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Working Paper Series

The Capital Asset Pricing Model

An Application on the Efficiency of Financing
Higher Public Education in Egypt

by

Nevine Mokhtar Eid

Working Paper No. 8   April 2008

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Abstract

In the Markowitz (1952) mean-variance model as well as the Capital Asset Pricing Model of Sharpe (1964) and Lintner (1965) agents make their investment decisions based solely on the expected return and variance. On the other hand, human capital theory does not consider uncertainty in its return function except recently initiated by Harmon et al. (2001) who distinguish between the level and the years of education and incorporates uncertainty in Mincer's Model (1974).

The study has twofold objectives: first, estimate the risk-return trade-off of the public higher education capital stock in Egypt to indirectly evaluate the performance of its current financing system, and second, investigate the inter-linkage between real investment (Human) and financial investment (lost opportunity or access to funds), then draw the channel through which they can affect the economic growth.

JEL classification

Keywords

Faculty of Management Technology
German University in Cairo
Al Tagamoa Al Khames
11835 New Cairo City – Egypt

nevine.eid@guc.edu.eg

1. Introduction

The paper is investigating the efficiency of financing the human capital in Egypt as the real asset investment using a financial assessment techniques not only to evaluate the current financing system but also to implicitly measure the capacity building adopted policy, in other words to solve for the following debate *"To What Extent Does Human Mind Set Really Matters?"*. Therefore, It is worthy to understand first the definition of the *"Human Mind Set"* that the authors meant:

> "Thirty years ago, 5-years old child was asked by her grandmother, to indicate whom does he love in chronological order, with a clear defined rationale. The kid answered, my mother because she cares for every single details of me, my father because he is buying me toys and give me money to buy candies, my young brother because he respects me, and you 'grandma' because you used to calm me down when I cry. Then, the same person was asked thirty years later, same question, he answered I have lost two of them, but the rest are still alive thanks God. I love them indeed, and I have to care for them…"

The difference in the concept and the mentality of thinking is very clear. The same person before being developed by education was seeking the satisfaction of needs in early ages, then, the mind set changes and love is redefined as an extension of undertaken responsibilities. By aggregating such a term of "responsibility" not only to close relatives whom he loves but also to work and colleagues whom he is responsible for their level of productivity, then in case of being more developed, his responsibility towards the society from political participation perspective.

Such productivity has been initially quantified by Becker (1964) and Mincer (1974) in the form of anticipated increase in future income either as a result of general education or firm-specific training. This initiative has been traditionally analyzed within a life-cycle framework, formulating the rate of return to education as a function in the years of schooling, experience, and experience squared. Then, the function has been developed to be regressed against the type as well as the level of education, which still can be interpreted as a modified version of Becker and Mincer's theory that draws a crucial

explanation between formal schooling and on-job training, which in turn highlighted the importance of strengthening vocational training, Belanger and Tuijnman (1997).

Despite the fact of supporting Harbinson and Hanushek (1992) argument that a country which is unable to develop skills and knowledge of its people and to utilize them effectively in the national economy will be unable to develop anything else, still I believe that this should be designed using more rational scenario financially wise, and not by accumulating the government public dept. Thus, the paper will start by tracing the first initiative of dealing with human capital as a source of income stream distinguishing the difference between human and nonhuman capital. Then introduce the development in measuring human capital stock to be able to evaluate the Egyptian highly educated human capital stock and investigate the efficiency of the existed funding system using Sharpe index as a performance measure. Furthermore, the author investigates the causal relationship between higher education human capital stock (measured by the growth rate of high education return), economic growth and financial investment (measured by the private credit by deposit money banks and other financial institutions as a percentage of GDP).

2. Literature Review

Human capital can be defined as the stock of individual knowledge, capability, and skills that are economically usable. It has been termed as a real asset investment because of being: sluggish (only changes slowly), able to be depreciated, its current expenditures are interchanged with future returns, its accumulation affects earnings. It only differs from other real capital in that it can not be either sold, or mortgaged, or separated from its owner.

Human capital seems like the financial assets (i.e. stock market) in that it consists of a wide range of assets, where each individual chooses the exact asset that matches her

preferred combination of risk and return in terms of future income. Only, two limitations characterize the former compared to the later; diversification and gearing disability. Recently, such an argument has been used to incorporate uncertainty in human capital models either by allowing returns to education to be stochastic, Carneiro et al (2001) and Harmon, Hogan and Walker (2001) or by estimating the risk compensation in incomes, Hartog and Vjiverberg (2002).

Measuring human capital value under uncertainty has been always a matter of interest from the accounting perspective, Lev and Schwartz (1971) valued the human capital in a person of age γ as the present value of his remaining future earnings from employment, which has been criticized because of the concept of being a measure of the expected conditional value of a person's human capital that is based upon the implicit condition of remaining at the same organization until either death or retirement, ignoring all other voluntarily or involuntarily reasons and the probability that people might make role changes during their careers. As a result the given method has been modified by including the expected realizable value which has been thoroughly discussed by Flamholtz (1970). Several modifications have been added to the given concept, the return to education has been calculated using Mincer (1974) framework[1] as the average annual income for workers within a given educational group, and the corresponding risk is the standard deviation of the annual income for workers within the same group. Then, both the Markowitzian efficient frontier as well as the Sharpian performance measure has been transferred to the human capital investment problem. Weiss (1972) supplies the first study of the mean-variance trade off that applied the Mincerian coefficient of variation to correct the return to education across age and educational group within a sample of scientists. Harmon and Hogan (2001) extended the standard human capital earnings function to include dispersion in the rate of return to schooling by treating the return as a random coefficient, which in turn can interpreted as an initial attempt to deal with the return of education as those of financial assets. Pereira and Martins (2002) use cross-country Ordinary Least Squares returns from Mincer equations and correlate those with

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[1] The standard equation formulates log-earnings as a function in years of schooling, experience, and experience squared.

the spread in returns as measured by the difference in coefficients from quantile regressions, assuming a linear risk-return trade-off[2]. Rosen (2002) addressed the same issue taking into account the fact that education is characterized by diversity[3].

3. Human Capital Measurement Techniques

There are three different measurement techniques: *Cost-Based* approach which has been initially conducted by Engel (1883), estimating human capital based on the cost of rearing a person from conception to the age of 25, ignoring the time value of money. Such an estimate has been modified by Schultz (1961) and Machlup (1962) assuming that the depreciated value of the dollar amount spent is equal to the stock of human capital[4], which in turn has been criticized for including physical capital costs, its failure to capture the time dimension of educational investment, Jorgenson and Fraumeni (1992) and disregarding non-market activities, Eisner (1988).

Consequently, *Income-Based* approach has been introduced to evaluate the future productive capacity of any dynamic economy, valuing human capital at market prices, which in turn does not reflect real differences in productivity[5]. Moreover, various models have been calibrated to estimate such a prospective approach within life cycle framework, either to obtain monetary or index values. Most of the micro-models have been constructed based on one common assumption; that the earnings of a person aged x expected to be received in n years is equated to the earnings of a person presently aged x+n with same characteristics (i.e. sex, race, education, occupation, ability, etc…) adjusted for real income growth and the probability of survival. They only vary in the

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[2] In other words, the market is assumed to provide a single risk-return trade-off.
[3] He argues that markets accommodate diversity by establishing prices that make differentiated items close substitutes at the margin.
[4] This includes both household expenditures: consumption effects to satisfy consumer preference as well as investment effects to enhance productivity, Machlup (1984).
[5] Graham and Webb (1979) argued that net productivity is a real measure of a person's value to other since it accounts for maintenance costs, economies of scale and public goods problems.

number of the identified stages of the life cycle[6]. However, such an assumption does not stand for micro-macro models that have been used to obtain index value either by dividing the total labor income per capita by the wage of uneducated, Mulligan and Sala-i-Martin (1997) or by weighting workers of different schooling levels with their wage income, Koman and Marin (1997). Despite, both models have one common deficiency, they assume equalizing the returns of all types of education investments of the same length while ignoring informal schooling.
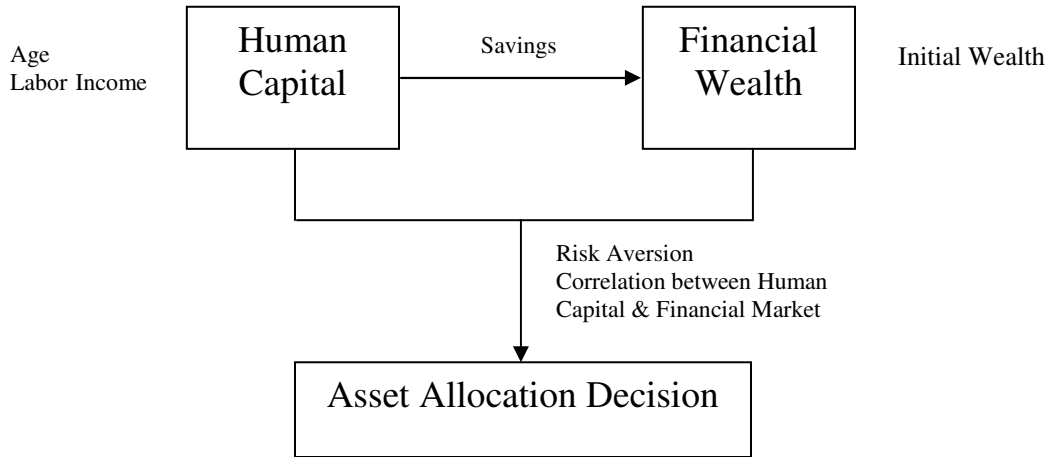
Furthermore, others develop *Integrated* approach in which they combine both approaches (income and cost based) in the same model to avoid double counting problems as it was the case in the standardized approach used by Tao and Stinson (1997) equating the human capital stock of base entrants with the accumulated real expenditures in their general education and to eliminate the omitted variable bias as implemented by Dagum and Slottje (2000) combining the estimation of human capital as a latent variable with a macroeconomic estimation of the average human capital of a population of economic units.

4. Asset Allocation in Egypt: 'Human versus Financial Capital'

It is quiet obvious that almost all of the above mentioned models have been estimated using survey – pooled data. The study will capture the risk versus return of investing in human capital on aggregate level using macro data, and investigate the hypothesis that human capital has a positive impact on taking the decision of either investing directly in financial sector or indirectly through saving as shown in the following diagram:

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[6] Jorgenson and Fraumeni model compared to that of Graham and Webb (1979).

Figure 1: Investment Channels

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 Age                ┌──────────┐    Savings    ┌──────────┐
 Labor Income       │  Human   │──────────────▶│ Financial│    Initial Wealth
                    │  Capital │               │  Wealth  │
                    └─────┬────┘               └────┬─────┘
                          │                         │
                          └────────────┬────────────┘
                                       │     Risk Aversion
                                       │     Correlation between Human
                                       │     Capital & Financial Market
                                       ▼
                          ┌────────────────────────┐
                          │ Asset Allocation Decision │
                          └────────────────────────┘
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It is worthy to note that *Education in Egypt has a very specific nature where equal access to educational investment opportunities exists, thus, individuals are highly expected to invest in schooling until the marginal rate of return equals its opportunity cost, the real interest rate.*

With regard to the existed secular education system, it is anticipated that by the age of 15, basic education will be covered. Then, the undertaken decision is either to be enrolled in 3-year general academic secondary school, or 5-year vocational schools[7]. Putting into consideration that in case of the former decision, enrollment in higher education level is highly expected, which in turn implies more expenses[8]. In other words, individuals can only choose the length of education but not the field of study since the whole public system is highly systematic.

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[7] The study denies such a choice in the empirical analysis, since the government is not committed by law to provide jobs to this category.
[8] World Bank (2002) showed that households with children in higher education have much larger education expenditures than do households with children at the basic-secondary level. They estimated the average expenditure per student at the higher education by L.E. 954 and L.E. 147 at the basic-secondary level, while household with children in private higher education institutions spend L.E. 1605 per student.

However, still expenses are not expected to be so high since officially, education in Egypt is "free of Charge"[9] from basic to higher education, where students only pay between L.E. 30 to L.E. 150 per year as a token tuition fee in government funded universities[10]. On the other hand, those who attend private schools, and state universities with foreign academic programs[11] or private universities[12] are expected to pay higher fees which vary according to the 'brand name' – foreign language versus International system - of either the school or the university.

Here-in appraised the importance of studying the risk-return tradeoff of public higher education from macro-perspective within (1971 – 2004), to investigate the efficiency of the current public funding system despite of being budget constraint. In other words, the core objective of such a test is to hypothesize the acceptability of article no. 20 in the Egyptian constitution in year 1971: "Education in all education institution in Egypt is free in its various stages".

The Capital Asset Pricing Model (CAPM) has been applied, where the return to an education is the average annual income for workers within a well-defined educational group and the corresponding risk measure is the standard deviation of the annual income for workers within such a group. Therefore, the performance measure based on Sharpe (1965) ratio 'the standardized excess return' has been denoted using a modified measurement technique:

(1) $\text{Sharpe}_i = (R_i^* - R_F)/\sigma_i$

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[9] Such a system has been initially designed in 1952, followed by a governmental commitment in 1964 of guaranteed jobs to university graduates, which in turn has been effectively suspended in early 1980s, Richards (1992). Despite of this stylized fact, the 1998-99 Egypt Human Development Report estimated that, in aggregate, households spent almost as much as the Government at the pre-university level due to private lessons.

[10] The state's share of higher education finance for universities was reduced to 85 percent of the universities' needs only in 1994-1995, leaving the rest to be generated by the universities through various revenue diversification strategies, For more details see Sanyal (1998:16) and the World Bank (2000:40-41).

[11] Some public universities charge about L.E. 1000 as tuition for degree programs that use English as a medium of instruction.

[12] The American University in Cairo charges a tuition fee of around L.E.10000 for 6 credits and around L.E. 1700 for each additional credit.

Where: R_i^* is the average return on asset i, R_F is the risk-free return, and σ_i is the volatility of asset i.

The risk-free return has been measured in case of developed economies by the unemployment insurance. Such an option is not existed in case of Egypt, thus rather, a base labor entrant has been assumed to be equal to the accumulated real expenditures in the basic education, then standardized by the author as the human capital stock of individuals before being enrolled in either secondary or vocational education, taking the share of basic education public spending in GDP[13] as a proxy, since basic education is compulsory (article no. 18 of the Egyptian constitution in 1971 for primary education) and extended to encompass preparatory education in law no. 139 in 1981, and re-emphasized in law no. 23 in 1999. Simply, the author assumes that this is the only path towards achieving article no. 21 of the given constitution, where it is clearly admitted that "Illiteracy eradication is a national duty".

The average return on higher education is computed as the expected present value of public spending in higher education, based on an estimated multivariate vector autoregressive (VAR) model for the real interest rate[14] (as a proxy for the lost opportunity), the growth rate of wages and salaries as a percentage of GDP[15], the growth rate of unemployment[16], and the share of higher education public spending in GDP[17]. Since the present value formula is non-linear, the estimated VAR is approximated as a discrete value finite-state Markov Chain, Koralov and Sinai (2007: Chapter 5), which allows expectations to be calculated as a weighted sum over possible outcomes instead of an intractable integral. The author assumes that the aggregate earnings of higher educated human capital stock should at least covers the costs taking into account the time value of money.

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[13] Ministry of Finance: Several Annual Issues
[14] Central Bank of Egypt: Several Annual Issues
[15] Ministry of Finance: Several Annual Issues
[16] CAPMAS: Several Annual Issues
[17] Ministry of Planning: Several Annual Issues

The volatility of the higher education enrollments in public universities[18] is computed as the standard deviation from its central trend according to a normal distribution, then, the highest Sharpe ratio within the given period implies an efficient mean variance that represents better return per unit of volatility.

Figure (2) shows that only within (1971-1981) the high education public funding system was slightly efficient, since the flood of enrollments was absorbed by the government bureaucracy. In 1982 the index starts to take negative value implying an inefficiency of the government funding system. Indeed, this is an expected result to the undertaken policy since the early 1980s, when the government suspended *de facto* the job guarantee, in parallel with raising the real resources reallocated to higher education. The deterioration of the situation in 1984 can be illustrated based on the fact that by then the university enrollments were more than three times as large as they had been only 13 years earlier. Then, the obvious slight stability in the level of inefficiency is supported by the fact that since 1984, university enrollments have fallen every year at a compound rate of about - 3% - a decline of sum 14% by 1989, Richards (1992:19). The change in the inefficiency trend by year 1990 is due to reallocation of resources towards basic-secondary education since the given date, at which expenditures per students in higher education have shrunk by 45%, while expenditures per student in pre-university education have increased by 33%. The ratio of per-pupil expenditures at the university level to per-pupil expenditures at the primary level has decreased from 8.2 to 3.5 over the same period, World Bank (2002:8). The slight stability of the inefficiency ratio since 1994 is due to the reduction of the state's share of higher education finance for universities to 85%, however, the enrollments increased by 42% in 1997 leading to an 8% decline in per-student that exacerbated disparities in resource allocation between faculties, World Bank (2002:41), after which the enrollments growth rate declines by 18% in sum by 2004.

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[18] CAPMAS: Several Annual Issues

Figure (2): Sharpe Index of Highly Educated Human Capital Stock in Public Universities
(1971-2004)
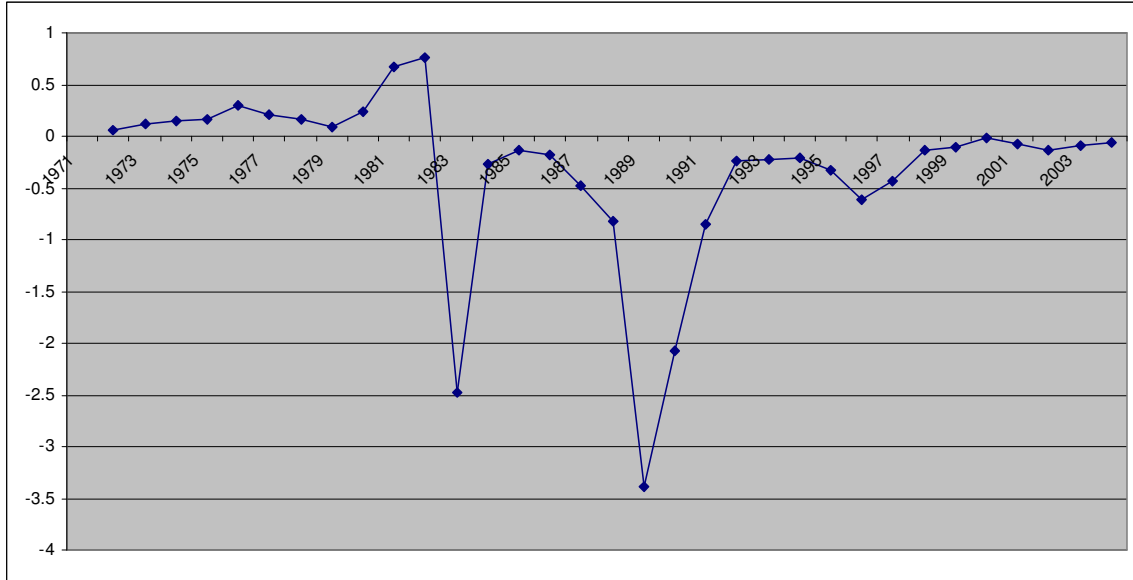
The appraised inefficiency fosters the author to study the causal relationship between the public highly educated human capital stock (measured by the growth rate of the computed average return of higher education - G_{HER})[19], the economic growth rate - G_{econ}[20] and the financial investment (measured by the private credit by deposit money banks and other financial institutions as a percentage of GDP - PC)[21] within 1971-2004. Standard Granger-causality test in Vector Auto Regression (VAR) framework is employed for this purpose. Since the conventional Granger Causality test based on standard VAR is conditional on the assumption of stationarity of the variables constituting the VAR, the Augmented Dickey-Fuller (ADF) test is used to check whether the underlying series contain unit roots. The unit root test shows that none of the variables are level stationery, but all are I (1).

Moreover, Johansen Cointegration test has been applied, but both the trace statistic and maximum eigenvalue statistic were below the critical values at 1% and 5% significance

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[19] CAPMAS: Several Annual Issues.
[20] Ministry of Finance: Several Annual Issues
[21] World Bank (2006): Financial Structure Dataset.

level suggesting that there is no cointegration relationship between the given three variables. In absence of cointegration the unrestricted VAR in first difference is estimated taking the following form:

$$(2)\ \Delta G_{HER\ t} = \sum_{i=1}^{n} b_{1i}\ \Delta G_{HER\ t-i} + \sum_{i=1}^{n} c_{1i}\ \Delta G_{econ\ t-i} + \sum_{i=1}^{n} d_{1i}\ \Delta PC_{\ t-i} + e_{1t}$$

$$(3)\ \Delta G_{econ\ t} = \sum_{i=1}^{n} b_{2i}\ \Delta G_{HER\ t-i} + \sum_{i=1}^{n} c_{2i}\ \Delta G_{econ\ t-i} + \sum_{i=1}^{n} d_{2i}\ \Delta PC_{\ t-i} + e_{2t}$$

$$(4)\ \Delta PC_{\ t} = \sum_{i=1}^{n} b_{3i}\ \Delta G_{HER\ t-i} + \sum_{i=1}^{n} c_{3i}\ \Delta G_{econ\ t-i} + \sum_{i=1}^{n} d_{3i}\ \Delta PC_{\ t-i} + e_{3t}$$

Where, Δ is the first difference operator, e_{1t}, e_{2t}, e_{3t} are random disturbances and n is the number of optimum lag length, which is determined empirically by Schwarz Criterion, then the joint significance of each of the lagged endogenous are to be tested using Wald X^2 statistics.

The results of the VAR pair-wise Granger-causality between the given variables as shown in table (1) suggested that in equation (2), the hypothesis that ΔG_{econ} does not granger-cause ΔG_{HER} is rejected at 10% level, however that ΔPC does not granger-cause ΔG_{HER} is not rejected. In equation (3), the hypothesis that ΔG_{HER} does not granger-cause ΔG_{econ} is not rejected, but that ΔPC does not granger-cause ΔG_{econ} is not rejected. In equation (4), the hypothesis that ΔG_{HER} does not granger-cause ΔPC is not rejected, however, that ΔG_{econ} does not granger-cause ΔPC is rejected at 10% level.

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Table (1): VAR pair-wise Granger-causality between ΔG_{HER}, ΔG_{econ} and ΔPC:

Dependent Variable	Short run Causality, Wald X^2 statistics (probability)		
	ΔG_{HER}	ΔG_{econ}	ΔPC
ΔG_{HER}		0.2034	0.00147
		(0.0776)*	(0.8966)
ΔG_{econ}	0.00265		0.0139
	(0.7895)		(0.5488)
ΔPC	0.03970	0.1628	
	(0.6497)	(0.0563)*	

* Indicates significant at 10% level

Then, the stability of the estimated VAR is examined by checking the Roots of Characteristic Polynomial. Table (2) results showed that the moduli of all roots are less than unity and lie within the unit circle, implying the stability of the estimated VAR.

Table (2): Roots of Characteristic Polynomial

Variables in VAR	Root	Modulus
ΔG_{HER}, ΔG_{econ} and ΔPC	- 0.535751	0.535751
	- 0.063827 – 0.434807i	0.439466
	- 0.063827 + 0.434807i	0.439466

5. Conclusions

The empirical results indicate that there is only one-way of causality passing from economic growth to both public high education enrollments and financial investment, which in turn implies that in case of having a slow economic growth great cautious is required to reallocate real resources efficiently.

On the other hand, the absence of causality moving from financial investment measured by the available private credit to both the economic growth was not surprising, since Eid (2006) has evidenced that the financial sector accelerates economic growth only indirectly through the domestic investment channel. Moreover, concerning the non-existence of any relationship between the financial sector and public high educated was expected, despite of the fact that in 2000, a plan was constructed to establish L.E. 100,000,000 loan program for the public university students who prove that they are in real need of financial assistance for education-related expenses. Under such a loan scheme, those students will be eligible to receive up to L.E. 1000 annually in government loans, which in turn are to be interest free and their repayment were to be spread out over a period of 40 years. The IFC study on the market for student loans in post-secondary education in Egypt resulted in a rationed refusal: limited market size, underdeveloped debt/credit market, cultural attitude uncomfortable with personal debt and loans and lack of a consumer credit agency (World Bank, 2000:41).

Furthermore, the given results implicitly point out the negligible contribution – nil additive value - of the public highly educated individuals in either the economic growth cycle or the financial investment, which is anticipated as long as the majority of them are unemployed. This in turn magnifies the importance of estimating the share of high educated individuals in unemployment, in an attempt to analyze its adverse economic spillover effect whether in the short run or the long run. Simply, the author can argue here-in that "Human mind set has not really matter yet, or even has been rationally evaluated to be efficiently reallocated as one of the precious real resources".

Recalling back our initial evidence of weak performance for the public highly education financing system, using the estimated Sharpe index, the author argues that there is no mean for further practicing the given system as long as the bureaucracy can not absorb the public highly educated graduates anymore.

In addition, the author proposes another scenario: The government should continue fully financing the basic education as the only path towards cultivating the overlapping generation mind, noticing that more focus should be given to general knowledge; financial awareness, economic and political involvement since early ages. No more funding for either secondary or post secondary education – article 20 in the Egyptian constitution year 1971 is highly recommended to be modified – public finance should be secured for prominent students, whose level of intelligence is to be measured based on their scores in different tests; IQ, GRE and GMAT, not only to cover their education expenses but also to cover all of their needs (i.e. medical insurance, feeding, clothing, ...). They should have free access to international scholarships with more concentration in Mathematics and Science studies. These scholarships are expected to be fully financed by the Government in the form of a long-term loan, and indeed jobs are guaranteed by then, for the graduates to repay the debt. Other students with normal trend of intelligence are to be diverted towards vocational education, whose distribution are to be predefined based on the real needs of different activities. The later will be the responsibility of the Key players per activity/industry, whose real contribution will be sponsoring the vocational system jointly with the government. On the other hand, the quality of high education provided by private institutions should be revised and monitored in accordance to international standards.

> "Education is the route to economic prosperity, the key to scientific and technological advancement, the means to combat unemployment, the foundation of social equity, and the spread of political socialization and cultural vitality",
> Psacharopoulous (1985: p.5)

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