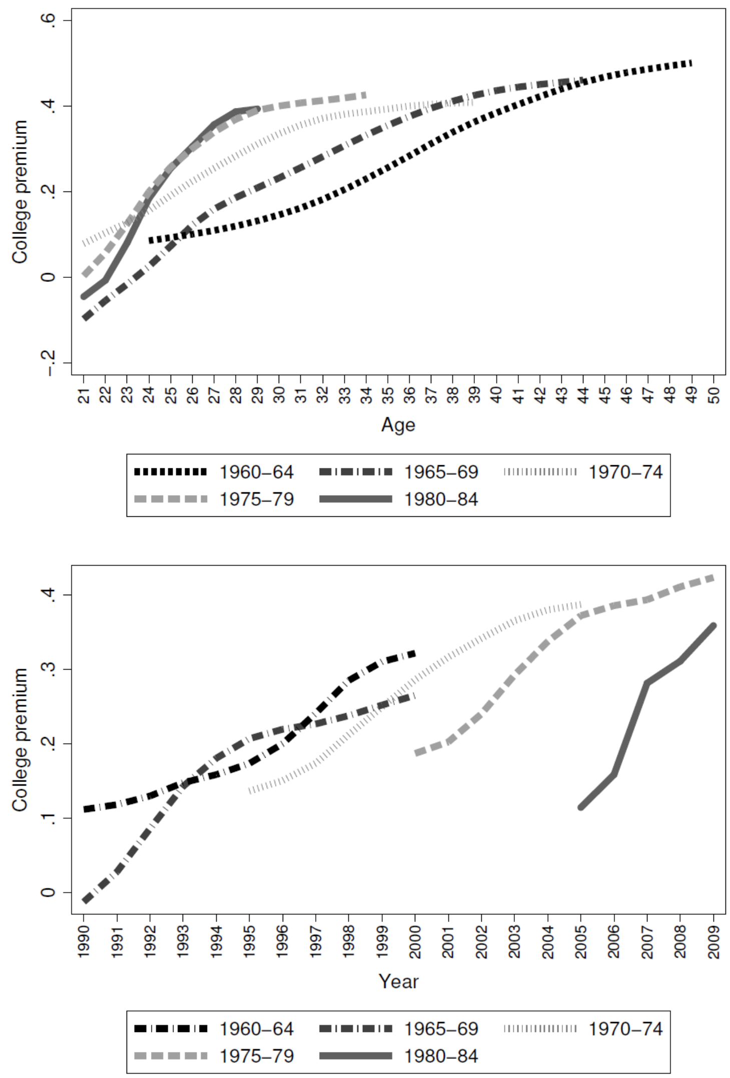


Figure A2 *Age Profiles of College Premiums for Different Cohorts*

Note: The five cohorts are individuals born in 1960-1964, 1965-1969, 1970-1974, 1975-1979, and 1980-1984. College premiums are estimated by cross-sectional regressions for each cohort group for each age for (a) and in each year for (b), with log wage as the dependent variable, and the college dummy, gender, and cohort and province fixed effects as independent variables.

Appendix C. Tables

Table A1 *Summary Statistics of Workers in Urban China (the Urban Household Survey)*

Year	Number of Obs. (1)	Years of experience (2)	Years of schooling (3)	Age (4)	Wage (5)	Female (6)	College graduate (7)	High school graduate (8)
1990	25014	17.5	10.9	36.8	4971	0.462	0.139	0.4
1991	25006	17.3	11.1	36.6	5181	0.462	0.155	0.417
1992	30225	17.6	11.3	37	5935	0.463	0.185	0.426
1993	29110	18	11.4	37.3	6355	0.462	0.194	0.431
1994	28343	18.1	11.5	37.3	7035	0.461	0.212	0.441
1995	28038	18.5	11.6	37.7	7436	0.462	0.211	0.448
1996	27849	18.9	11.6	38.1	7617	0.461	0.219	0.45
1997	27195	18.8	11.6	38.1	8521	0.458	0.223	0.447
1998	26349	19.2	11.8	38.5	8915	0.454	0.243	0.452
1999	25302	19.6	11.9	38.9	9715	0.452	0.263	0.454
2000	23046	19.3	12.1	38.8	10756	0.441	0.294	0.436
2001	22232	19.8	12.1	39.3	11873	0.433	0.297	0.441
2002	59399	19.1	12.3	39.5	13259	0.429	0.328	0.425
2003	64908	19.3	12.4	39.7	14794	0.427	0.337	0.425
2004	66115	19.6	12.5	40	16334	0.423	0.358	0.415
2005	69345	19.2	12.6	39.8	18423	0.418	0.389	0.388
2006	70893	19.6	12.7	40.2	20117	0.417	0.405	0.383
2007	76004	19.9	12.8	40.3	22055	0.419	0.423	0.373
2008	79983	18.9	12.7	39.5	24599	0.417	0.425	0.344
2009	80697	19.3	12.9	40	27105	0.42	0.442	0.341

Note: Wages (in 2009 RMB prices) include salary, bonus, commissions, tips, pecuniary subsidies, and overtime pay. Workers are aged 16-60, not self-employed, not disabled, and not retired.

Table A2 *College Wage Premiums by Age or Years of Experience*

	College premiums (college vs. high school)											College premiums (college vs. all others)		
	Age groups								Experience groups			Age groups		
	16-60	21-25	21-25	26-50	26-40	30-39	40-49	50-59	0-4	5-29	5-19	16-60	21-25	26-50
Year	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
1990	0.089	-0.062	-0.096	0.091	0.094	0.085	0.085	0.079	0.120	0.105	0.111	0.140	-0.036	0.142
1991	0.101	0.056	0.024	0.090	0.096	0.099	0.078	0.071	0.148	0.103	0.116	0.150	0.066	0.136
1992	0.134	0.054	0.033	0.128	0.135	0.130	0.116	0.081	0.168	0.137	0.154	0.183	0.064	0.181
1993	0.142	0.168	0.149	0.125	0.129	0.123	0.118	0.084	0.244	0.137	0.153	0.200	0.192	0.187
1994	0.201	0.177	0.160	0.183	0.185	0.181	0.167	0.159	0.301	0.193	0.215	0.273	0.226	0.253
1995	0.178	0.129	0.112	0.157	0.161	0.158	0.144	0.168	0.223	0.175	0.201	0.242	0.174	0.220
1996	0.190	0.173	0.153	0.170	0.186	0.183	0.134	0.160	0.258	0.187	0.214	0.253	0.201	0.233
1997	0.233	0.150	0.135	0.231	0.245	0.248	0.196	0.173	0.269	0.231	0.255	0.310	0.197	0.307
1998	0.254	0.102	0.087	0.258	0.266	0.279	0.233	0.169	0.218	0.266	0.284	0.336	0.160	0.339
1999	0.289	0.107	0.098	0.292	0.294	0.291	0.282	0.230	0.204	0.304	0.318	0.378	0.174	0.382
2000	0.330	0.212	0.199	0.329	0.316	0.324	0.333	0.294	0.260	0.342	0.343	0.424	0.260	0.423
2001	0.354	0.154	0.140	0.361	0.348	0.357	0.359	0.304	0.314	0.365	0.355	0.448	0.197	0.450
2002	0.368	0.223	0.185	0.376	0.360	0.357	0.394	0.289	0.367	0.372	0.373	0.451	0.223	0.458
2003	0.388	0.215	0.174	0.393	0.377	0.385	0.404	0.320	0.406	0.389	0.392	0.468	0.217	0.474
2004	0.410	0.233	0.183	0.420	0.402	0.410	0.431	0.322	0.417	0.411	0.412	0.485	0.228	0.493
2005	0.422	0.170	0.114	0.434	0.404	0.403	0.466	0.341	0.409	0.422	0.411	0.504	0.172	0.517
2006	0.400	0.140	0.091	0.410	0.385	0.387	0.429	0.331	0.384	0.399	0.393	0.476	0.143	0.486
2007	0.428	0.211	0.148	0.434	0.396	0.398	0.470	0.397	0.398	0.427	0.410	0.505	0.191	0.514
2008	0.443	0.208	0.139	0.449	0.417	0.424	0.488	0.446	0.369	0.438	0.424	0.524	0.202	0.537
2009	0.442	0.156	0.090	0.449	0.415	0.420	0.479	0.444	0.389	0.437	0.419	0.518	0.154	0.531

Notes: The college premiums are estimated by cross-sectional regressions for each age group or experience group for each year with the following independent variables: a college dummy, gender, and province fixed effects. We also control for age and age square for age groups except for columns 1, 2, and 12, and experience and experience square for columns 1 and columns for experience groups. Column 2 shows the estimate for college premium for the age group 21-25 without controlling for age and experience effects. For the age group 26-50, we exclude age 50 to avoid the complication that females are usually retire at 50 in China, but we use the label 26-50 to simplify exposition. Including 50 barely changes the results. Columns 1-11 use the sample of individuals with at least a high school degree. Columns 12-14 include all workers. The years of experience variable is defined as the difference between the current year and the year in which the individual joined the labor market. The results using potential experience are similar.

Table A3 *Estimated Experience Premiums for Different Age Groups*

	College					High-school				
	26-50	26-40	30-39	40-49	50-59	26-50	26-40	30-39	40-49	50-59
Year	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
1990	0.681	0.594	0.635	0.812	0.921	0.48	0.405	0.453	0.659	0.724
1991	0.532	0.462	0.518	0.669	0.796	0.474	0.417	0.453	0.638	0.745
1992	0.542	0.475	0.513	0.663	0.691	0.466	0.41	0.438	0.617	0.73
1993	0.439	0.372	0.397	0.557	0.593	0.479	0.428	0.448	0.614	0.725
1994	0.434	0.377	0.409	0.553	0.667	0.438	0.388	0.41	0.576	0.695
1995	0.46	0.403	0.43	0.578	0.709	0.442	0.39	0.408	0.564	0.66
1996	0.443	0.399	0.427	0.533	0.677	0.448	0.394	0.416	0.566	0.666
1997	0.507	0.462	0.495	0.605	0.693	0.43	0.379	0.403	0.534	0.63
1998	0.559	0.519	0.575	0.648	0.659	0.405	0.345	0.378	0.504	0.619
1999	0.554	0.504	0.533	0.655	0.649	0.367	0.311	0.339	0.446	0.545
2000	0.475	0.436	0.48	0.581	0.658	0.355	0.308	0.339	0.423	0.602
2001	0.483	0.443	0.494	0.592	0.633	0.3	0.252	0.285	0.364	0.523
2002	0.543	0.503	0.538	0.651	0.681	0.392	0.352	0.389	0.443	0.637
2003	0.539	0.501	0.545	0.634	0.707	0.36	0.323	0.357	0.406	0.615
2004	0.525	0.483	0.528	0.613	0.703	0.333	0.298	0.331	0.376	0.576
2005	0.609	0.56	0.593	0.71	0.816	0.349	0.324	0.357	0.38	0.569
2006	0.628	0.577	0.623	0.722	0.808	0.365	0.331	0.361	0.404	0.52
2007	0.556	0.498	0.539	0.655	0.747	0.367	0.337	0.363	0.398	0.532
2008	0.552	0.505	0.553	0.657	0.751	0.331	0.31	0.336	0.361	0.463
2009	0.601	0.546	0.591	0.706	0.795	0.335	0.306	0.331	0.368	0.467

Notes: The experience premiums are estimated by cross-sectional regressions for college graduates (columns 1-5) and high school graduates (columns 6-10) for each year with the following independent variables: the experience dummy, gender, and province fixed effect. The experience dummy for the specific age group in each column is defined such that it equals 1 if an individual falls in that age group (e.g., 26-50 in column 1) and 0 if aged 21-25. For the age group of 26-50, we exclude age 50 to avoid the complication that females are usually retire at 50 in China. The results of including 50 are very similar.

Table A4 *10-Year Span vs. Cross-Sectional College Premiums*

	First 10-year span college premiums		Cross-sectional average college premiums		College premiums for age 22-31		College premiums for age 21-25	
	Coefficient	S.E.	Coefficient	S.E.	Coefficient	S.E.	Coefficient	S.E.
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
1990	0.166***	-0.026	0.089***	-0.006	0.075***	-0.023	-0.096**	-0.037
1991	0.26***	-0.027	0.101***	-0.008	0.073***	-0.02	0.024	-0.041
1992	0.259***	-0.023	0.134***	-0.009	0.119***	-0.019	0.033	-0.039
1993	0.288***	-0.025	0.142***	-0.009	0.147***	-0.017	0.149***	-0.036
1994	0.289***	-0.028	0.201***	-0.01	0.202***	-0.022	0.160***	-0.036
1995	0.35***	-0.028	0.178***	-0.009	0.181***	-0.019	0.112**	-0.047
1996	0.327***	-0.023	0.190***	-0.01	0.197***	-0.022	0.153***	-0.035
1997	0.373***	-0.025	0.233***	-0.01	0.211***	-0.025	0.135***	-0.041
1998	0.337***	-0.029	0.254***	-0.011	0.185***	-0.025	0.087*	-0.043
1999	0.363***	-0.026	0.289***	-0.011	0.209***	-0.023	0.098**	-0.047
2000	0.335***	-0.023	0.330***	-0.016	0.277***	-0.03	0.199***	-0.039

Notes: The 10-year time-span college premium in columns 1 and 2 are estimated for each cohort. Specifically, the 10-year college premium for year t represents the 10-year premium for cohort t, where t is the year a college graduate cohort enters the labor market (age 22). Take year 1990 as an example. The birth cohort of 1968, if going to college, enters the labor market in 1990. We take those born in 1968 (both college graduates and high school graduates) from the samples covering the period 1990-1999. Using this pooled sample, we run a Mincer regression, adding controls for year fixed effects to control for time effects. This regression generates the average college premium for the first 10 years after graduating from college, specific for the entry cohort of 1990 or the cohort born in 1968. College premiums in columns 3-8 are estimated using Mincer regressions for each year. If not stated, the Mincer regression controls for experience, experience square, gender, and province fixed effect. The cohort estimates for 10-year span and cross-sectional estimates for all workers are not sensitive to the choice of experience or age. Columns 3-4 use the sample of all workers between 16 and 60. Columns 5-6 (7-8) use the sample of workers aged 22-31 (21-25), and control for age (and age square) rather than experience in the Mincer regressions.

Table A5 *Simulation Parameter Values*

Parameters	Definitions	Values used in simulation	Reference or justification	Alternative values tried
σ	Elasticity of demand	2.54	Kee, Nicita, Olarreag (2008)	1.1; 7.1
n_d	Number of local firms	10	A normalization	
n_f	Number of high-productivity firms	Increases from 0 to 5; the arrival follows a normal distribution $N(7.1,4.1)$	The distribution fits best (nonlinear least squares model) on the increase in the proportion of industrial outputs produced by foreign firms.	$N(8.9,6.8)$
δ	Productivity of firms; productivity gap between the high- and medium-skilled workers	Uniform distributed on [1,1.6]	The distribution of δ and the value of α imply a college premium of 13% and an experience premium of 45% in the initial steady state, close to the real values (13% and 47%) in 1992.	[1,1.5]; [1,2]
Δ	Productivity of high-productivity firms	1.6	Upper bound of the distribution of δ	1.5; 2
α	δ^{α} is the productivity gap between the medium- and low-skilled workers	0.3	See above	0.2; 0.4
μ	Probability of staying in the labor force	0.967	Same as one minus the annual labor new entry rate from 1990 to 2010.	
η	Probability of the medium-type (m) becoming the high-type (h)	0.15	A worker is expected to become experienced in 6.7 years. The proportion of inexperienced college graduates among all college graduates ($= (1-\mu)/(\mu\eta+1-\mu)$) is 19% in equilibrium, which is close to the level in the data in early 1980.	0.1; 0.2
C	College tuition cost	0.062	The ratio of amortized 4-year college cost (twice of the tuition) to the wage of low-skilled (without a college degree) urban workers in 1990.	Varies year by year, using numbers in the data.
$G(.)$	Supply function of college graduates; distribution of effort cost of education	Normal distribution ($\mu = 0.3$, $\sigma = 0.4$)	The enrollment rate would be 69% when the lifetime college premium is 0.5.	($\mu = 0.3, \sigma = 0.3$), ($\mu = 0.4, \sigma = 0.2$)

Table A6 *Time Series Used for Simulation*

Year	The proportion of industrial output by foreign firms	The proportion of high-tech products in trade	Real GDP index (1990 =100)	The growth rate of college enrollment quota	Amortized college tuition as a % of low-skilled wage	The proportion of new entrants (age 22) in urban labor force (22-60)	Share of young college graduates (under 25) in urban labor force	Share of experienced college graduates (26-60) in urban labor force
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
1990	0.023	0.084	10	0.02	0.01	0.051	0.013	0.029
1991	0.053	0.091	10.93	0.018	0.009	0.045	0.013	0.031
1992	0.071	0.089	12.48	0.217	0.017	0.048	0.013	0.033
1993	0.091	0.105	14.22	0.225	0.04	0.042	0.013	0.035
1994	0.113	0.114	16.07	-0.026	0.043	0.04	0.013	0.037
1995	0.143	0.114	17.83	0.029	0.044	0.037	0.013	0.039
1996	0.151	0.121	19.6	0.043	0.052	0.035	0.014	0.04
1997	0.186	0.124	21.4	0.035	0.056	0.032	0.015	0.041
1998	0.243	0.153	23.07	0.084	0.063	0.03	0.015	0.042
1999	0.278	0.173	24.85	0.429	0.082	0.026	0.015	0.043
2000	0.313	0.189	26.96	0.425	0.054	0.027	0.015	0.045
2001	0.323	0.217	29.2	0.216	0.089	0.027	0.015	0.046
2002	0.334	0.243	31.85	0.195	0.095	0.026	0.016	0.046
2003	0.359	0.27	35.04	0.193	0.09	0.026	0.019	0.047
2004	0.344	0.283	38.58	0.17	0.087	0.031	0.024	0.047
2005	0.33	0.293	42.97	0.128	0.082	0.027	0.03	0.049
2006	0.315	0.3	48.43	0.082	0.073	0.026	0.036	0.051
2007	0.309	0.292	55.31	0.036	0.086	0.026	0.043	0.054
2008	0.297	0.295	60.68	0.074	0.083	0.03	0.05	0.059
2009	0.28	0.311	66.38	0.052	0.078	0.033	0.055	0.065
2010	0.271	0.304	73.41	0.035		0.031	0.058	0.074
2011	0.261	0.278	80.46	0.03		0.033	0.06	0.083
2012	0.25	0.287	86.82	0.011		0.034	0.061	0.093
2013	0.236	0.293	93.59	0.016		0.026	0.062	0.104
2014	0.236	0.282	100.52	0.031		0.025	0.062	0.115
2015	0.237	0.304	107.55	0.023		0.025	0.062	0.125
2016	0.234	0.306	114.87	0.015		0.023	0.062	0.136
2017	0.229	0.305	122.79	0.017		0.022	0.063	0.147
2018	0.218	0.307	131.02	0.039		0.019	0.063	0.158
2019	0.204	0.299	138.88	0.157		0.018	0.064	0.169
2020	0.198		142.07	0.057		0.018	0.064	0.179
Mean								
1990-2010	0.23	0.198	32.35	0.128	0.062	0.033	0.028	0.041
1990-2020	0.23	0.227	57.994	0.099	0.062	0.03	0.044	0.066

Notes: For post-2020 years (some measures start missing earlier), we usually use the number in the most recent year that is available. For the proportion of industrial output by foreign firms, the values after 2011 are predicted based on the trade share by foreign firms and the ratio between trade share and output share of foreign firms in 2011. For amortized college tuition as a percent of low-skilled wage, we consider the average wage of workers without college education, and assume that the cost of attending college is twice of the tuition expenditure, paid for 4 years, and amortized for 35 years. The size of urban labor force is calculated based on the number of urban employees and the official urban unemployment rate.