

Saving and Growth in Egypt

Constantino Hevia

Norman Loayza

The World Bank
Development Research Group
Macroeconomics and Growth Team
January 2011



Abstract

This study illustrates the mechanisms linking national saving and economic growth, with the purpose of understanding the possibilities and limits of a saving-based growth agenda in the context of the Egyptian economy. This is done through a simple theoretical model, calibrated to fit the Egyptian economy, and simulated to explore different potential scenarios. The main conclusion is that if the Egyptian economy does not experience progress in productivity—stemming from technological innovation, improved public management, and private-sector reforms—then a high rate of economic growth is not feasible at current rates of national saving and would require a saving effort that

is highly unrealistic. For instance, financing a constant 4 percent growth rate of gross domestic product per capita with no improvement in total factor productivity would require a national saving rate of around 50 percent in the first decade and 80 percent in 25 years. However, if productivity rises, sustaining and improving high rates of economic growth becomes viable. Following the previous example, a 2 percent growth rate of total factor productivity would allow a 4 percent growth rate of gross domestic product per capita with national saving rate in the realistic range of 20-25 percent of gross domestic product.

This paper is a product of the Macroeconomics and Growth Team, Development Research Group. It is part of a larger effort by the World Bank to provide open access to its research and make a contribution to development policy discussions around the world. Policy Research Working Papers are also posted on the Web at <http://econ.worldbank.org>. The authors may be contacted at chevia@worldbank.org or nloayza@worldbank.org.

The Policy Research Working Paper Series disseminates the findings of work in progress to encourage the exchange of ideas about development issues. An objective of the series is to get the findings out quickly, even if the presentations are less than fully polished. The papers carry the names of the authors and should be cited accordingly. The findings, interpretations, and conclusions expressed in this paper are entirely those of the authors. They do not necessarily represent the views of the International Bank for Reconstruction and Development/World Bank and its affiliated organizations, or those of the Executive Directors of the World Bank or the governments they represent.

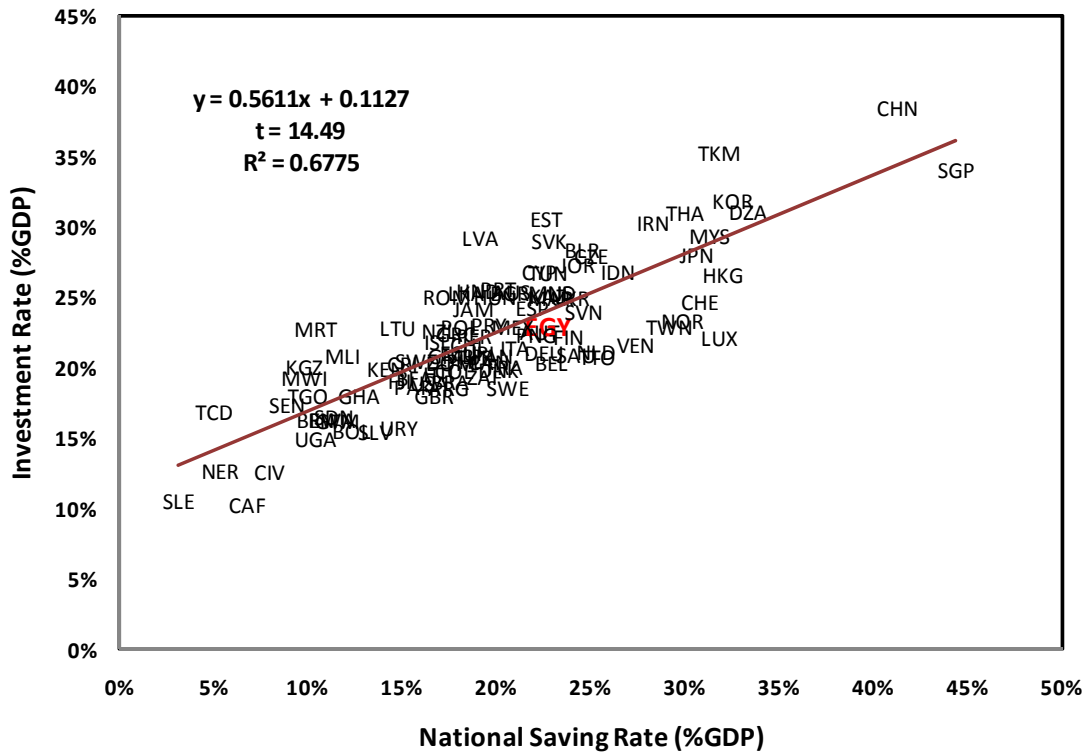
Saving and Growth in Egypt

Constantino Hevia and Norman Loayza*

World Bank

* We are grateful to Mahmoud Mohieldin, Farrukh Iqbal, Santiago Herrera, Inessa Love, Alan MacArthur, Tarek Moursi, Brian Pinto, Ritva Reinikka, and Luis Servén for useful insights and comments. We are indebted to Hoda Youssef and Yuki Ikeda for data collection and to Tomoko Wada for editorial assistance. The usual disclaimer applies.

Figure 2: Saving and Investment
Average, 1980-2008



To be sure, some of the relationship between growth and saving reflects the positive impact that higher income has on improved saving (see Loayza et al. 2000). However, no less important is the causality that runs from higher saving to larger growth, where the mechanism resides on the well-known process of capital accumulation. Improved national saving provides the funds to take advantage of more and larger investment opportunities. This, in turn, increases the capital stock, which effectively used for economic production contributes to higher output growth. Although in theory domestic investment does not have to be supported by national saving, in practice the connection between the two is quite close. This is especially true in the long run, when external sources of funds can be tapped only in a restricted manner: large current account deficits cannot be sustained indefinitely. This is exemplified by the strong relationship between the average saving and investment rates across countries in the last three decades, as depicted in Figure 2. Mirroring its saving-growth situation, Egypt conforms to the cross-country pattern regarding the relationship between saving and investment. The links in the relationship between saving and growth are not, however, mechanical but depend on the

quality of the financial system and public institutions in general. Without an efficient financial system, the best investment opportunities will not be matched with the available saving (see Levine 2005). Likewise, without proper public institutions (that guarantee macroeconomic stability and contract enforcement, for instance), accumulated capital may remain idle or ineffectively used (see Hall and Jones 1999 and Easterly and Levine 2001). This points out to the crucial importance of the efficiency or productivity with which physical capital, human capital, and labor are used in the production process. The growth of factor productivity is what in the end determines whether a saving and investment effort will result (or not) in improved economic growth.

The objective of this study is to illustrate the mechanisms linking national saving and economic growth in Egypt. We will do this through a simple theoretical model, calibrated to fit the Egyptian economy, and simulated to explore different potential scenarios. Our goal is to understand the two-way connection between saving and growth and the possibilities and limits of a saving-based growth agenda, in the context of the Egyptian economy.

Optimality of saving behavior can be posed from different angles. The most common in the academic literature is the perspective of optimal saving as the behavior that maximizes a consumer welfare function. This, however, may be too abstract for the needs and objectives of policy practitioners. For this reason, we pose the problem of optimal saving from the perspective of financing a given rate of economic growth while simultaneously achieving external sustainability. First, we present the basic elements of a simple model, constructed with the purpose of understanding optimal saving from this perspective. Next, we calibrate the model to the Egyptian economy, using parameters and relationships obtained in the received literature for the country. Using the calibrated model, we perform some simulations that clarify the relationship between saving, productivity, and growth, allowing us to discuss policy options for improving economic growth in Egypt.

A Simple Model

We consider a model of an open economy with a single sector that produces a unique final good which we call ‘gross domestic product’ or, simply, output. The economy evolves in discrete time and each time period, denoted by an index t , represents one year.

We assume that the economy has access to a technology to produce output by combining capital and labor inputs according to the production function

$$Y_t = A_t K_t^\alpha L_t^{1-\alpha} \quad (1)$$

where Y_t denotes output, K_t is the stock of physical capital, L_t denotes the amount of effective labor input, A_t is a measure of the level productivity of capital and labor, and the technology parameter $\alpha \in (0,1)$ measures the relative contribution of capital to the production of output—in a competitive economy, the parameter α coincides with the share of output distributed as payments to capital.

We abstract from distributional issues and assume that labor is homogeneous across the population. Following Bils and Klenow (2000) and Hall and Jones (1999) we assume that each worker has been trained with E_t years of schooling, which delivers productivity $e^{\phi E_t}$ per worker. Thus, effective labor is given by

$$L_t = e^{\phi E_t} N_t, \quad (2)$$

where N_t denotes the total number of workers. In this specification, ϕE_t measures the relative efficiency of a worker with E_t years of schooling relative to one with no schooling.

Capital depreciates at a constant rate δ between time periods, but can be augmented through investment. Namely, the stock of capital evolves according to

$$K_{t+1} = (1 - \delta)K_t + I_t \quad (3)$$

where I_t denotes aggregate investment.

Abstracting from valuation changes, the current account deficit at period t , CAD_t , is defined as the change in net foreign liabilities of the whole economy; that is,

$$CAD_t \equiv B_{t+1} - B_t = rB_t + C_t + G_t + I_t - Y_t - TR_t, \quad (4)$$

where B_t is the stock of net foreign liabilities due at period t ; r is the world interest rate, assumed constant for simplicity; C_t denotes private consumption; G_t denotes government

expenditures; and TR_t denotes the flow of net external current transfers (worker remittances plus official grants) that are not reflected as changes in the country's net foreign liabilities.¹

If we let $S_t^N = Y_t + TR_t - rB_t - C_t - G_t$ denote aggregate national saving, the previous equation can be rearranged into the familiar investment-saving gap identity of an open economy,

$$I_t = S_t^N + CAD_t. \quad (5)$$

That is, domestic investment I_t can be financed through national saving or through external borrowing (i.e. foreign saving).

External solvency requires that the current value of foreign liabilities be no larger than the present value of net exports, and can be obtained by iterating forward on the current account identity (4); namely,

$$\sum_{j=0}^{\infty} \frac{1}{(1+r)^j} [Y_{t+j} + TR_{t+j} - I_{t+j} - C_{t+j} - G_{t+j}] = (1+r)B_t.$$

This solvency condition imposes certain assumptions about the functioning of international capital markets that are difficult to reconcile with the experience of emerging market economies. In particular, it fails to capture the financial frictions that are pervasive in developing countries. For this reason, we follow Milesi-Ferretti and Razin (1996) and impose a sufficient condition for current account sustainability that is also appealing in terms of its realism.

We assume that the economy is required to maintain the ratio of foreign debt to gross domestic product constant; namely, that

$$\frac{B_t}{Y_t} = \beta \text{ for all } t. \quad (6)$$

This constraint can be due to the reluctance of foreigners to lend money when the level of debt is sufficiently high, or because the government wants to maintain a safe level of foreign borrowing relative to output.²

¹ Historically, workers' remittances and official grants to Egypt have been an important fraction of GDP, averaging about 5% in the present decade.

² Alternatively, we could assume that the interest rate that the country pays on its foreign debt, r , depends on the difference between the actual and some target level of the debt-to-GDP ratio. With this modification, there is an endogenous risk premium that induces the debt-to-GDP ratio to converge to the target value in the long run

Using the definition of the current account, the last constraint imposes the following restriction on the current account deficit as a fraction of gross domestic output,

$$\frac{CAD_t}{Y_t} = \frac{B_{t+1}}{Y_{t+1}} \frac{Y_{t+1}}{Y_t} - \frac{B_t}{Y_t} = \beta \left(\frac{Y_{t+1}}{Y_t} - 1 \right). \quad (7)$$

That is, the ratio of the current account deficit to the value of output depends upon the net foreign liabilities as a fraction of GDP, β , and on the growth rate of output, Y_{t+1}/Y_t . For example, if the economy is a net borrower ($\beta > 0$) and contemplates growing ($Y_{t+1} > Y_t$), then it must necessarily run a current account deficit.

We find it convenient to rewrite all previous equations in per-worker terms. Introducing the definition of effective labor (2) into the production function (1) and dividing the resulting expression by N_t gives

$$y_t = A_t k_t^\alpha (e^{\phi E_t})^{1-\alpha} \quad (8)$$

where $y_t = Y_t/N_t$ denotes output per worker and $k_t = K_t/N_t$ is capital per worker. More generally, throughout the paper lowercase letters are used to denote variable in per-worker terms.

Following the same approach, we write the equilibrium equations (3), (5), and (7) in per-worker terms,

$$k_{t+1}(1 + \gamma_{Nt}) = (1 - \delta)k_t + i_t, \quad (9)$$

$$i_t = s_t^N + cad_t, \quad (10)$$

and

$$\frac{cad_t}{y_t} = \beta [(1 + \gamma_{yt})(1 + \gamma_{Nt}) - 1]. \quad (11)$$

where $\gamma_{Nt} = N_{t+1}/N_t - 1$ denotes the growth rate of the workforce between periods t and $t + 1$. More generally, we denote by γ_{xt} the (net) growth rate between periods t and $t + 1$ of any variable x_t .

(Scmitt-Grohé and Uribe 2003). Because of this fact, we conjecture that the main message of the paper is the same in the alternative model.

We now use the previous equations to write a condition that relates saving and growth. First, we use the production function (8) at periods t and $t + 1$ to write the growth rate in output per worker as

$$(1 + \gamma_{yt}) = (1 + \gamma_{At})(1 + \gamma_{kt})^\alpha [e^{\phi(E_{t+1}-E_t)}]^{1-\alpha} \quad (12)$$

That is, the (gross) growth rate of output $(1 + \gamma_{yt})$ depends upon the growth rate of productivity $(1 + \gamma_{At})$, the growth rate of the stock of capital $(1 + \gamma_{kt})$, and the growth rate of human capital $e^{\phi(E_{t+1}-E_t)}$.

Second, introducing the investment-saving equation (10) into the capital accumulation equation (9) and rearranging gives

$$(1 + \gamma_{kt})(1 + \gamma_{Nt}) = 1 - \delta + \frac{i_t y_t}{y_t k_t} = 1 - \delta + \left(\frac{s_t^N + cad_t}{y_t} \right) \frac{y_t}{k_t}$$

This equation describes the growth rate of the stock of capital per worker as a function of the growth rate of the workforce γ_{Nt} , the depreciation rate δ , the national saving ratio with respect to output s_t^N/y_t , the current account deficit as a fraction of GDP cad_t/y_t , and the degree of capital deepening in the economy k_t/y_t .

Imposing the sustainability condition (11) into the last equation, the evolution of the stock of capital becomes

$$(1 + \gamma_{kt})(1 + \gamma_{Nt}) = 1 - \delta + \left\{ \sigma_t + \beta[(1 + \gamma_{yt})(1 + \gamma_{Nt}) - 1] \right\} \frac{y_t}{k_t}, \quad (13)$$

where $\sigma_t = s_t^N/y_t$ denotes the national saving ratio with respect to GDP.³

Finally, introducing (13) into the output growth equation (12) gives an equation that links the growth rate of output per worker to the national saving ratio σ_t , the growth rate of productivity γ_{At} , the growth rate of the workforce γ_{Nt} , the increase in human capital $\phi(E_{t+1} - E_t)$, and the level of capital deepening k_t/y_t ,

$$(1 + \gamma_{yt}) = (1 + \gamma_{At}) \left[\frac{1 - \delta + \left\{ \sigma_t + \beta[(1 + \gamma_{yt})(1 + \gamma_{Nt}) - 1] \right\} \frac{y_t}{k_t}}{1 + \gamma_{Nt}} \right]^\alpha e^{(1-\alpha)\phi(E_{t+1}-E_t)}. \quad (14)$$

³ Note that s_t^N/y_t is neither the national saving rate nor the domestic saving rate as defined in the national accounts statistics. The national saving rate is defined as s_t^N/y_t^N where $y_t^N = y_t - rb_t + TR_t$ is national disposable income, whereas the domestic saving rate is defined as s_t^D/y_t , where $s_t^D = y_t - c_t - g_t$ is domestic saving.

We use equation (14) in our numerical experiments.

To understand the implications of the previous equation, we take logarithms and use the approximations $\log(1 + x) \approx x$ for small x and $xy \approx 0$ for small x and y to write (14) as

$$\gamma_{yt} = \gamma_{At} + \alpha \left[(\sigma_t + \beta[\gamma_{yt} + \gamma_{Nt}]) \frac{y_t}{k_t} - \delta - \gamma_{Nt} \right] + (1 - \alpha)\phi(E_{t+1} - E_t).$$

Solving for the growth rate of output gives

$$\gamma_{y,t} = \frac{\gamma_{At} + \alpha \left[(\sigma_t + \beta\gamma_{Nt}) \frac{y_t}{k_t} - \delta - \gamma_{Nt} \right] + (1 - \alpha)\phi(E_{t+1} - E_t)}{1 - \alpha\beta y_t/k_t}$$

This equation shows that output growth is positively associated with the national saving ratio and with the growth rate in productivity, the workforce, and human capital. As the economy grows, however, the capital-GDP ratio k_t/y_t changes as well. Therefore, the level of saving required to finance a given growth rate in output per worker varies through time.⁴

Model Calibration

We use the relationship imbedded in equation (14) to illustrate the mechanisms linking saving and growth applied to the Egyptian economy. The first step is to use information specifically related to Egypt to calibrate the model. The main pieces of information are the following,

- The current capital-output ratio: $k_t/y_t = 2.6$. This is the ratio estimated for the year 2008, using the methodology and basic information from Loayza and Honorati (2007). This paper applies the perpetual inventory method to accumulate investment in order to produce a measure of the capital stock. For this purpose, it uses a depreciation rate of 0.04, consistent with that used in this study (see below).
- The capital share in output: $\alpha = 0.5$. This is an average of the most sensible estimates available. Using time-series analysis, Loayza and Honorati (2007) estimate the capital share in Egypt to be 0.35. This is also the average across countries that Bernanke and Gürkaynak (2002) obtain using factor payment data from national accounts. Herrera (2009) uses a combination of national accounts information and

⁴ This approximation is only for illustration purposes. We always use equation (14) to compute the experiments.

labor survey data for Egypt to arrive at a larger estimate of the capital share in Egypt, 0.6.

- The annual capital depreciation rate: $\delta = 0.04$. This is the depreciation rate used in the estimation of the capital stock and follows the seminal work of Nehru and Dhareshwar (1993).
- The annual growth rate of the labor force: $\gamma_{Nt} = 0.025$. This is the average growth rate of the number of workers for the period 2001-2008, as estimated from Egypt's national employment statistics. This represents an update of the estimate presented in Loayza and Honorati (2007).
- The annual average increase in education: $(E_{t+1} - E_t) = 0.12$. Education is proxied by the average number of schooling years in the adult population, as reported in Said (2008) for Egypt for the period 1980-2000. This estimate for the average increase in schooling is similar to that obtained using the Barro and Lee (2001) database for the same period.
- The average annual rate of return to education: $\phi = 0.05$. This is proxied by the average rate of return for each year of schooling, as reported in Herrera (2009) for Egypt for the period 1988-2006.
- The current (or targeted) level of net foreign liabilities as ratio to GDP: $\beta = 0.2$. This corresponds to the official "international investment position" in average for the period 2001-2007, as reported by the IMF's Balance of Payments Statistics.
- Net income plus transfers from abroad, as ratio to GDP : $(-r\beta + \frac{tr_t}{y_t}) = 0.052$. The numerator of this ratio is equal to the difference between Gross National Disposable Income (GNDI) and Gross Domestic Product (GDP), and the ratio corresponds to the average for the period 2001-2007. It is obtained from statistics reported by the World Bank and the IMF.

Productivity Scenarios. A key parameter in the simulations presented below is the rate of growth of total factor productivity, γ_{At} . The available estimated rates of TFP growth in Egypt vary according to the period under consideration and the method of estimation (see Herrera 2009, and Loayza and Honorati 2007). They approximately range from -1.5% to 2.5%, with the

extreme rates lasting for short periods of time. Our goal here is to establish what a reasonable range is for TFP growth for long periods of time (say 25 years, the simulation horizon). On the one hand, it is difficult to understand how TFP growth rates can be negative for a sustained period of time, unless there is prolonged macroeconomic disarray (e.g., hyper-inflation, civil conflict, or systemic financial crisis). In times of socio-economic stability, a reasonable lower bound for TFP growth rate is 0, representing lack of progress. On the other hand, it is also difficult to accept long-run TFP growth rates that exceed those that the highest growing countries have been able to achieve for a sustained period of time. According to the TFP growth estimates presented in Bernanke and Gürkaynak (2002), only the top five percent of countries in the world have been able to achieve an average growth rate of TFP around 2% during the period 1965-1995. This, then, seems to be a reasonable upper bound for TFP growth for a sustained period of time in Egypt. In the simulations that follow, we will consider three scenarios: Pessimistic, Moderate, and Optimistic, depending on whether the TFP growth rate is 0%, 1%, or 2%, respectively.

Simulations of the Model

Using the model developed above and the calibration parameters, we can perform different numerical exercises to give answers and insights regarding the link between saving, investment, and growth. We perform two basic, complementary simulations. The first one is designed to measure the saving rates that are required to finance a given rate of economic growth. This rate is set to 4% of GDP growth per worker. Although ambitious from historical and cross-country perspectives, this rate corresponds to the average that Egypt has been able to obtain in the last 3 years and approaches the rate that policy makers set as target for the country. The second simulation changes perspectives and asks what economic growth rates can be financed if the saving rate is fixed at a given level. This is set to 20% of national saving with respect to GDP. It is a realistic rate, corresponding to the average Egypt has been able to achieve in the last few years.

Both simulations are dynamic in the sense that they follow the evolution of the economy for an extended period of time, chosen to be 25 years in our case. Also in both cases,

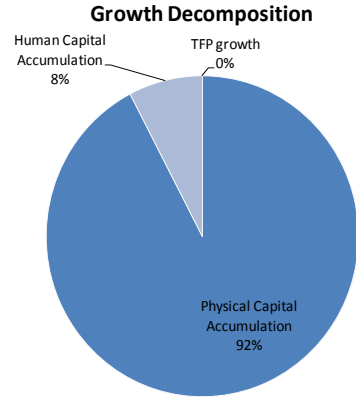
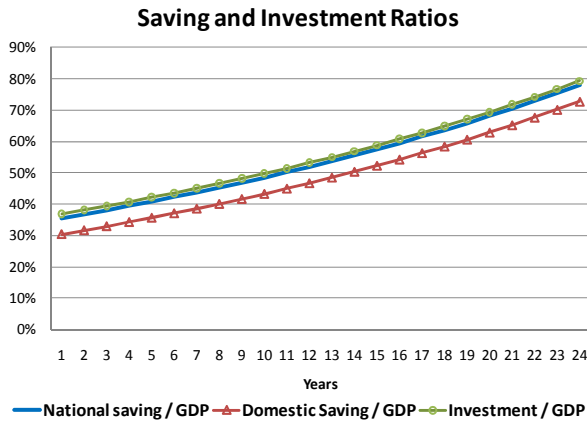
we compute the corresponding Solow growth decomposition in order to understand the role played by factor accumulation and productivity advances in the process of economic growth.

As mentioned in the previous section, the simulations are performed under three scenarios regarding the behavior of total factor productivity. Respectively, TFP growth is assumed to be 0%, 1%, 2%, and the corresponding scenarios are labeled, pessimistic, moderate, and optimistic. The simulation results are presented in Figures 3, 4, and 5. In each of them, the upper panel corresponds to the simulation where the growth rate of GDP per worker is fixed and the saving rate changes to obtain such growth; and, conversely, the lower panel shows the simulation where the saving rate is fixed and economic growth changes in reaction to it.

Let us start with the pessimistic scenario of lack of progress in total factor productivity (Figure 3). The first simulation (upper panel) shows that, in the absence of TFP growth, the demands on capital accumulation to attain the goal of 4% growth are excessively large. In fact, as the growth decomposition indicates, more than 90% of GDP per-worker growth would have to be supported by physical capital accumulation. (Following its historical trend, human capital would contribute only 0.3 percentage points of GDP growth per worker). The investment rate would need to jump to around 37% of GDP and then increase even further over time as the marginal returns to capital decrease. The limits to external financing imposed by current account sustainability imply that foreigners may supply only a small fraction of capital investment. Thus, national saving would have to almost fully match investment, increasing enormously, first to about 35% of GDP, then to 50% in 10 years, and to almost 80% by the end of the 25-year period. Domestic saving would need to increase by a smaller amount given the substantial remittances and official grants that Egypt receives (of the order of 5% of GDP). Even so, domestic saving would need to jump to twice its recent average and increase from there. Clearly, growing at 4% of GDP per worker cannot be sustained by capital accumulation in a context of nil TFP growth and small contribution from human capital.

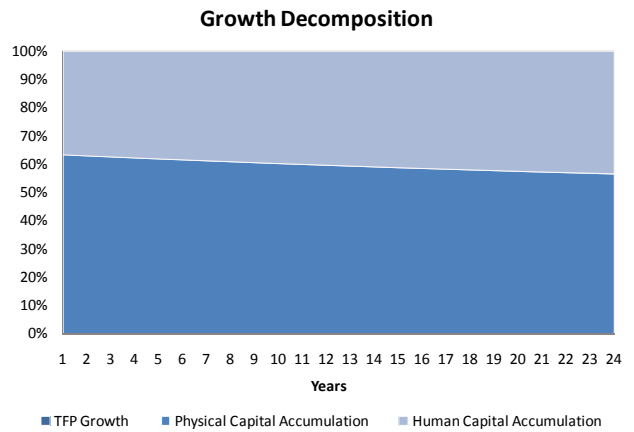
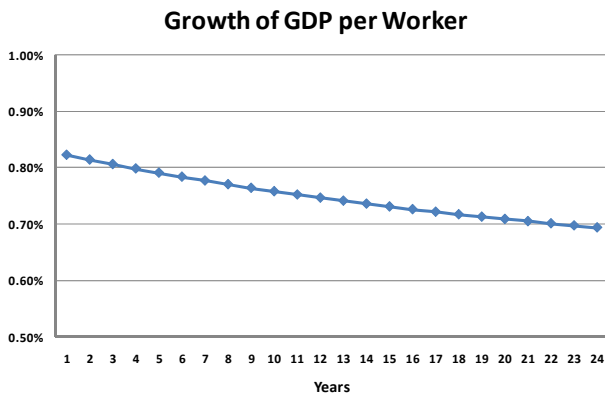
Figure 3. Pessimistic Scenario
TFP Growth Rate = 0%

GDP Growth per Worker = 4%



National Saving / GDP = 20%

Implied Domestic Saving / GDP = 14.8%
Implied Investment / GDP = 20.6%



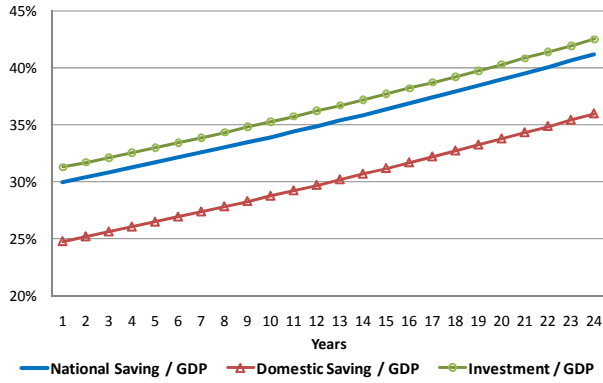
The second simulation (lower panel) provides rather realistic results when TFP growth is absent. It shows that with a national saving ratio of 20% of GDP, the growth rate of GDP per worker will start at 0.8% and then decrease gradually to 0.7% in 25 years. The decrease in growth is explained by diminishing returns to capital, which in this simulation is accumulated at a constant rate (dictated, naturally, by the fixed saving ratio). The contribution of physical capital to economic growth declines over time (implying a declining share with respect to that of human capital in the Solow growth decomposition, shown on the right side of the lower panel).

Let us now turn to the moderate scenario, where TFP grows at a constant rate of 1% (Figure 4). The first simulation indicates that achieving a target of GDP per worker growth rate of 4% is still a difficult goal. It would require a jump in national saving / GDP from the current 20% to about 30% and then increase it over time to around 40% in 25 years. (As explained above, investment would be larger than national saving given the participation of foreign investors, and domestic saving lower than national saving because of net transfers from abroad in the form of official grants and workers' remittances.) The lion share of the contribution to growth would still need to come from capital accumulation, with one-quarter coming from TFP growth (see Solow growth decomposition on the right side of the upper panel). However, although the required increase in national saving is substantial, it is no longer infeasible (as was the case with zero TFP growth). In fact, similar or even larger jumps in national saving have taken place in East Asian countries, most notably China, and have supported their remarkable growth performance.

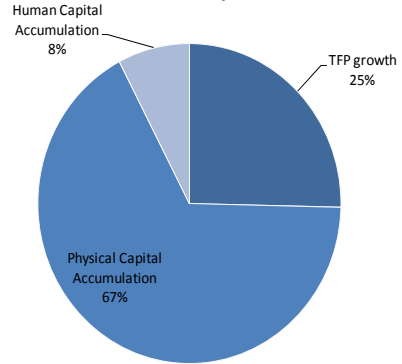
Figure 4. Moderate Scenario
TFP Growth Rate = 1%

GDP Growth per Worker = 4%

Saving and Investment Ratios



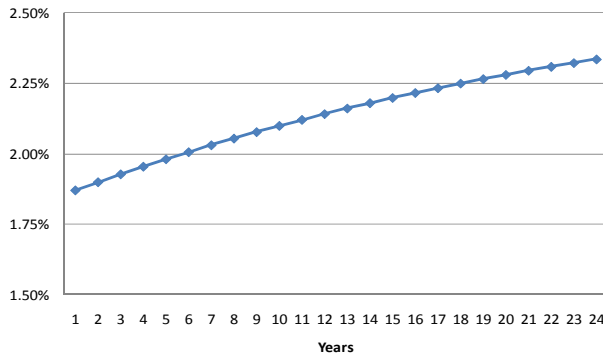
Growth Decomposition



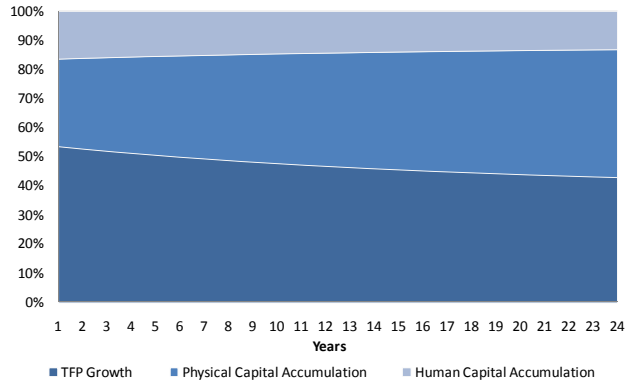
National Saving / GDP = 20%

Implied Domestic Saving / GDP = 14.8%
Implied Investment / GDP = 21%

Growth of GDP per Worker



Growth Decomposition



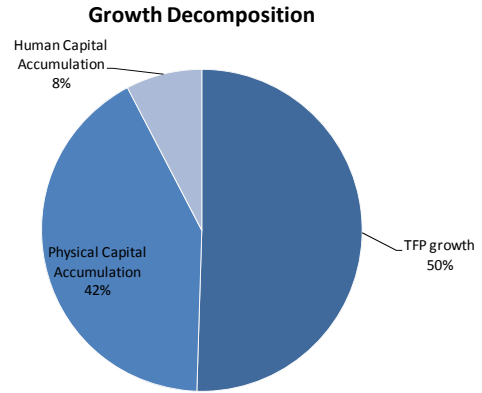
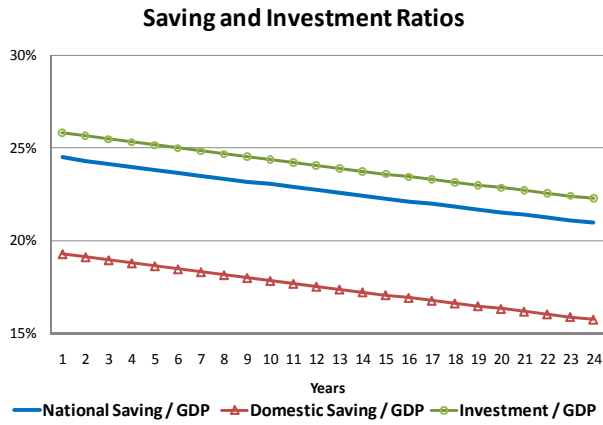
The second simulation under the moderate scenario shows the behavior of GDP per worker growth when national saving stays at the current level of 20% of GDP. Given TFP growth of 1%, the growth rate of GDP per worker is expected to rise gradually from about 1.9% to 2.3% in the 25 years of the simulation period. In contrast to the case of zero TFP growth, when TFP grows even moderately the same rate of national saving leads not only to higher but also to increasing GDP per worker growth. TFP growth alleviates the restriction of foreign saving, producing a level of investment rate of 1 percentage point of GDP higher than national saving (and 6 p.p. higher than domestic saving). Moreover, TFP growth reduces the pressure of diminishing capital returns, which combined with higher investment leads to an expansion of the contribution that capital accumulation makes for output growth (see the Solow growth decomposition on the right of the lower panel).

Finally, let us consider the optimistic case, where TFP grows at a 2% rate (Figure 5). According to the first simulation (upper panel), the required saving rates to finance a 4% GDP growth per worker is only slightly higher than current averages. National saving would need to rise to about 24% of GDP and then gradually decrease to 21%, meaning that the same growth target can be financed with lower saving effort over time. As the Solow growth decomposition shows, now half the contribution to GDP per worker growth comes from TFP. It is this impulse which relieves the pressure on capital accumulation which can now take second stage on the generation of economic growth.

The second simulation under high TFP growth indicates that GDP per worker growth will start strong and increase even further, from 3 to 4% in the 25 years of the simulation horizon. This is achieved even maintaining the national saving rate at the current level of 20% of GDP. As the Solow growth decomposition shows, the contribution of capital accumulation actually grows over time, from about 20% to 40% of economic growth. More strongly than in the moderate case, the growth of TFP allows higher participation of foreign saving (and thus larger investment rate), produces higher *level* of national saving, and alleviates the pressure of decreasing capital marginal productivity.

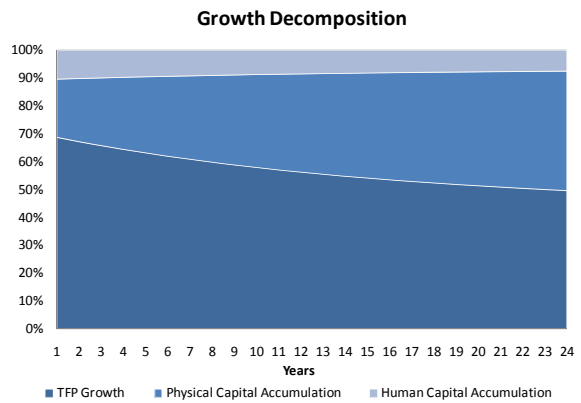
Figure 5. Optimistic Scenario
TFP Growth Rate = 2%

GDP Growth per Worker = 4%



National Saving / GDP = 20%

Implied Domestic Saving / GDP = 14.8%
Implied Investment / GDP = 21.3%



Robustness to Changes in Parameters

The quantitative predictions of our model depend on the calibrated parameter values. In this section we compute some robustness exercises by changing some parameters that are difficult to measure or subject to controversy. In particular, we consider changes in α , the capital share in output; in δ , the depreciation rate of capital; and in β , the targeted level of foreign liabilities as percentage of GDP. Tables 1 and 2 present the results of these experiments, along with those corresponding to the benchmark calibration. Table 1 displays the national saving rate that is necessary to finance a GDP per-capita growth rate of 4 percent under the three scenarios regarding TFP growth. The rows labeled “Baseline calibration” report results of the baseline model. The remaining rows report results of the different calibrations. Likewise, Table 2 reports projected per-capita growth paths when the national saving rate remains fixed at 20 percentage points of GDP.

Consider first the capital share in output. Reliable estimates of α require reliable estimates of national account data on employee compensation. Gollin (2002) and Bernanke and Gürkaynak (2002) argue that, in many developing countries, series on employee compensation substantially understate the labor share in output because of the large number of self-employed workers or employees working outside the corporate sector. Adjusting these series with complementary data, these authors find that, in those countries for which these adjustments can be made, the capital share in output is about one third, consistent with the values obtained in developed countries.

In our benchmark calibration, the capital share in output α was set equal to 0.5, which is an average of available Egypt-specific estimates. We now check the robustness of our results using $\alpha = 0.35$, a value more aligned with the international evidence cited above. Under the new calibration, the main message of the paper is, in fact, reinforced. Take, for example, the economy with moderate TFP growth in Table 1. The required national saving rate to finance 4 percent of GDP per capita growth increases to 41 percent in five years, 49 percent in 10 years, and 81 percent in 25 years. These rates are substantially larger than those obtained under the baseline calibration. Likewise, Table 2 shows that when the capital share in output decreases, projected growth rates decrease as well over the next 25 years relative to the baseline

calibration. The intuition for this result is as follows. As the capital share in output decreases, the contribution of capital to total output decreases as well. Thus, if growth is to be sustained through capital accumulation alone (instead of productivity growth), investment must increase at a substantially higher rate, inducing a higher burden on domestic saving. The need to increase productivity to achieve growth is even more important when α decreases relative to the baseline calibration.

**Table 1. Required saving rate to finance 4% per capita GDP growth
Benchmark calibration and parameter variations to check for robustness**

Productivity Growth Scenarios	National saving rate over time (% of GDP)		
	5 years	10 years	25 years
Pessimistic Scenario: $\gamma_A = 0\%$			
Baseline Calibration	41	48	81
Capital share, $\alpha = 0.35$	57	77	198
Depreciation rate, $\delta = 0.06$	47	55	92
Long-run Debt/GDP, $\beta = 0.4$	40	47	79
Moderate Scenario: $\gamma_A = 1\%$			
Baseline Calibration	32	34	42
Capital share, $\alpha = 0.35$	41	49	81
Depreciation rate, $\delta = 0.06$	37	40	49
Long-run Debt/GDP, $\beta = 0.4$	30	33	40
Optimistic Scenario: $\gamma_A = 2\%$			
Baseline Calibration	24	23	21
Capital share, $\alpha = 0.35$	28	29	31
Depreciation rate, $\delta = 0.06$	29	28	25
Long-run Debt/GDP, $\beta = 0.4$	23	22	19

Consider now the depreciation rate, δ . In the baseline calibration we set $\delta = 0.04$. While this is a standard value, many studies consider higher depreciation rates. We thus study the properties of our model when the annual depreciation rate of capital is 6 percentage

points. As above, our results are reinforced with the new calibration. Table 1 shows that, for any degree of TFP growth, national saving rates required to finance a growth rate of GDP per capita of 4 percent invariably increases as δ increases from 0.04 to 0.06. Likewise, Table 2 shows that, given a level of TFP growth, projected per-capita GDP growth rates are lower when the depreciation rate increases. In effect, as δ increases, a larger fraction of capital depreciates from year to year. Thus, if GDP growth rates are to remain constant—as the exercises in Table 1 assume—the investment rate must increase to maintain the same growth rate in the stock of capital. Given TFP, this can be achieved only through an increase in national saving. Likewise, if the national saving rate remains constant, increasing the depreciation rate induces lower capital accumulation and, therefore, a lower GDP per-capita growth (Table 2).

**Table 2. Projected per-capita growth rate if saving rate remains at 20 % of GDP
Benchmark calibration and parameter variations to check for robustness**

Productivity growth scenarios	Per-capita GDP growth rate over time (%)		
	5 years	10 years	25 years
Pessimistic scenario: $\gamma_A = 0\%$			
Baseline calibration	0.8	0.8	0.7
Capital share, $\alpha = 0.35$	0.7	0.7	0.6
Depreciation rate, $\delta = 0.06$	-0.1	0.0	0.3
Long-run Debt/GDP, $\beta = 0.4$	0.9	0.8	0.7
Moderate scenario: $\gamma_A = 1\%$			
Baseline Calibration	2.0	2.1	2.3
Capital share, $\alpha = 0.35$	1.9	1.9	2.1
Depreciation rate, $\delta = 0.06$	1.1	1.4	2.0
Long-run Debt/GDP, $\beta = 0.4$	2.1	2.2	2.4
Optimistic scenario $\gamma_A = 2\%$			
Baseline Calibration	3.2	3.5	4.1
Capital share, $\alpha = 0.35$	3.0	3.2	3.5
Depreciation rate, $\delta = 0.06$	2.3	2.8	3.8
Long-run Debt/GDP, $\beta = 0.4$	3.4	3.7	4.2

Consider finally an increase in the targeted value of foreign debt as a fraction of GDP, β . In the baseline calibration we chose $\beta = 0.2$ to match historical evidence in Egypt. But 20 percent of GDP of foreign debt is somewhat low based on the international evidence. By increasing the targeted level of debt to GDP ratio, Egypt could reduce the dependence on national saving and rely more on foreign saving to finance its domestic investment. Thus, in the final experiment we assume that β increases from 20 percent of GDP to 40 percent of GDP. While, in effect, a larger fraction of domestic investment can be financed by foreign investors, we find this effect to be quantitatively small. Consider, for example, the moderate TFP growth scenario in Table 1. While it is true that the required national saving decreases when β doubles, these declines are small: in a 25 year span, the difference between domestic saving rates under the baseline calibration relative to the higher debt calibration never exceeds 2 percentage points. Similarly, if the national saving rate is fixed at 20 percent of GDP (Table 2), projected growth rates are very similar when compared to those in the baseline calibration.

In summary, we performed a number of robustness checks relative to some parameters that are difficult to calibrate or subject to controversy: the capital share in output, the depreciation rate of capital, and the targeted level of foreign debt to GDP. In all cases, our main message remains intact: a growth agenda based on increasing national saving alone is not sustainable; a successful development strategy requires large and persistent increases in productivity.

Conclusions, Policy Implications, and Potential Extensions

With an average per capita GDP growth rate of 3% in the last five decades, Egypt has been in the top 25% of all countries around the world. This remarkable growth performance has been enabled by major private and public investment and, at certain times, by significant productivity gains.⁵ This process would not have occurred if national saving had not been up to standards. In fact, Egypt's national saving rate was well above that of the median country in the world in average since the 1960s. However, since the 1990s, Egypt's national saving rate

⁵ For an analysis of total factor productivity in Egypt, see Loayza and Honorati (2007), Favaro et.al. (2009), and Herrera et.al. (2010).

has stopped increasing and has fluctuated around 20% of GDP. For Egypt’s high development aspirations to have any plausible chance to be met, they require a stronger performance on both economic growth and national saving.

The objective of this paper has been to understand the interconnection between saving and growth and the possibilities and limits of a saving-based growth agenda in Egypt. Tables 3 and 4 summarize the results obtained in the paper. The first shows the required saving rate to finance a GDP per capita growth rate of 4%, while the second presents the projected growth rate if national saving rate remains at 20% of GDP.

Table 3. Required saving rate to finance 4% per capita GDP growth

Productivity growth	National saving rate (%GDP) over time		
	5 years	10 years	25 years
0%	41	48	81
1%	32	34	42
2%	24	23	21

Our main conclusion is that if the Egyptian economy does not experience progress in productivity—stemming from technological innovation, improved public management, and private-sector reforms—, then a high rate of economic growth is not feasible at current rates of national saving and would require a saving effort that is highly unrealistic. However, if productivity starts to rise to at least moderate levels, sustaining and improving high rates of economic growth becomes viable. For the goal of achieving high economic growth, the national saving effort can only realistically be alleviated by forceful and purposeful productivity improvements.⁶

The following describes a number of policy measures and reforms that could be implemented to foster sustained productivity growth in Egypt. These measures broadly fall

⁶ In any case, increasing the national saving rate is still a desirable objective. Hevia, Ikeda, and Loayza (2010) discuss policy measures targeted at increasing national saving independently of productivity.

under the areas of institutional reform, infrastructure investment, credibility and public management, and financial intermediation.

Table 4. Projected per-capita growth rate if saving rate remains at 20 % of GDP

Productivity growth	Per-capita GDP growth rate over time (%)		
	5 years	10 years	25 years
0%	0.8	0.8	0.7
1%	2.0	2.1	2.3
2%	3.2	3.5	4.1

Consider first the privatization of state-owned firms. In 1991, over 300 state-owned firms were identified as candidates for privatization in Egypt (Law 203). Evidence suggests that firms privatized under the new law enjoyed a substantial increase in productivity. In effect, this improvement in productivity was observed with great strength during the 1990s, the period when most of the privatization wave took place: privatized firms increased investment expenditures, profitability, and overall efficiency (Omran 1997). Related to this point is the observation that, historically, a unit of investment by the private sector is almost invariably more productive than a unit of public investment (World Bank 2008). Today, many firms identified by Law 203 as candidates for privatization still remain publicly owned—the privatization wave was temporarily stalled in the late 1990s, but partially resumed in mid-2004. In light of the above evidence—and, more generally, worldwide evidence—it is expected that continuing with the privatization effort is likely to promote significant productivity gains.

Analysis of firm-level data shows that Egypt has experienced substantial progress in labor and total factor productivity between 2004 and 2008 (World Bank 2009). Moreover, the same study reports substantial progress in improving the overall investment climate during these years. In effect, the country experienced significant improvements in the tax code, in customs and tax administration, and in how costly it is to open a new business—in monetary and non-monetary terms. Yet, firms still report macroeconomic and regulatory uncertainty as

the main constraints on their operations and growth. Therefore, effort should be devoted in simplifying rules; in providing consistent and clear information; and in reducing macroeconomic uncertainty, mainly through the consistent and predictable conduct of monetary policy—and, therefore, the management of inflation.

Related to the above discussion, the improvement in credibility and policy predictability would not only have a positive impact on the efficiency of existing firms and the entrance of new firms, but also on the ability to borrow in international financial markets without creating concerns about debt sustainability. Being able to safely borrow in foreign capital markets—preferably in the form of FDI or portfolio equity—increases the rate of capital accumulation and allows the country to catch-up faster with richer countries.

In addition, more effort should be devoted to improving public infrastructure, preferably through changes in the composition of public expenditures and increased private sector participation. In effect, since the mid-1990s infrastructure investment has suffered a substantial decline—mostly due to lower public investment. While the current level of infrastructure in Egypt is what is expected given its national income, the low level of investment is unlikely to sustain the current stock of infrastructure given its natural depreciation and aging. Estimates in Loayza and Odawara (2010) suggest that increasing infrastructure investment from 5 to 6 percentage points of GDP is expected to raise the annual per capita growth rate of GDP by about 0.5 percentage points in the medium term and about 1 percentage points in the long run. Moreover, if the increase in infrastructure investment does not imply a heavier tax burden, the increase in growth would be substantially larger. Because infrastructure and other factors of production complement each other, an increase in infrastructure investment is expected to increase the productivity of physical capital and labor. In effect, in the light of our simple model, an increase in the level of infrastructure is immediately reflected as an increase in total factor productivity. It should be noted, however, that increasing infrastructure investment does not necessarily mean building new roads or new telephone lines. The maintenance and improvement in the current infrastructure should also be amply beneficial.

Finally on productivity improvements, increasing the efficiency of the financial system is necessary to allocate actual saving to their more efficient uses (Levine 2005). Better and more

competitive financial institutions are a necessary step toward that direction. Likewise, providing households with new financial instruments to channel their saving through the financial system is also necessary. In effect, while saving in the form of precious metals (e.g. gold) or durables goods (e.g. cattle) serves its purpose as a store of value, it does not provide the financial system with the needed funds to finance new productive activities.

The model, calibration, and simulation presented in the paper provide a stylized analytical tool to examine the possibilities and limitations of a saving-based growth agenda. In our view, it focuses on the most relevant issues for the current Egyptian experience. Although it may be applicable to other countries and contexts, various extensions would surely be needed to accommodate specific cases. A richer model would take into account, among other things, the disaggregation of savings into its public and private components and the relationship between the two; the behavioral response of private savings to changes in income, demographic structure, and economic uncertainty; and the changing nature of external solvency in the presence of concessional borrowing, international financial shocks, or financial deepening. This we leave for future work.

References

- Attanasio, Orazio P., Lucio Picci and Antonello Scurco. 2000. "Saving, Growth and Investment: A Macroeconomic Analysis Using a Panel of Countries." *The Review of Economics and Statistics* 82 (2): 182-211.
- Banerjee, Abhijit, and Esther Duflo. 2005. "Growth Theory Through the Lens of Development Economics." In *Handbook of Economic Growth*. Philippe Aghion and Steven N. Durlauf, eds. Vol. 1A, pp. 473-552. Amsterdam: North-Holland.
- Barro, Robert, and Jong-Wha Lee. 2001. "International Data on Educational Attainment: Updates and Implications." *Oxford Economic Papers* 53 (3): 541-563.
- Bernanke, Ben S., and Refet S. Gürkaynak. 2002. "Is Growth Exogenous? Taking Mankiw, Romer, and Weil Seriously." In *NBER Macroeconomics Annual 2001*, Vol. 16, ed. Ben S. Bernanke and Refet S. Gürkaynak, 11-72. Cambridge, MA: MIT Press.
- Bils, Mark, and Peter J. Klenow. 2000. "Does Schooling Cause Growth?" *American Economic Review* 90 (5): 1160-1183.
- Levine, Ross. 2005. "Finance and Growth: Theory and Evidence." In *Handbook of Economic Growth*. Philippe Aghion and Steven Durlauf, eds. The Netherlands: Elsevier Science.
- Easterly, William and Ross Levine. 2001. "It's Not Factor Accumulation: Stylized Facts and Growth Models." *World Bank Economic Review* 15: 177-219.
- Favaro, Edgardo, Leonardo Garrido and Tihomir Stucka. 2009. "The Global Crisis and the Egyptian Economy." Mimeo. World Bank.
- Gollin, Douglas. 2002. "Getting Income Shares Right." *Journal of Political Economy*. Vol 110(2): 458-474.
- Hall, Robert E., and Jones, Charles I. 1999. "Why Do Some Countries Produce So Much More Output Per Worker Than Others?" *Quarterly Journal of Economics* 114(1): 83-116.
- Herrera, Santiago. 2009. "Egypt Beyond the Crisis: Medium Term Challenges for Sustained Growth." Mimeo. World Bank, Washington, DC.
- Herrera, Santiago, Hoda Selin, Hoda Youssef and Chahir Zaki. 2010. "Egypt Beyond the Crisis—Medium Term Challenges for Sustained Growth." Mimeo. World Bank.
- Hevia, Constantino, Yuki Ikeda, and Norman Loayza. 2010. "Saving in Egypt: Trends and Explanations." Mimeo. World Bank, Washington, DC.

- Loayza, Norman, and Maddalena Honorati. 2007. "Investment and Growth in Egypt." Mimeo. World Bank, Washington, DC.
- Loayza, Norman, and Rei Odawara. 2010. "Infrastructure and Economic Growth in Egypt." Mimeo. World Bank, Washington, DC.
- Loayza, Norman, Klaus Schmidt-Hebbel and Luis Servén. 2000. "What Drives Private Savings Across the World." *The Review of Economics and Statistics* 82 (2): 165-181.
- Mankiw, Gregory, David Romer and David Weil. 1992. "A Contribution to the Empirics of Economic Growth." *The Quarterly Journal of Economics* 107 (2): 407-437
- Milesi-Ferretti, Gian Maria, and Assaf Razin. 1996. *Current-Account Sustainability*. Princeton Studies in International Economics No. 81. Princeton, NJ: International Economics Section, Princeton University.
- Nehru, Vikram, and Ashok Dhareshwar. 1993. "A New Database on Physical Capital Stock: Sources, Methodology, and Results." *Revista de Análisis Económico* 8 (1): 37-59.
- Omran, Mohammed. 1997. "Performance Consequences of Privatizing Egyptian State-Owned Enterprises: The effect of Post Privatization Ownership Structure on Firm Performance." *Multinational Finance Journal*, Vol. 1.
- Said, Mona. 2008. "The Fall and Rise of Earnings and Inequality in Egypt: New Evidence from the Egypt Labor Market Panel Survey 2006." In *The Egyptian Labor Market Revisited*, ed. Ragui Assaad, 53-81. New York and Cairo: American University in Cairo Press.
- Schmitt-Grohé, Stephanie and Martín Uribe. 2003. "Closing Small Open Economies." *Journal of International Economics* 61 (1): 163-185.
- World Bank. 2008. "Transforming Egypt: A Development Policy Review." World Bank, Washington, DC.
- World Bank. 2009. "Egypt Investment Climate Assessment 2009: Accelerating Private Enterprise-Led Growth." World Bank, Washington, DC.
- Young, Alwyn. 1995. "The Tyranny of Numbers: Confronting the Statistical Realities of the East Asian Growth Experience." *The Quarterly Journal of Economics* 110 (3): 641-680.