

MINCER EQUATION FUNCTION AND AN EMPIRICAL TEST

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ABSTRACT

The aim of this paper is to try to define and study Mincer earning equation's properties and reevaluate it after the publication of Schooling, Experience and Earnings.

In this working paper, i tested this theoretical model and studied about the other variables which expand the pure model and their effects on individual's wage. Studying the effects of education, experience, race and IQ on individual's wage, the results weren't against to Mincer's theory and recorrected his earning equation. In this study, i used an extracted form of a dataset from National Longitudial Survey.

JEL Classification: B21, J24, J31, D31

Keywords: human capital, earnings, IQ, race, Jacob Mincer.

I. INTRODUCTION

The Mincer earning function is the first analytical innovation in human capital model. Early economists had some workings about it but in general, main concern was to measure national wealth and the changes in national wealth after the wars. But with the help of some econometrics tools, Mincer developed this function to define the main determinants of an individual's wage. This equation has become the “cornerstone” of empirical researches on earnings determinations. It has been estimated on thousands of datasets for a large number of countries and time periods which clearly makes it one of the most widely used model in empirical economics studies. Although the most of these studies corrected the model of Mincer, some contemporary researches showed that, the Mincer equation does not fit the data as well as it used in 1950's.¹ But some “fine-tunings” can make the model more substantial for nowadays empirical researches. In the later sections, we'll discuss about them in details.

All researches about Human Capital has drawn a line of explanation about why education enhances earnings; why earnings rise at diminishing rate in one's life; why men earn more than women; why whiteman earn more than black one's; why unemployment lower among the skilled labors and etc. All these questions and their possible answers are researched under the field of labor economics for a longtime and “Human Capital Model” has been developed to systematize these findings.

An earlier version of this working paper is studied in the econometrics class of Professor Carla Sa named “Determinants of the Wages, an Empirical Test” by Cenk Yurtsever. This version captures more detailed analysis of Mincer Equation and a new dataset with more observations is used.

I.a. Econometrics vs. Labor Economics

It's not possible to define the framework of this working just with the knowledge of econometrics or labor economics. Because econometrics is concerned with the empirical determination of economic laws.² Although economic theory makes statements or hypotheses that are mostly qualitative in nature, econometrics gives empirical content to most economic theory. On the other hand labor economics studies how labor market work.³ In order to find the determinants of the wages, we need to apply an interdisciplinary study between econometrics and labor economics.

I.b. About Dataset and Computer use

The dataset which is used in this working paper is taken from National Longitudinal Survey (NLS). In the web site of NLS⁴ it's possible to reach a huge raw researchments results about any categories. That helps researchers to study about any subject. In this working paper, we will use an extracted or composed dataset created by Professor David Card. That dataset has been also used in his one of working.

In the past 2 or 3 decade, new technologies about computers and softwares⁵ related to statistics give us opportunity to study on big datasets with lots of variables. Evenmore, nowadays it's impossible to think of econometrics without using of computers. Infact, all these software packages do the same job on analysing datasets but we will use “Stata 8” because of its simplicity and power.

1 Lemieux, Thomas (2003) “The Mincer Equation” Thirty Years after Schooling, Experience and Earnings.

2 Damodar N. Gujarati - “Basic Econometrics”

3 George J. Borjas - “Labor Economics”

4 “ <http://www.bls.gov/nls> “

5 Like as Stata, SAS, SPSS, ET, LIMDEP, SHAZAM, MICRO TSP, MINITAB, BMD

II. HISTORY OF HUMAN CAPITAL MODEL

The Mincer Earning Equation isn't the first approach to examine the determinants of earnings. But it was the first analytical innovation that enlightened the main determinants of earnings. In this equation, Mincer concerned about the “earnings of an individual” not anything about the government and whole economy.

Although Mincer came up with these innovations in the late 1950's, human capital's roots go back to Sir William Petty(1691) who, according to B. F. Kiker, considered labor to be “the father of wealth” (Kiker, 1971, p61) Petty capitalized the wage bill (which he got by deducting property income from national income) to obtain an estimate of human wealth. Other early economists who considered human capital include Adam Smith, Jean Baptiste Say, Nassau William Senior, Friedrich List, Johann Heinrich von Thunen, Ernst Engell, Leon Walras, Irving Fisher and Karl Marx.⁶ But the main concern in much early workings were applying the human capital concept to measure national wealth and the changes in the national wealth caused by war. But what Mincer developed in his working is about the earning of an individual. He invented an equation that the human capital model generates an “age-earnings” profile.

III. THE PURE MINCER EARNING FUNCTION

After the publishing of “Schooling, Experience and Earnings” by Jacob Mincer, this had a profound and lasting influence on empirical work in the field of labor economics. In the most widely used version of Mincer's “human capital earning function”, log earnings are modelled as the sum of a linear function of years of education and a quadratic function of years of potential experience. It can be shown as;

$$\log w = as + bt - ct^2 + \text{other variables}$$

In this function, w indicates the worker's wage rate, s is the number of years of schooling, t gives the number of years of labor market experience, and t^2 is a quadratic on experience that captures the concavity of the age-earnings profile.

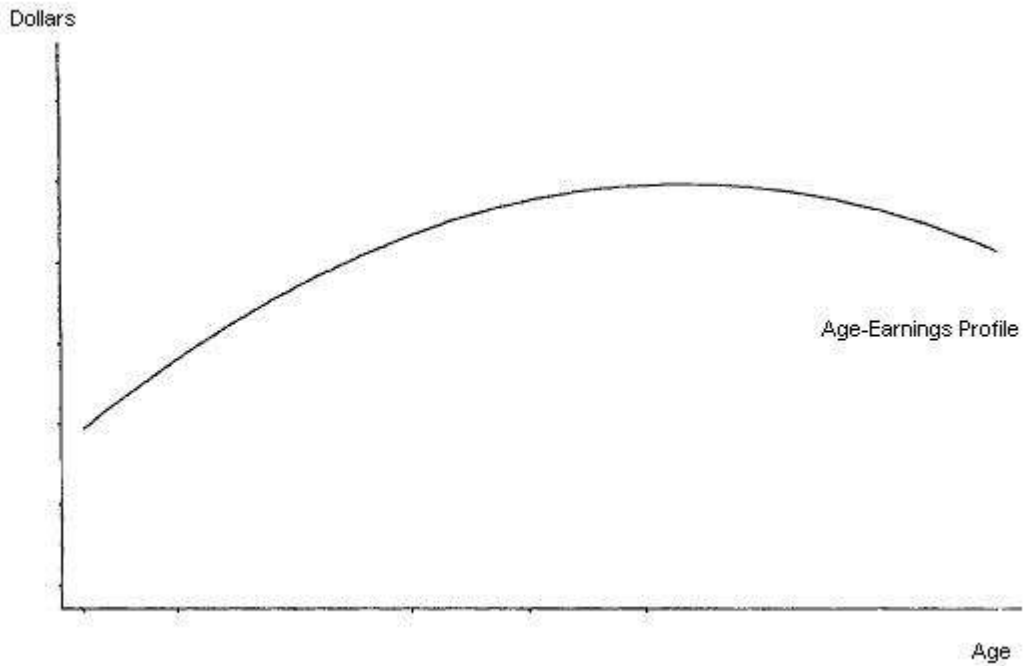
Why this equation has been used so widely in the workings of human capital? One part of the answer lies in the fact that equation is based on the formal model of investment in human capital. Another answer is that the Mincer equation provides an economical specification that fits the data remarkably well in most contexts.

III.a. Age-Earnings Profile

In fact, what Mincer explained in his equation is “age- earnings profile”. This profile gives us the relation between age and earning of an individual. When a person become older, his/her earnings will increase but this increase will happen in a decreasing way. We can explain it by mathematics like, the first derivation of this function will be bigger than zero but the second derivation of this function will be smaller than zero.(figure 1) That's alright but why? A possible explanation can be like this: During the life period the individual will get more experience about his/her job and this will increase his/her productivity and also earnings. On the other hand, the labor will make human capital investments to gain more and more. But when he/she becomes older, of course one will decrease this investment because he/she will be aware of “death”. Also after one point, the productivity of a person will decrease and he/she will decide to retire. Under the all these effects, the age-earning profile will have an upward-sloping and a concave shape.

6 Polachek, Solomon (2003) “Mincer's overtaking point and the Lifecycle Earnings Distribution”

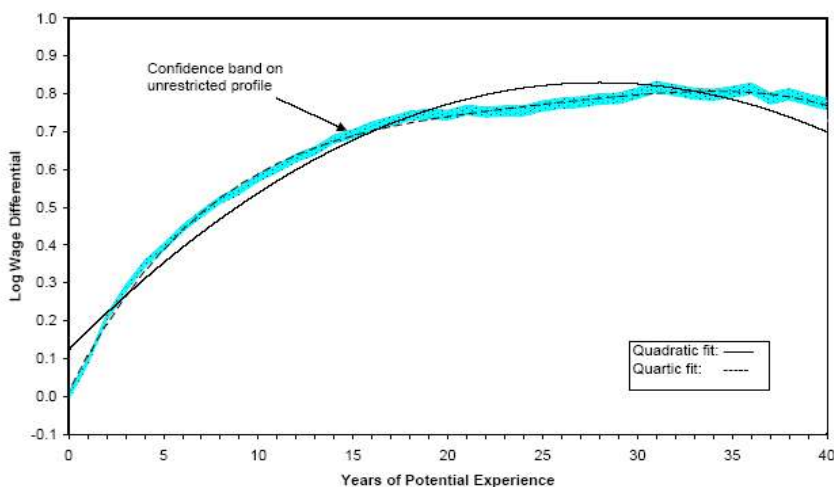
Figure: 1



III.b. Quadratic Formation

The Mincer earning equation is used and tested in this form for along time. Some results were suitable to the model but some studies were against to this equation. In the working of “ Empirical Age-earnings profiles”, Murphy and Welch examine in details whether the standart quadratic specification in years of potential experience captures well the emprical experience-earning profile. With the help of dataset from 1967-1987, they concluded that a quadratic function isn't flexible enough to capture the main features of the experience-earnings profile. According to Murphy and Welch, the main problem is that the quadratic function understates earnings growth over the first 10-15 years of career. By contrast, they find that a quartic function in years of experience captures very well the main features of the empirical experience-earning profiles.⁷

(Figure: 2)



7 Kevin M. Murphy, Finis Welch (1990) “Empirical Age-Earnings Profiles”

III.c. Logwage or Wage?

The dependent variable in the standard Mincer equation is in the logarithmic form. While logarithmic forms are used in the econometric models for reason of convenience or fit, there is a strong theoretical rationale for using log earnings in a human capital earnings regression. The existing evidence generally supports the log-earnings specification.⁸

But in general, the log-form helps us to see the percentage effects of the independent variables. In this form of Mincer equation, coefficients of the independent variables are the percentage effects on the wage. This usage will give us a clearer idea to make predictions.

III.d. Cohort Experience: Is it a really big problem of theoretical frameworks?

In order to set individual models, we use the cumulative informations and experiences in the studies of statistics and econometrics. But there has been an important gap between the theory underlying the human capital earnings and the empirical researches. In the equation of Mincer and an entire literature, we have estimated returns to schooling using cross-section data, which takes the standard synthetic cohort approach assuming that younger workers base their earnings expectations on the current experiences of older workers. In this case, cross-section and cohort earnings-education profiles are the same. However, if skill prices are changing over time and workers are able to at least partially anticipate these changes, then estimates of the return to different schooling levels based on cross-sectional data may not represent the ex ante rates of return governing human capital investment decisions. While estimates based on cross-section data reflect current price differentials and opportunity costs, they do not capture future skill price differentials that forward-looking individuals would take into account. Consider, for example, a cohort of individuals deciding whether to attend college just prior to a permanent increase in the relative price of college educated workers. Those cohorts will experience higher returns to college than earlier cohorts, which would be reflected in cohort-based estimates but not in cross-section estimates. If cohorts anticipate the rise in the skill premium, they will base their schooling decisions on their true cohort-specific rate of return and not the rate of return estimated from a cross-section of workers. However, if individuals do not anticipate the price change, cross-section estimates may better represent the expected return from attending college that guides their decisions. Thus, expectations about the future play a crucial role in determining whether cross-section or cohort-based estimates influence schooling decisions.

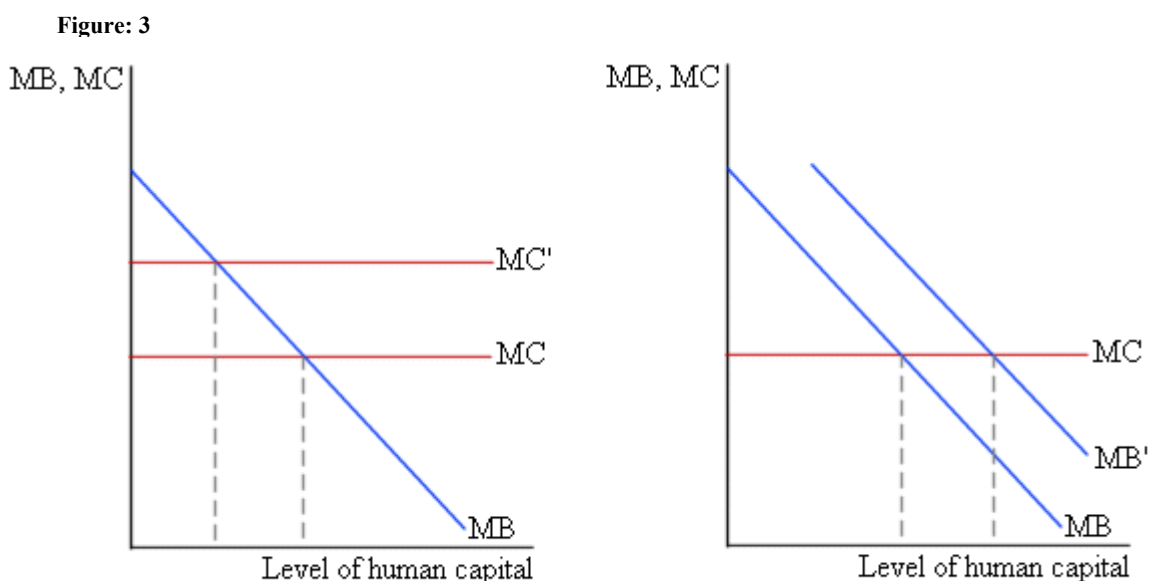
Another possible source of difference between cross-section and cohort-based rate of return estimates is a change in cohort quality. Consider an increase in school quality for cohorts entering the market after some date. If relative skills for some schooling classes increase permanently, then cohort rates of return jump up with the first 'new' cohort and remain higher for all succeeding cohorts. Cross-section estimates only reflect the changes slowly as more and more high quality cohorts enter the sample each year. As a result, they under-estimate true rates of return for all cohorts entering the labor market after the change in school quality, with the bias slowly disappearing as time progresses.

⁸ Fortin, Nico M. and Thomas Lemieux (1998), "Rank Regression, Wage Distributions and the gender gap", *Journal of Human Resources* 33, Summer, 610-643.

IV. INDEPENDENT VARIABLES OF THE MINCER EQUATION

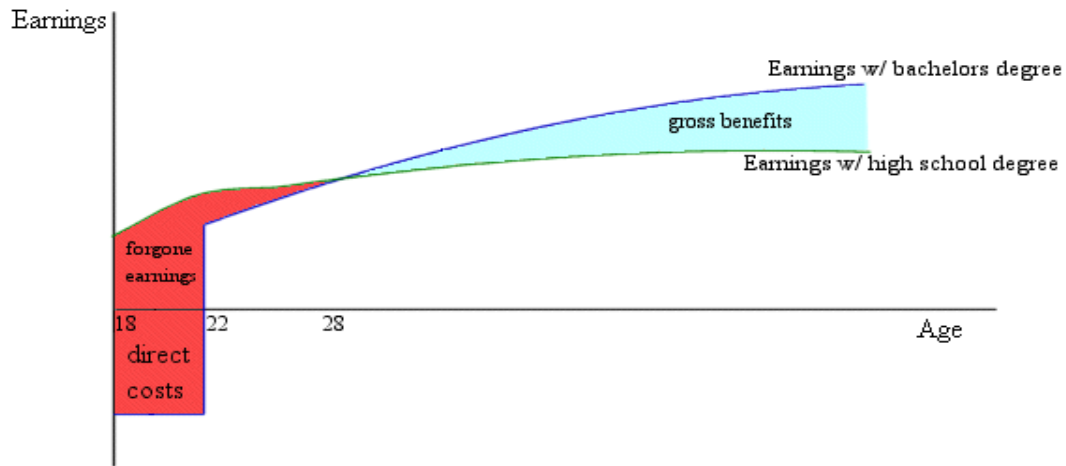
IV.a. Education and the Returns

There are at least three distinct ways of defining the returns of the education: (a) the private return, (b) the social return and (c) the labour productivity return. The first of these is made up of the costs and benefits to the individual. The second definition highlights any externalities or spill-over effects and includes transfers and taxes. The final definition simply relates to the gross increase in labour productivity (or growth). But the main concern of the Mincer's theory is about the positive or negative effects of private return. An individual will acquire additional education as long as the present value of the marginal benefits from this additional education outweighs the present value of the marginal costs. Those individuals who have higher benefits and/or lower costs will acquire more education. The diagram (figure 3) below illustrates the effect of changes in MC and MB on the optimal level of human capital investment.



The costs and benefits associated with deciding to acquire a bachelors degree are represented in the diagram below. This diagram illustrates two possible earnings streams facing an 18-year old high school graduate. The costs associated with college attendance includes both forgone earnings (the upper portion of the area shaded in red in the diagram) and the direct costs of college (the lower rectangle that is shaded in red in the diagram below. Note that this diagram suggests that a 22-year old college graduate earns less than they would have at this age if they had gone to work directly after high school. On average, it takes approximately 6-7 years for the earnings of a college graduate to catch up to the earnings of a high school graduate with identical observable characteristics. The area shaded in light blue represents the increase in earnings that a college graduate would be expected to receive over the rest of his or her worklife. (These earnings streams, of course would differ across individuals due to differences in individual ability and costs.)

Figure: 4



It is expected that an individual would attend college if the present value of the costs (the red area in figure 4) is less than the present value of the benefits (the light blue area in figure 4).

IV.b. Experience Variable and On-the-Job Training

In the article of “Investment in Human Capital and Personal Income Distribution”, Mincer pioneered the detailed study of the effect of labor market experience or on-the-job training on the determination and distribution of earnings. His model provided an analysis of the manner in which on-the-job training influences differences in earnings across individuals and how this determines the inequality and skewness of earnings. It is a model based on rational economic behavior by individuals in the labor market. As a result, this work served as the base for several researches in labor economics.

Mincer used the experience data in two different form to define the age-earnings profile. The normal indpended 'experience' was for the explanation of the upward-sloping form of profile and the 'quadratic experience' was for the explanation of the concavity of the age-earnings profile.

IV.c. About “other variables”

In the pure form of earning equation, Mincer's main concern was on the effect of experience and the education. But of course there are some other significant variables that effect the individual's wage. They can be; race, marriage status, family background, gender, IQ and etc. In order to make an absolute decision, the best way is to apply an empirical test with these variables and compare the results about them. But there're some studies about these “other variables” in the labor economics field and the details about them are studied in “The Economics of Earnings” by Polachek and Siebert (1993).

IV.c.1. Race

One of the most important wage determinant variable is “race”. It's obvious that, there is a significant wage gap between blackman and whiteman. In the labor economics field, the economists are divided into two group to define it's cause. One is about the relative less-quality of black education. Because before the ‘Brown vs. the Board of Education,’ blackmen in the U.S. were relegated to separate but ‘equal’ schools. But in practice, it wasn't so easy to provide 'equal' conditions for this group of people. The other thing is about the federal government policies. Before

the Civil Right Act policies, in America, there was a significant difference of the rights between blacks and whites. But nowadays, there are some attempts against to this situation.

The trends in USA about earnings and schooling data suggest that both hypotheses have some merit. Some studies showed a rise in black-white relative earnings in the years immediately following passage of the Civil Rights Act. This change is often cited as evidence that equal employment opportunity programs led to a closing between wage gap. Blacks who entered the job market in the 1960s, however had received substantially more and better education than any previous generation of black workers. It caused a decrease of the wage gap between black and white labor from 40 percent in 1960 to 25 percent in 1980.⁹

IV.c.2. IQ

Although the compensatory education and other anti-poverty programs, the poors are still poors. Because of lacking mental skills. Their poverty is particularly intractable because it is rooted in the genetic structure inherited from their parents who were also poor and “mentally deficient”. An explanation of transmission of economic status from one generation to the next is thus found in the heritability of IQ.

But what is IQ? It's called as “intelligent test” This value gives an indicator about one's intelligent level. Is it certain that, IQ has an impact on one's wage? In their working, Bowles and Valerie¹⁰ found that, the genetic inheritance of IQ isn't the mechanism which reproduces the structure of social status and economic privilege from generation to generation and they guess that, intergenerational immobility may well be found in aspects of family life related to social-economic status and in the effects of social-economic background operating both directly on economic success and indirectly via the medium of inequalities in education attainments.

In order to claim this situation, more observations and empirical researches are needed about IQ knowledge. In the next empirical chapters, we'll use IQ as an independent variable and will see the results.

V. EMPIRICAL TEST OF MINCER EARNING FUNCTION

In this chapter, we will apply an empirical test to examine the robustness of his theory. There are a lot of studies in the labor economics field to do the same job but why one more? We can categorize the reasons into the 3 part:

1. Since the publishing of *Schooling, Experience and Earnings* by Mincer, there has been a phenomenal expansion in the computer power. With the help of these machines, we are allowed to research, test and play with the huge databases. A lot of powerful softwares are programmed for this purpose and can be used in easy ways to research.
2. Nowadays, number of micro data sets are available for empirical labor economic researches. These datasets can be used to test the robustness of Mincer equation.
3. Sophisticated parametric and non-parametric procedures are now available to perform careful specification analyses.

9 David Card and Alan B. Krueger (1992) “Schooling Quality and Black-White Relative Earnings : A direct Assessment”

10 Samuel Bowles and Valerie I. Nelson (1974)“ The Inheritance of IQ and Intergenerational Reproduction of Economic Inequality” JTOR

However we test the pure Mincer earning function with the Young Men's Cohort of the National Longitudinal Survey (NLS), the results correct his theory.(Figure: 5)

Figure: 5

lwage	Coef.	Std. Err.	t	P> t
educ	.0931707	.0035802	26.02	0.000
exper	.0897828	.0070636	12.71	0.000
expersq	-.0024859	.0003377	-7.36	0.000
_cons	4.46854	.0686899	65.05	0.000

In the figure 5, coefficient *educ* gives the education level of individual and *exper* gives the experience value and the *expersq* shows the quadratic form of experience. The experience value can be calculated as;

$$\text{experience} = \text{age} - \text{education} - 6$$

As we see in the figure 5, the all coefficients in the Mincer equation are statistically significant. So, we can write the equation like;

$$\text{lwage} = 4.46 + .093\text{educ} + .089\text{exper} - .0024\text{expersq} + \text{other variables}$$

In fact, there isn't any meaning of constant value in the equation but the other coefficients give us an idea about their percentage effects on the wage.

Now we will expand our test with the coefficients of *IQ* and *gender* to define their effect on the individual's wage.

Figure: 6

lwage	Coef.	Std. Err.	t	P> t
educ	.0711206	.0049762	14.29	0.000
exper	.0950217	.0097499	9.75	0.000
expersq	-.0027256	.0005027	-5.42	0.000
IQ	.0032186	.0006856	4.69	0.000
black	-.1408274	.0261811	-5.38	0.000
_cons	4.465064	.1049158	42.56	0.000

In the figure 6, as an addition *IQ* variables shows individual's IQ test score and the *black* variable shows one's race. If the individual is black, the variable will equal to 1 and if the individual is white, the variable will equal to 0 if the individual is black. Variables of pure Mincer earning equation are still significant and also the *IQ* and *black* are statistically significant with the 5% critic value. It shows that, there are significant effects of IQ and race on one's wage. The positive coefficients of IQ value (.0032186) indicates that, however the IQ test mark of one's increase, it'll also increase one's wage positively. The negative coefficient of black value indicates that, if individual is black, his/her wage will be less. (with the -.1408224 coefficient, it shows that black people earns less than white one's. So, we can write expanded Mincer earning equation like;

$$\text{lwage} = 4.46 + .07\text{educ} + .09\text{exper} - .002\text{exper}^2 + .003\text{IQ} - .14\text{black} + \text{other variables}$$

VI. CONCLUSION

In terms of econometric practice, these findings suggest that it is important to verify the robustness of the standard Mincer equation. It's shown that, this theory will remain a cornerstone of Human Capital Model for along time. But some studies are resulted with a “fine-tuning” advises to the model like about quadratic form.¹¹ The experiences and scientific working path will drive these studies to a more substantial form and robust model.

However Mincer's main concern was on the effects of education and experience, our empirical study showed that the IQ and race values are also determinants of one's wage. Especially, the race has a large negative effect on wage depended if individual is a black. As we mentioned earlier, the main result of this condition is about education quality of black schools and federal government policies about race discriminations. Some improvements about these conditions will increase the wage gap between white and black labors.

Although Bowles and Valerie concluded their study¹² as there isn't any direct mechanism between IQ and earnings values, our study is concluded with a significant importance of IQ value on individual's wage. It shows that “lacking of mental skill” is an disadvantage about earnings.

11 Lemieux, Thomas (2003) “The Mincer Equation” Thirty Years after Schooling, Experience and Earnings.

12 Samuel Bowles and Valerie I. Nelson (1974)“ The Inheritance of IQ and Intergenerational Reproduction of Economic Inequality” JTOR

BIBLIOGRAPY

1. Blundell, Richard, Lorraine Dearden and Barbara Sianesi (2001) "Estimating the Returns to education: Models, Methods and Results" **University College London and Institute for Fiscal Studies.**
2. Borjas, George J. (2005) "Labor Economics" **Mcgraw-Hill Irwin.**
3. Bowles, Samuel and Valerie I. Nelson (1974) "The Inheritance of IQ and the Intergenerational Reproduction of Economics Inequality" **JTOR**
4. Card, David and Alan B. Krueger (1992) "School Quality and Black-White Relative Earnings: A direct Assesment"
5. Chiswick, Barry R. "Jacob Mincer, Experience and the Distribution of Earnings" **University of Illinois at Chicago and IZA Bonn**
6. Fortin, Nico M. and Thomas Lemieux (1998) "Rank Regressions, Wage Distributions and the gender gap" **Journal of Human Resources 33, Summer, 610-643**
7. Gujarati Damodar N. (1995) "Basic Econometrics" Third Edition **Mcgraw-Hill, Inc.**
8. Heckman, James J. , Lance J. Lochner and Pedra E. Todd " Fifty Years of Mincer Earnings Regressions" **National Bureau of Economic Research, Working Paper 9732**
9. Lemieux Thomas (2003) "The Mincer Equation: Thirty Years after Schooling, Experience and Earnings".
10. Mincer, Jacob (1974) "Schooling, Experience and Earnings"
11. Mincer, Jacob (1974) "Progress in Human Capital Analyses of the Distribution of Earnings"
12. Murphy, Kevin M. and Finis Welch (1990) "Empirical Age-Earnings Profiles".
13. Polachek, Solomon W. (2003) " Mincer's Overtaking Point and the lifecycle Earnings Distribution"