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THE EDUCATION MARKET IN EGYPT:
A GAME THEORY APPROACH

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Abstract

Education in Egypt has been an economic paradox for a long time and there is urgent need for change. The Egyptian Constitution guarantees the "right of education in all its stages" for every citizen free of charge in state educational institutions. Yet, there is overwhelming evidence suggesting that such a right is not exercised without the heavy financial burden of private tutoring and other overhead educational expenses, in addition to pressing problems of the educated unemployed and the opportunity cost of expenditure on critical problems such as illiteracy. This research paper will tackle such an urgent topic based on a game theory and decision science approach. The research will focus on higher education and government subsidization from an economic productivity point of view based on a multitude of factors. These include opportunity costs, private tutoring costs, lifetime earnings, government expenditures on education, private returns to education, unemployment, differential labor productivity, incremental income and human capital externalities to social gains. The analysis will be integrated into a three-stage game theory model. The main outcome yields that the constitutional right of 'free education for all' is not economically efficient and yields excessive social losses in the long run. On the other hand, lifting all subsidization also does not yield to an efficient outcome. Targeted partial subsidization achieves an efficient outcome.

Introduction

There is a paradox in the current educational system in Egypt — high expenditures with low returns, excess demand with oversupply, unemployment of the educated labor, undersupply of technical labor and opportunity costs of private tutoring. The current system of "free education for all" is deemed both inefficient and non-sustainable. Hence, this paper takes education rights as stipulated in the Egyptian Constitution and analyzes education-related constitutional articles based on economic efficiency. A game theory approach is formulated based on three stages in which 'Government', 'Aptitude', and 'Individual' are stakeholders. Based on detailed economic analysis, a more sustainable education scheme which includes partial subsidization is proposed. The paper starts by outlining articles in the Egyptian Constitution related to education. Then, such articles are analyzed based on efficiency and sustainability concerns. Critical elements for the non-sustainability of the status quo are outlined. In order to solve this education paradox, a three stage game is formulated: 'Government' moves first by deciding on an education scheme which includes subsidization, 'Aptitude' moves second based on the probability of success and failure of education aptitudes of the education system, and finally, 'Individual' (citizens) moves last by deciding to enroll or forgo the stage of higher education inclusive of private and social opportunity costs. The game theory model is solved and a system of targeted subsidization is proposed.

1. Articles of the Egyptian Constitution Related to Education

Article 4

The economic foundation of the Arab Republic of Egypt is a socialist democratic system based on sufficiency and justice in a manner preventing exploitation, conducive to liquidation of income differences, protecting legitimate earnings and guaranteeing the equity of the distribution of public duties and responsibilities.

Article 8

The State shall guarantee equality of opportunity to all citizens.

Article 11

The State shall guarantee the proper coordination between the duties of woman towards the family and her work in the society, considering her equal with man in the fields of political, social, cultural and economic life.

Article 13

Work is right, a duty and an honor ensured by the State. Workers who excel in their field of work shall receive the appreciation of the State and the society. No work shall be imposed on the citizens, except by virtue of the law, for the performance of a public service and in return for a fair remuneration.

Article 17

The State shall guarantee social and health insurance services and all the citizens have the right to pensions in cases of incapacity, unemployment and old-age, in accordance with the law.

Article 18

Education is a right guaranteed by the State. It is obligatory in the primary stage and the State shall work to extend obligation to other stages. The State shall supervise all branches of education and guarantee the independence of universities and scientific research centers, with a view to linking all this with the requirements of society and production.

Article 19

Religious education shall be a principal subject in the courses of general education.

Article 20

Education in the State educational institutions shall be free of charge in its various stages.

Article 21

Combating illiteracy shall be a national duty for which all the people's energies should be mobilized.

Article 23

The national economy shall be organized in accordance with a comprehensive development plan which ensures raising the national income, fair distribution, raising the standard of living, eliminating unemployment, increasing work opportunities, connecting wages with production, fixing a minimum and a maximum limit for wages in a manner which guarantees lessening the disparities between incomes.

Article 25

Every citizen shall have a share in the national revenue to be defined by the law in accordance with his work or his un-exploiting ownership

Article 26

The workers shall have a share in the management and profits of the projects.

Article 30

Public ownership is the ownership of the people and it is confirmed by the continuous consolidation of the public sector. The Public sector shall be the vanguard of progress in all spheres and shall assume the main responsibility in the development plan.

Article 34

Private ownership shall be safeguarded and may not be put under sequestration except in the cases specified in the law and with a judicial decision. It may not be expropriated except for the general good and against a fair compensation in accordance with the law. The right of inheritance is guaranteed in it.

Article 36

General sequestration of funds shall be prohibited.

Private sequestration shall not be allowed except with a judicial decision.

Article 37

The law shall fix the maximum limit of land ownership with a view to protecting the farmer and the agricultural laborer from exploitation and asserting the authority of the alliance of the people's working powers at the level of the village.

Article 38

The tax system shall be based on social justice.

Article 39

Saving is a national duty protected, encouraged and organized by the State.

Article 61

Payment of taxes and public imports is a duty, in accordance with the law.

2. Analysis of Education Rights in the Egyptian Constitution

Article 4

"The economic foundation of the Arab Republic of Egypt is a socialist democratic system conducive to *liquidation of income differences*".

Liquidation of income differences, as a constitutionally enshrined policy, has the potential to clash with a private system of education. Private nature of higher education will invariably reduce its accessibility which, notwithstanding that a reduction in higher education enrollment might be more efficient, will in turn impact distribution of incomes. Given the high degree of correlation between levels of education and incomes attained, as higher education enrollment decreases the income gap between those possessing such education and those who do not will widen. Therefore a policy of reducing current levels of subsidization towards higher education might run counter to the constitutionally-stated goal of "liquidating income differences".

Article 13

"Work is a right, a duty and an honor ensured by the State".

If a certain element of civil life is deemed by the Constitution of the political state to be a right that the citizen possesses, the conclusion that one can draw is that a citizen deprived of the element he has a right to is being wronged, and can assert his right against the State ensuring its provision. Consequently if work is deemed to be a constitutional "right" coloring economic policies, then the State must provide the citizen with a place of work to meets its obligation towards him.

The acclaim of work as a constitutional right can have an impact on education, in particular when accompanied by a system of free education. An example of this was the government's avowed policy of guaranteed public sector employment.

If one views education, from an economic perspective, as being governed by the traditional forces of supply and demand, then an equilibrium level of education is attained when these forces are balanced. Demand for education is dependent on the individual's expectations relative to future incomes and job prospects. A policy of guaranteed employment, as seemingly mandated by a right to work, distorts this economic equilibrium by artificially creating demand beyond the market equilibrium. Therefore market signals no longer fully reach individual decision makers, and the guarantee of employment increases education demand beyond the efficient level. As a result there is a greater than efficient level of enrollment. This result is exacerbated by the absence of tuition costs for higher education.

Article 18

"Education is a right guaranteed by the State"

In a fashion similar to that of article 13 regarding work, this article sets education as a right guaranteed by the State. As a result each individual citizen is capable of asserting this right against the State guaranteeing it.

By guaranteeing access to education, the Constitution is seemingly rendering a systemic fee-based approach to higher education unconstitutional. An individual who is deprived of access to higher education if he is unable to meet the costs of tuition, and falls outside the band covered by potential scholarships and bursaries, would have a constitutional challenge against such a policy. Consequently if such a fee-based system should be open for consideration and implementation an amendment to the constitution, perhaps affirming a right to basic and secondary education only, should be considered.

"It is obligatory in the primary stage and the State shall work to extend obligation to other stages"

The second component of this provision enables the State to extend obligatory education beyond the primary stage. The Constitution therefore allows not only for free, but potentially obligatory, secondary and higher education. While obligatory higher education is highly improbable and unrealistic, it is noteworthy that the letter of the Constitution can be interpreted to support such a policy.

Article 20

"Education in the State educational institutions shall be free of charge in its various stages"

This is a key article for the provision of education in Egypt. It constitutionally mandates absence of fees for State-provided higher education. Therefore the introduction of a tuition system would require an amendment of this provision.

Much like the guarantee of employment, this provision distorts the market equilibrium for education. The two primary costs of education to an individual are the opportunity cost of time spent learning and not earning income, and the direct costs associated with enrollment. By partially removing the direct costs from an individual's consideration, the guarantee of free access to education is increasing the demand for education beyond the level otherwise determined by market forces and expectations. This leads to over enrollment in State-provided higher education and can lead to problems such as: oversupply of university educated workforce causing unemployment, undersupply of trained/skilled workers, devaluation of university degrees and displacement of secondary-educated citizens in job competitions.

Article 21

"Combating illiteracy shall be a national duty for which all the people's energies should be mobilized"

Studies show that the educational system with the highest social return and impact to growth is primary education. Therefore improving access to primary education and combating illiteracy are important goals.

This constitutionally mandated goal might in fact be undermined by the universal absence of fees at all levels of State-provided education for two reasons.

1. Costs of education increase as its level progresses, and hence higher education is the costliest to subsidize. As a result, higher education subsidies divert State investment away from the primary and secondary levels, thereby reducing the quality of education at those levels.
2. Private tutoring in Egypt is pervasive and can make a significant difference on the chances of a student enrolled in primary and/or secondary education, in particular when many peers are also enrolled in such tutoring. By not allowing market forces to at least partially dictate the costs of enrolling in State-provided educational institutions, the salaries of teachers are determined by government allocations and not market forces. This can work to keep teacher salaries artificially low and create the incentive, and often the need, to supplement such wages with private tutoring. This tutoring imposes a cost associated with primary education and hence disadvantages poorer families from which potentially illiterate students are likely to emerge.

Article 23

"The national economy shall be organized in accordance with a comprehensive development plan which ensures….fixing a minimum and maximum limit for wages".

When an artificial ceiling for wages is imposed by policy, this can have an impact on the labor market on which the ceiling is imposed. If the ceiling is set above the market equilibrium for that market then the ceiling will not have any adverse effects. If, however, the ceiling is imposed below the market-clearing wage rate then this will cause labor demand in that market to exceed labor supply, for the given wage ceiling. This shortfall of labor is likely to stifle growth in the affected sectors and potentially limit economic expansion and hence future job creation.

One of the problems affecting the Egyptian education system is the lack of demand for graduates of higher education due to shortfall in the type of jobs requiring such education. Such shortfall can be cured by economic expansion and job creation, and any policies stifling this expansion will exacerbate the unemployment problem.

Article 30
"The Public sector shall be the vanguard of progress"

Public sector in Egypt is already overstaffed due to the years of policies directed at absorbing graduates entering the labor force. In order to ensure continued economic development, the private sector must be encouraged to expand in order to ensure the creation of jobs which demand graduates of higher education. Increase in private sector demand for skilled workers is necessary in order for expansion in education to lead to increased productivity and income for educated workers. In addition, when the public sector is deemed the vanguard of progress and innovation in public enterprises are low, then economic development will suffer. When this happens, demand for higher education skills will not match supply consequently leading to unemployment.

3. The Education Paradox in Egypt
"Work is a right, a duty and an honor ensured by the State" along with "Education is a right guaranteed by the state" are core premises in the Egyptian Constitution. Such guarantees of lifetime employment stimulated an enormous growth in the demand for secondary and university education with the intent to acquire future government jobs. In parallel this resulted in a shortage of skilled workers and overstaffing in government jobs. Unemployment is massing around the educated population. Those with intermediate education comprise 55% of the total unemployed while those with university and higher education account for 14% of the total unemployed.

In general, 1.28 million university students are enrolled (Egypt Human Development Report), and it is estimated that such pool of students will increase at an annual rate of at least 4%. If part time students, amounting for about 250,000 are included, then the total number of students will roughly reach 1.53 million — the majority attending public universities. The government is accountable for granting the Egyptian population free education at all levels. For instance, tuition fees in faculties of Medicine and Engineering do not surpass LE 70 per year excluding book fees and other expenses. Overall expenditure on education as a percentage of GDP has grown from 3.9% in 1991 to 5.2% in 2002 of which 27.3% was allocated to higher education. The unit cost of total expenditure on higher education amounted to LE 3,467 [1] which, according to the Egyptian Human Development Report, is more than *seven* times its value at the basic educational level. Hence, subsidizing higher education generates an opportunity cost per student of seven other students at the basic education level. In addition, contributions to value-added economic growth are triggered by pre-university education more than that of university education (Selim 2004, 2005). Hence, such opportunity costs stifle economic growth.

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[1] The average private tuition per year reached LE 24,260 in 2003/2004 academic year.

Moreover, the general education environment in public universities can be labeled incomplete and inefficient; hence students complement their education by private tutoring. There is evidence to suggest that the government expenditure on education is insufficient to ensure maintaining high quality education for a rapidly increasing population. Inadequate equipment and testing facilities coupled with an increasing number of students per teacher and the lack of emphasis on research productivity or innovation by staff members are among the aspects impinging on the quality of research generated by Egyptian public universities. Furthermore, there is indication of a dual misallocation of spending and bad planning in public universities. As a response to the inefficiency of the public education system, the demand for private tutoring has extensively grown to compensate for low teacher salaries. It is worth noting that private tutoring is a widespread phenomenon not only among developing countries, but also in countries such as Hong Kong, Taiwan, and Turkey. In Egypt, the proportion of students taking private lessons is more than 51%, including poor students who endure such a burden. The average tutoring cost per student amounts to a an estimated figure of LE 933 per student, per year. Hence, private tutoring per student in a traditional four year university program costs LE 3,732 per student. Such financial burden on a population with a 40% poverty rate is deemed non-sustainable.

In essence, the following factors are important determinants to the non-sustainability of the status quo:

1. Artificially creating excess education demand beyond the efficient level
2. Artificially creating oversupply of highly educated population
3. Unemployment of the educated population
4. Undersupply of skilled workers in technical jobs
5. Devaluation of wages for university graduates
6. Diverting state investment away from combating illiteracy
7. Diverting state investment away from higher value-added education in schooling
8. Artificially low fees creating low quality educational output
9. Teacher salaries artificially low creating incentives for private tutoring
10. Opportunity cost of low innovation which hampers economic development
11. Opportunity cost of expenditures on education towards combating poverty

4. A Game Theory Approach to Combating the Education Paradox

Let us consider the retreat of the Egyptian education system to two extremes: full subsidization versus no subsidization. A moderate treatment of these two extremes is possible using 'mixed strategy' equilibrium. From this perspective, consider a three stage game theory model as follows:

1. The 'Government' moves first by choosing between two options: full subsidization versus no subsidization.
2. 'Aptitude' moves second by determining the probability of success/failure
3. The 'Individual' moves last by deciding to enroll or forgo higher education.

This three-stage model is depicted in Figure 1.

GN I1/2 E

This scenario is the "status quo" of the constitutional right of full subsidization of higher education. Given an aptitude of 90% success rate (proportion of passing grades to total expected enrolment) based on international education standards (World Bank and Egypt

Human Development Reports), students will enroll in higher education with a probability of (p). Social gains/losses are calculated as follows:

Social Gains/Losses for GN I1/2 E = [- a – b + c + d – e]

where

a = amount of subsidy for a four year higher education program[2] (LE 16,780)

b = opportunity loss of high school salary for four years[3] (LE 20,736)

c = change in productivity due to university education[4] (LE 5,816)

d = lifetime post-university increase in wage due to higher education[5] (LE 27,350)

e = cost of private tutoring[6] (LE3,735)

GN I1/2 F

This scenario is still the status quo but when individuals choose not to enroll in higher education. Although higher education is fully subsidized, some individuals will choose to forgo the stage of higher education due to its opportunity cost of forgone wages and additional burden of private tutoring costs, or due to social constraints such as family related work especially in agriculture. Since students enroll with probability (p), then those who forgo higher education will be with probability (1-p).

Social Gains/Losses for GN I1/2 F = [a + b – c – d – f]

where

f = human capital lost when forgoing higher education[7]

It should be noted here that, under the status quo, society is better off when individuals forgo the stage of higher education by the difference (GN I1/2 F – GN I1/2 E) which amounts to LE 6,619 per person. Yet, on an individual scale, individuals are better off by enrolling.

GN I3/4 E

This scenario is the full extreme to subsidization: no subsidy. Hence, market forces dictate the efficient level of education enrollment. There are, however, opportunity costs involved including loss of private tutoring wages and loss of forgone wages for individuals choosing to enroll. In addition, individuals rather than the government, have to absorb the financial burden of full tuition costs.

Social Gains/Losses for GN I3/4 E = [-a^P – b + a^G + c + d + f ' – e]

where

a^P = cost of higher education paid by private individuals

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[2] Based on Galal (2002), per year education subsidy cost for higher education is LE 4,195. Please note that all data are corrected for inflation for same year comparison.

[3] Based on Assad (2003), the average salary for high school graduates is LE 432 per month.

[4] Based on Selim (2004, 2005), the additional productivity for university education is 0.83% of the country's GDP per capita. It is assumed that individuals will work for 35 years until retirement.

[5] Based on Assad (2003) and various Egypt Human Development Reports, the hourly wage for university educated labor is LE 1.22 per hour whereas that of high school labor is LE 0.85. It is assumed that labor works for 8 hours per day, 22 days per month, for 35 years until retirement.

[6] Based on various Egypt Human Development Reports, the cost of private tutoring averages LE 933.8 per student per year.

[7] The human capital lost when forgoing higher education is estimated as the mirror image of the change in productivity when enrolling in higher education. Hence, f = c in absolute value.

a^G = government opportunity gain from not subsidizing higher education

$a^P = a^G$ = LE 16,780

f ' = human capital gain from higher education enrollment = f

GN I3/4 F

This scenario is that of no subsidy and when individuals choose not to enroll in higher education. There are losses in productivity, lifetime earnings, and human capital. On the other hand, there is the opportunity gain by the government not subsidizing higher education, and the loss of private tutoring wages by teachers. There is also the opportunity loss of tuition fees.

Social Gains/Losses = [a^G + b – c – d – f – e – a^P]

Here, it should be noted that under the no subsidy scheme, society is better off when individuals enroll in higher education by the difference (GN I3/4 E – GN I3/4 F) which amounts to a sizeable sum of LE 36,492 per person. However, society is worse off when individuals choose to forgo higher education by LE 21,981 under the no subsidy scheme (compared to social losses of only LE 1,466 under the full subsidization scheme). This implies that if a no subsidy scheme is implemented there is a high risk of social losses if individuals forgo higher education, but at the same time, there are substantial social gains when individuals choose to enroll.

Net Social Gains/Losses from the Two Scenarios

If 90% of those with aptitude choose to enroll, and 10% choose to forgo, based on self-selection, then:

Social Gains/Losses from the Full Subsidization Scheme = - LE 7,423 per person

(90% of GN I1/2 E and 10% of GN I1/2 F)

Social Gains/Losses from the No Subsidy Scheme = LE 10,861 per person

(90% of GN I3/4 E and 10% of GN I3/4 F)

Hence, it is clear that the no subsidy scheme for higher education is superior and leads to social gains, whereas the status quo of full subsidization for higher education is socially inefficient and leads to social losses.

Probability of Enrollment (p)

Consider the no subsidy scheme. Under what conditions will individuals enroll in higher education? Equivalently, what is the efficient probability of enrollment when the education system has no subsidies and is left for the market forces of supply and demand? The break-even point will occur under the following condition:

90% [(GN I3/4 E)(p) + (GN I3/4 F)(1-p)] + 10% [(GN I3/4 E)(p) + (GN I3/4 F)(1-p)] = 0

This leads to:

p* = 0.60   (60%).

Hence, under the no subsidy scheme, 60% of individuals will choose to enroll and 40% will choose to forgo higher education.

Amount of Targeted Subsidy (1-p)

In order to ensure that all individuals have an incentive to enroll in higher education, the government should consider targeted subsidies beyond the efficient level of enrollment. Since 60% of individuals will efficiently enroll under the no subsidy system, the government should target a subsidy for (1-p)= 0.40 (40%) of individuals eligible for higher education.

Hence, an economically efficient outcome in solving the education paradox in Egypt is for the education system to be left for market forces to dictate the efficient amount of enrollment, and when this system is enforced, 60% of individuals will enroll in higher education by efficient self-selection, and the government will have to regulate the education market by offering a subsidy to 40% of eligible individuals to be enrolled in higher education. If left alone, those individuals will choose to forgo higher education and will cause a sizeable social loss to society.

5. Conclusion

The current education system in Egypt leads to oversupply of education with unemployment concerns, produces low quality educational output which must be supplemented by private tutoring costs and creates opportunity losses by diverting state investments away from key issues such as illiteracy and poverty concerns. It is also the main reason for undersupply of skilled workers in technical jobs, wage devaluation for university graduates and low innovation in the workforce. The status quo hampers economic development and leads to net social losses. In order to solve the education paradox in Egypt, a three stage game theory approach is formulated based on government subsidies, education aptitude and individual choice of enrollment. Neither a full subsidization scheme nor a no subsidization scheme is stand alone efficient. An economically efficient outcome is for education to be left to market forces (no subsidization), in which 60% of eligible individuals will self-select to enroll in higher education, but such a system must be complemented by a subsidy scheme targeting 40% of individuals who would not enroll without a government subsidy.

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Figure 1: Three-Stage Game Theory Choice for Higher Education based on Government Subsidization Schemes
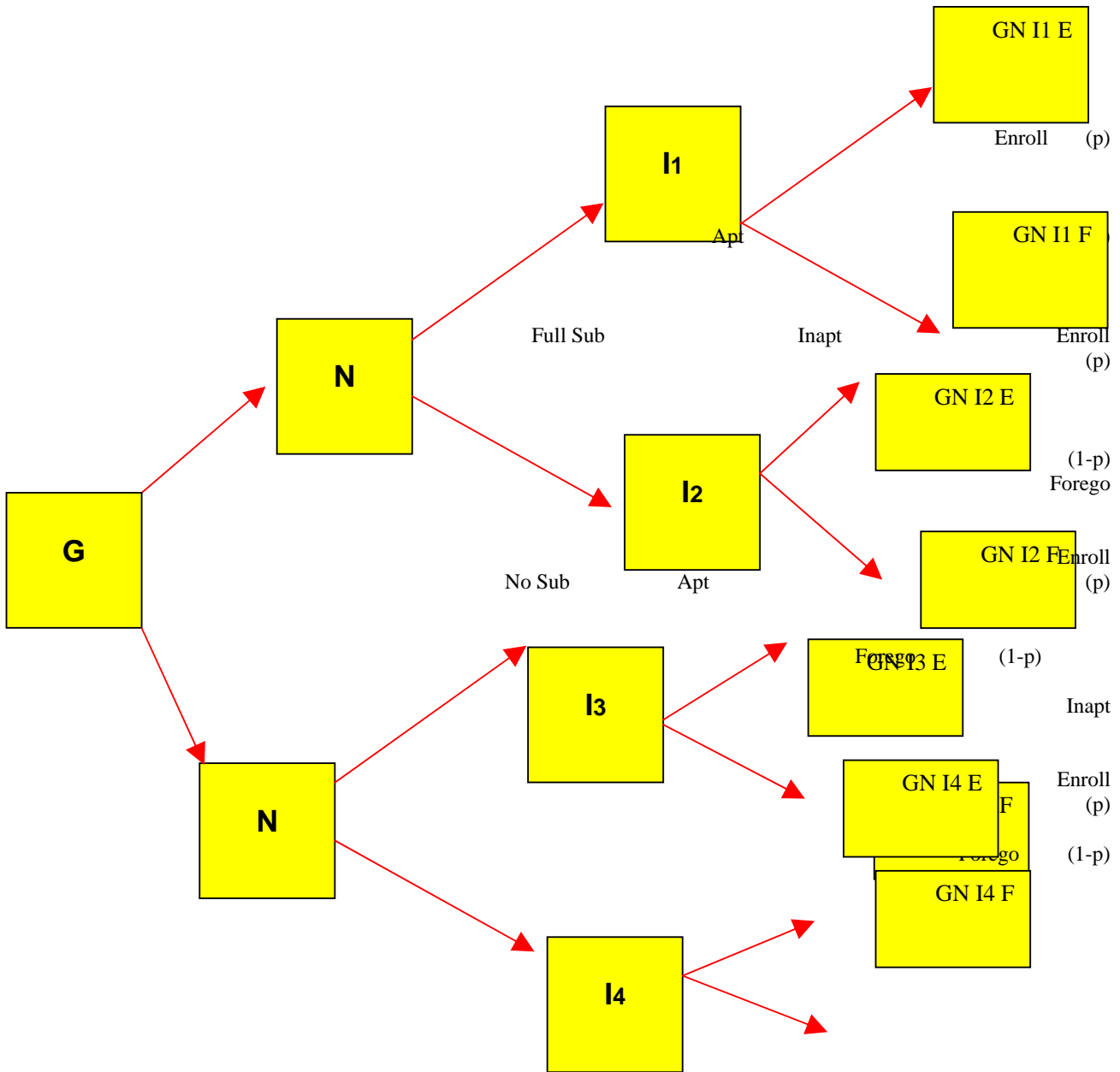
Table 1: Critical Higher Education Statistics for Egypt

No of students/year = 1.53 million
Growth rate = 4% per year
Unit expenditure = LE 3,467/yr
Multiple of basic level = 7
Private tutoring = 51% of students
Cost of private tutoring = LE 933/yr
Official Fees = LE 70/yr

Table 2: Important Education Parameters for the Game Theory Model

a = amount of subsidy for a four year higher education program (LE 16,780)
b = opportunity loss of high school salary for four years
(LE 20,736)
c = change in productivity due to university education
(LE 5,816)
d = lifetime post-university increase in wage due to higher education (LE 27,350)
e = cost of private tutoring (LE 3,735)
f = human capital lost when forgoing higher education
(LE 5,816)
a_P = cost of higher education paid by private individuals
a_G = government opportunity gain from not subsidizing higher education
f ' = human capital gain from higher education enrollment = f

Table 3: Benefit-Cost Allocations for Four Scenarios in the Game Theory Model

G/A/I	a	b	c	d	e	f	Economic Returns
Scenario 1 "The Status Quo": **Full Subsidization / Enroll**	–	–	+	+	–		**Loss** **LE 8085/per/yr**
Scenario 2: **Full Subsidization / Forgo**	+	+	–	–		–	**Loss** **LE 1466/per/yr**
Scenario 3: **No Subsidization / Enroll**	$-^P$ $+^G$	–	+	+	–	+'	**Gain** **LE 14,511/per/yr**
Scenario 4: **No Subsidization / Forgo**	$-^P$ $+^G$	+	–	–	–	–	**Loss** **LE 21,981**
Full Subsidy Scheme							**Loss** **LE 7,423**
No Subsidy Scheme							**Gain** **LE 10,861**
Break-Even Probability of Enrollment = p							**p*=0.60 (60%)**
Amount of Targeted Subsidy =(1-p)							**0.40 (40%)**