Institute of Economic Development and Research
SCHOOL OF ECONOMICS
University of the Philippines

Discussion Paper No. 68-35 December 19, 1968

# THE SUPPLY OF PROFESSIONAL DEGREES IN THE UNITED STATES

by

*Edita Abella Tan*

# THE SUPPLY OF PROFESSIONAL DEGREES IN THE UNITED STATES

by

*Edita Abella Tan*

## Introduction:

This paper will try to analyze the factors that individuals consider when choosing a field of specialization once they have decided to pursue a university degree---bachelors, master and Ph.D.---. This choice of a field of specialization at each level of degree sought is formally treated as an investment decision. To be realistic, the investment model presented specifies the investment alternatives that are relevant to a decision-maker of given personal characteristics and academic ability. Also the assumption of certainty about future returns will be discarded. Instead some bases for estimating future returns are suggested.

This investment model differs from the more general models presented in the past which dealt with the options to pursue or not to pursue a given level of degree and to invest in non-human capital. For instance, Becker's calculation of the rate of return to high school and college education implies that these are the options open to individuals who are deciding to acquire education. It will be noted from Table A.7 in the appendix that the discounted income stream

from education by level differ as widely as the discounted income stream from education by field of specialization at each level. One can be better off not only by completing a degree but by choosing that field which gives the highest rate of return. On the other hand there are factors other than those which investment in education theories consider that influence the decision to pursue college education. Some of these factors are discussed below.

Differences in ability and in personal interest or specific aptitude in various types of work are among the most important of these factors. Economists would instinctively call the latter "taste". The analysis and treatment of these factors is explained in Part I.

The absence of lending institutions for education except the small loan programs provided by the schools themselves makes it impossible to treat investment in education on the same basis as investment in non-human capital.

A high proportion of degree holders come from the more educated and higher-income families. This fact may mean that there is a heavy reliance on the family for support of one's education unless the student decides to be self-supporting by working part-time while in school. The more educated families which also have higher income are probably better informed about educational facilities and the relative

cost-benefits of higher education at each level and field. Intuitively, we might say that occupational identification of children is related to their parents' education and socio-economic class. In fact, survey studies by James Davis[1] and Dael Wolfle[2] show that there is a significant and positive correlation between the parents' education and income and the number of school years completed by their children.

It is also found that those with college education have a higher average academic ability as measured by the Army General Classification Test (AGCT) or by Average Proficiency Index (API) which is the cumulative grade point average, than those who completed high school or less education. Indeed, the higher the level of education completed, the higher the average academic ability of the population.[3] There is a minimum academic requirement to qualify for college work which a portion of the high school graduates do not meet. To these graduates, investment in college education is not a relevant alternative.

When the socio-economic background and personality differences of the people eligible for college plays an important role in individual decision to pursue a degree,

---

[1]James Davis, *Career Aspiration* (National Opinion Research Center, University of Chicago Press).

[2]Dael Wolfle, *America's Resources for Specialized Talent* (Harper and Row).

[3]See Table I.2 on page 12.

we are then confronted with the question of whether a less than optimum optimurum solution is attainable in the investment market for education. If the decision to pursue a degree is significantly influenced by socio-economic background, personality differences and by the unavailability of credit for education, the investment in education may never reach an optimum equilibrium solution where the present values in all the investment alternatives are equal. However, a second best solution is still possible to attain within a specified group of alternatives and after the decision to acquire a degree in any one of the relevant fields has been made. In the latter case, the full implications of capital market imperfections are avoided when the analysis is limited to the choice of field only and not to the choice of field and degree together. The main problem here is the identification of the relevant alternatives or fields that a student of given personal characteristics faces. This problem is discussed in Part I. The method used is to find common characteristics of individuals in various professions and

ordinary investment criteria cannot be generalized to govern investment decision in education such that we can count as alternatives investment in non-human capital, investment in various levels of degree and investment in particular fields at each level considered. The alternatives will not apply to everybody.

We are then confronted with the question of whether a less than *optimum optimurum* solution is attainable in the investment market for education. If the decision to pursue a degree is significantly influenced by socio-economic background, personality differences and by the unavailability of credit for education, the investment in education may never reach an optimum equilibrium solution where the present values in all the investment alternatives are equal. However, a second best solution is still possible to attain within a specified group of alternatives and after the decision to acquire a degree in any one of the relevant fields has been made. In the latter case, the full implications of capital market imperfections are avoided when the analysis is limited to the choice of field only and not to the choice of field and degree together. The main problem here is the identification of the relevant alternatives or fields that a student of given personal characteristics faces. This problem is discussed in Part I. The method used is to find common characteristics of individuals in various professions and

consider these as the relevant alternative occupations that a student of the same characteristics may choose from.

Part II will present the model of investment introduced above. As a corollary, a supply function of degrees by field at each level is derived from the analysis of individual decision: the labor and investment markets adjustments are also analyzed. Methods of estimating expected income are suggested.

Part III gives different methods of estimating expected income.

Part IV will compare the results of the statistical test of the model on U.S. aggregate data and those based on the graduates of California's extensive public institutions of higher learning. The other aim of these tests is to show the difference in the behavior of students under a system of more heavily subsidized education to those in the nation as a whole. The results obtained would have some policy implications on the contribution of public education to the adjustment of supply to the demand for specific skills.

Part V gives the conclusion and Part VI contains the data and their sources and how some were derived.

Part I - Personal Characteristics and the Investment Alternatives

This section considers two inter-related questions: (1) What personality characteristics significantly affect a person's decision to pursue education of a given level and field; and (2) observing that people differ in personality traits, what education alternatives are relevant to individuals of certain characteristics.

Differences in ability - general academic ability and special aptitude - and personal interests have been found to be the most important non-economic variables considered in the choice of specific professional training. Psychologists have observed that specific aptitudes for some work activities are closely related to interest in the same activities. This fact is observed among students majoring in fields where they have had the highest proficiency.

Tideman's study of career choices made by students of different ages showed that the very young were apt to choose fields wherein they could strongly identify with someone they highly respected. On the other hand, the older students consistently showed interest in occupations in which they had special aptitudes. Other studies support Tideman's observations. Economists would agree with these studies for economic and non-pecuniary benefits will be maximized by developing

one's special talents rather than his weaker ones, everything else being equal.

Other works on occupational psychology show a pattern of interest and aptitude for a group of professions, but the pattern of interest-aptitude differs among *groups* of professions. Persons engaged in professions belonging to a group possess a common dominant interest-aptitude different from the interest-aptitude observed in other groups of occupations. Because of these differences in the interest-aptitude patterns in various groupings of professions, the professional fields as a whole will not have equal appeal to a student of given personal characteristics. He is likely to choose a field of specialization from a group of professions whose interest-aptitude pattern coincide with his own. His choice is limited to the professions in the group, rather than to all professions.

The formal training preparatory to entry into each professional field is considered an investment alternative. And the fields of specialization corresponding to the professional fields within a group are the relevant investment alternatives of students who have the required ability and interest.

The most recent study and one which is both consistent with patterns evolved earlier by other psychologists

and easily adapted to this study is the occupational grouping of Ann Roe.[4] Miss Roe classified occupations into the following groups, ranking the occupations in each group by degrees of responsibility, capacity and skill:

GROUP I. SERVICE. The outstanding characteristics of this group is the fact that personal interactions are a predominant interest, and that the character of this interest is succorant and nurturant, or if it has dominating elements they are usually restrained. Persons in this Group tend to be high in religious and social values, low in others, and to be markedly feminine. They usually have relatively few intellectual and artistic interests, and at the lower levels may be lower on general intelligence than the average of all Groups. At the upper levels, there is probably some emphasis on verbal abilities.

GROUP II. BUSINESS CONTACT. This Group shares with the preceding a dominant interest in personal relations, but the nature of the relationship is quite different, being exploitative rather than nurturant. They are high in dominance scores on tests, and high Kuder Persuasive scores are particularly characteristic. They, too, lack intellectual and aesthetic interests for the most part.

GROUP III. ORGANIZATION. Like both preceding groups, this Group is generally nonartistic and nonintellectual. Personal relationships are frequently important, and both poles of the dominance-submission relation appear. In general economic values are given high importance, and persuasive scores may also be high in the upper Levels. Clerical interests are of more importance in this Group than in any of the others, and a factor in many of these occupations. This very large Group also includes many persons without marked personality deviations.

GROUP IV. TECHNOLOGY. In this Group interest in personal interactions is generally low, perhaps at the lowest for all the Groups, although Group V may be about the same in this respect and Group VI is not much above it. There are marked intellectual interests in the upper Levels of this Group, but these are distinctively quantitative and spatial

---

[4]Ann Roe, *The Psychology of Occupations*, (John Wiley and Sons, Inc., New York, 1956), pp. 86.

rather than verbal. Mechanical aptitudes and interests are of greater significance in this Group than in any of the others. Artistic interests and values are low, and masculinity ratings are high. Persons in this Group seem to have an object-orientation of interests which has generally characterized them throughout life, and the lack of interest in or necessity for personal interaction is not necessarily defensive.

GROUP V. OUTDOOR. Information on persons in this Group is very scanty. One would judge that intellectual and artistic interests are generally lacking and that mechanical abilities and interests may be common, but less important than in Group IV. We have already noted that persons in this Group tend to come from family backgrounds of the same sort.

GROUP VI. SCIENCE. Intellectual interests and abilities are strongest in this Group and the next, and the patterning of verbal and non-verbal interests are not important. For many of this Group the orientation is away from persons as it is in Group IV, but there is reason to think that with some in the Group it may be defensive. A few in this Group, however, are very directly interpersonally oriented, as the psychologists and anthropologists, but the nature of this orientation is rather different from that in Group I. (It is possible that it would be more enlightening to sub-divide this Group further, perhaps into physical, biological, and social sciences, but for the time being the present arrangement seems adequate.)

GROUP VII. GENERAL CULTURAL. This is the most verbally oriented Group, and their interest in persons is again of a somewhat different sort, though similar to that held by those in Group VI of whom such an orientation is also true. It is probable that these persons are considerably higher in dominance than many in Group I. Artistic interest may be of some importance with a few in this Group; intellectual interests are generally strong.

She also lists the occupations falling under each group. This list is found on Table I.1.

---

Source: Ann Roe, *ibid.*, pp. 316-318.

Table I.1

Interest Factors and Classification of Occupation

| I. Service | II. Business Contact | IV. Engineering | V. Outdoor | VI. Sciences | VII. General and Cultural | VIII. Arts and Entertainment |
|---|---|---|---|---|---|---|
| 1. Social work | 1. Business & commerce | 1. Engineering | 1. Agriculture | 1. Chemistry | 1. Economics | 1. Fine Arts |
| | | | | 2. Phy. Sciences | 2. History | 2. Phy.Educ. |
| | | | | 3. Earth Sci. | 3. Social Sci. | |
| | | | | 4. Biology | 4. Home Econ. | |
| | | | | 5. Psychology | 5. English | |
| | | | | 6. Medicine | 6. Language | |
| | | | | 7. Dentistry | 7. Philosophy | |
| | | | | 8. Nursing | 8. Education | |
| | | | | 9. Other health | 9. Law | |

Source: Ann Roe, *The Psychology of Occupations*, T. 12.2, pp. 154-55.

A second set of studies which deal mainly with professional occupations has been done by Dael Wolfle and James Davis. Wolfle studied both graduate and undergraduate students while Davis investigated the graduate students in different fields of study. They tried to describe students in each field by their occupational interest as was done by Ann Roe, by general academic ability index (AGCT scores), socio-economic background, and by masculinity or femininity (percentage of male students and percentage female students over total). The result of their study is presented on Table A.2 in the Appendix. No clear pattern of interest and other characteristics can be gathered from these two studies because the personal characteristics they included are too numerous. One important information they give is the distribution of students by general academic ability at the undergraduate and the graduate level given in Table I.2.

As can be observed from Table I.2, the average ability index differs significantly between professions in each group, for each level of degree sought. If we assume that the median scores found in this sample of B.S. and Ph.D. graduate students by field indicate the required academic ability to major in each field, we can then count the investment alternatives within any group of fields for students of any given academic ability. Given the minimum requirement for say field i, all students attracted to major in field i and

*Table I.2*

*Median Scores on AGCT Test of Students*
Specializing in Different Fields of Study

| *Field of Specialization* | *A.B.* | *Graduate Students* | *Ph.D.* |
|---|---|---|---|
| Natural Sciences | 123 | 128 | 133 |
| Chemistry | 125 | 129 | 135 |
| Physical Sciences | 127 | 131 | 138 |
| Earth Sciences | 121 | 124 | 134 |
| Biological Sciences | 121 | 126 | 129 |
| Mathematics | 127 | 131 | 137 |
| Engineering | 124 | 126 | 133 |
| Civil | 114 | 116 | 122 |
| Chemical | 126 | 128 | 135 |
| Electrical | 122 | 124 | 131 |
| Mechanical | 117 | 119 | 125 |
| Psychology | 123 | 132 | 137 |
| Social Sciences | 120 | 124 | |
| Economics | 122 | 125 | |
| History | 120 | 124 | |
| Other Social Sciences | 118 | 124 | |
| Humanities and Arts | 122 | 125 | |
| English | 123 | 129 | |
| Languages | 123 | 126 | |
| Philosophy & others | 118 | 130 | |
| Fine Arts | 121 | 121 | |
| Applied Biology | 116 | 124 | |
| Agriculture | 119 | 127 | 130 |
| Home Economics | 113 | 116 | |
| Health Fields | | 125 | |
| Medical school students | 127 | | |
| Dentistry students | 121 | | |
| Nursing | 120 | | |
| Other | | 126 | |
| Business & Commerce | 119 | 121 | |
| Education | 117 | 121 | |
| General Education | 118 | 122 | |
| Physical Education | 112 | 115 | |
| Other Fields | | | |
| Law | 124 | | |
| Social Work | 121 | | |

Source: Dael Wolfle, *op.cit.*, T.I.1, pp. 319-322.

who have at least this required ability can actually specialize in this field. Therefore, if we arrange our fields in the order of academic ability requirements from the lowest to the highest, students who meet the highest requirement are eligible to enter any field. Consequently, the less intelligent a student is, the less the number of fields are open to him, or, the fewer his investment alternatives.

It will also be observed from Table I.2 that the higher the level of education or degree achieved by the sample, the higher AGCT score is for every field. There are, therefore, fewer and fewer individuals who are eligible to pursue succeedingly higher education. But, at each level of degree sought, the relative number of students eligible in each field will depend on the respective academic requirement.

In other words, the lower the academic requirements for any field, the larger the number of students who can major in this field. This is true for any field in general and for fields falling into each group, as well as for the level of degree sought.

Briefly, the alternatives open to a student depends on his specific aptitude or interest in work activity and on his general academic ability. By grouping professional or major fields into those characterized by the same aptitude-interest, the effect of this factor in the investment

decision is eliminated. Within the group the alternatives are adjusted according to academic requirement. Here we analyze the decision of students of given abilities by estimating the proportion of students who majored in field i relative to the proportion who are eligible to major in this field. The data on eligibility is based on Davis and Wolfle's studies which give the distribution of the population, of college students, of graduates at the bachelor, masters and Ph.D. levels, by AGCT scores, and by field.

Four groups of fields can be derived from these studies - science, technical, service or medical and the women professions.

Part II - The Choice of Field as an Investment Decision

The decision to get a degree in any one field is simply treated as an investment choice just like investment in durable equipment. As such we assume that the investor tries to maximize the present value of the net expected returns from his investment. In education this involves the choice of field among the relevant set of alternatives contained in a group of fields as discussed in Part I. Once the investment alternatives are specified and the information on cost and returns for each alternative is available, the student can rank these alternatives by their present values and be able to choose that which will maximize the present

value of his investment. However, his choice will still be subject to the imperfections in the capital market for education.

It was stated at the beginning that there hardly exist lending institutions for educational purposes except some loan programs provided by the universities and colleges. The main sources of funds to pay for schooling in the United States have been savings from the family of the student, self-support and all forms of private and public subsidies in the forms of scholarship and fellowships. As one can see, the loan programs of schools which go mostly to the less affluent students reduce the imperfection of the capital market. But in as much as the per-capita subsidies and the socio-economic background of students differ by field and by degree, an optimum choice may not be obtained. Differences in the degree of imperfection in the capital market will certainly affect the students decision. The problem is treated in the following:[5]

1. If we consider the investment decision to be the choice of a field of specialization after the students have decided to pursue a given level of degree, then the ability to

---

[5] In the absence of credit, stipends or family support, the student may finance his education by postponing consumption, and working part-time instead of full-time and making out-of-pocket expenditure for school fees. The investment period will be lengthened. His decision will depend mostly on his time preference of consumption and will be subject to the maximization of total lifetime utility from all possible streams of consumption from the returns to different investment options, including not making any investment.

finance the completion of the degree can be ignored.

2. We can hypothesize how some of the variables which contribute to the relative imperfections in the capital market will affect the investment choice. Stipends definitely reduce the private cost of education, and so increase the present value of investment. However, where the unavailability of funds prevents some students from pursuing a degree, stipends given in some fields will definitely attract students who would not otherwise be pursuing a degree, and a degree in fields where subsidy is available. Therefore, a positive relation between stipends and investment by field is to be expected.

A brief summary of the calculation of cost and the net returns to investment in education, specifically in completing a degree in each field is outlined below.

1. The total cost of a year in college would include books, tuition, other fees, supplies and related items, plus the students foregone income while attending school. Foregone income while pursuing a bachelor's degree is approximately the income that could be earned by a high school graduate if he were not in college, minus whatever income he would

receive from part-time employment and/or stipend.[6]

The foregone income of one who is pursuing a graduate degree in field i, is the income that he could earn were he not in school minus any income from part-time employment and/or any stipend while he is in school. The foregone income of graduate students will vary as incomes of bachelor graduates vary in different fields at the relevant ages, that is, the average income of members of the profession with a bachelor's degree at the same age as the student when in graduate school.

As shown in Table A.2 in the Appendix, stipends also vary by fields. This variation in stipend income will obviously affect the foregone income in different fields.

Tuition and other fees for each institution do not normally vary by field and level of degree pursued. For this reason the academic cost in each field is assumed to be the same for undergraduate and graduate students. But the academic cost year differs by field because there are no

---

[6]To be more accurate in evaluating foregone income, every completed year of college education should be taken into consideration as being an additional training stage for any job. But the income of high school graduates and those with less than four years of college are not substantially different. Hence, the complicated estimation involved in taking into account all of the school years completed between high school and college graduation do not seem to be that important.

uniform fees for all institutions and the tuition and other fees vary between privately and publicly supported institution. These institutions offer different curricula. Therefore, the field which public institutions heavily support will be relatively less costly to the students than a field that is given mostly by private universities and colleges.

2. On the average in the American society, full-time work can begin at the age of 16 when one is not compelled to remain in school, and usually end at the retirement age of 65.

In estimating the present value of income received during the working lives of those with degrees, the retirement age is assumed to be 65 for everybody. Full-time work after graduation is assumed to begin at the age of 22, 24 and 27 for those with bachelor's degree, master's degree and and Ph.D. degree, respectively.

3. The capital market is assumed to be equally imperfect for all fields, except for the effect of differences in the availability of stipends on students' decisions. This is a necessary assumption in order to make investment in education in different fields at each level competitive for equally qualified students.

Because of the limited amount of credit available for education the market rate of interest is not used. Instead, arbitrary number - 3%, 6% and 8% - are used. The rate which

gives the best fit of the theory is considered the rate students use to discount future earnings. The writer realizes that no further rationale is offered for using these discount rates.

The Investment Function:

At any time period, t, we have a population of high school and bachelors graduates who have decided to complete a bachelor's or graduate degree, respectively. They can be grouped such that they are homogeneous in terms of personal interest-aptitude corresponding to the grouping of fields by interest-aptitude patterns. Within a group the students have varied general academic ability. All are eligible to major in at least one field, that is, that field which has the lowest academic requirement. On the other hand, the most intelligent students are eligible to major in all fields in the group. The student of given academic ability may choose to major in all fields whose minimum ability requirement is equal or lower than his ability index. Therefore the higher is his ability, the larger the number of fields that he can specialize in. These fields are regarded in this paper as his relevant investment alternatives.

Given that an individual's investment alternatives are fields i, j,. . . , m in Group G, he will choose that field which will give him the highest present value of net expected lifetime income, discounted at the market rate of interest or

at his consumption time preference if credit is not available to him. Designating the expected stream of income during his working life as Y, p as the rate of discount, $\hat{I}$ as cost of investment, his decision can be expressed in the following functional relationship:

$$I_i = f\left\{\sum_{t=1}^{T}\left(\frac{\hat{Y}_{it}-C_{it}}{(1+p)^t}\right), \sum_{t=1}^{T}\left(\frac{\hat{Y}_{jt}-C_{jt}}{(1+p)^t}\right), \ldots\ldots, \sum_{t=1}^{T}\left(\frac{\hat{Y}_{mt}-C_{mt}}{(1+p)^t}\right)\right\} \qquad (1)$$

If

$$\sum_{t=1}^{T}\left(\frac{\hat{Y}_{it}-C_{it}}{(1+p)^t}\right) > \sum_{t=1}^{T}\left(\frac{\hat{Y}_{jt}-C_{jt}}{(1+p)^t}\right) > \ldots \sum_{t=1}^{T}\left(\frac{\hat{Y}_{mt}-C_{mt}}{(1+p)^t}\right) > 0 \qquad (2)$$

students will choose to go into field i which has the highest present value of expected lifetime income net of cost. As more and more students major in field i, the relative discounted income in field i will be pushed down, assuming the demand curve for labor with education in field i is downward sloping. Equilibrium will be reached when

$$\sum_{t=1}^{T}\left(\frac{\hat{Y}_{it}-C_{it}}{(1+p)^t}\right) = \sum_{t=1}^{T}\left(\frac{\hat{Y}_{jt}-C_{jt}}{(1+p)^t}\right) = \cdots\cdots = \sum_{t=1}^{T}\left(\frac{\hat{Y}_{mt}-C_{mt}}{(1+p)^t}\right) \qquad (3)$$

field i has attracted more and more students who are eligible to go into this field until the present value of lifetime income is pushed down by an increase in the labor force who have education in field i. If equilibrium in the investment and labor markets in education is reached, members of each profession in group G who have the same academic ability will receive the same net returns on the margin. Correspondingly, the expected marginal