ENHANCING EGYPT'S COMPETITIVENESS: EDUCATION, INNOVATION AND LABOR

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1. INTRODUCTION

In today's globalised world, a country's success is often measured by its competitiveness. Competitiveness, in turn, is closely related to the degree by which a country can simultaneously increase the real incomes of its citizens and produce internationally demanded goods and services in accordance with free and fair market conditions. Over the last few years, Egypt's national competitiveness reports showed that Egypt performs poorly in terms of its global competitiveness ranking as per the World Economic Forum Competitiveness Index in pillars such as macroeconomic stability and those related to human capital development, namely education, innovation and labor.[1]

The World Economic Forum (WEF) defines competitiveness as the set of institutions, policies, and factors that determine the level of productivity for a country. Generally speaking, greater productivity levels result in higher levels of income, and higher rates of return on investments. Because the rates of return are the fundamental determinants of the growth rates of an economy, a more competitive economy is one that is likely to grow faster over the medium to long run. The WEF has been studying the competitiveness of nations since 1979. In 2005/2006, the WEF introduced the Global Competitiveness Index (GCI), a highly comprehensive index for measuring national competitiveness that takes into account both microeconomic and macroeconomic foundations of national competitiveness. Starting from the Global Competitiveness Report of 2007/2008, some refinements were introduced to the GCI,[2] such as increasing the number of pillars to 12 compared to 9. Egypt's performance in the GCI has fluctuated from one year to another.[3] Yet, its overall rank deteriorated over the period 2005/06–2010/11, from 52 out of 114 countries in 2005/06 to 81 out of 139 countries in 2010/11. However, over the same period Egypt's score has almost remained circa 4 (the score ranges from 1= lowest and 7= the highest).

This study has several objectives. First, to investigate and quantify how education, innovation and labor impact competitiveness and in turn real economic growth for a set of 25 countries at the same stage of development, including Egypt, as designated by the world economic forum—namely, factor-driven economies in a transition to efficiency-driven

[1] Egypt's rank in the various pillars is displayed in the appendix.
[2] For more information on the composition of the GCI and its calculation refer to the appendix.
[3] As illustrated in the appendix.

economies. Second, the study discusses the relationship between competitiveness indicators and economic growth, using both panel data and time series data for Egypt. Finally, the study projects potential growth that could be attained by Egypt if education, innovation and labor indicators were to improve.

The research encompasses four stages of analysis. In the first stage, we use panel data regressions for 25 countries at the same stage of development during the period 2005-2011, namely, factor-driven economies in a transition to efficiency-driven, including Egypt. The purpose is to investigate the relationship between the competitiveness score and labor, education and innovation. In the second stage, we quantify the relationship between real growth of gross domestic product and the competitiveness score as well as the underlying labor, education and innovation indicators. Furthermore, the analysis will focus on the Egyptian case by conducting a time series analysis for the period from 1980 to 2009 where we assess the relationship between real GDP growth and a set of corresponding indicators on labor, education and innovation.

Following the introduction, the study is organized as follows: Section 2 assesses Egypt's key education, innovation and labor indicators; Section 3 presents the methodology; Section 4 provides key findings, while Section 5 concludes with a summary of findings and recommendations.

2. EGYPT'S KEY EDUCATION, INNOVATION AND LABOR INDICATORS

The World Bank (2007c) defines human capital as "a broad range of knowledge, skills and capabilities needed for life and work, including those related to capability in successful living; engendered through quality education". Inadequate human capital constrains productivity and growth, and compromises the overall well-being of citizens.

Human capital challenges in Egypt include high population exceeding 80 million as per the CIA factbook estimate in July 2010, a growing workforce, a high unemployment rate of 11.9 percent,[4] 40 percent of the population is poor or near poor,[5] weak female participation in

[4] CAPMAS (2011).

[5] World Bank (2007a).

the labor force[6] and lack of sufficient supply of skilled and committed workers, which is one of the key cited obstacles for doing business in Egypt.

Egypt's competitiveness is undermined by its poor human capital development as reflected by its poor rank in the human development index (101 out of 169 countries) in 2011, as well as its poor rank in the indicators for education, innovation and labor as per the GCI reports. In what follows, the study will discuss briefly Egypt's education, labor and innovation indicators.

2.1. Education Indicators

The Global Competitiveness Index comprises two sub-pillars addressing education. These are the primary education sub-pillar and the higher education and training pillar. In the next sub-sections we will discuss Egypt's stance in education as per the GCI while highlighting some key national education indicators (Figure 1).

2.1.1 Primary education

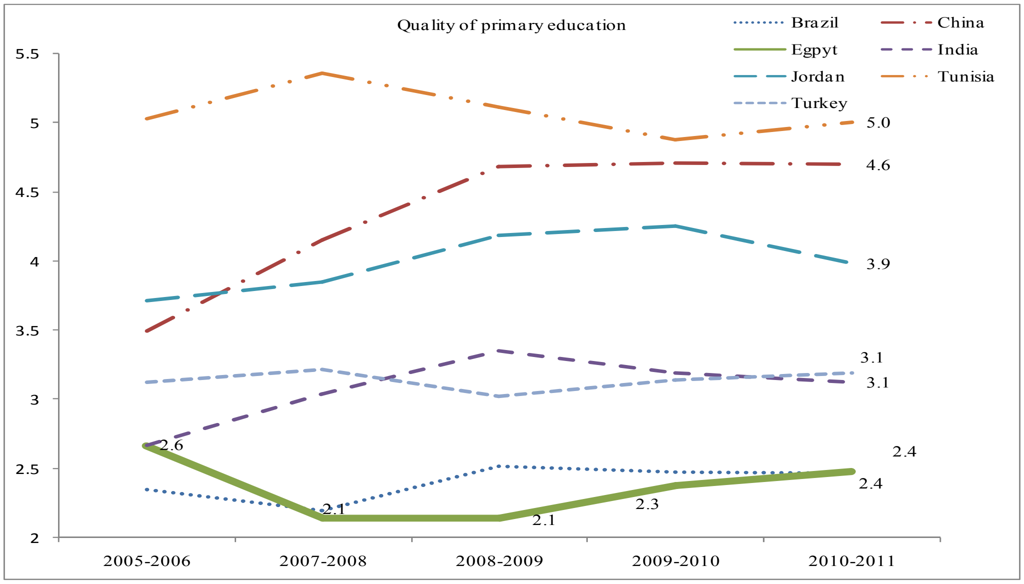
Egypt's competitiveness rank in terms of primary education registered 100 out of 114 countries in the 2005/06 GCI and 108 out of 139 countries in 2010/11. This low ranking is attributed primarily to the decline in the perceived quality of primary education as well as the slight decrease in enrollment rates. Egypt's primary enrollment rate fell to 93.6 percent in 2010/11 from 97.4 percent in 2005/06. Compared to other selected countries—namely India, Jordan, Tunisia, Turkey, Brazil and China—Egypt is the poorest performer in terms of quality of primary education. This, in turn, affects labor productivity negatively and leads to unequal educational outcomes.

Weaknesses in the educational system include outdated curriculums, high-stake tests that do not teach or measure the skills needed by the labor market, low incentive environment, low pay for teachers, coupled with poor accountability and prevalence of private tutoring, and a serious need to monitor the quality of outcomes and develop monitoring and evaluation frameworks. Reforms needed to improve the quality of education include formulating new curriculums, using new technologies, improving teachers' pay and increasing accountability. Moreover, despite the introduction of the internet to some schools, Egypt is ranked 122nd out

[6] The ratio of female to male participation in the labor force was as low as 0.35 in 2010 as per the WEF Global Competitiveness Report 2010-11.

of 139 countries in terms of internet usage at schools, lower than all of the selected comparator countries. Hence, there is the need to invest more in increasing both access to and usage of internet in schools to catch up with comparators.

Figure 1. Quality of Education Score: Egypt Compared to Selected Countries (Highest Score Attainable=7 Lowest= 1)



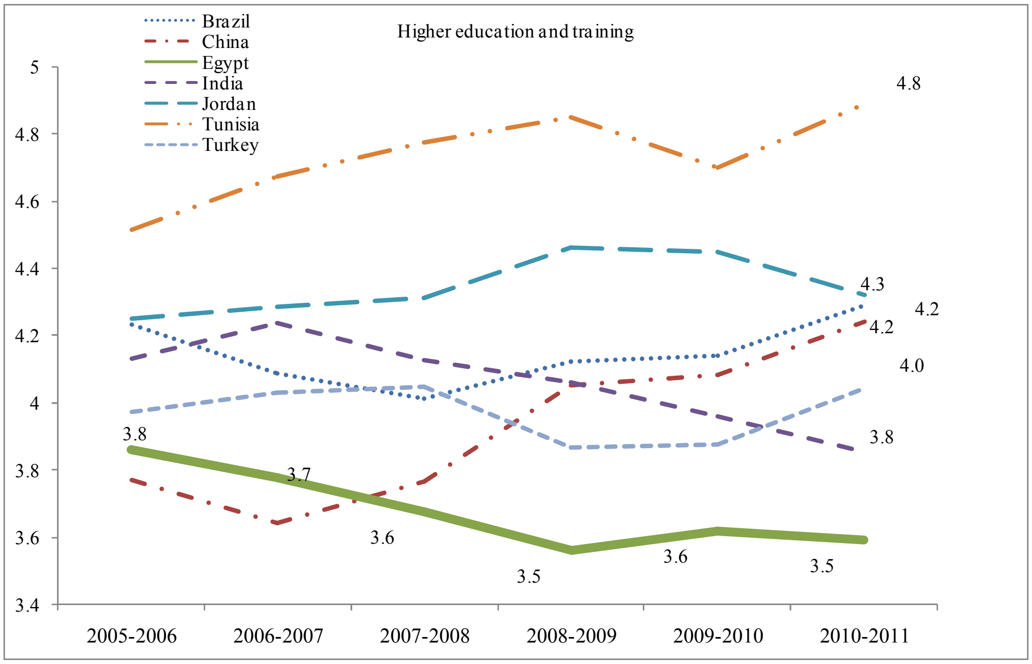
Source: WEF (several issues).

2.1.2 Higher education and training

The youth is Egypt's greatest asset. The number of students enrolled in basic education (prior to university education) amounts to 17.7 million, in addition to 2.5 million enrolled in higher education. Yet, Egypt's rank in higher education and training has been deteriorating both quantitively and qualitatively over time. Egypt's rank in terms of the quality of higher education declined from 80 out of 114 countries in 2005/06 to 128 out of 139 in 2010/11. Further, the quality of education declined from 57 out of 114 in 2005/06 to 88 out of 139 countries in 2010/11, as a result of the reduction in enrollment rates for both secondary and tertiary education. Secondary enrollment rate declined from 85.3 percent in 2005/06 to 79.3 percent in 2010/11. Tertiary enrollment rate declined by one percentage point to 28.4 percent in 2010/11 compared to 2005/06.

Critical factors that are essential for human capital development—such as quality of higher education, secondary and tertiary enrollment rates and on-the-job training—continue to be a major impediment towards greater competitiveness. Compared to the selected countries, Egypt is not only the worst performer in this pillar, but also its score is deteriorating over time, as demonstrated in Figure 2.

Figure 2. Egypt Compared to Selected Countries in Higher Education and Training Indicators

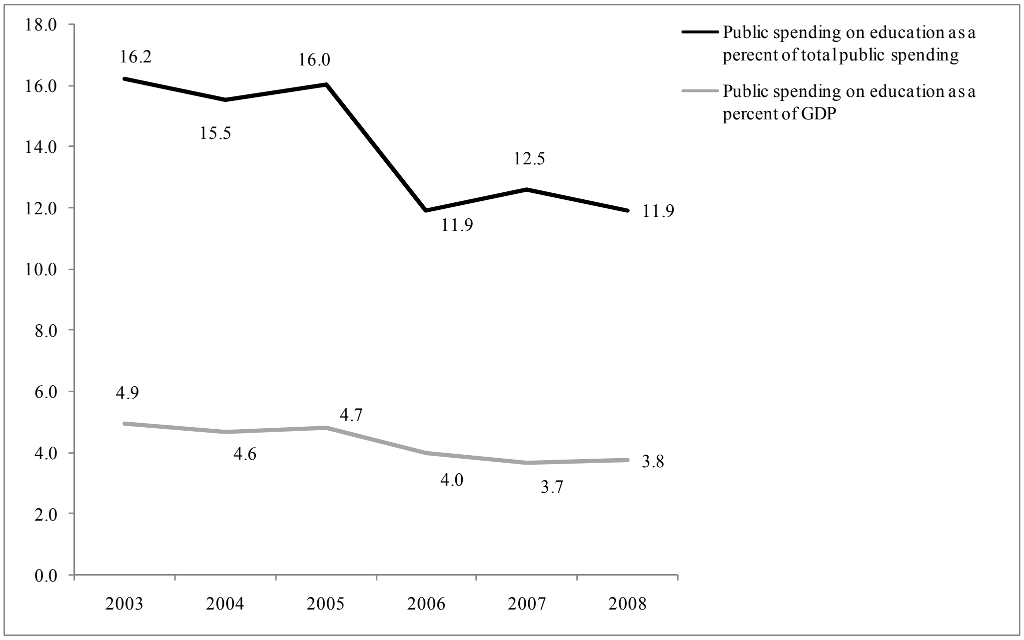


Source: WEF (several issues).

Egypt's public spending on education has been on the decline, as shown in Figure 3, and is lower than the average for lower middle income countries according to several indicators, as shown in Figure 4. Similarly, Egypt's spending on education, as a percentage to GDP, is lower than several MENA countries as shown in Figure 5.

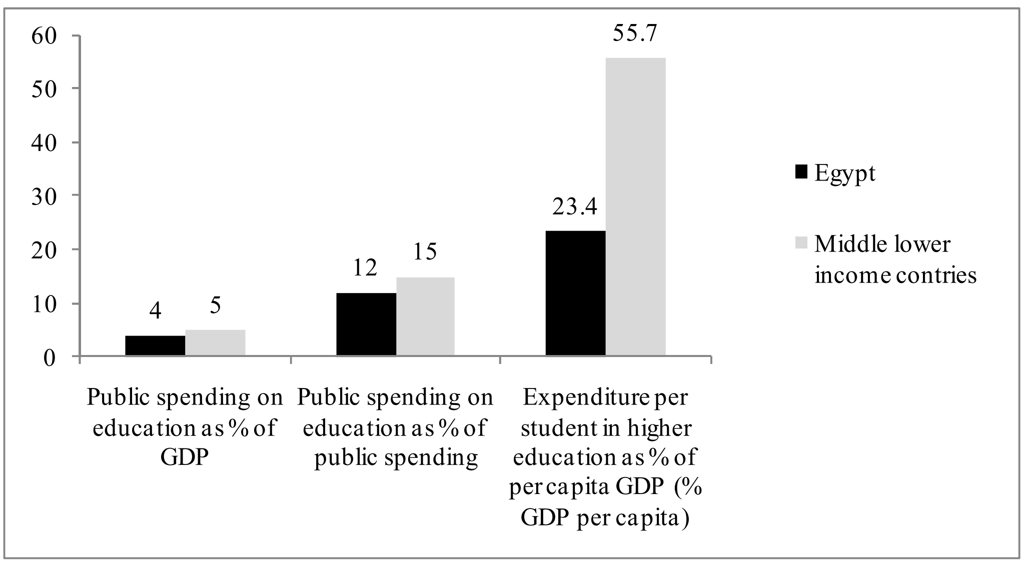
The problem is not only the relatively low expenditure but also the inefficiency of spending. Examples of imbalances in public spending on education include the following: only 36 percent of the total budget for education is allocated to pre-tertiary education, even though it accounts for 80 percent of total enrollment. Within secondary education, the general and technical streams receive approximately the same amount, although the number of students enrolled in technical education is much higher than those enrolled in the general secondary stream as shown in Figure 6, whereas technical education has a higher unit cost than general secondary schools. These imbalances need to be addressed.

Figure 3. Egypt's Public Spending on Education (2003 – 2008)



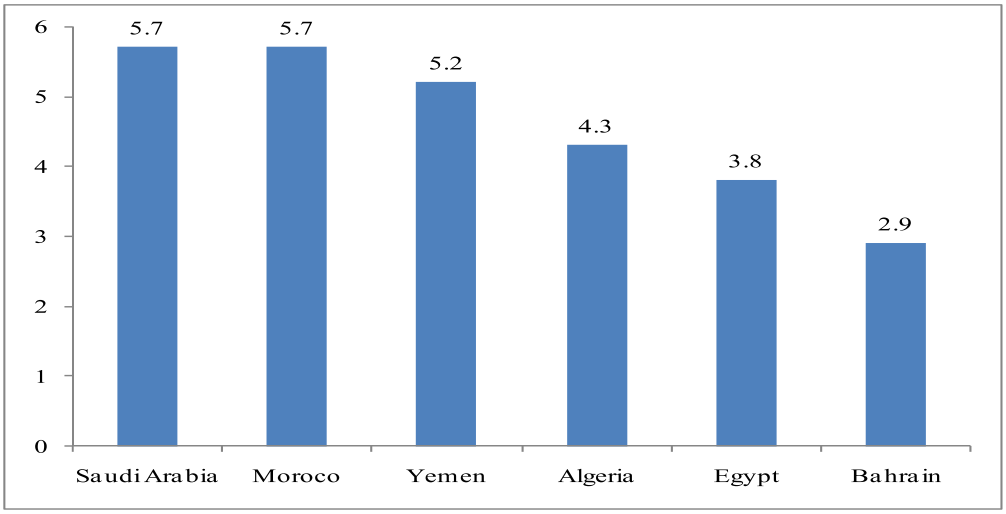
Source: World Bank (2011).

Figure 4. Expenditure on Education in Egypt versus Middle Lower Income Countries in 2007



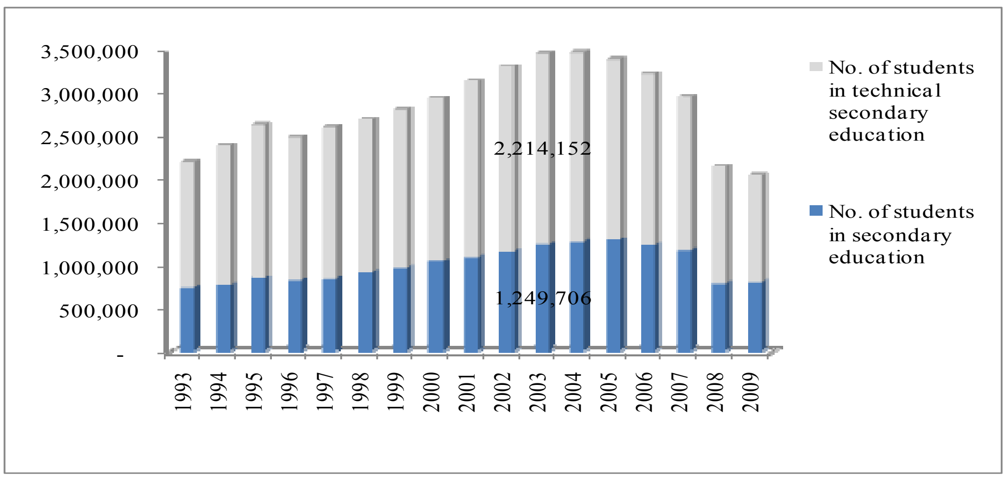
Source: World Bank (2011).

Figure 5. Public Spending on Education in Egypt versus Selected MENA Countries in 2008 (as a Percent of Total GDP in 2008)



Source: World Bank (2011).

Figure 6. Number of Students Enrolled in General and Technical Secondary Schools (1993-2009)



Source: CAPMAS (1993-2010).

Moreover, there is a need to address internal and external inefficiency of expenditure. In terms of internal inefficiency, 70 percent of total public spending on higher education is directed towards salaries and wages. The non-academic university staff absorbs almost 50 percent of the total. As for external inefficiency, we can look at unemployment by the level of education as an indicator. The data for the distribution of unemployment by level of education is revealing. The probability of being unemployed is consistently higher for more educated job seekers, indicating a high level of inefficiency. Unemployment is the lowest among holders of education below the secondary level, followed by those with university degrees and finally those with secondary education. The unemployment rate among university graduates is almost 18 percent. Higher unemployment rates among higher education graduates signify a waste of resources invested by both the government and households. Hence the need to improve the quality of educational outcomes, and reduce the mismatch between educational qualifications and labor market needs.

Table 1. Unemployment (%) and Labor Force Distribution (%) by Educational Level in Egypt

	% of unemployment		**% of labor force**	
	2007	**2009**	**2007**	**2009**
Illiterate	1	1	29	26
Read & write	1	1	9	10
Below intermediate	3	4	8	10
General intermediate	10	9	2	2
Technical intermediate	15	14	31	30
Above intermediate	14	16	5	4
University & postgraduates	17	18	16	18

Source: CAPMAS online data (accessed in 2011).

Moreover, the poor quality of higher education is reflected in the ranking of national universities in the top world 500 universities. For instance, Egypt has only one university in the last fifty of the top 500 universities—namely Cairo University—compared to other countries such as China (16 universities), India (3 universities), Brazil (3 universities), and Turkey (5 universities). Higher unemployment among highly educated job seekers is another indicative proxy of poor quality. All those indicators reflect the need to improve the efficiency of expenditure and the need to raise the quality of higher education. Also, the transition from public to private provision of higher education should go hand in hand with introducing more efficient systems of financial assistance that guarantee equal opportunities to disadvantaged students.

Moreover, the poor quality of higher education is also evidenced by the fact that the majority of university students are enrolled in the fields of humanities and social sciences, rather than science and engineering or practical fields much needed for economic development. More than 75 percent of those enrolled in higher education in Egypt are in humanities and social sciences, whereas the share of medical, scientific, technical and engineering disciplines in total enrollment in higher education is less than 20 percent, as illustrated in Table 2.

There is a need to improve learning outcomes, particularly those related to mathematics, science and soft skills including computer skills. The UNESCO educational report for 2010 stated that scientific research in the MENA region is insignificant. Egypt allocated less than 0.23 percent of GDP to scientific research and R&D. The report also revealed that the correlation between population and scientists in the Arab world is very low. There are 373 researchers per one million persons, while the world average is 1,081 researchers per one million persons. The problem is further compounded by the brain drain of Egyptian scientists due to the lack of adequate opportunities in the country.

Table 2. Higher Education Graduates by Study Orientation 2005/06

Study orientation	2005/06 (Persons)	Share (%)
Arts and humanities	238,019	13
Other theoretical	1,278,334	68
Total theoretical	1,516,353	81
Medicine	62,934	3
Engineering	98,382	5
Sciences	46,240	2
Others practical	156,551	8
Total practical	364,107	19
Total all	1,880,460	100

Source: Ministry of Higher Education (2008).

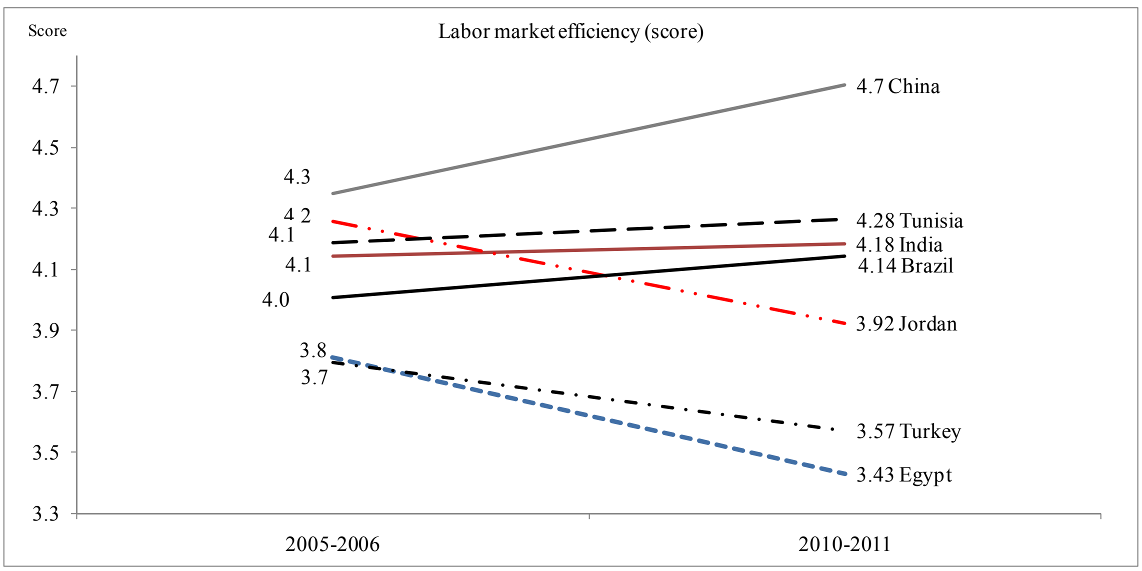
Moreover, universities place a lot of emphasis on routine learning and memorization of facts while the demand for labor is turning more and more towards the skills of "expert thinking" and "complex communications," and away from the ability to conduct routine tasks; hence the inability of graduates to meet labor market demand.

Key targets for education reform should include not only increasing public spending on education but also ensuring efficient spending and continuous monitoring of the quality and efficiency of outcomes. There is a need to apply quality assurance in all universities, including national public and private universities with foreign affiliations. It is imperative to reduce unnecessary expenditure to direct spending to areas of education that have an equivalent demand in the labor market. In other words, reducing the mismatch between education outcomes and the labor market, particularly among the category of *educated and unemployed*, would help close the gap between qualifications and the needs of the job market. Moreover, it is important to tackle the issues of shortage of workers in technical and soft skills, which are required by the private sector, by addressing the low quality of vocational training.

2.2. Labor Market Efficiency

Egypt's rank in labor market efficiency has registered 79 out of 114 countries in 2005/06 and 133 countries out of 139 countries in 2010/11, and has been consistently poorer than the selected countries. This poor ranking is attributed to low level of labor market flexibility caused by the high firing cost and inefficient use of talent, which is manifested by the brain drain and low female participation in the labor market.

Figure 7. Labor Market Efficiency Scores: Egypt versus Selected Countries



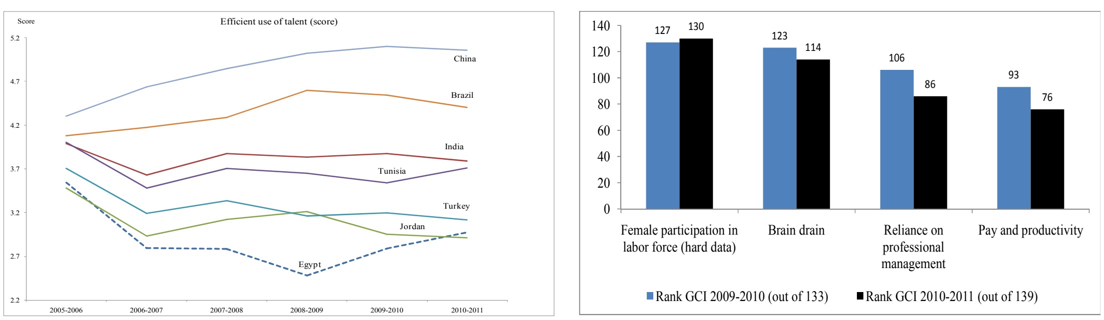
Source: WEF, Global Competitiveness Reports, several issues.
Note: The score ranges between 1 and 7; where 1 is the lowest labor market efficiency score and 7 is the highest score that a country can attain in terms of labor market efficiency.

Caution is required while examining the results of the WEF concerning the labor market due to the existing duality in the Egyptian labor market. By this we mean the existence of both formal and informal employment, where the informal labor market constitutes more than 40 percent of total employment (ENCC 2009).

The Egyptian labor market is perceived as highly inflexible and ranks 120 among 139 countries in GCI 2010-11. The cost of firing an employee in Egypt amounted to 28 weeks of wages in 2010 (WEF 2010). Egyptian firing costs are about 74 weeks longer than the MENA average of 53 weeks, creating a strong disincentive for businesses to employ full-time workers. Although the current labor law no. 12/2003 allowed greater flexibility in working hours, fixed duration contracts, and a more streamlined firing process, there seems to be a need for greater flexibility.

Egypt ranks among the worst performing countries in the efficient use of talent (Figure 8). The overall poor performance is particularly severe in terms of female participation in the workforce, brain drain and reliance on professional management. The ratio of female to male participation in the labor force was as low as 35 percent in 2010. Many highly skilled Egyptians continue to immigrate to other MENA countries or around the world for better opportunities. As a result, Egypt ranks 114 in brain drain, making it the lowest ranked country among benchmark economies. Egypt also performs poorly in terms of reliance on professional management. The executive opinion survey (EOS) found that senior management positions in Egypt are often filled by relatives or friends without regard to merit (score=1) rather than professional managers chosen for their qualifications (score=7). As a result, Egypt scores 4.1 in terms of reliance on professional management, below the GCI mean of 4.4.

Figure 8. Efficient Use of Talent



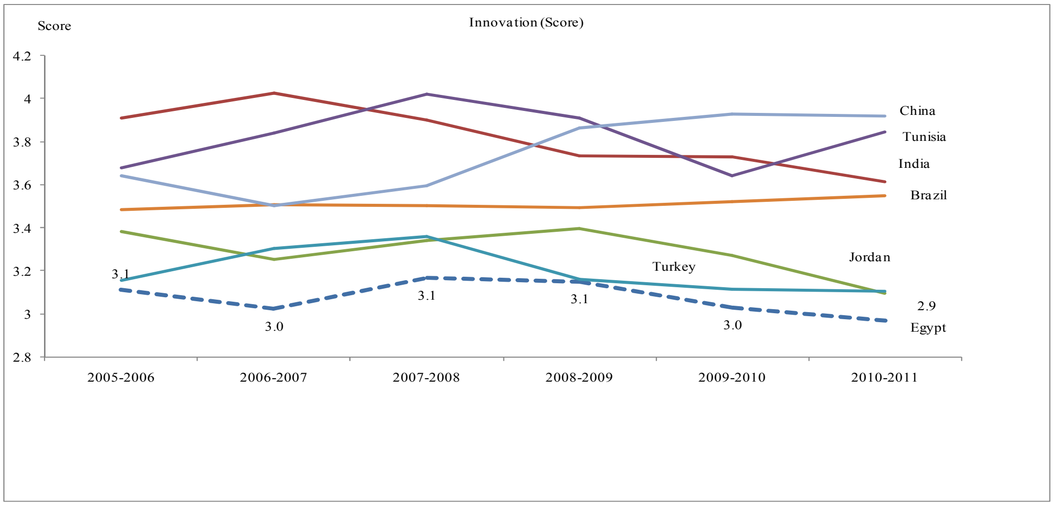
Source: WEF (2010).

Reform of the labor market should include greater flexibility. Addressing inefficiencies may require both legislative and institutional reforms such as amending contributions to social security and decreasing the cost of redundancy.

2.3. Innovation

The overall rank of Egypt in innovation has deteriorated over the years from 59 out of 114 countries in 2005/06 to 83 out of 139 countries in 2010/11. The deterioration in Egypt's overall rank is attributed to the decline in Egypt's rank in the capacity for innovation, quality of scientific research institutions, company spending on R&D, university-industry collaboration in R&D, and government procurement of advanced technology products. Egypt has continued to lag behind all the selected comparators. China and Tunisia are far more competitive than Egypt, as shown in Figure 9.

Figure 9. Innovation: Egypt Performance Compared to Selected Countries



Source: WEF, global competitiveness reports, (several issues).

Various measures of innovation are assembled in Table 3 below, showing Egypt's relative position to comparator countries, and indicating that there is room for improvement. With the exception of availability of scientists and engineers where Egypt has a competitive advantage, and university-industry collaboration where Egypt is better than Jordan, Egypt is the worst performer in all other indicators. Although some efforts are made in R&D and innovation, Egypt's position is falling behind other countries. Therefore, there is a need to adopt an educational curriculum that promotes creativity, innovation and leadership skills at both school and university levels, and to increase university-industry collaboration in R&D.

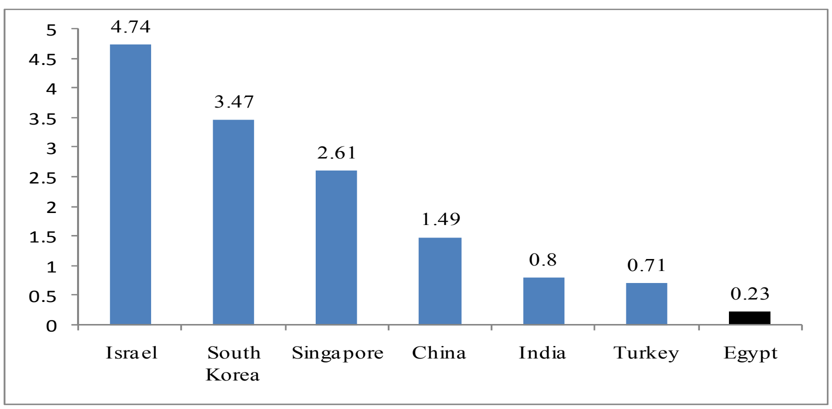
Table 3. Egypt's Rank on a Range of Innovation Measures

	Overall rank out of 139 countries	Capacity for innovation	Quality of scientific research institutions	Company spending on R&D	University-industry collaboration in R&D	Government procurement of advanced technology products	Availability of scientists and engineers	Utility patents per million population
Brazil	42	29	42	29	34	50	68	61
Turkey	67	55	89	62	82	62	44	70
Jordan	68	96	98	116	99	57	26	76
China	26	21	39	22	25	12	35	51
Tunisia	31	36	38	35	41	14	7	76
Egypt	**83**	**109**	**110**	**74**	**120**	**86**	**25**	**84**
India	39	33	30	37	58	76	15	59
South Korea	12	18	25	12	23	39	23	5
Singapore	9	17	11	8	6	2	10	11

Source: WEF (2010).

Egypt's expenditure on R&D is very low compared to countries like China, which has committed 2.5 percent of its GDP to R&D by 2030 (World Bank 2007b). In order to overcome this loss of relative position, Egypt will need to catch up, move fast and make innovation one of the key national priorities supported by higher spending on R&D. Figure 10 compares Egypt to other countries in terms of spending on R&D as a percentage of GDP.

Figure 10. Spending on R&D as a Percent of GDP



Source: WDI (2007).

Key inhibitors to greater innovation include limited financial resources and R&D expenditure; lack of education that encourages innovation; weak university-industry linkages, low private sector contribution to scientific research and low rates of technology transfer.

To achieve greater competitiveness, Egypt needs to adopt a national strategy that would increase the capacity of the youth to innovate and commercialize new goods and services. One of the impediments is the lengthy process for obtaining patents which could take up to four years and is inefficient. Moreover, Egypt needs to have a national science, technology and innovation strategy. The adoption of a national innovation system[7] (NIS) should also be considered with a view to providing solutions to many of the major national challenges such as water, energy and food security.

3. METHODOLOGY

The study involves a multi-stage analysis[8] as follows:

Stage 1

The first stage of analysis aims to investigate how labor, education and innovation indicators affect Egypt's competitiveness. This question will be answered by running panel data regressions[9] where the dependent variable is the GCI score and the independent variables are all qualitative and quantitative variables that relate to education, labor and innovation that form part of the GCI composite index. The panel data regressions will be run once using the fixed effect model and once using the random effects model (REM). Our model uses a short balanced panel data as the number of cross-sectional subjects N is greater than the number of time periods t. The panel data comprise 25 countries[10] in stage 1 of development, as defined by the WEF, over 6 years (from 2005/06 to 2010/2011).

The model below is known in literature as the fixed effects (regression) model (FEM). The term *fixed effects* indicates that although the intercept may differ across countries, each country's intercept does not vary over time.

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[7] A national innovation system is defined as the network of institutions in the public and private sectors, whose activities and interactions initiate, import, modify and diffuse new technologies.

[8] For stage 1, all data were obtained from the GCR reports. For stages 2 and 3, we depended on the IMF International Financial Statistics and statistics available from the World Bank's World Development Indicators. Data for stage 4 are obtained from CAPMAS and the World Bank's World Development Indicators. For data analysis, we used STATA software for panel data multiple regressions' estimation.

[9] As reported by Gujarati and Porter (2009), panel data have several advantages over cross-section or time series data. For example, panel data take into account the heterogeneity of the units involved (countries in our case); give "more informative data, more variability, less collinearity among variables, more degrees of freedom and more efficiency"; and are better suited to study the dynamics of change such as unemployment and labor mobility.

[10] Countries and corresponding id's are presented in the appendix.

$$GC_{it} = \beta_{1i} + \beta_2 pres_{it} + \beta_3 qedus_{it} + \beta_4 quaedus_{it} + \beta_5 onjtr_{it} + \beta_6 flexs_{it} + \beta_7 effuse_{it} + \beta_8 innov_{it} + \varepsilon_{it} \quad (1)$$

i= 1,2,3,….25

t=1,2,…6

where *gci*= global competitiveness score; *pres*= primary education score;[11] *qedus*= quantity of higher education;[12] *quaedus*= quality of higher education; *onjtr*=on-the-job training; *flexs*= labor flexibility; *effuse*=efficient use of talent;[13] and *innov*= overall score in innovation pillar.[14]

We also estimate the random effects model (REM), which could be written as follows:

$$GC_{it} = \beta_1 + \beta_2 pres_{it} + \beta_3 qedus_{it} + \beta_4 quaedus_{it} + \beta_5 onjtr_{it} + \beta_6 flexs_{it} + \beta_7 effuse_{it} + \beta_8 innov_{it} + w_{it}$$

i= 1,2,3,….25

(2)

t=1,2,…6

where $w_{it} = \varepsilon_i + u_{it}$

[11] Primary education score (*pres*) as reported by the World Economic Forum's (WEF) global competitiveness report, which contributes to the score of the 4th pillar in the global competitiveness index, namely the health and primary education pillar.

[12] The key scores that make up the 5th pillar of the global competitiveness index (higher education and training) are:

a. quantity of higher education (*qedus*),
b. quality of higher education (*quaedus*),
c. on-the-job training (*onjtr*).

[13] Key scores forming the 7th pillar of the global competitiveness index (labor market efficiency) are:

d. labor flexibility (*flexs*),
e. efficient use of talent (*effuse*).

[14] The overall score in the innovation pillar (*innov*), the 12th pillar of the global competitiveness index, is obtained from several indicators (hard data and executive opinion scores), namely: innovation capacity, quality of scientific research institutions, company spending on R&D, university-industry collaboration in R&D, government procurement of advanced technological products, availability of scientists and engineers and utility patents per million population.

The composite error term w_{it} consists of two components: ε_i, which is the cross section, or country specific error component, and u_{it} which is the combined time series and cross section error component term (idiosyncratic term).

In the random effects model, instead of treating β_{1i} as fixed, we assume that it is a random variable with a mean value of β_1. The intercept value for an individual country can be expressed as:

$$\beta_{1i} = \beta_1 + \varepsilon_i$$

where ε_i is the random error with a mean value of zero and a variance of $\sigma^2{}_\varepsilon$.

To see whether we should opt for the fixed effects model or the random effects model, we use the Hausman specification test.

Stage 2

This stage aims to investigate whether there is a relationship between growth in real GDP and GCI. We run panel data regressions that comprise the same countries as in stage 1 of the analysis, over 6 years (2005/2006 – 2010/2011). The panel data used could be described as short unbalanced panel data.

The fixed effects (regression) model (FEM) is as follows:

$$rgdp_{it} = \beta_{1i} + \beta_2 \ln govcons1_{it} + \beta_3 m2gr_{it} + \beta_4 \ln fsdr1_{it} + \beta_5 wgtrtsh_{it} + \beta_6 gci_{it} + \varepsilon_{it} \qquad (3)$$

i= 1,2,3,….25

t=1,2,…5

where (rgdp) is the real growth of gross domestic product; (lngovcons1) is a proxy for government spending;[15] (m2gr), M2 growth as a monetary variable;[16] (lnfsdr1) is the rate of appreciation in SDR exchange rate relative to the national currency, as an external variable; [17] (wgtrtsh)[18] is the weighted average of real GDP growth in major trading partners (the US and

[15] Fiscal variable: general government consumption expenditures on goods and services include compensation of employees and net purchases of goods and services (IMF 2005-2010).

[16] M2 is currency, checking account deposits and savings (IMF 2005-2010).

[17] In other words, growth in national currency per SDR. That is, when it goes up the local currency depreciates.

[18] WDI online data (accessed in 2011).

the euro zone) based on trade shares with the respective countries as another external variable; and (gci), competitiveness score as reflected by the country's global competitiveness score.[19] Data are scaled down and transformed to yield stationary series, taking the first difference of natural log transformation of the explanatory and dependent variables to correct for non-stationarity.

Stage 3

Model A

This stage analyzes the relationship between real GDP growth and the labor, innovation and education indicators that underlie the global competitiveness index. The purpose is to quantify direct contributions of the pillars that determine the quality of human capital to real growth.

In this stage, we run panel data regressions, where the dependent variable is the growth of real gross domestic product and we replace the GCI score with the underlying indicators. The panel data used comprise the same countries as in stages 1 and 2 of the analysis, over 6 years (2005/06 – 2010/2011). The panel data used could be described as short unbalanced panel data due to one year data loss for some of the explanatory variables.

The fixed effect model could be written as follows:

$$RGDP_{it} = \beta_{1i} + \beta_2 qpre_{it} + \beta_3 prenr_{it} + \beta_4 qqtrs_{it} + \beta_5 lmrefs_{it} + \beta_6 innov_{it}$$
$$+ \beta_7 \ln govcons1_{it} + \beta_8 m2gr_{it} + \beta_9 \ln fsdr1_{it} + \beta_{10} wgtrtsh_{it} + \varepsilon_{it}$$

(4) i= 1,2,3,….25

t=1,2,…5

where rgdp= real growth in gross domestic product; lngovcons1= growth in government consumption; lnfsdr1= growth in SDR exchange rate; m2gr=M2 growth; wgtrtsh= weighted average of real GDP growth in major trading partners (US and Euro Zone) based on trade shares with the respective countries; qpre=quality of primary education score; prenr= primary education enrollment rate; qqtrs=overall score for higher education and training; lmrefs=overall score of the labor market efficiency; innov=overall score in innovation.

[19] WEF, Global Competitiveness Reports (online data, accessed in 2011).

Model B

The model employs panel data regressions with the aim of analyzing the relationship between real GDP growth and the labor, innovation and education indicators that underlie the Global Competitiveness Index. This model is slightly different from Model A in two ways: it employs the details of the labor market indicators and those of the higher education.

The fixed effects (regression) model (FEM) could be written as follows:

$$RGDP_{it} = \beta_{1i} + \beta_2 pres_{it} + \beta_3 qedus_{it} + \beta_4 quaedus_{it} + \beta_5 onjtr_{it} + \beta_6 flexs_{it} + \beta_7 effuse_{it} + \beta_8 innov_{it}$$
$$+ \beta_9 \ln govcons1_{it} + \beta_{10} m2gr_{it} + \beta_{11} \ln fsdr1_{it} + \beta_{12} wgtrtsh_{it} + \varepsilon_{it}$$

(5) i= 1,2,3,….25

t=1,2,…6

Variables*:* rgdp= real growth in gross domestic product; pres= primary education score; qedus= quantity of higher education; quaedus=quality of higher education; onjtr=on-the-job training; flexs= labor flexibility; effuse= efficient use of talent; innov= overall score in innovation pillar; lngovcons1= growth in government consumption; lnfsdr1= growth in SDR exchange rate; m2gr= M2 growth; wgtrtsh= weighted average of real GDP growth in major trading partners (the US and the Euro Zone) based on trade shares with the respective countries.

To see whether we should opt for the fixed effects model or the random effects model, we use the Hausman specification test.

Stage 4

In this stage, we run a regression model using Egypt's specific time series data for the period 1980–2009 where the independent variable is the growth of real gross domestic product (GDP) and the explanatory variables are the following:

1- Education expenditure: two variables are chosen; education expenditure as a percentage of GNI (eduexpgni) and public spending on education as a percentage of total spending (pubspendedugdp),

2- Labor: youth employment (youthemp),

3- Innovation: number of patents per residents (patentappresidents), 4- Fiscal variable: growth of government consumption (lngovcons1),

5- Monetary variable: real M2 growth (m2gr),

6- External variable: foreign exchange (fxst) USD to LE, where an increase indicates an appreciation of the local currency.

Data are scaled down and transformed to yield stationary series, taking the first difference of natural log transformation of the explanatory and dependent variables to correct for non-stationarity.

4. RESULTS

Running panel data regression models, our key results are summarized in Table 4.

Table 4. Results of Panel Data Regressions

	Stage 1		**Stage 2**		**Stage 3**		**Stage 3**
	REM		REM		REM Model A		REM Model B
Variables	Gci	Variables	Rgdp growth	Variables	Rgdp growth	Variables	Rgdp growth
Pres	0.0883***	lngovcons	1.136	lngovcons	4.955	lngovcons	-1.049
	(0.00976)		(2.648)		(3.341)		(2.835)
Qedus	0.0861***	lnfsdr1	2.784	lnfsdr1	-0.925	lnfsdr1	1.448
	(0.0186)		(2.971)		(4.572)		(3.131)
Quaedus	-0.0298	m2gr	5.368***	m2gr	7.276***	m2gr	5.274***
	(0.0426)		(1.799)		(1.912)		(1.942)
Onjtr	0.244***	wgtrtsh	0.321	wgtrtsh	0.116	wgtrtsh	0.522
	(0.0418)		(0.399)		(0.511)		(0.461)
Flexs	0.0320	gci	2.245*	qpre	-1.028	pres	-0.573
	(0.0281)		(1.278)		(0.650)		(0.406)
Effuse	0.0953***	Constant	-4.478	prenr	-0.0448	qedus	0.502
	(0.0259)		(4.928)		(0.0467)		(0.398)
Innov	0.181***			qqtrs	0.260	quaedus	0.544
	(0.0593)				(0.886)		(1.141)
Constant	1.289***			lmrefs	2.063**	onjtr	-1.992
	(0.155)				(0.805)		(1.218)
				innov	2.400***	flexs	0.874
					(0.889)		(0.670)
				Constant	-5.954	effuse	1.441*
					(5.735)		(0.741)
						innov	2.834*
							(1.561)
						Constant	-7.872*
							(4.578)
Observations	150	Observations	87	Observations	59	Observations	87
R-squared	0.812	R-squared	0.252	R-squared	0.379	R-squared	0.219
Number of id	25	Number of id	24	Number of id	22	Number of id	24

Standard errors in parentheses.

*** p<0.01, ** p<0.05, * p<0.1.

Stage 1

Using the Hausman specification test to see whether to adopt the FEM or REM models, results indicate that both are equally valid.[20]

Using the random effects regression, coefficients for all variables, with the exception of quality of education and labor flexibility indicators, are significant at the 10 percent level. The regression coefficients that are highly significant include primary education, quantity of higher education, on-the-job training, and efficient use of talent. The multiple coefficient of determination R^2 is very high. The explanatory variables used in the model explain 81.2 percent of the variation of the global competitiveness score.

Our key finding from this stage of analysis is that improving both the quantity and quality of primary education would positively affect the country's competitiveness. Similarly, increasing the quantity of higher education and on-the-job training will lead to greater competitiveness. Hence, Egypt should aim to improve the quantity of primary education and the quality of education at all levels and to increase on-the-job training to achieve greater competitiveness. To improve the quality of education, there is a need to set measures of accountability and to put in place a well-functioning monitoring and evaluation unit. Egypt could also address the imbalances in expenditures, including salaries of the non-teaching staff and the levels of expenditure on the various types of education, especially for vocational training, which gets significantly less than its needs. Egypt could benefit from other country experiences such as South Korea, which, according to the literature and to reports on quality of education worldwide, has achieved major improvements. The high quality of education in South Korea is a result of several measures. For instance, the ministry of education in South Korea invests heavily in teacher education programs and training. Moreover, there is strong emphasis on up-to-date curricula, and investment in new learning pedagogies such as e-learning.

Improving the efficiency of the labor market would have a positive impact on the country's global competitiveness. In this respect, Egypt should reform its labor market by reducing the number of weeks paid for firing. Raising the country's capacity for innovation and increasing the number of utility patents will result in a more competitive stance vis a vis

[20] Results are presented in the appendix.

other countries. To improve the innovation capacity, there is a need to adopt a national innovation strategy that entails incentives for industry innovation—such as tax exemptions and greater spending on R&D—which is currently as low as 0.24 percent of GDP compared to other countries such as China, where it amounts to 2 percent of GDP.

Stage 2

Using Hausman specification test to see which model to adopt, we find that either model can be used (i.e., estimators do not differ substantially).[21] As portrayed in Table 4, the random effects regression results show that there is a significant positive relationship between RGDP and only two variables, namely, the growth of money supply and the global competitiveness score. Our key finding from this stage is that improving the global competitiveness score is an important determinant of higher real GDP growth across countries over time.

Stage 3

Model A

Using Hausman specification test to see which model to adopt, we find that either model can be used (i.e., estimators do not differ substantially).[22] Using the random effects model we find four variables that have a positive and significant explanatory power, namely: labor market efficiency, innovation and money growth.

Our key finding from this model is that money growth, higher labor market efficiency and innovation positively impact real GDP growth. To achieve greater output and welfare, Egypt should focus on improving the overall efficiency of the labor market, including efficient use of talent and increasing labor market flexibility. Reforming the labor market would entail several measures, including: addressing the mismatch between supply and demand; encouraging private-public partnerships in mega projects; supporting SMEs to create more jobs; reforming insurance legislation and practices; reviewing the labor law and facilitating the formalization of informal businesses. Moreover, there is a need to align wages with productivity. In addition, it is important to invest in innovation capacity, including investing in R&D and strengthening capacity for research. It is also important to increase the

[21] Results are presented in the appendix.

[22] Results are presented in the appendix.

efficient use of scientists and engineers and to facilitate registration of utility patents by reducing the requirements and time needed for patent registry.

Model B

Using Hausman specification test to see which model to adopt, we find that either model can be used (i.e., estimators do not differ substantially).[23] Based on the results of the random effect model, we can see that there are three variables that have a positive significant effect on real GDP growth: money growth, efficient use of talent and innovation. So the results of this modified model confirm our earlier findings in Model A.

Our key finding from this modified model is that the efficient use of talent is essential to realizing greater real GDP growth. Egypt should focus on the efficient use of talent to achieve greater economic output and welfare for its citizens. This could be achieved by assessing the needs of the labor market and ensuring that the educational outcomes are in accordance with market needs. As previously shown, based on indicators Egypt is one of the worst countries in the efficient use of talent. Brain drain, low female participation in the labor force, low return on education and high unemployment, especially among youth, are all problems that need to be fixed. There is a need to establish a human development strategy that addresses these issues in detail with key targets and time lines for implementation. As previously found in Model A, improving Egypt's innovation capacity could be a factor that leads to greater real GDP growth; hence the need to adopt a national innovation strategy.

Stage 4

Now that we have seen the panel data results, we would like to investigate further the relationship between real GDP growth, and education, labor and innovation indicators, using time-series data for Egypt.

Table 5 below portrays the results of running a time series regression for the period 1980-2009.

[23] Results are presented in the appendix.

Table 5. Egypt's Regression Results (1980-2009)

Variables	Rgdpgr
eduexpgni	-1.361*
	(0770)
youthemp	0.348**
	(0.149)
patentappresidents	-0.00462**
	(0.00195)
govconsgr	-0.258***
	(0.0474)
fxst	-3.634**
	(1.376)
m2gr	0.00798
	(0.0450)
pubspendedugdp	-2.195***
	(0.405)
Constant	16.56**
	(6.666)
Observations	30
R-squared	0.801

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Variables: education expenditure as a percentage of GNI (eduexpgni); youth employment (youthemp); number of patents per residents (patentappresidents); government consumption growth (govconsgr); foreign exchange USD to LE (fxst); money growth (m2gr); and public spending on education as a percentage of total public spending (pubspendedugdp).

As noted from the results, the coefficient of education expenditure is significant, but negative. Expenditure on education appears to be inefficient and leads to low quality outcomes and hence deters growth. Moreover, the youth employment coefficient is significant and positive, signaling the importance of youth employment as a key engine of growth. If we take into account that Egypt loses a great potential with high unemployment, particularly for university and vocational training graduates, it is necessary to increase employment for this segment to mobilize growth. This could be done by increasing career counseling services, giving incentives to companies to hire fresh graduates of universities and technically trained personnel and to embark on mega national projects that will utilize the idle capacities and use the talents of the youth.

Similarly, the coefficient for the change in foreign exchange, USD to LE, is negative and significant. An increase in this exchange rate indicates depreciation of the Egyptian pound. Hence, a depreciation of the local currency will have a negative net effect on real GDP growth. Depreciation increases the cost of imports and boosts export competitiveness. The first channel shrinks the output supply with a negative effect on growth while the second channel, if effective, could stimulate growth. The evidence for Egypt indicates that higher cost of imports following depreciation outweighs the positive effect of depreciation on export competitiveness.

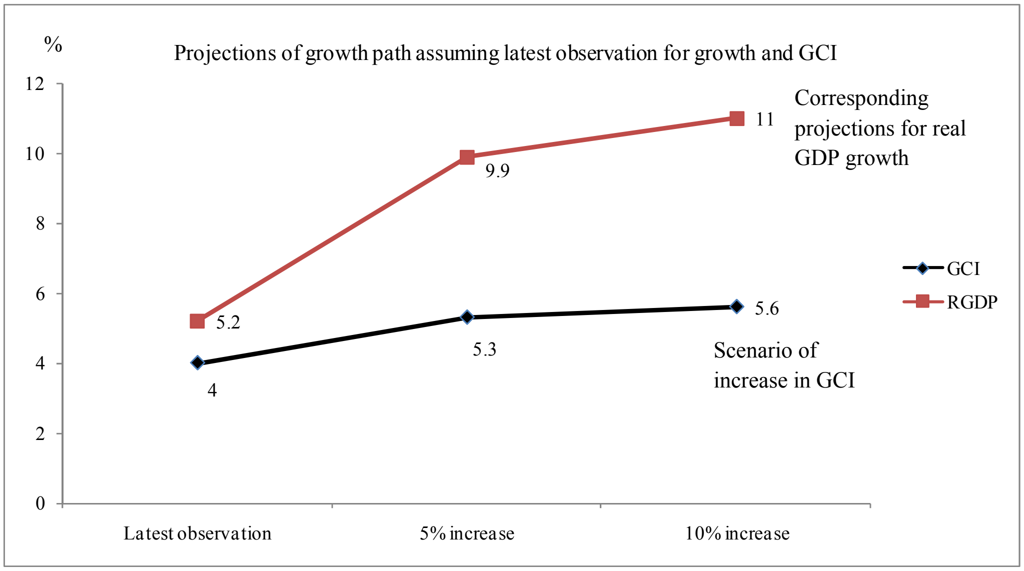
Moreover, the coefficient of *the number of patents per resident* is negative and significant. The increase in patents has been too negligible and ineffective to contribute to real growth. Therefore, to catch up with more competitive economies, Egypt should focus on increasing its capacity for innovation by adopting a national innovation plan and, therefore, improve output growth. Egypt should design its own national science, technology and innovation strategy (NSTI). Such a strategy should aim at building a culture of innovation and entrepreneurship, providing incentives to encourage industries and private research and development (R&D) and raising expenditure on R&D among others.

Scenarios

Given the confirmed relationship between real GDP growth and the global competitiveness score we want to see where Egypt would be in terms of competitiveness if it improves its labor, innovation and education indicators by 5 percent or 10 percent and the resulting effects on real GDP growth.

Using the last observation of GCI and RGDP, i.e., data for 2009 obtained from the Global Competitiveness Report 2010-2011, we assume an increase of 5 percent and 10 percent consecutively in education, labor and innovation indicators. If Egypt were to improve its education, labor and innovation indicators by 5 percent, the country would be on a par with countries like Canada and Germany in terms of the global competitiveness score. This, in turn, will translate into an expected real GDP growth of 9.9 percent. If Egypt were to improve its indicators for education, labor and innovation by 10 percent, that would translate into greater competitiveness similar to countries like Sweden and Singapore, and will lead to a higher real GDP growth rate amounting to approximately 11 percent. Hence, such areas should be among the country's top priorities going forward.

Figure 11. Scenarios for Egypt's Competitiveness Score and RGDP Growth



Source: Author's calculations based on data used in stages 1 and 2.

5. Summary of Key Findings and Policy Implications

This study investigates the impact of labor, education and innovation on Egypt's competitiveness, and in turn, real economic growth. The study encompasses four stages of analysis. In the first stage, we used panel data regressions for 25 countries at the same stage of development during the period 2005-2011, namely, factor-driven economies in transition to efficiency-driven, including Egypt. The purpose was to investigate the relationship between the global competitiveness score and the underlying education, labor and innovation indicators. We found that improving the quantity and quality of primary education positively affects the country's competitiveness. Moreover, increasing enrollment in higher education and on-the-job training will lead to greater competitiveness. Furthermore, innovation does matter towards improving Egypt's global competitiveness.

In the second stage, we tried to quantity the relationship between real growth of gross domestic product and the competitiveness score as well as the underlying labor, education and innovation indicators. We found that improving the global competitiveness score boosts real GDP growth. In the third stage, and substituting the GCI score with its underlying labor, education and innovation indicators, we found that labor market efficiency and innovation positively impact real GDP growth. To achieve greater output and welfare, Egypt should focus on: 1) improving its labor market's overall efficiency, including the efficient use of talent; 2) targeting higher labor market flexibility, which could be achieved by amending existing labor and insurance regulations; 3) increasing innovation capacity, including higher investment in R&D and research capacity; 4) increasing the efficient use of scientists and engineers, and facilitating the registration of utility patents. Using a more detailed model, it has been found that the efficient use of talent is essential for achieving higher real GDP growth. Egypt should focus on the efficient use of talent to achieve greater economic output and welfare for its citizens. Furthermore, the analysis will focus on the Egyptian case by conducting time series analysis for the period 1980–2009 where we assess the relationship between real GDP growth and a set of corresponding indicators on labor, education and innovation.

In the fourth stage of analysis, we focused on Egypt's specific data for the period 1980-2009 using time series analysis. The results stress the importance of youth employment as a catalyst for growth. Therefore, there is a need to raise the quantity and quality of expenditure on education and to decrease the level of unemployment, particularly among the youth. This could be done by increasing career counseling services, giving incentives to companies to hire fresh university graduates and technically trained personnel, and to embark on mega national projects that will utilize idle capacities and capitalize on the talents of the youth. Moreover, patents per residents, as a proxy for innovation, are insignificant in terms of contributing to growth. To catch up with more competitive economies, Egypt should focus on increasing its capacity for innovation by adopting a national innovation plan towards boosting output growth.

In summary, there are a number of factors hindering the efficient use of the abundant human capital in Egypt. Poor quality of education, labor market inefficiency and weak innovation capacity all contribute to poor utilization of Egypt's greatest asset, i.e., human capital. This, in turn, affects the country's competitiveness negatively and leads to low productivity and output growth.

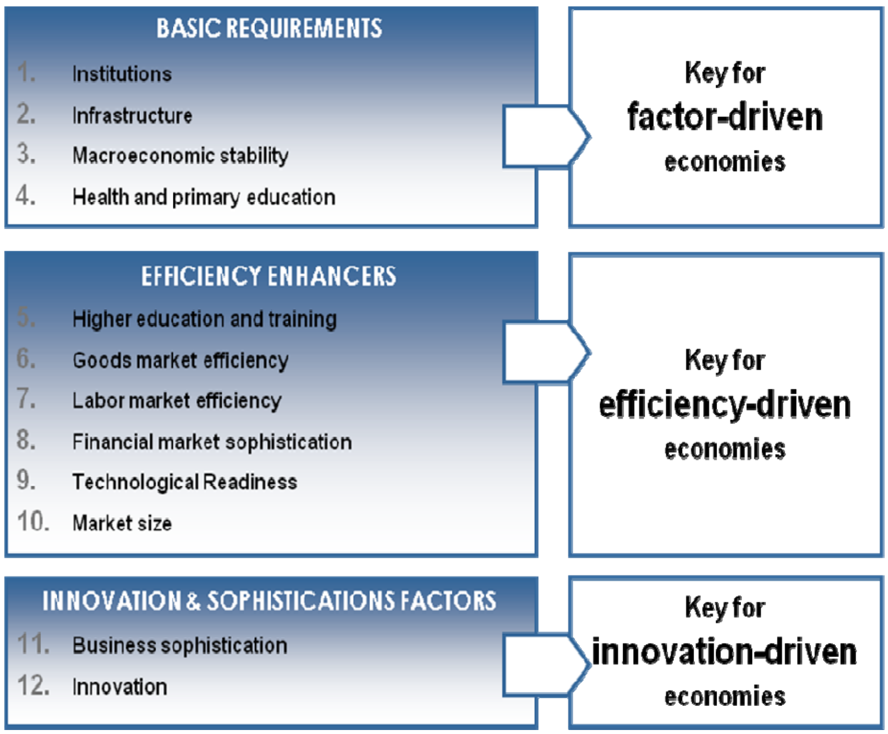
To attain higher levels of competitiveness and achieve greater real GDP growth, Egypt should invest heavily in education, on-the-job training and innovation. Increasing actual expenditure on education and R&D and enhancing its efficiency is a priority. Addressing the chronic mismatch between supply and demand in the labor market and employing the youth, especially those with vocational training and university graduates, are essential for greater productivity and higher output growth. Moreover, there is a need to re-examine labor market policies to develop policies that are more conducive to employment. Achieving a more flexible and efficient labor market requires increasing female participation in the labor market and increasing opportunities for qualified and talented labor and professionals to reduce the brain drain. Improving the capacity for innovation—via more expenditure on R&D, more collaboration between industries and universities, more patent registry and better quality and quantity of scientists and engineers, are all measures that could lead to greater innovation enhancement and would, in turn, lead to greater productivity and competitiveness.

At a time of change, removing barriers that hinder education, labor and innovation should help achieve better quality of education, greater labor market efficiency and higher capacity for innovation towards greater competitiveness and higher growth. Indeed, if Egypt realizes a five percent improvement in its education, labor and innovation indicators, the country would surpass efficiency-driven economies, and be on a par with innovation-driven economies, achieving a higher real GDP growth of around 9.9 percent and, thereby, increasing the scope for greater employment and higher welfare. In this respect, Egypt could benefit from other countries' experiences, such as South Korea, in terms of improving the quality of education, or Brazil, toward raising the capacity for innovation.

Appendix

The GCI is composed of 113 variables, 79 of which come from the Executive Opinion Survey (EOS) carried out annually by the WEF. Those form part of the 12 pillars that make up the GCI. The pillars are grouped to calculate three sub-indices as shown in Box A1.:

Box A1. Note on the GCI and Egypt's Performance in the GCI



Source: WEF, Global Competitiveness Report (GCR), 2007/2008.

The GCI is based on two key tenets. The first is that the determinants of competitiveness are many, complex and open-ended. The second is that different pillars affect different countries differently. The best way for Egypt to improve its competitiveness is not the same as for Germany. This is because Egypt and Germany are at different stages of development. As countries move along the development path, wages tend to increase and, in order to sustain this higher income, labor productivity must improve. In the first stage of development, the economy is factor-driven and countries compete based on their factor endowments, primarily unskilled labor and natural resources. Companies compete in terms of price and sell basic products or commodities, with their low productivity reflected in low wages. Maintaining competitiveness at this stage of development depends on the first four pillars.

As wages rise with advancing development, countries move into the efficiency-driven stage of development, when they must develop more efficient production processes and increase product quality. At that point, competitiveness is increasingly driven by pillars 5 to 10.

Finally, as countries move into the innovation-driven stage, they are able to sustain higher wages and the associated standard of living only if their businesses are able to compete with new and unique products (pillars 11 and 12).[24]

The process of economic development evolving in stages is captured by the GCI model by attributing higher relative weights to those pillars that are relatively more important for a country, given its particular stage of development (Table A1. shows the weights over the years). Countries are allocated to stages of development based on two criteria. The first is the level of GDP per capita at market exchange rates. The second criterion measures the extent by which countries are factor-driven. This is proxied by the share of exports of primary goods in total exports (goods and services). The assumption made by WEF is that countries that export more than 70 percent of primary products are—to a large extent—factor-driven.

Table A1. Weights Used for Factor-Driven Stage over the Years

	Year	**Basic requirements**	**Efficiency requirements**	**Innovation and sophistication factors**
Factor-driven stage	2005/2006	50	40	10
	2006/2007	50	40	10
	2007/2008	60	40	20
	2008/2009	60	40	20
	2009/2010	60	40	20
	2010/2011	60	40	20

Note: The weights were slightly modified as of GCR 2007/08 as the number of pillars increased from 9 to 12.

[24] One of the drawbacks of the competitiveness index is that it does not take into account the equity dimension. Attempts are currently underway by the WEF to include equity measures into the index.

The GCI index is calculated as follows:

GCI=α_1 x basic requirements + α_2 x efficiency enhancers+ α_3 x innovation factors

where α_1,α_2, and α_3 are the weights that each sub-index gets in the overall index.

Table A2. Egypt's Rank and Score (2005/06 to 2010/2011)

	2005/06	2006/07	2007/08	2008/09	2009/2010	2010/2011
Coverage (no. of countries)	**114**	**122**	**131**	**134**	**133**	**139**
Egypt's rank	52	63	77	81	70	81
Egypt's rank/no. of countries	46	52	59	60	53	58
Egypt's score	**3.95**	**4.02**	**3.96**	**3.98**	**4.04**	**4.20**

Source: WEF, global competitiveness reports (several issues).

Figure A1. Egypt's Rank in the GCI's Sub-indices and its Various Pillars in 2010/11

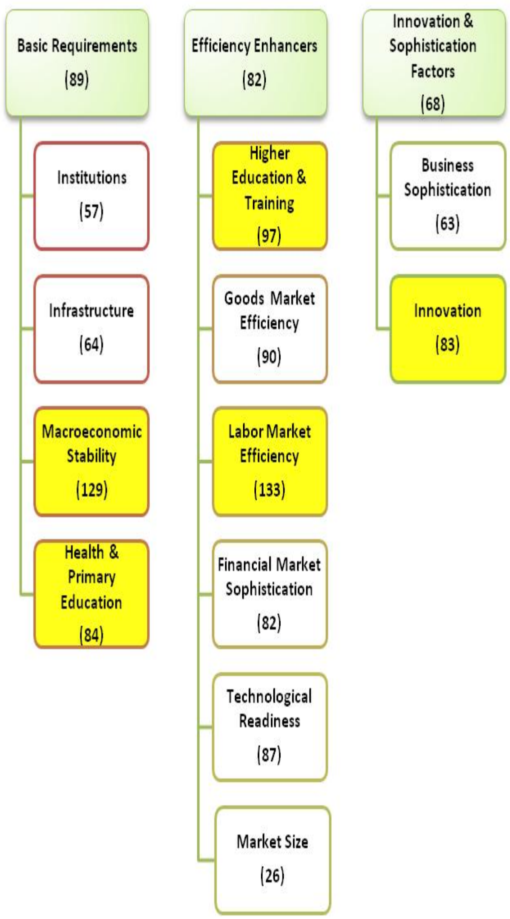


Table A3. Countries Included in the Study

Id	Country	Id	Country
1	Egypt	14	Indonesia
2	Bangladesh	15	Kenya
3	Benin	16	Madagascar
4	Bolivia	17	Mongolia
5	Cambodia	18	Morocco
6	Cameroon	19	Nicaragua
7	Ethiopia	20	Paraguay
8	Gambia	21	Philippines
9	Georgia	22	Sri Lanka
10	Guatemala	23	Tanzania
11	Guyana	24	Uganda
12	Honduras	25	Vietnam
13	India		

To test whether we would opt for the fixed or random effect models, we use the Hausman specification test.[25] The null hypothesis underlying the Hausman test is that FEM and ECM or REM estimators do not differ substantially. The test statistic developed by Hausman has an asymptotic (X^2) chi-square distribution.

Table A4. Stage 1- Hausman Test Results

	(b)	(B)	(b-B)	sqrt(diag(V_b-V_B))
	Fixed	**Random**	**Difference**	**S.E.**
Pres	0.0892766	0.0882722	0.0010045	0.0004945
Qedus	0.0870335	0.0860512	0.0009823	0.0136062
quaedus	-0.0528120	-0.0297960	-0.0230160	0.0143960
Onjtr	0.2447754	0.2440663	0.0007091	0.0109257
Flexs	0.0512929	0.0319836	0.0193093	0.0114347
Effuse	0.1064550	0.0952717	0.0111834	0.0094877
Innov	0.1506749	0.1810439	-0.0303690	0.0235898

b = consistent under Ho and Ha; obtained from xtreg

B = inconsistent under Ha, efficient under Ho; obtained from xtreg

Test: Ho: difference in coefficients not systematic

chi2(7) = (b-B)'[(V_b-V_B)^(-1)](b-B)

= 13.01

Prob>chi2 = 0.0719

(V_b-V_B is not positive definite)

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[25] Baltagi (2009).

The Hausman test significantly rejects the null hypothesis for the estimated x^2 value at 7 degrees of freedom. Hence, we can use either the fixed effects model or random effects model. That is, FEM and REM estimators do not differ substantially.

Table A5. Stage 2-Hausman Test Results

	(b)	(B)	(b-B)	sqrt(diag(V_b-V_B))
	Fixed	**Random**	**Difference**	**S.E.**
lngovcons1	0.8266002	1.2681430	-0.4415430	1.1031080
lnfrsdr1	2.4805630	2.6283700	-0.1478071	0.9387410
m2gr	5.0096420	5.2592810	-0.2496383	0.6723277
Rgdptr	0.6875819	0.4886468	0.1989351	0.1137813
Gci	7.6339830	2.4677030	5.1662800	2.3907470

b = consistent under Ho and Ha; obtained from xtreg
B = inconsistent under Ha, efficient under Ho; obtained from xtreg
Test: Ho: difference in coefficients not systematic
chi2(5) = (b-B)'[(V_b-V_B)^(-1)](b-B)
= 5.87
Prob>chi2 = 0.3186

The Hausman test does not reject the null hypothesis, as the estimated x^2 value for 5 degrees of freedom is not significant. Hence, we can use either the fixed effects or random effects model. In other words, FEM and REM estimators do not differ substantially.

Table A6. Stage 3- Hausman Test

	(b)	(B)	(b-B)	sqrt(diag(V_b-V_B))
	Fixed	**Random**	**Difference**	**S.E.**
Pres	-0.1180750	-0.5389898	0.4209147	0.4367111
Qedus	0.3929774	0.5288377	-0.1358603	0.7662389
quaedus	-0.6881655	0.4970647	-1.1852300	2.3367770
Onjtr	0.6806732	-1.7144010	2.3950750	1.6665960
Flexs	0.8734961	0.9166971	-0.0432010	1.2287120
Effuse	0.8946273	1.4847690	-0.5901416	1.6382620
Innov	1.8982330	2.4997790	-0.6015459	2.4331090
lngovcons1	0.4557894	-1.0469740	1.5027630	1.7878540
lnfrsdr1	1.7027070	1.3641800	0.3385275	1.4007930
m2gr	4.3810680	5.2616960	-0.8806280	1.3710240
Rgdptr	0.5911973	0.6249020	-0.0337046	0.2297528

b = consistent under Ho and Ha; obtained from xtreg
B = inconsistent under Ha, efficient under Ho; obtained from xtreg
Test: Ho: difference in coefficients not systematic
chi2(11) = (b-B)'[(V_b-V_B)^(-1)](b-B)
= 3.36
Prob>chi2 = 0.9851

The Hausman test does not reject the null hypothesis, as the estimated x^2 value for 11 degrees of freedom is not significant. Hence, we can use either the fixed effects or random effects model. That is, FEM and REM estimators do not differ substantially.

Table A7. Modified Stage 3—Hausman Test

	(b)	(B)	(b-B)	sqrt(diag(V_b-V_B))
	Fixed	**Random**	**Difference**	**S.E.**
Qpre	3.5806200	-1.0619560	4.6425760	2.6929160
Prenr	-0.0116517	-0.0438221	0.0321704	0.1331172
Qqtrs	-1.2573500	0.3584553	-1.6158050	4.0400770
Lmrefs	0.3368289	2.0597930	-1.7229640	2.5326800
Innov	3.5200910	2.3422320	1.1778580	3.9823820
lngovcons1	4.4099780	5.3496020	-0.9396236	2.6757650
lnfrsdr1	-1.1303910	-0.6199863	-0.5104049	4.3033740
m2gr	3.8340620	7.0882270	-3.2541650	2.2809000
Rgdptr	0.7784738	0.3516001	0.4268737	0.3949758

b = consistent under Ho and Ha; obtained from xtreg

B = inconsistent under Ha, efficient under Ho; obtained from xtreg

Test: Ho: difference in coefficients not systematic

chi2(9) = (b-B)'[(V_b-V_B)^(-1)](b-B)

= 8.21

Prob>chi2 = 0.5129

Our finding is that the Hausman test does not reject the null hypothesis, as the estimated x^2 value for 9 degrees of freedom is not significant. Hence, we can use either the fixed effects or random effects model. That is, FEM and REM estimators do not differ substantially.

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