Further Evidence of Cohort Size Effects on Earnings: The Case of Taiwan*

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I. Introduction

Recently Berger (1983), Freeman (1979), and Welch (1979) have discussed the effects of changes in labor force age composition on age-earnings profiles for the United States. They present evidence which supports the idea that rapid increases in the proportion of young workers, due to the entry of peak baby-boom cohorts into the labor market is associated with a reduction in their relative earnings, especially for college graduates in the United States. Martin (1982) also finds that, in Japan, the size of young workers relative to old workers would affect their relative wage ratio.

A possible and plausible explanation of these findings is that, as far as production is concerned, workers with different attributes such as educational attainment and work experience are not perfect substitutes for each other, therefore the earnings of a certain type of labor will be adversely affected by its size, relative to those of the others. Another possible explanation is offered by Welch (1979), who argues that the abrupt now-you-are-in-now-you-are-out implication of the imposed rigid age demarcations in production function's analysis is unappealing from the point of view of human capital theory. He points out that a work career

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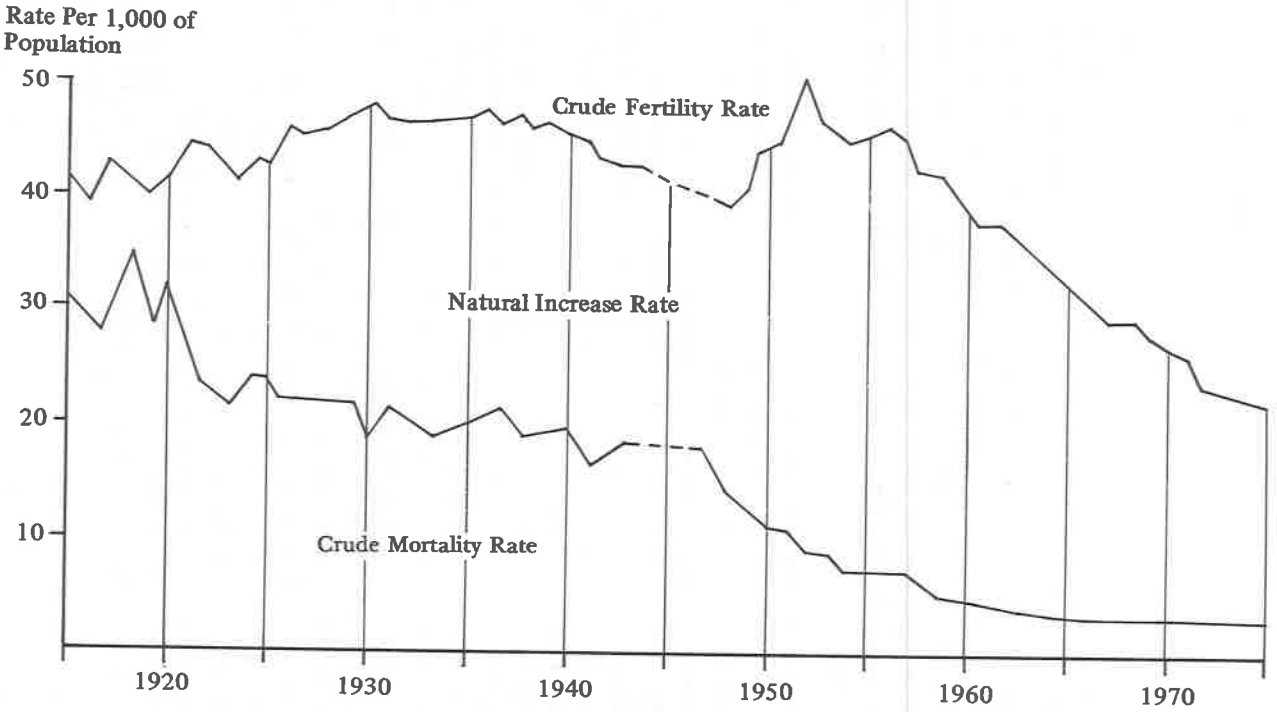
Figure 1

VITAL RATES IN TAIWAN, 1915-74



Source: Cho (1979), p. 118.

post-war "baby boom" period have reached child-bearing age. This ripple from the high post-war fertility rate significantly affects the current population age distribution. The total fertility rate suddenly rose to 3.08 in 1976, and the rate of decline in fertility has slowed down thereafter.

Selected age composition data of the male population ages 15-65 are presented in Table 1. The figures in the table indicate the dynamic impact of the high post-war fertility rate on the age composition of the population. For instance, the proportion of males 15-19 in the male population of working age, 15-65 years, started to grow in 1964; reached its peak around 1969, sustained a high ratio of 0.22 in the years 1969-74, and then declined. Thus, the entry of "baby boom" cohorts into the working age category reached its zenith around 1969 and was sustained to 1974.

Table 1

AGE COMPOSITION OF MALE POPULATION OF AGES 15-65 IN TAIWAN, 1969-79

Unit: %

Ages	1960	1964	1969	1974	1979
15-19	16.7	16.7	22.6	22.1	18.8
20-24	10.8	9.5	7.3	10.4	11.0
25-40	39.7	39.7	35.1	32.3	34.0
40-54	25.1	25.7	25.5	25.8	24.9
55-59	4.7	4.9	5.6	5.2	6.6
60-65	3.1	3.6	3.9	4.1	4.6
Total	100.0	100.0	100.0	100.0	100.0

Source: Directorate-General of Budget, Accounting & Statistics, Executive Yuan, the Republic of China, *Quarterly Report on the Labor Force Survey in Taiwan*, various issues.

III. Taiwan's Labor Market Institutions

Some economists argue that large labor cohorts would tend to

In general, Taiwan is very much a market economy in terms of the manner in which job placements and wage determinations are made. Thus, institutional factors in Taiwan's labor market seem to be less important in the determination of wages, as compared to Japan's labor market.

Thus, it can be seen that Taiwan is a developing country nicely appropriate for an analysis of demographic effects on the earnings structure, as it has experienced the peak entry of large postwar birth cohorts into the labor market from the mid-1960s to the mid-1970s. Our data for the analysis are mainly drawn from the government-conducted Survey of Family Income and Expenditures, which is a systematic, stratified, and random sample of all households and household members in Taiwan area. The sampling ratio was 3/1,000 for 1976 and 1/1,000 for 1966 and 1981 with a sample error of less than 5 percent.

IV. Specification of Regression Analysis

Here we estimate the labor earnings for the male workers in each education group based on the earnings data of 1966, 1976 and 1981, in order to examine the relation between the age-earnings profiles and the labor force age composition across education groups at different stages of development in Taiwan. The equation is specified as follows.

$$\ln W_x = a_0 + a_1 \ln L(x) + a_2 S \cdot \ln L(x) + a_3 x + a_4 x^2 + a_5 DA$$

$$+ a_6 DM + a_7 X \cdot DA + a_8 X \cdot DM + \text{errors}$$

where

W_w = annual labor earnings in New Taiwan Dollars (NT$) for those who have x years of potential working experience.

x = years of potential labor market experience including military experience = age-schooling years-6.

L(x) = weighted cohort size of workers having x years of

dingly so as to sum to 1 (see Welch, 1979).

In order to allow the elasticities of earnings with respect to cohort size to vary over experience levels, the interaction term between S, the early career spline function, and (lnL (x)) is included in the equations, since the effect of cohort size of very young workers in their early careers could be greater. That is, their substitutability for older workers in production might increase as their experience grows. The wage elasticities with respect to relative cohort size hence are formulated as follows:

$$\frac{\partial \ln W_x}{\partial \ln L(x)} = \begin{cases} a_1 + a_2 S & \text{if } x \leqslant \bar{x} \text{ (early career stage level)} \\ a_1 & \text{if } x > \bar{x} \text{ (persistent level)} \end{cases}$$

where S is the early-career spline function and is equal to max (0, $1-x/\bar{x}$). The elasticity begins with a value of $(a_1 + a_2)$ at the entry level ($x=0$) and then declines linearly at a rate of $(-a_2/\bar{x})$ to the permanent level of a_1 in the x-th year of experience. The spline function captures the differences in the wage elasticities for different career stages, which otherwise would have to be represented by a number of dummy variables. After trying alternative values of $\bar{x}$ (the duration of the initial effects of cohort size) for the five education groups of Taiwan's male labor force, we have chosen particular values of $\bar{x}$ which maximize the value of R^2 (one degree of freedom is lost as a result). The chosen $\bar{x}$'s are 4, 6, 9, 10 and 10 (rounded to integers) for primary school, junior high school, senior high school, senior vocational school, and college groups respectively, for 1981. For 1976, the figures are 4, 6, 8, 9, 11 , and for 1966, 4, 4, 4, 4, 5. These findings of $\bar{x}$'s values apparently indicate that economic development indeed extends the initial training period for most labor market entrants as the production technology gradually upgrades. If the effects of cohort size on earnings are statistically significant for young workers in the early career stage, the increased $\bar{x}$ values imply that the duration of initial effects of cohort size has been prolonged by the progress of economic development.[1] The empirical evidence in the

[1] To say that duration of cohort size effects has been prolonged over time can mean two different things. One is that the x's have increased over the years, another is that the cohort size effects at the persistent level (i.e., when x x) were not significant for earlier years but became significant later. Here we are only referring to the first meaning.

Table 2

EFFECTS OF COHORT SIZE ON THE EARNINGS STRUCTURE
(Dependent Variable = Ln (earnings))

Explanatory Variables	Primary School		
	1966	1976	1981
X	0.0843***	0.0649***	0.0194***
	(0.0093)	(0.0101)	(0.0034)
X^2	-0.0014***	-0.0013***	-0.0004***
	(0.0002)	(0.0002)	(0.0001)
L(x)	0.1068	-0.1449**	-0.1495***
	(0.0905)	(0.0703)	(0.0235)
S·L(x)	-1.2775***	-0.1200***	-0.2864***
	(0.4558)	(0.0271)	(0.07349)
DM	0.0454	-0.2175***	-0.0677***
	(0.1256)	(0.0537)	(0.0180)
	[0.0382]	[-0.1966]	[-0.0656]
DA	-0.7743***	-0.7389***	-0.5180***
	(0.1263)	(0.0595)	(0.04340)
	[-0.5426]	[-0.5232]	[-0.4048]
X·DM	0.0007*	0.0070***	0.0012**
	(0.0004)	(0.0020)	(0.0005)
X·DA	-0.0076*	-0.0085**	0.0001
	(0.0043)	(0.0021)	(0.0011)
Constant	8.5282	11.0721	10.9425
R^2	0.4612	0.4146	0.2486
F	174.7839	351.1898	349.8200
n	1625	3956	8433

* Significant at 10% level
** Significant at 5% level
*** Significant at 1% level

Table 2. (Continued)

Explanatory Variables	Senior Vocational-High School		
	1966	1976	1981
X	0.0617***	0.0689***	0.0246***
	(0.0183)	(0.0090)	(0.0085)
X^2	-0.0011***	-0.0013***	-0.0006***
	(0.0004)	(0.0003)	(0.0001)
L(x)	0.0143	0.0190	-0.1045***
	(0.0937)	(0.0962)	(0.0369)
S·L(x)	-2.9753**	-0.0771***	-0.1662***
	(1.517)	(0.0300)	(0.0382)
DM	-0.0157	-0.0159	-0.1139***
	(0.1481)	(0.0623)	(0.0441)
	[-0.0263]	[-0.0177]	[-0.1085]
DA	-0.0954	-0.3233**	-0.5849***
	(0.3495)	(0.1518)	(0.1196)
	[-0.1047]	[-0.2845]	[-0.4468]
X·DM	0.0076	0.0020	0.0036*
	(0.0087)	(0.0035)	(0.0021)
X·DA	0.0213	-0.0180*	0.0070
	(0.0207)	(0.0096)	(0.0047)
Constant	9.4718	10.5348	12.3170
R^2	0.4243	0.3660	0.2161
F	14.3077	60.7534	45.8739
n	237	829	1303

Table 2. (Continued)

Explanatory Variables	College		
	1966	1976	1981
X	0.0541***	0.0575***	0.0283***
	(0.0141)	(0.0106)	(0.0048)
X^2	-0.0008***	-0.0011***	-0.0006***
	(0.0002)	(0.0002)	(0.0001)
L(x)	-0.1561	0.0905**	-0.0376*
	(0.1361)	(0.0423)	(0.0212)
S·L(x)	0.9247	-0.0500	-0.0572***
	(0.8321)	(0.0422)	(0.0149)
DM	0.6665***	0.1542**	-0.0222
	(0.1654)	(0.0644)	(0.0157)
	(0.9210]	[0.1643]	[-0.0221]
DA	N.a.	0.8777	-0.2351**
		(0.9337)	(0.1099)
		[0.5555]	[-0.2143]
X·DM	-0.0108	-0.0024	0.0037***
	(0.0085)	(0.0036)	(0.0009)
X·DA	N.a.	-0.2722*	-0.0031
		(0.1623)	(0.0060)
DC	-0.1440	-0.1493***	-0.1935***
	(0.1786)	(0.0607)	(0.0287)
	[-0.1478]	[-0.1403]	[-0.1763]
X·DC	-0.0003	-0.0010	0.0006
	(0.0087)	(0.0030)	(0.0014)
Constant	9.7922	11.2273	12.3185
R^2	0.2871	0.1554	0.21369
F	19.2980	21.2836	60.5737
n	254	1214	2189

rapidly grows, (the average annual growth rae of real GNP has been 9.7 percent for 1966-1976, and 8.3 percent for 1977-1981), the effects have apparently spreaded in their scope of coverage.

Secondly, from the lower part of Table 3 which indicates the persistent effects of cohort size on earnings, it is clear that the effects are not significant for any of the five groups in 1966. The situation changes a little bit in 1976 when the elasticity for the primary school group becomes significant, although that for the college groups becomes significant with a wrong sign. In 1981, however, all elasticities are significant with the correct signs.

Thirdly, we learn earlier that the values of $\bar{x}$'s have increased a great deal between 1966 and 1976. We are interested of course only in the significant coefficients of the term $S \cdot \ln L(x)$ in the regression. From Table 2, in 1966 only the primary and the senior vocational school groups have significant cohort size effects for this term. Since the value of $\bar{x}$ remains the same for the former, but it increases from 4 to 9 for the later group from 1966 to 1976, we see that for the senior vocational school graduates, the duration of cohort size effects has been prolonged in the sense that $\bar{x}$ becomes higher.[5]

An over-all picture has therefore emerged. It seems that in Taiwan, the effects of cohort size on earnings are shorter in duration and significant only for lower education groups at its earlier stage of development. Then, as the economy grows, the effects become longer in duration and applicable to workers at all education levels.

This interesting and significant phenomenon certainly deserves economists' major attention. A full explanation may not be forthcoming without great efforts in future studies. We do not intend to solve the puzzle here but will offer a conjecture. Could the phenomenon be a result of the dynamic gap between labor demand and supply? That is, in the 1960s, when the Taiwanese economy was growing at its fastest, the demand for all types of labor must have been very strong. The supply of labor undoubtedly was quickly increasing during this same period of time but

[5] As a possible test of whether the increase in x is "significant," we re-run the 1966 equation with x set at 9 (the 1976 level) for this education group. It turns out that the coefficient is no longer significant. This method is suggested to us by an anynomous reader.

(Table 3; row 2, column 2). Applying similar reasoning, we see that the baby-boom effect is significant for all education groups (Table 3; rows 2 and 3, columns 3 and 4; row 3, column 5) for the early career stage.

Next we come to the persistent level as these baby-boom cohorts moved on. Here, too, the effects are significant for the primary and junior high school groups (Table 3; rows 5 and 6, column 1; row 6, column 2). For the senior and vocational high school groups, by 1981 the baby-boom cohorts were just about to pass their early career stage, so the elasticities at row 6 and columns 3 and 4 at least partially give support to the cohort size effects. Finally, for the college group, it is still too early to tell whether the effects exist at the persistent level.

So we have seen that the baby-boom cohorts do carry with them a series of cohort size effects for all education groups. This observation further strengthens the importance of cohort size and is consistent with our conjecture.

Two additional points are worth making before we leave this section.

First, in 1976 at the persistent level, the cohort size effect of the college group is significantly positive. This can also be explained by the dynamic gap phenomenon referred to above. Given that the early career stage lasts for about ten years for college graduates, people who by 1976 have passed this stage are those who were born in around 1944 and entered primary school in about 1950. They are therefore among the first batch of college level elite workers who accepted a complete set of post-war, post-colonial modern education from the primary school and on. It seems that the increases in the demand for them, relative to that for the older college graduates, more than offset the increases in their supply. Not as fortunate are their successors, because only three years later in 1947, the baby-boom age started and the crude fertility rate quickly reached its climax in 1952 (Fig. 1). No wonder by 1981 at the persistent level, the cohort size effect is already significantly, though weakly, negative for college graduates.

Secondly, Table 2 shows that the dummy variables of labor market characteristics are more likely to be significant for groups with lower educational attainments. In particular, agricultural

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