The Career Decisions of Young Men

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Outline

Introduction

- The target of the of study is to explain the observed patterns of school attendance, work, occupational choice, and wages.
- It provides structural estimates of a dynamic model of schooling, work, and occupational choice decisions.
- The starting point is the basic human capital investment theory.
- The authors find that a suitably extended human capital investment model succesfully fits to an observed data .

Introduction

- Solves an optimization problem and determines the optimal decision rules.
  - school and work decisions are not exogenous
- Isolates the quantitative effect of school attainment and occupation-specific work experience in the production of occupation-specific skills.
- Emphasize the importance of unobserved heterogeneity in production of skill and expected life time utility

Literature

- Willis and Rosen, 1979. "Education and Self-Selection." *JPE*.
- Heckman and Sedlacek, 1985. "Heterogeneity, Aggregation, and Market Wage Functions: An Empirical Model of Self-Selection in the Labor Market." *JPE*.
- Willis, 1986. "Wage Determinants: A Survey and Reinterpretation of Human Capital Earnings Functions."

This study extend the static deterministic setting of those models to one in which decision making is sequential and the endowment is uncertain.

A Basic Human Capital Model
Individual optimization problem

- At each age $a \in [16, A]$, individual chooses among five mutually exclusive alternatives:
    - work in a blue-collar occupation $(m = 1)$,
    - work in a white-collar occupation $(m = 2)$,
    - work in the military $(m = 3)$,
    - attend school $(m = 4)$,
    - engage in home production $(m = 5)$.

A Basic Human Capital Model

Return per period for occupation and occupation-specific skill technology functions for each m:

I. *Working Alternatives* $(d_m(a) = 1; m = 1, 2, 3)$

$$\begin{aligned} R_m(a) &= w_m(a) \\ &= r_m e_m(a), \end{aligned}$$

$r_m =$ occupation-specific market equilibrium rental price,
$e_m(a) =$ occupation-specific skill units possessed by the individual.

I. *Working Alternatives* $(d_m(a) = 1; m = 1, 2, 3)$(Cont'd)

The technology of skill production,

$$\begin{aligned} e_m(a) = exp[&e_m(16) + e_{m1}g(a) + e_{m2}x_m(a) - e_{m3}x_m^2(a) \\ &+ e_{m4}x_{m' \neq m}(a) + e_{m5}x_3(a) + \epsilon_m(a)], \quad m, m' = 1, 2. \end{aligned}$$

$$e_3(a) = exp[e_3(16) + e_{31}g(a) + e_{32}x_3(a) - e_{33}x_3^2(a) + \epsilon_3(a)]$$

$e_m(16)$ =the skill "endowment" at age 16,
$g(a)$ = the number of years of schooling (successfully) completed
$x_m(a)$ = work experience in that occupation,
$\epsilon_m(a)$ = occupation-specific productivity shock.

A Basic Human Capital Model

II. *Nonworking Alternatives*

a. Attending School $d_4(a) = 1$

$$R_4(a) = e_4(16) - tc_1.I[g(a) \geq 12] - tc_2.I[g(a) \geq 16] + \epsilon_4(a)$$

is the effort cost at age a which involves both monetary costs and indirect cost of schooling. The effort cost is denominated in wage units (dollars).

b. Remaining at Home $d_5(a) = 1$

$$R_5(a) = e_5(16) + \epsilon_5(a) \qquad .$$

*Occupation-specific productivity shocks are assumed to be joint normal and serially uncorrelated.

Individual's objective..

Individual knows all relevant prices and functions, and maximizes the value function as the maximum over alternative-specific value functions.

$$V(\mathbf{S}(a), a) = \max_{m \in M}\{V_m(\mathbf{S}(a), a)\},$$

where

$$\begin{aligned} \{V_m(\mathbf{S}(a), a)\} = R_m(\mathbf{S}(a), a) \\ + \delta E[V(\mathbf{S}(a+1), a+1) | \mathbf{S}(a), d_m(a) = 1], a < A \end{aligned}$$

$$\{V_m(\mathbf{S}(A), A) = R_m(\mathbf{S}(A), A)\},$$

and $\mathbf{S}(a) = \{\mathbf{e}(16),\ \mathrm{g(a)},\ \mathbf{x}(a),\ \epsilon(a)\}$.

Solution

- There is no closed form solution.
- Numerical solution is carried out by backward induction using the approximation method (Keane and Wolpin, 1994).
- The solution of the optimization problem serves as the input into estimating the parameters of the model

Estimation of the parameters
Sample Likelihood Function

- Estimation is by maximizing sample likelihood function (product of contributions).
- The contribution for the nth individual to sample likelihood function is

$$Pr[c(16), ..., c(\bar{a})|g_n(16)] = \sum_{k=1}^{K} \prod_{a=16}^{\bar{a}} \pi_{k|g_n(16)} Pr[c_n(a)|g_n(16), type = k].$$

  - There exist K types of individuals. A type k individual has endowment vector $\mathbf{e}_k(16) = \{e_{mk}(16) : m = 1, ..., 5\}$.
  - The data consists of set of choices and rewards: $c(a) = \{d_{mn}(a), w_{mn}(a)d_{mn}(a) : m = 1, 2, 3\}$ and $d_{mn}(a) : m = 4, 5\}$ for all ages a.
  - Assume that initial schooling is exogenous conditional on the age 16 endowment vector.

An Extended Model

Basically, the reward functions and skill production technology functions were augmented.

I. Work Alternatives

Skill technology functions.

- allow for a skill depreciation effect: $I[d_m(a-1)=0]$
- a first-year experience effect: $I[x_m(a)>0]$
- age effects: a linear age term a and $I[a<18]$
- high school and college graduation effects: $I[g(a)\geq 12]$ and $I[g(a)\geq 16]$

Mobility and job search costs into the reward functions.

- include a direct monetary job-finding cost if one did not work in the occupation in the previous period: $c_{m1}.I[d_m(a-1)=0]$.
- additional job-finding cost if the individual had no prior work experience in that occupation: $c_{m2}.I[x_m(a)=0]$

Nonpecuniary rewards plus indirect compensation.

- monetary-equivalent value of working conditions or indirect compensation: α_m

II. School Attendance

- Consumption value depend on age: a
- reentry cost: $rc_1.I[d_4(a-1)=0, g(a) \leq 11]$
  $rc_2.I[d_4(a-1)=0, g(a) \geq 12]$

III. Remaining at Home

- The payoff differ by age: $I(18 \leq a \leq 20)$ and $I(a \geq 21)$

Data

- 1979 National Longitudinal Surveys of Labor Market Experience (NLSY) data.
- based on the 1,400 white males in age 16 or less as of October 1, 1977. The individuals were followed from the first year they reach age 16 until 1988.
- The age of the overall sample observations varies from 16 to 26.

Results

Data and extended model provide evidence on persistence.

	Choice (t)				
Choice (t-1)	School	Home	White-Collar	Blue-Collar	Military
School:					
NLSY %	69.9				
Basic %	54.9				
Extended %	63.3				
Home:					
NLSY %		47.2			
Basic %		24.0			
Extended %		38.9			
White-Collar:					
NLSY %			67.4		
Basic %			45.9		
Extended %			64.5		
Blue-Collar:					
NLSY %				73.4	
Basic %				67.3	
Extended %				72.4	
Military:					
NLSY %					80.5
Basic %					47.6
Extended %					59.0

- skill depreciation during periods of nonwork, of mobility or job-finding costs, and school reentry costs captures the persistence.

TABLE 5

χ^2 Goodness-of-Fit Tests of the Within-Sample Choice Distribution: Dynamic Programming Model and Multinomial Probit

Age	School	Home	White-Collar	Blue-Collar	Military	Row
16:						
DP-basic	103.05*	17.10*	†	92.61*	†	213.2*
DP-extended	.00	.07	†	.15	†	.22
APP	2.00	.19	†	7.05*	†	9.24*
17:						
DP-basic	74.13*	7.37*	21.14*	54.63*	11.86*	169.15*
DP-extended	.95	.02	.28	3.31	.42	4.98
APP	.02	.00	1.78	.03	.00	1.84
18:						
DP-basic	15.02*	1.60	2.18	6.75*	1.71	27.26*
DP-extended	.03	.00	.93	.01	3.09	4.06
APP	.09	.94	3.03	.42	.17	4.65
19:						
DP-basic	35.83*	5.04*	.26	7.23*	14.41*	62.77*
DP-extended	.83	.51	.07	1.27	.34	3.02
APP	.00	.02	.01	.17	1.53	1.73
20:						
DP-basic	31.10*	6.24*	.14	.92	24.47*	62.86*
DP-extended	.16	.25	.24	.22	.22	.94
APP	.25	.01	.82	.06	.17	1.31
21:						
DP-basic	31.28*	6.54*	.01	1.46	16.61*	55.89*
DP-extended	2.91	3.50	2.45	.23	.72	9.81*
APP	.00	.65	.05	.03	.41	1.14
22:						
DP-basic	23.78*	2.94	1.01	.08	11.84*	39.66*
DP-extended	12.43*	.11	.61	3.04	.38	16.60*
APP	.12	1.49	.72	.64	1.21	4.19
23:						
DP-basic	12.63*	7.78*	2.99	2.00	3.15	28.56*
DP-extended	14.66*	.12	3.76	.42	.44	19.40*
APP	.23	.14	5.90*	.44	4.38	10.97*
24:						
DP-basic	.18	4.76*	2.28	4.61*	1.40	13.30*
DP-extended	.18	.99	.81	.04	.04	1.89
APP	1.21	2.77	2.20	.05	2.77	10.01*
25:						
DP-basic	.30	12.35*	6.21*	9.31*	1.84	30.01*
DP-extended	.14	3.45	2.71	.29	.23	6.82
APP	.01	2.98	5.00*	.61	2.56	11.16*
26:						
DP-basic	4.96*	38.64*	.17	3.13	†	46.90*
DP-extended	2.61	2.14	.45	.00	†	5.20
APP	2.84	4.95*	.10	.01	†	7.90*

Note.—The basic dynamic programming (DP-basic) model has 50 parameters, the extended dynamic programming (DP-extended) model has 83 parameters, and the approximate decision rule (APP) model has 75 parameters.

* Statistically significant at the .05 level.

† Fewer than five observations.

Importance of Unobserved Skill Heterogeneity

TABLE 7

ESTIMATED OCCUPATION-SPECIFIC PARAMETERS

	White-Collar	Blue-Collar	Military
	1. Skill Functions		
Schooling	.0700 (.0018)	.0240 (.0019)	.0582 (.0039)
High school graduate	−.0036 (.0054)	.0058 (.0054)	. . .
College graduate	.0023 (.0052)	.0058 (.0080)	. . .
White-collar experience	.0270 (.0012)	.0191 (.0008)	. . .
Blue-collar experience	.0225 (.0008)	.0464 (.0005)	. . .
Military experience	.0131 (.0023)	.0174 (.0022)	.0454 (.0037)
"Own" experience squared/100	−.0429 (.0032)	−.0759 (.0025)	−.0479 (.0140)
"Own" experience positive	.1885 (.0132)	.2020 (.0128)	.0753 (.0344)
Previous period same occupation	.3054 (.1064)	.0964 (.0124)	. . .
Age*	.0102 (.0005)	.0114 (.0004)	.0106 (.0022)
Age less than 18	−.1500 (.0515)	−.1433 (.0308)	−.2539 (.0443)
Constants:			
Type 1	8.9370 (.0152)	8.8811 (.0093)	8.540 (.0234)
Deviation of type 2 from type 1	−.0872 (.0089)	.3050 (.0138)	. . .
Deviation of type 3 from type 1	−.6091 (.0143)	−.2118 (.0144)	. . .
Deviation of type 4 from type 1	−.5200 (.0199)	−.0547 (.0177)	. . .
True error standard deviation	.3864 (.0094)	.3823 (.0074)	.2426 (.0249)
Measurement error standard deviation	.2415 (.0140)	.1942 (.0134)	.2063 (.0207)
Error correlation:			
White-collar	1.0000	. . .	. . .
Blue-collar	.1226 (.0430)	1.0000	. . .
Military	.0182 (.0997)	.4727 (.0848)	1.0000
	2. Nonpecuniary Values		
Constant	−2,543 (272)	−3,157 (253)	−.0900 (.0448)
Age	. . .	. . .	−.0313 (.0057)
	3. Entry Costs		
If positive own experience but not in occupation in previous period	1,182 (285)	1,647 (199)	. . .
Additional entry cost if no own experience	2,759 (764)	494 (698)	560 (509)
	4. Exit Costs		
One-year military experience	. . .	. . .	1,525 (151)

NOTE.—Standard errors are in parentheses.
* Age is defined as age minus 16.

TABLE 8

ESTIMATED SCHOOL AND HOME PARAMETERS

	School	Home
Constants:		
Type 1	11,031 (626)	20,242 (608)
Deviation of type 2 from type 1	−5,364 (1,182)	−2,135 (753)
Deviation of type 3 from type 1	−8,900 (957)	−14,678 (679)
Deviation of type 4 from type 1	−1,469 (1,011)	−2,912 (768)
Has high school diploma	804 (137)	. . .
Has college diploma	2,005 (225)	. . .
Net tuition costs: college	4,168 (838)	. . .
Additional net tuition costs: graduate school	7,030 (1,446)	. . .
Cost to reenter high school	23,283 (1,359)	. . .
Cost to reenter college	10,700 (926)	. . .
Age*	−1,502 (111)	. . .
Aged 16–17	3,632 (1,103)	. . .
Aged 18–20	. . .	−1,027 (538)
Aged 21 and over	. . .	−1,807 (568)
Error standard deviation	12,821 (735)	9,350 (576)
Discount factor	.9363 (.0014)	

NOTE.—Standard errors are in parentheses.
* Age is defined as age minus 16.

- Type proportions are conditioned on two values of initial schooling: $g(16) = \{7, 8, 9\}$ or $g(16) = \{10, 11\}$
- There exists 4 types of individuals.

Estimated Type Proportions

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TABLE 9

ESTIMATED TYPE PROPORTIONS BY INITIAL SCHOOLING LEVEL AND TYPE-SPECIFIC ENDOWMENT RANKINGS

	Type 1	Type 2	Type 3	Type 4
Initial schooling:				
Nine years or less	.0491 (· · ·)	.1987 (.0294)	.4066 (.0357)	.3456 (.0359)
10 years or more	.2343 (· · ·)	.2335 (.0208)	.3734 (.0229)	.1588 (.0183)
Rank ordering:				
School attainment at age 16	1	2	3	4
White-collar skill endowment	1	2	4	3
Blue-collar skill endowment	2	1	4	3
Consumption value of school net of effort cost	1	3	4	2
Value of home production	1	2	4	3

NOTE.—Standard errors are in parentheses.

- Type differs in initial schooling levels.
- Only 5 percent of type 1 has less than 10 years of schholing.
- Type 1's are the most productive in each but blue-collar

TABLE 12

Expected Present Value of Lifetime Utility for Alternative Choices at Age 16 and at Age 26 by Type ($)

	All Types	Type 1	Type 2	Type 3	Type 4
	Initial Schooling 10 Years or More				
School:					
Age 16	321,008	415,435	394,712	228,350	289,683
Age 26	384,352	499,162	494,107	272,985	314,708
Home:					
Age 16	298,684	380,660	376,945	207,768	274,901
Age 26	426,837	611,167	516,547	291,932	338,653
White-collar:					
Age 16	293,683	372,544	372,733	207,586	262,370
Age 26	439,970	637,616	528,107	303,228	338,967
Blue-collar:					
Age 16	296,736	373,156	377,618	210,699	266,206
Age 26	438,240	617,873	534,578	305,641	342,195
Military:					
Age 16	285,686	350,655	356,202	210,461	261,944
Age 26	415,374	581,996	492,531	298,431	329,938
Maximum over choices:					
Age 16	321,921	415,503	396,108	229,265	291,122
Age 26	445,488	638,820	537,226	308,259	346,695
	Initial Schooling Nine Years or Less				
School:					
Age 16	273,186	387,384	371,369	211,942	276,040
Age 26	308,808	564,590	446,163	243,734	274,979
Home:					
Age 16	260,668	352,274	360,495	197,288	268,047
Age 26	334,643	578,637	468,465	268,815	305,262
White-collar:					
Age 16	253,764	342,833	354,261	196,294	253,686
Age 26	339,093	602,915	474,796	277,488	300,917
Blue-collar:					
Age 16	257,720	343,873	359,370	199,945	257,697
Age 26	344,179	583,895	486,456	282,223	305,520
Military:					
Age 16	251,710	322,293	340,126	199,737	254,386
Age 26	328,916	550,521	447,443	275,660	295,996
Maximum over choices:					
Age 16	275,634	387,384	374,154	213,823	286,311
Age 26	347,741	604,549	487,466	284,073	310,598

Note.—Based on a simulation of 5,000 persons.

- on the basis of the simulated data, the between-type variance in expected lifetime utility is calculated to account for 90 percent of the total variance.

TABLE 13

Relationship of Initial Schooling and Type to Selected Family Background Characteristics

	Initial Schooling Nine Years or Less and Person Is of Type				Initial Schooling 10 Years or More and Person Is of Type					Expected Present Value of Lifetime Utility at Age 16
	1 (1)	2 (2)	3 (3)	4 (4)	1 (5)	2 (6)	3 (7)	4 (8)	Observations (9)	(10)
All	.010	.051	.103	.090	.157	.177	.289	.123	1,373	307,673
Mother's schooling:										
Non–high school graduate	.004	.099	.177	.161	.038	.141	.276	.103	333	286,642
High school graduate	.011	.043	.086	.071	.143	.210	.305	.131	685	309,275
Some college	.023	.021	.043	.058	.294	.166	.263	.133	152	328,856
College graduate	.007	.005	.049	.023	.388	.151	.222	.154	142	339,593
Household structure at age 14:										
Live with mother only	.001	.062	.133	.119	.123	.137	.297	.128	178	296,019
Live with father only	.026	.037	.088	.120	.062	.180	.378	.106	44	291,746
Live with both parents	.011	.049	.097	.082	.169	.184	.284	.124	1,123	310,573
Live with neither parent	.0001	.090	.154	.184	.037	.175	.275	.085	28	290,469
Number of siblings:										
0	.002	.041	.086	.092	.142	.227	.285	.126	50	310,833
1	.002	.029	.064	.051	.236	.199	.287	.133	261	320,697
2	.016	.048	.104	.063	.191	.157	.275	.146	364	311,053
3	.013	.056	.119	.090	.147	.182	.288	.104	320	306,395
4+	.009	.067	.117	.141	.081	.171	.303	.111	378	296,089
Parental income in 1978:										
$Y \leq$ ½ median*	.002	.078	.155	.181	.071	.132	.221	.161	214	292,565
½ median $< Y \leq$ median	.007	.053	.120	.103	.103	.173	.328	.113	382	296,372
Median $\leq Y \leq 2 \cdot$ median	.015	.044	.071	.051	.177	.204	.304	.134	446	314,748
$Y \geq 2 \cdot$ median	.014	.025	.024	.021	.479	.167	.182	.087	83	358,404

* Median income in the sample is $20,000.

- Regression of expected life time utility on family background at age 14 explained only 10 percent of the variance in the expected life time utility value.

Conclusion

- The augmented human capital investment model does a good job of fitting the data.
- Main channels are skill depreciation during periods of nonwork, of mobility or job-finding costs, of school reentry costs.
- unobserved heterogeneity at age 16 accounts for 90 percent of variation in lifetime utility.
- It is crucial to understand the source of endowment heterogeneity..

Thanks!

Effect of college tuition subsidy

TABLE 14

EFFECT OF A $2,000 COLLEGE TUITION SUBSIDY ON SELECTED CHARACTERISTICS BY TYPE

	All Types	Type 1	Type 2	Type 3	Type 4
Percentage high school graduates:					
No subsidy	74.8	100.0	68.6	70.2	67.0
Subsidy	78.3	100.0	73.2	74.0	72.2
Percentage college graduates:					
No subsidy	28.3	98.7	11.1	8.6	19.5
Subsidy	36.7	99.5	21.0	17.1	32.9
Mean schooling:					
No subsidy	13.0	17.0	12.1	12.0	12.4
Subsidy	13.5	17.0	12.7	12.5	13.0
Mean years in college:					
No subsidy	1.34	3.97	.69	.59	1.05
Subsidy	1.71	3.99	1.14	1.00	1.58

NOTE.—Subsidy of $2,000 each year of attendance. Based on a simulation of 5,000 persons.

TABLE 15

DISTRIBUTIONAL EFFECTS OF A $2,000 COLLEGE TUITION SUBSIDY

	Type 1	Type 2	Type 3	Type 4
Mean expected present value of lifetime utility at age 16:				
No subsidy	413,911	391,162	225,026	286,311
Subsidy	419,628	392,372	226,313	288,109
Gross gain	5,717	1,210	1,287	1,798
Net gain:				
Subsidy to all types*	3,513	−994	−917	−406
Subsidy to types 2, 3, and 4†	−1,134	76	153	664
Subsidy to types 3 and 4‡	−862	−862	425	936

* The per capita cost of the subsidy program is $2,204.
† The per capita cost of the subsidy program is $1,134.
‡ The per capita cost of the subsidy program is $862.

Estimation Results

Within- and out-of-sample fit of choice patterns based on a simulation of 5,000 individuals

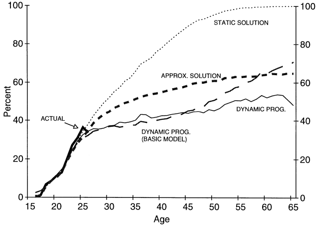

FIG. 1.—Percentage white-collar by age

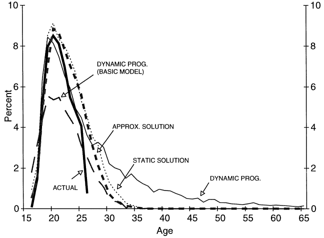

FIG. 3.—Percentage in the military by age

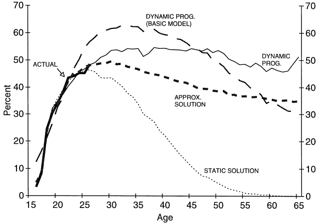

FIG. 2.—Percentage blue-collar by age

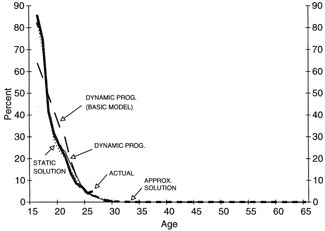

FIG. 4.—Percentage in school by age

Estimation Results

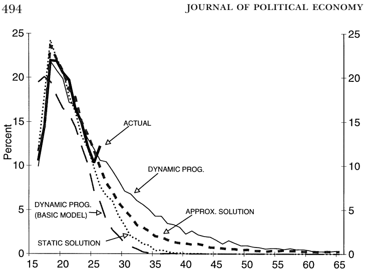

Fig. 5.—Percentage at home by age

- Decrese in schooling is more prominent in the extended model.
- In the basic model, steep wage offer-experience gradient outside of the sample.
- Average wage of white collar workers by age 50 estimate is $181, 834 in the basic model, $48, 497 in the extended model.
- For blue collar, the estimate is $169, 376 vs. $42, 222.

TABLE 6

WITHIN-SAMPLE WAGE FIT

	White-Collar				Blue-Collar			
	NLSY*	DP-Basic	DP-Extended	Static	NLSY†	DP-Basic	DP-Extended	Static
Wage:								
Mean	19,691	17,456	19,605	19,688	16,224	16,230	15,805	15,914
Standard deviation	12,461	10,324	12,091	13,664	8,631	8,437	8,431	9,837
Wage regression:								
Highest grade completed	.095	.033	.090	.091	.048	.006	.047	.056
	(.007)‡	(.007)	(.006)	(.007)	(.008)	(.006)	(.006)	(.007)
Occupation-specific experience	.103	.017	.080	.123	.096	.082	.078	.108
	(.009)	(.011)	(.012)	(.010)	(.005)	(.004)	(.004)	(.005)
Constant	8.33	9.15	8.44	8.22	8.80	9.25	8.84	8.54
	(.102)	(.087)	(.080)	(.100)	(.096)	(.069)	(.078)	(.082)
R^2	.213	.021	.182	.172	.150	.117	.104	.142
Observations	1,509	1,605	1,685	1,698	3,143	4,013	3,761	3,772

* Three wage outliers of over $250,000 were discarded. The only important effect was to reduce the wage standard deviation significantly.
† Two wage outliers of over $200,000 were discarded. The only important effect was to reduce the wage standard deviation significantly.
‡ Heteroskedasticity-corrected standard errors are in parentheses.

- Predicted and actual mean and standard deviations are similar.
- a two-variate regression based on simulated data produced from the basic model suggests that the basic model dose not replicate the wage-education and wage-experience relationship

Parameters

	Skill Functions		
	White-Collar	Blue-Collar	Military
Schooling:			
Basic %	9.4	1.9	4.4
Extended %	7.0	2.4	5.8
First year experience:			
Basic %	11.7	14.3	33.9
Extended %	21.5	24.7	12.0
Experience:			
Basic %	11.7-0.05x_1	14.2-0.18x_2	33.9-2.99x_3
Extended %	2.7-0.8x_1	4.6-0.16x_2	4.5-0.1x_3