Economic Freedom and the Business Cycle: The Egyptian Experience.

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Abstract

Most studies that emphasize and encourage the shift towards a less regulated and financially open system rest on the premise of a prosperous growth prospect. Accordingly, interests have focused on growth models as a framework to understand and to analyze the effects of economic freedom. In this paper, we investigate the short-run characteristics of economic freedom. Using a stochastic general equilibrium framework, we argue that economic reforms tend to ease periods of recessions, increase welfare, and alleviate the burden of unemployment. Calibrated to the Egyptian economy, we simulate our model and investigate the [robust] relationship between economic reforms and the business cycle.

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1 Introduction

Propagated since the early 1980s, and developed on the economic adaptation of what Hayek (1960) labeled as "the constitution of liberty," President's Ronald Reagan perception of the "magic of the marketplace" grew into a worldwide consensus known as the "Washington Consensus." Articulated and adopted by the World Bank and the International Monetary Fund, the tenets of the "Washington Consensus" uphold the principles of deregulation; privatization; and the free setting of prices (such as wages) in competitive markets (Galbraith 2003, p. 8). Broadly defined, the principles emphasize investments in education, job training and freedom from government regulation and control. At the outset, these principles are to serve as a template for future political and economic guidelines.

Briefly, it is generally understood and frequently applied in practice, that the Washington consensus means a redeployment of resources and a redefining role of existing - as well as creating new - institutions. The Washington consensus is emerging as a well-accepted and defined path for policy, that is, economic freedom provides a Pareto improving framework and approach for economic prosperity. Criticism to this consensus has led to a resurgence in interest to define and understand the inner workings of economic freedom and the political economy.

Many theoretical questions arise with limited answers. At the core, one question stands out, 'How does economic freedom (reforms)[1] influence the economy?' What is paradoxical in this policy-making process is the following. How can one support and most importantly how

[1] Given the definition of economic freedom index (see the Appendix), we use the term 'economic freedom' and 'economic reforms' interchangeably.

can one convince other countries to adopt the consensus without reference to a structural model? There exists no analytical model that investigate the qualitative and the quantitative aspects of the interdependence between economic freedom and the aggregate behavior of the economy, in the short or long run. In the literature, most studies - if not all - address the issue and the nature of the relationship at the empirical level. Based on ad-hoc causal relationships and a limited set of long-run stylized facts, conclusions are drawn and policy recommendations are made without reference to a structural model that encompasses this interdependence.

What is at odd and often controversial, is that most empirical research in economics identify and test for a causal relationship from economic freedom to economic growth (uni-causal), while that empirical research in political sciences[2] emphasize the causal relationship from the latter to the former.

In this paper, we attempt to juxtapose the separate strands of this diverse literature by proposing a model which enhances our understanding of the contribution that economic freedom makes to the business cycle. To overcome the theoretical shortcoming in the liter-

[2] Although, we acknowledge the importance of political freedom and that various aspects of freedom are related (see Dawson (2003)) - in this paper - we confine ourselves to the space of economic freedom and economic activity. Ali and Crain (2002) investigated the effect of economic freedom and political freedom on growth. They concluded that political regimes do not matter for growth. Here, we abstract from the issue of political freedom. Also, there exists a large body of empirical evidence that concludes a negative relationship between Social and Political Instability (SPI) and investment. In general, periods of SPI are characterized by a negative impact on investment and growth due to the destruction of some capital stock and the interruption of otherwise well-functioning production processes. In most of these studies, the question of causality was rarely addressed. Campos and Nugent (2003) investigated the causality between SPI and the rate of investment across 94 developing countries. Surprisingly, they concluded the existence of a Granger-causality relationship between SPI and investment, but it is a robust *positive* relationship and specifically strong in low-income countries. Again we limit the model to abstract from SPI.

ature, we integrate economic freedom into a stochastic dynamic general equilibrium model to investigate the contentious nature of the circular causal relationship.

Section 2 reviews the literature. Section 3 reports the business cycle stylized facts for Egypt and its relation with economic freedom. Section 4 outline the proposed model, reports the results and a discussion. Section 5 advances extensions to the proposed model. And, finally, Section 6 concludes.

2 Review of Literature

Empirical studies addressed and documented a strong correlation between economic freedom and economic growth. For example, Gwartney, Lawson, and Holcombe (1998, p. 26) concluded that, "There is a strong and robust relationship between increases in economic freedom, and economic growth. This relationship is present even after measures of physical and human capital are taken into account." Dawson (2003) investigated these correlations and used the Granger-causality test to test for causation. The results suggest that the overall level of economic freedom appears to cause growth, while changes in freedom are jointly determined with growth.

In many instances in the literature, economic freedom is perceived as less regulated institutions.[3] Few have framed the discussion and linked economic freedom to the nature of institutions. A correlation between institutions and economic growth is well documented

[3] An institution is not merely an organization or establishment for the promotion of a single or particular objective, like a school, a union or a federal reserve bank. It is also an organized pattern of group behavior, well-established and accepted as a fundamental part of the culture.

(see Knack and Keefer 1995, Mauro 1995, La Porta, Lopez-de-Salines, Shleifer and Vishny 1998, De Haan 1998, Hall and Jones 1999). North (1990) emphasized the importance of institutions that shape the incentive structure that directly influences the productive capacity within society. Hall and Jones (1997, p. 173) concluded that "difference in levels of economic success across countries are driven primarily by the *institutions* [our emphasis] and government policies that frame the economic environment in which people produce and transact."

Recently, Acemoglu, Johnson, and Robinson (2001, 2003) and Acemoglu, Johnson, Robinson and Thaicharoen (2003) resurrected and revived the institutionalist school without reference to the 'circular causation.' They documented a thorough empirical investigation of the unicausal relationship between institutions and macroeconomic volatility - from the former to the latter. Acemoglu, Johnson and Robinson (2003, p. 17) concluded "that institutional differences across countries are a fundamental determinant of economic and political instability." Their studies concluded with an open call for further research into the how and the why of this interrelated causal effect. In this paper, we attempt to answer the call by proposing a model that captures the how does such causal relationship exist.

As for the relationship between economic freedom and well-being, a growing body of evidence seems to suggest that economic liberty is indeed important and necessary for the enhancement of economic well-being. Farr et al. (1998) concluded that a circular causation exists between economic freedom and economic well-being. Their study concluded that economic freedom significantly Granger-cause the level of economic well-being for both industrial and nonindustrial countries. Also, the level of economic well-being is shown to significantly

Granger-cause economic freedom. This causality analysis suggested the presence of a feedback mechanism that is embedded in the functioning of the economy. Again, few have framed the well-being within the institutional perspective. For example, Wolfers (2003, p. 3) suggested that "...establishing the right institutional frameworks is the key to higher levels of happiness."

3 The Egyptian Experience

Egypt has the largest population and the second largest economy in the Arab world. In 2000, GDP totaled $78 billion of 1995 US dollars. Per capita GDP stood at $1,226. Since 1991, the government seriously questioned and effectively - to some degree - addressed the question of how to abandon the vestiges of the old dirigiste economic system. At a variable pace, many measures were implemented to ease the transition towards a system that emphasizes economic freedom and production over diversion.

Figure 1 illustrates the Egyptian business cycle.[4] The standard deviation of real GDP per capita is 3.77 percent and 1.81 percent over the consecutive periods 1950 to 1990 and 1991 to 2000, respectively. Prior to 1991, the business cycle was three times more volatile relative to the period of post-reforms starting in 1991/1992. Figure 2 graphs the business cycle and the index of economic freedom for Egypt. A simple graphical inspection reveal milder recessions associated with increases in the index of economic freedom. Following the implementation

[4] All variables are in log form and detrended using the Hodrick-Prescott filter. The data covers the period from 1950 to 2000, except for the Employment series, which covers the period from 1970 to 2000. Real GDP per capita (1996 Constant) and Capital are from the IFS databank, labels: 46999B and 46993E, respectively. The Employment series is from the ILO databank. Consumption and Investment are taken from the World Penn Tables, labels: CKON and IKON, respectively.

of a series of measures aimed to reform the economy in 1991/1992, and as a result of both macroeconomic stabilization and the reallocation of resources from unproductive sectors to productive ones, output declined in the initial years of transition. This is similar to the same stylized fact that is observed in the transition economies of Central and Eastern Europe (Fischer and Sahay (2000)). Figure 3 illustrates the behavior of capital over the business cycle. Capital is strongly procyclical and more volatile (as much as three times) than GDP.

Subramanian (1997) reported that the year 1991/1992 marked the beginning of reforms that were undertaken by the Egyptian government. These reforms mainly focused on: fiscal stabilization, interest rates liberalization, disinflation, exchange stabilization and structural reforms to remove price distortions. Current account improved from a deficit of 5 percent to a surplus of 1.1 percent (see Figure 4). GDP steadily increased and reached a 5 percent growth by 1994. Inflation sharply fell from 21 percent to 7 percent. The following Table summarizes the cyclical characteristics of the Egyptian economy.

Table 1: The Cyclical Behavior of the Egyptian Economy, 1970-2000.

	Volatility relative to Output	**Cross Correlation of Output with**		
Variable x	**(% Std. Dev)**	$x(t-1)$	$x(t)$	$x(t+1)$
Real GDP	1.00	0.86	1.00	0.86
Employment	0.40	-0.53	-0.45	-0.26
Capital	3.09	0.78	0.78	0.69
Investment	3.03	0.78	0.73	0.58
Consumption	0.56	0.09	0.35	0.52

According to the World bank, Egypt's weighted tariff rates were reduced. The weighted average annual rate of inflation from 1992 to 2001 dropped to 2.55 percent. The government embarked on a multi-dimensional legislative privatization plan. Investment laws were enacted that allow 100 percent foreign ownership without a pre-incorporation approval. Approval is automatic in specific sectors. Other provisions included: the guarantee against confiscation,

sequestration and nationalization; the right to own land; the right to maintain foreign currency bank accounts (for foreign and non-foreign residents); freedom from administrative attachment; the right to repatriate capital and profits; and equal treatment regardless of nationality. The economy witnessed the removal of price controls except for pharmaceutical goods, cigarettes, rationed edible oil and rationed sugar.

Private property rights are protected by the constitution. Delays and inefficiencies in the legal system are often cited. A commercial case could be resolved in six years and appeal procedures allow many cases to be unsettled beyond 15 years. With a heavy involvement in the labor market, the state dominate the economy. In 2000, government expenditures stood at 31.4 percent of GDP. [5]

On the other hand, there is still much room to improve. Egypt's tax income rate is relatively high. The corporate tax rate is 40 percent and the marginal rate for the average tax payer is 27 percent. Regarding privatization, some companies were 'off limits' [6] while others that deemed 'strategic' [7] were allowed a 40 percent cap on privatization. The purchase of agricultural land is not allowed to foreigners and prior approval from the cabinet is required for any investment project in the Sinai region. New bank formation is restricted. Energy and basic foods prices are supported by government subsidies. The multiplicity of regulatory agencies and high market entry transaction costs are major impediments to a sound and efficient economy.

[5] Source: The African Development Bank report.
[6] The 'off limits' companies are Egypt Air, The Egyptian General Petroleum Corporation and the Suez Canal.
[7] 'Strategic sectors' companies include pharmaceuticals, flour mills and telecommunications.

4 The Model

The purpose of the model is to integrate economic freedom into a standard stochastic dynamic general equilibrium model. We confine the model to a closed economy setup. In developing countries, we argue that domestic shocks are the main driving forces for business cycles fluctuations. [8] The economy is characterized by a large number of identical consumers. The single consumer is assumed to be representative [9] of the society as a whole. Representative agents' preferences are represented by a utility function which is time separable in consumption and leisure and it is state independent. The representative household solves the following problem.

$$\max_{(c_t,n_t,k_{t+1},m_{t+1})_{t=0}^{\infty}} \left\{ E_t \sum_{t=0}^{\infty} \beta^t U(c_t, l_t) \right\} \tag{1}$$

subject to

$$y_t = A\left[z_t m_t\right]^{\kappa} \left[\pi(k_t)\right]^{\alpha} n_t^{\eta} \tag{2}$$
$$k_{t+1} = (1-\delta_k)k_t + i_t \tag{3}$$
$$m_{t+1} = (1-\delta_m)m_t + \phi(y_t) \tag{4}$$
$$z_{t+1} = z_t^{\rho}\varepsilon_{t+1} \tag{5}$$
$$0 \leq \rho \leq 1, \quad \ln(\varepsilon_t) \backsim iid \quad N(\mu,\ \sigma^2) \tag{6}$$
$$c_t + i_t \leq y_t \tag{7}$$
$$l_t + n_t \leq 1 \tag{8}$$

where the discount factor β is contrained to $0 < \beta < 1$, the momentary utility is $U(c_t, l_t) =$

[8] See for example, Hoffmaister and Roldòs (2001) wherein they concluded that domestic shocks are at the source of business cycle fluctuations in Brazil and Korea. Although the results does not imply that the same will hold true for Egypt, we adopt the closed economy to understand the effect of economic freedom on the cost of business cycle. The model presented here, can be adapted for an open economy framework.

[9] For an excellent and comprehensive development of the representative agent in macroeconomics modeling, refer to Hartley (1997).

$\ln c_t + \gamma \ln l_t$, is twice continuously differentiable, strictly increasing, and strictly concave. This log specification of the utility implies an intertemporal elasticity of substitution equal to one.

m_t refers to the index of economic freedom.[10] The core ingredients of economic freedom are personal choice, protection of private property, and freedom of exchange. Individuals have economic freedom when: (a) property acquired without the use of force, fraud, or theft is protected from physical invasions by others and (b) such property can be freely used, exchanged, or given to another as long as the owner's actions do not violate the identical rights of others.[11]

Output is a function of economic freedom - or in other words, institutional efficiency $z_t m_t$. The inclusion of other input factors (here, m_t) in the production function is without precedence. Production is indivisible as in Edgeworth (1911) and Lerner (1944). Azariadis (1993, p. 232) proposed a production function $H(K_t, L_t, A_t)$ where A_t denoted intangible but a variable factor of production such as the stock of useful knowledge. Also, originally due to Rosentein-Rodan (1943) and formulated by Murphy et al. (1989), A_t was considered as a function of government spending on infrastructure. Given the Cobb-Douglas shape of the production function, κ refers to the elasticity of output with respect to economic freedom.

The aggregate production function (Equation (2)) exhibits increasing returns in economic freedom to capture the stylized fact presented in Figure 5. As for individual firms, there

[10] Many researchers attempted to measure economic freedom (Gastil 1982, Scully and Slottje 1991, Johnson and Sheehy 1995, and 1996, Gwartney, Lawson and Block 1996). Outgrown of a series of conferences at the Fraser Institute and the Liberty Fund, Gwartney, Lawson and Block (1996) provided the most comprehensive index to measure economic freedom.

[11] For the development of and the computation of the index, see Gwartney and Lawson (2003).

are N firms. Each representative firm takes $\overline{m} = m_t/N$ as given. The representative firm production displays a constant returns to scale with $\alpha + \eta = 1$, and $\pi(k_t) = k_t$. Equation (3) refers to a standard law of motion for capital, where investment is irreversible ($i_t \geq 0$) and capital depreciates at the rate δ_k.

Equation (4) describes the accumulation of economic freedom over time. The second part of the equation, encompass the circular causation from output to economic freedom. Assume that $\phi'(y_t) > 0$ and $\phi''(y_t) < 0$ and satisfy $\lim_{y \to 0} \phi'(y_t) = \infty$ and $\lim_{y \to \infty} \phi'(y_t) = 0$. For the model here, we choose $\phi(y_t) = y_t^{\psi}$, where $0 < \psi < 1$, to ensure the concavity of the influence of per capita GDP on economic freedom. With full depreciation ($\delta_m = 1$), ψ refers to the elasticity of economic freedom with respect to output. Empirically, recent cross-section research in political sciences pointed to and emphasized the role and the direction of causality from output to economic freedom. This causality is captured by the influence of $\phi(y_t)$ on m_{t+1}. Also, the concavity is chosen to conform with the cross-country empirical stylized facts (see Figure 5, page 34, reprinted from O'Driscoll et al. 2003, p. 20). Intuitively, as defined and measured in the literature, economic freedom is an index, i.e., it is a bounded variable. Therefore, we abstract from linear functions of output (e.g., $\phi(y_t) = y_t$).

For simplicity, we assume that the relative price of one unit of output relative to one unit of economic freedom equals to one. Otherwise, and assuming that the price of one unit of output equals 1, equation (4) will be modified as such $m_{t+1} = (1 - \delta_m)m_t + y_t^{\psi}/p_m$, where p_m is constant and denotes the price of one unit of economic freedom.

Subjected to (a stochastic shock z_t) an improvement in economic freedom, the model propagates the effect and describes the influence on the economy. First, a note on the impulse

is due. We assume that the shock (institutional efficiency) is brought on or imposed by the World Bank and/or the International Monetary Fund for loan purposes, for example. z_t refers to factors (such as institutions changes) that impinge on productivity not stemming from differences in technology (Romer (2001, p. 8)).

As for how does the World Bank or the International Monetary Fund (IMF) influence z_t, we assume that is it done through the credit channels. Boockmann and Dreher (2003) analyzed the effect of World Bank and IMF policies on the composite index of economic freedom - as measured by Gwartney et al.(2000) - as well as its sub-indexes, using a panel of 85 countries observed between 1970 and 1997. With respect to the World Bank, they found that the number of projects has a positive impact on overall economic freedom, while the effect of the amount of World Bank credits is negative. Their study concluded that there is no clear relationship between credits and programs of the IMF and economic freedom as measured by the index. Here, for simplicity, we assume that there is one. Equations (7) and (8) complete the model by imposing the resources and time constraints, respectively.

Note that if $\psi = 0$, $\kappa = 0$, $\delta_m = 0$ and $m_t = m_{t+1} = m$ $(\forall t)$, then the proposed model reduces to a standard real business cycle model.

The social planner solves the following Bellman equation, subject to the above constraints,

$$v(n_{t-1}, k_t, m_t|z_t) = \max_{(n_t, k_{t+1}, m_{t+1})} \{\ln C_t + \gamma \ln(1 - n_t) + \beta E_t v(n_t, k_{t+1}, m_{t+1}|z_{t+1})\} \qquad (9)$$

In sequence form, the social planner solves the following Lagrangian problem,

$$\max_{(c_t,n_t,k_{t+1},m_{t+1})_{t=0}^{\infty}} E_t \sum_{t=0}^{\infty} \beta^t \left\{ \begin{array}{c} \ln c_t + \gamma \ln l_t \\ +\lambda_t^1 \left[A \left(z_t m_t \right)^{\kappa} k_t^{\alpha} n_t^{\eta} - c_t - k_{t+1} + (1-\delta_k) k_t \right] \\ +\lambda_t^2 \left[(1-\delta_m) m_t + A \left(z_t m_t \right)^{\psi\kappa} k_t^{\psi\alpha} n_t^{\psi\eta} - m_{t+1} \right] \end{array} \right\} \tag{10}$$

The first-order conditions (FOC) are,

$$c_t: \quad \frac{1}{c_t} - \lambda_t^1 = 0 \tag{11}$$

$$n_t: \quad \frac{\gamma}{1-n_t} = \lambda_t^1 \left[\eta A \left(z_t m_t \right)^{\kappa} k_t^{\alpha} n_t^{\eta-1} \right] + \lambda_t^2 \left[(\psi\eta) A \left(z_t m_t \right)^{\psi\kappa} k_t^{\psi\alpha} n_t^{\psi\eta-1} \right] \tag{12}$$

$$\begin{aligned} k_{t+1}: \quad \lambda_t^1 &= \beta E_t \lambda_{t+1}^1 \left[\alpha A \left(z_{t+1} m_{t+1} \right)^{\kappa} k_{t+1}^{\alpha-1} n_{t+1}^{\eta} + 1 - \delta_k \right] \\ &\quad + \beta E_t \lambda_{t+1}^2 \left[(\psi\alpha) A \left(z_{t+1} m_{t+1} \right)^{\psi\kappa} k_{t+1}^{\psi\alpha-1} n_{t+1}^{\psi\eta} \right] \end{aligned} \tag{13}$$

$$\begin{aligned} m_{t+1}: \quad \lambda_t^2 &= \beta E_t \lambda_{t+1}^1 \left[\kappa A z_{t+1}^{\kappa} m_{t+1}^{\kappa-1} k_{t+1}^{\alpha} n_{t+1}^{\eta} \right] \\ &\quad + \beta E_t \lambda_{t+1}^2 \left[(1-\delta_m) + (\psi\kappa) A z_{t+1}^{\psi\kappa} m_{t+1}^{\psi\kappa-1} k_{t+1}^{\psi\alpha} n_{t+1}^{\psi\eta} \right] \end{aligned} \tag{14}$$

Combine the FOC with the constraints to form the rational expectation system,

$$c_t + k_{t+1} = A \left(z_t m_t \right)^{\kappa} k_t^{\alpha} n_t^{\eta} + (1-\delta_k) k_t \tag{15}$$

$$m_{t+1} = (1-\delta_m) m_t + A \left(z_t m_t \right)^{\psi\kappa} k_t^{\psi\alpha} n_t^{\psi\eta} \tag{16}$$

$$\log z_{t+1} = (1-\rho) \log \overline{z} + \rho \log z_t + \ln(\varepsilon_t) \tag{17}$$

The log-linearized rational expectation system is as follows,

$$-c_t - \lambda_t^1 = 0 \tag{18}$$

$$-\overline{\Lambda^1} \lambda_t^1 + \beta E_t \left[\begin{array}{c} \alpha \overline{\Lambda^1 Y K^{-1}} \left(\lambda_{t+1}^1 + y_{t+1} - k_{t+1} \right) + (1-\delta_k) \overline{\Lambda^1} \lambda_{t+1}^1 \\ +\psi\alpha \overline{\Lambda^2 Y^{\psi} K^{-1}} \left(\lambda_{t+1}^2 + \psi y_{t+1} - k_{t+1} \right) \end{array} \right] = 0 \tag{19}$$

$$\gamma \left(1 - \overline{N} \right)^{-1} n_t + \eta A \frac{\overline{\Lambda^1 Y}}{\overline{N}} \left(\lambda_t^1 + y_t - n_t \right) + \psi\eta A \frac{\overline{\Lambda^2 Y^{\psi}}}{\overline{N}} \left(\lambda_t^2 + \psi y_t - n_t \right) = 0 \tag{20}$$

$$-\overline{\Lambda^2} \lambda_t^2 + \beta E_t \left[\begin{array}{c} \kappa \overline{\Lambda^1 Y M^{-1}} \left(\lambda_{t+1}^1 + y_{t+1} - m_{t+1} \right) \\ +(1-\delta_m) \overline{\Lambda^2} \lambda_{t+1}^2 + \psi\kappa \overline{\Lambda^2 Y^{\psi} M^{-1}} \left(\lambda_{t+1}^2 + \psi y_{t+1} - m_{t+1} \right) \end{array} \right] = 0 \tag{21}$$

$$\overline{C} c_t + \overline{K} k_{t+1} - \overline{Y} y_t - (1-\delta_k) \overline{K} k_t = 0 \tag{22}$$

$$\overline{M} m_{t+1} - (1-\delta_m) \overline{M} m_t - \psi \overline{Y^{\psi}} y_t = 0 \tag{23}$$

$$y_t - \kappa z_t - \kappa m_t - \alpha k_t - \eta n_t = 0 \tag{24}$$

$$z_{t+1} - \rho z_t - \varepsilon_t = 0 \tag{25}$$

The log-linearization of $\gamma(1-n_t)^{-1}$ follows as, $1 - n_t = l_t$, using l_t instead of n_t lead to $\overline{L^{-1}} \exp(-l_t) \approx \overline{L^{-1}}(1-l_t) = (1-\overline{N})^{-1} n_t$.

We solve and simulate the model with sensitivity to the structure following Uhlig (2001, p. 38). The log-linearized system is solved using numerical rational expectations.[12] The calibrated parameters are chosen to ensure that the capital to output steady state value matches the sample data. The following Table reports the calibrated parameters used to generate the impulse responses,

Table 2: The Calibrated Parameters

β	κ	α	η	δ_k	δ_m	ψ	ρ
0.99	1.5	0.3	0.7	0.06	0.05	0.3	0.7

Given the lack of time series data on economic freedom, there is no single point estimate

[12]
Write the log-linearized system as,

$$\begin{aligned} 0 &= Ax_t + Bx_{t-1} + Cy_t + Dz_t \\ 0 &= E_t\left[Fx_{t+1} + Gx_t + Hx_{t-1} + Jy_{t+1} + Ky_t + Lz_{t+1} + Mz_t\right] \\ z_{t+1} &= Nz_t + \epsilon_{t+1} \qquad\qquad E_t\left[\epsilon_{t+1}\right] = 0 \end{aligned}$$

where x_t denotes the state vector, y_t refers to the jump variables and z_t refers to the exogenous ones. It is assumed that N has only stable eigenvalues. Using Theorem 3.2 in Uhlig (2001, p. 38), we solve for the recursive equilibrium law of motion

$$\begin{aligned} x_t &= Px_{t-1} + Qz_t \\ y_t &= Rx_{t-1} + Sz_t \end{aligned}$$

To compute the P, Q, R and S matrices, we solve,

$$\begin{aligned} 0 &= C^0AP + C^0B \\ 0 &= (F - JC^+A)P^2 - (JC^+B - G + KC^+A)P - KC^+B + H \\ R &= -C^+(AP + B) \\ V &= \begin{bmatrix} I_k \otimes A & I_k \otimes C \\ N' \otimes F + I_k \otimes (FP + JR + G) & N' \otimes J + I_k \otimes K \end{bmatrix} \\ V\begin{bmatrix} vec(Q) \\ vec(S) \end{bmatrix} &= -\begin{bmatrix} vec(D) \\ vec(LN + M) \end{bmatrix} \end{aligned}$$

given that all eigenvalues of P are less than unity in absolute value. We choose the root(s) manually. C^+ denotes the pseudo-inverse of C. $C^+ = (C'C)^{-1}C'$. $C^0 \equiv (null(C'))'$. The C^0 is found by singular value decomposition of C'. Note that $C^0C = 0$.

for the elasticities parameters for Egypt, κ and ψ. We address this issue by calibrating the model with different set of points for these parameters.

4.1 Results and Discussion

We measure the welfare of the representative household using the discounted sum of the momentary utility as in Lucas (1987). Lucas (1987) initiated the literature emphasizing the evaluation cost of business cycles. He reported that the welfare cost associated with eliminating consumption fluctuations stood at 0.05% of permanent consumption. Many others investigated the merits of the welfare costs associated with the business cycle. Among many, *İ*mrohoroğlu (1989) showed that these costs are three to five times higher than reported by Lucas. Shiller (1997, p. 22) reported a survey wherein 80% of Americans agree with the statement that preventing recessions is as important as preventing drug abuse. Wolfers (2003) examined the effects of business cycle volatility on well-being. The study concluded robust evidence that high inflation and unemployment lower perceived well-being. Eliminating unemployment volatility benefited well-being and accounted for a similar effect of lowering the average level of unemployment by a quarter of a percentage point.

Different approaches have been pursued to study the cost of business cycle volatility on welfare. The approach used by Lucas (1987) was theoretical, by Shiller (1997) was based on a survey and by Wolfers (2003) was empirical, using data on self-reported happiness and macroeconomics conditions.

Since the representative consumer is representative of the society, a change in the level of

her utility reflects and is equivalent to a change in the overall level of social welfare. That is, an increase (decrease) in her utility [13] implies an improvement (loss) in social welfare. Here, we answer the following question. By how much does welfare improve or decline when institutional effectiveness increases by one percent? Our simulation suggest that the welfare gains from increasing institutional effectiveness of one percent, equals to 1.37 percent in terms of permanent consumption. In other words, this welfare increase translates to an increase of £*E* 93.36 Egyptian pounds per person per quarter.

Figure 6 illustrates the impulse response for capital following a shock to institutional efficiency under three different rates of time preferences ($\beta \in \{0.1, 0.5, 0.9\}$). The more patient the representative consumer is, the stronger the influence is on capital of an improvement in economic freedom. The results of the impulse response suggest that an improvement in economic freedom is futile if the representative household has a high rate of time preference (i.e., impatient). For a patient household, the effect is an increase in capital that peaks after one year of the shock, and lasts for three years.

Figure 7 illustrates the impulse response for capital following a shock to institutional efficiency under three different rates of elasticities of output with respect to economic freedom ($\kappa \in \{1.0, 1.5, 2.0\}$) The impulse response shows that the effect on capital is strictly increasing and almost one-to-one to the value of the elasticity. The effect on capital doubles with the value of the elasticity. The lack of sufficient time series data on economic freedom makes it relatively difficult in practice to estimate this coefficients from sample data. An interesting empirical research agenda should include an investigation of the determinants of

[13] The actual numerical value of utility is irrelevant. A change in the utility level provides a measure of the direction of welfare change.

this elasticity. The effect peaks at five quarters and lasts for seven years.

The model could be perceived as a return to the Institutionalist School. It emphasizes the role of institutions in economic life and advocates that higher economic freedom can mitigate the sharp swings of the business cycle (see subsection 5.1). The focus of the model is on 'how does institutional effectiveness interact and contribute to economic efficiency?'. However, unlike the old-institutionalists, this model does not condemn laissez-faire, but embraces it. Also, the model provides a role for the government to adopt higher levels of economic freedom.

5 Extensions

The model proposed here is flexible enough to serve as a basis for a multitude of interesting and viable extensions. In this section, we suggest a selective host of these extensions.

5.1 Economic Freedom and BC depth/duration

Edwards et al. (2003) analyzed the behavior of the stock markets in six emerging countries. They found that cycles in emerging countries tend to have shorter duration and larger amplitude and volatility than in developed countries. Here, prior to 1991, the Egyptian business cycle was three times more volatile relative to the period of post-reforms starting in 1991.

The proposed model in section 4 could be adapted to investigate the merit of such a stylized fact. We address the depth of the cycle at the impulse level and the duration at the

propagation level.

Assume that cycles are caused by technology shocks A_t, and let $\ln A_{t+1} = (1-\theta)\ln \overline{A} + \theta \ln A_t + \varepsilon_t$, where ε_t is a white noise. Let $\Delta z_t = 1/B_t$, and $0 < B_t \leq (\Delta A_t)^{1/\kappa}$ where the ratio $1/B_t$ is defined as the business cycle absorption factor due to the presence of effective institutions. $1/B_t$ will absorb part of the general shock to the production capacity. In this setup, higher institutional effectiveness will cushion the depth of recessions. Also, if θ is an increasing function of $\overline{m}$, then a lower steady state level of economic freedom (as observed in transition economies) will result in shorter duration of cycles. As the economy acquire higher levels of economic reforms, its cycles are trading depth for duration.

5.2 Convex-Concave Technology

The model is flexible to accomodate an output that is convex-concave in economic freedom. Different levels of economic freedom yield different levels of output. Most previous growth studies were limited to the narrow class of concave production function. The concavity of the production function is a good approximation for well-developed countries, wherein the capital-labor ratio is high. For less developed countries, this concavity is not applicable. At early stages of industrialization, returns to scale are increasing and the production function becomes concave at a higher level of economic activity. Figure 8 illustrates the ordinary least squares regression line of the logarithm of output on the logarithm of employment. The slope estimate is 1.07. If all movements of employment and output are attributed to movements along a fixed production function, then this coefficient would be an unbiased estimate of the slope of the production function. The value of 1.07 causes one to doubt the assumption of

diminishing returns for labor.

To solve for the model with a convexo-concave production function, Skiba (1978) initiated the study of convex-concave production function in continuous-time optimal growth models. The maximum principal of Pontryagin applies well to concave technology. Whenever technology is non-concave, the Mangasarian's theorem on the sufficiency of the Pontryagin's conditions is not valid. By using a derivative of the Arrow maximum principle, these mathematical difficulties were overcome by Skiba (1978).

Alternatively, one can argue that (or the quantity of) output is the same across different freedom regimes - as in Djankov et al. (2003, Figure 1, p. 8). In this latter case, economic freedom must play the role of providing higher output quality, that is, the production function will include an interaction term between economic freedom and product quality.[14] We find it difficult to accept such an argument. Such an argument imply that a dirigiste system does provide the same incentives for its workers to produce the same *exact* (in terms of quantity and quality) output as the one produced in a free system.

Therefore, as an extension, we propose that for $\kappa > 1$, $0 < \alpha < 1$ and $0 < \eta < 1$, the firm production function (Equation 2) to be strictly increasing and convex-concave in m_t with $\pi(m) = -m^3 + (3/2)\, m + (1/12)\, m$. We normalized m to be bounded between [0,1] and there exists a point $m_I = 0.5$ such that $\pi''(m) < 0$ if $m > m_I$ and $\pi''(m) > 0$ if $m < m_I$.

For such a problem, an optimal path exists. The problem is equivalent to a maximization problem of a continuous function on a compact set by using the product topology defined on

[14] For product quality in endogenous growth models, see Grossman and Helpman (1991).

the space of infinite sequences of real numbers. To prove the existence of the optimal paths of capital and consumption, see Le Van and Dana (2003, p. 40) for the details.

5.3 Jumps in Economic Freedom

In continuous time, one can re-write the model in a deterministic optimal control framework wherein economic freedom takes on discrete values (and hence the term 'jump'). Suppose that the state variable m has a jump at time $\tau_j \in [t_0, t_1]$. Let $m(\tau_j^+)$ denote the right-hand limit of $m(t)$ at time τ_j, and $m(\tau_j^-)$ denote the corresponding left-hand limit. Alternatively, $m(\tau_j^-)$ and $m(\tau_j^+)$ are the values of the state variable m before and after the jump, respectively. The magnitude of the jump is then $m(\tau_j^+) - m(\tau_j^-)$. Assume that the number k of jumps points as well as the locations of the jump points $\tau_1, ..., \tau_k$ in the interval $[t_0, t_1]$ are controlled by the social planner. The planner controls the magnitude of the jumps at τ_j by choosing a control jump parameter $v^j = (v^1, ..., v^k)$, $v^j \in V \times \{0\} \subset \mathbb{R}^k$, and the set V is convex. Also, assume that the magnitude of the jump depends explicitly on the τ_j and the state of the system immediately before the jump. Formally,

$$m(\tau_j^+) - m(\tau_j^-) = g(m(\tau_j^-), v^j, \tau_j) \qquad\qquad j = 1, ..., k \tag{26}$$

with $g(m, v, t) : \mathbb{R}^{1+k+1} \to \mathbb{R}$, and $g(m, 0, t) = 0$ for all m and t. $g(m, v, t)$ is continuous and $g \in C^2$. Note that if the magnitude of the jump is independent of the state of the system before the jump, then $g(m, v^j, \tau_j) = \overline{v_g^j}(m(\tau_j^+) - m(\tau_j^-))$ as in Arrow and Kurz (1970, p. 52).

Between the jumps the system evolves according to

$$\dot{m}_t = -\delta_m m_t + \phi(y_t) \tag{27}$$

Also, one can include a cost that is associated with each jump. Such a cost divert resources from production and consumption towards providing the necessary framework to sustain economic freedom. These costs include - but are not limited to - the direct costs imputed from changing: the legislative system and the infrastructure, as well as indirect costs, such as menu costs needed to implement the legislative changes. Formally, let $h(m(\tau_j^-), v^j, \tau_j)$ denote this cost, with $h(m, v, t) : \mathbb{R}^{1+k+1} \to \mathbb{R}$, and $h(m, 0, t) = 0$ for all m and t. $h(m, v, t)$ is continuous and $h \in C^2$. Also, if the costs are independent of the state of the system before the jump, then $h(m, v^j, \tau_j) = \overline{v_h^j}(m(\tau_j^+) - m(\tau_j^-))$.

Therefore, the social planner maximizes

$$\int_{t_0}^{t_1} e^{-\rho t} U(c_t, t) dt + \sum_{j=1}^{k} h(m, v^j, \tau_j) \tag{28}$$

Let x_t denotes the vector of the state variables, and c_t denotes the vector of the control variables. Assume that x_t and c_t are left continuous in $[t_0, t_1]$, U is well-defined and C^2 in $(0, \infty)$. $U' > 0$ and $U'' < 0$ on $(0, \infty)$. $\lim_{c \to \infty} U' = 0$ and $\lim_{c \to 0} U' = \infty$. Then the problem reduces to maximizing equation (28) subject to,

$$\dot{x}_t \equiv \begin{bmatrix} \dot{k}_t \\ \dot{m}_t \end{bmatrix} = f(x_t, c_t, t) \tag{29}$$

$$\dot{k}_t = -\delta_k k + y_t - c_t \tag{30}$$

$$\dot{m}_t = -\delta_m m_t + \phi(y_t) \tag{31}$$

$$y_t = m_t^{\kappa} \left[A\pi(k_t)\right]^{\alpha} n_t^{\eta} \tag{32}$$

with $\pi(k_t) = k_t$. A solution to this problem exists. The proof is done by modifying the Filippov-Cesari Theorem of existence of an optimal control.

Theorem [Filippov-Cesari] Consider the optimal control problem (28). Assume that,

A1. There exists an admissible pair (x_t, c_t),

A2. $f_i(x, c, t)$ is non-decreasing in x and concave in c for $i = 1, 2$,

A3. U is convex,

A4. There exist piecewise continuous functions $a(t)$ and $b(t)$, such that

$\| f_i(x, c, t) \| \leq a(t) \| x_i(t) \| + b(t)$ for all (x, t), $c(t) \in \mathbb{R}_+$,

Then there exist an optimal pair $(x^*(t), c^*(t))$ that solves the optimal control problem.

The necessary condition for this problem are given by Seierstad and Sydsaeter (1987, Theorem 7, p. 196). What is of interest in this exercise, is the derived result regarding the effect of the rate of time preference on the behavior of the economy - as articulated in the basic model in Figure 6. Sbika (1978), Majumdar and Mitra (1982) and Dechert and Nishimura (1983) proved [15] that for an interval of values of the discount factor, the economy converges

[15] The model of Dechert and Nishimura (1983) has been adapted, in continuous time, for a developing country facing foreign debt (Askenazy and Le Van (1999)) and, in discrete time, for a

to a "poverty trap". If the economy exhibits a low discount factor, then it converges to a zero steady state (the so-called "trap"). For intermediate values of the discounting parameter, there exists a critical value of the initial stock below which the optimal path converges to zero, and above which, it converges to a positive steady state.

6 Conclusions

In this paper, we proposed a basic theoretical model to integrate economic freedom into a stochastic dynamic general equilibrium model. The aim was to assess and enhance our understanding of the effects of an increase of economic freedom on the short-run characteristics of the economy. Such a model provides a structural approach and a viable ground for the argument leading to the adoption of the Washington consensus. To show how flexible the model is to adapt, we also proposed a set of extensions that stem from the basic model.

Conditioned on the calibrated parameters, the results show that a one percent increase in the economic freedom index leads to a welfare improvement that is equivalent to an increase in consumption of *£E* 93.36 Egyptian pounds per person per quarter. This increase in economic freedom brings an increase in capital that peaks at five quarters and lasts for a full seven years. The increase in capital is dependent onto the value of the elasticity of output with respect economic freedom. However, the increase in economic freedom is worthless if the representative household possesses a high rate of time preference (i.e., impatient).

developing country facing debt, corruption and R&D (Dimaria and Le Van (2002)).

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7 Appendix:

Components of the Index of Economic Freedom (7 areas/25 factors)

1. Size of Government: Consumption, Transfers, and Subsidies [11.0%]

A General Government Consumption Expenditures as a Percent of Total Consumption (.500)
B Transfers and Subsidies as a Percent of GDP (.500)

2. Structure of the Economy and Use of Markets (Production and allocation via government and political mandates rather than private enterprises and markets) [14.2%]

A Government Enterprises and Investment as a Share of the Economy (.327)
B Price Controls: Extent to Which Businesses Are Free to Set Their Own Prices (.335)
C Top Marginal Tax Rate (and income threshold at which it applies) (.250)
D The Use of Conscripts to Obtain Military Personnel (.088)

3. Monetary Policy and Price Stability (Protection of money as a store of value and medium of exchange) [9.2%]

A Average Annual Growth Rate of the Money Supply during the Last Five Years minus the Growth Rate of Real GDP during the Last 10 Years (.349)
B Standard Deviation of the Annual Inflation Rate during the Last Five Years (.326)
C Annual Inflation Rate during the Most Recent Year (.325)

4. Freedom to Use Alternative Currencies (Freedom of access to alternative currencies) [14.6%]

A Freedom of Citizens to Own Foreign Currency Bank Accounts Domestically (.335)
B Freedom of Citizens to Maintain Foreign Currency Bank Accounts Abroad (.357)
C Freedom to Convert Domestic Currency to Foreign Currencies in Order to Engage in Current and Capital Account Transactions (.308)

5. Legal Structure and Property Rights (Security of property rights and viability of contracts) [16.6%]

A Legal Security of Private Ownership Rights (Risk of confiscation) (.345)
B Viability of Contracts (Risk of contract repudiation by the government) (.339)
C Rule of Law: Legal Institutions, Including Access to a Nondiscriminatory Judiciary, that Are Supportive of Rule of Law Principles (.317)

6. International Exchange: Freedom to Trade with Foreigners [17.1%]

A Taxes on International Trade

i Revenue from Taxes on International Trade as a Percent of Exports plus Imports (.214)
ii Mean Tariff Rate (.227)
iii Standard Deviation of Tariff Rates (.117)

B Non-tariff Regulatory Trade Barriers
i Percent of International Trade Covered by Non-tariff Trade Restraints (.198)
ii Actual Size of Trade Sector Compared to the Expected Size (.105)

C Difference between the Official Exchange Rate and the Black Market Rate (.139)

7. Freedom of Exchange in Capital and Financial Markets [17.2%]

A Ownership of Banks: Percent of Deposits Held in Privately Owned Banks (.271)
B Extension of Credit: Percent of Credit Extended to Private Sector (.212)
C Interest Rate Controls and Regulations that Lead to Negative Interest Rates (.247)
D Restrictions on the Freedom of Citizens to Engage in Capital Transactions with Foreigners (.271)

Note: The numbers in the brackets, e.g. [11.0%], indicate the percentage weight allocated to each area when the weighted summary rating was derived. The numbers in parentheses, e.g. (.500), indicate the weights used to derive the area rating. These weights are derived by principal component analysis.

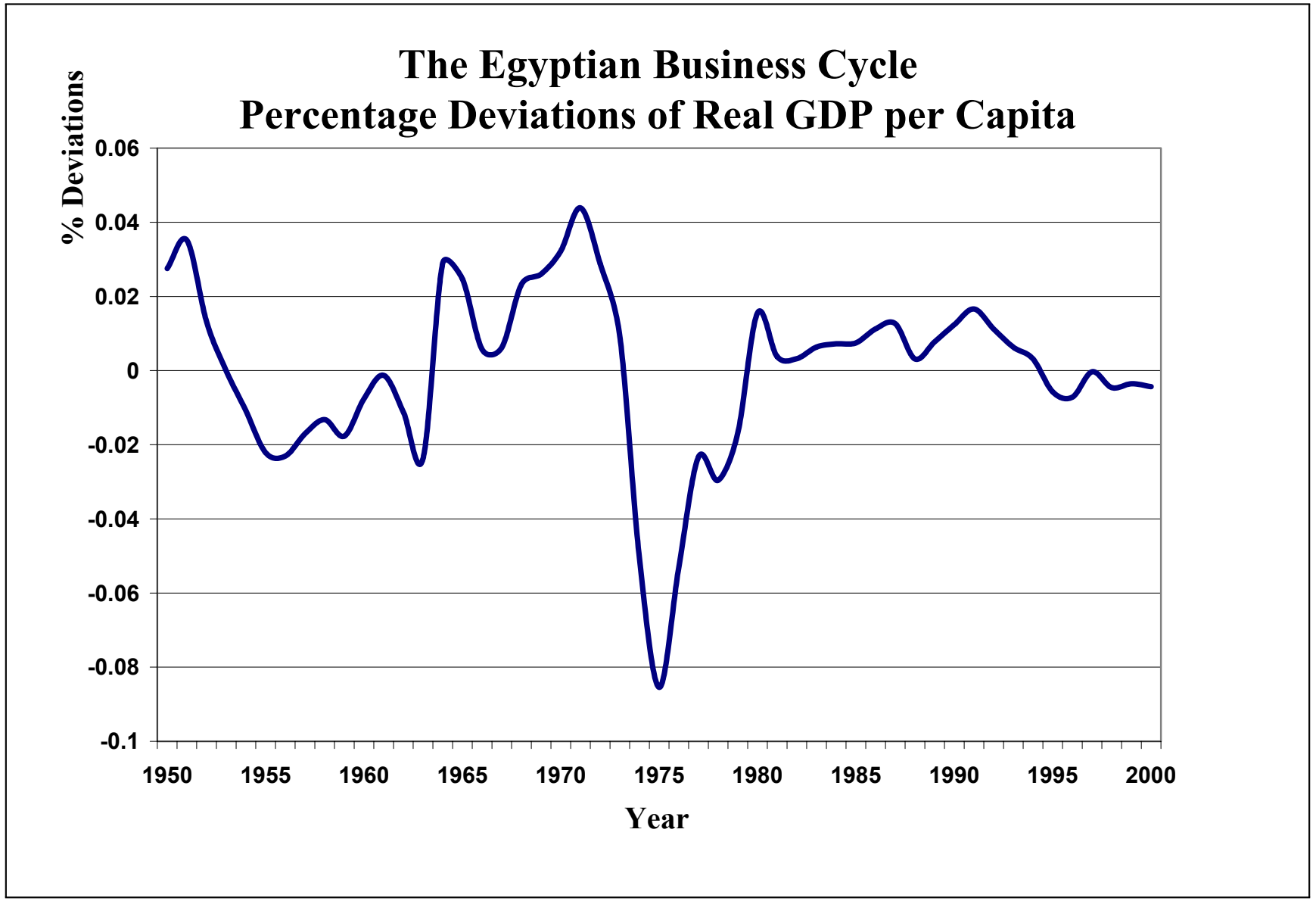

Figure 1. The Egyptian Business Cycle

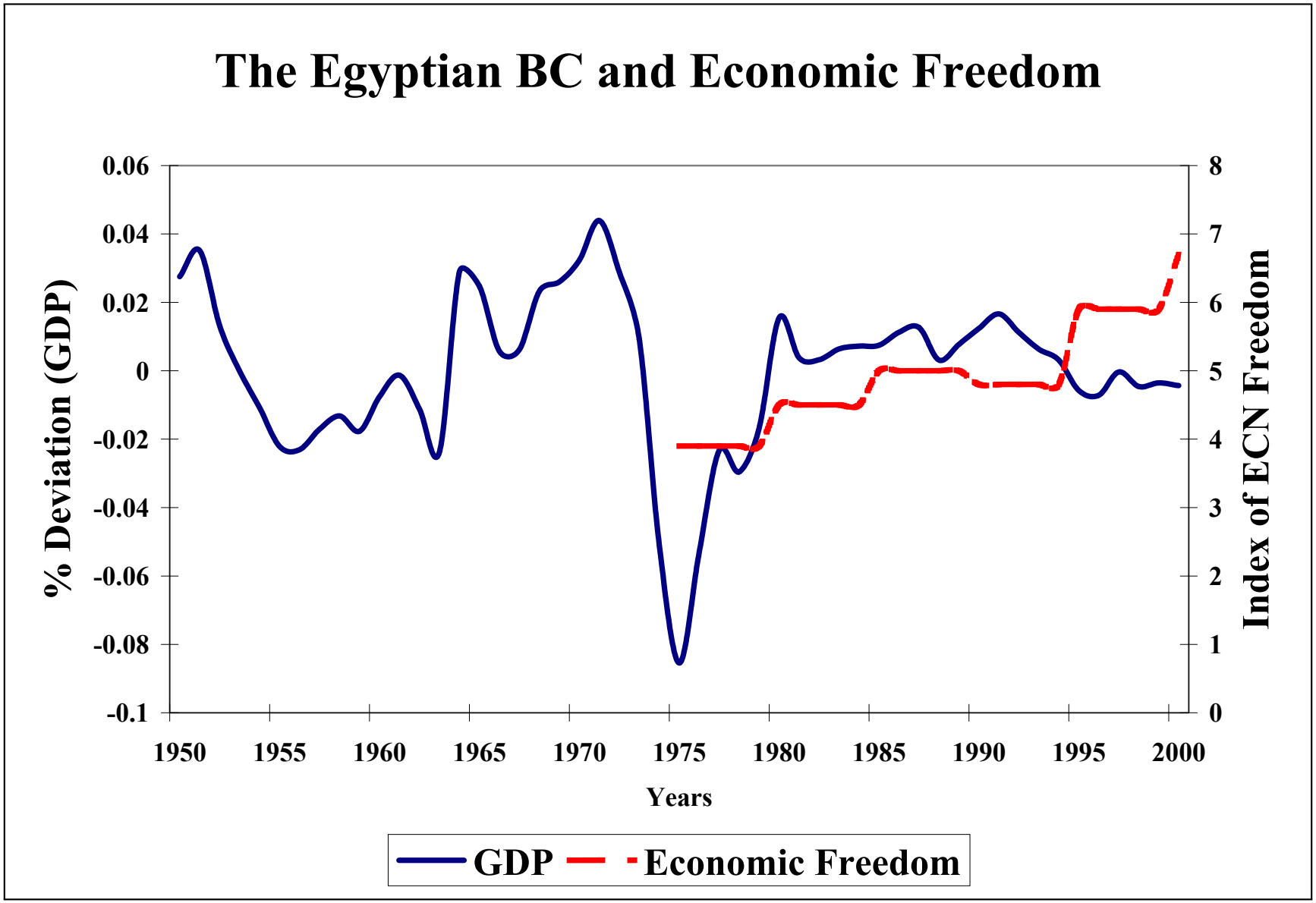

Figure 2. The Business Cycle and Economic Freedom

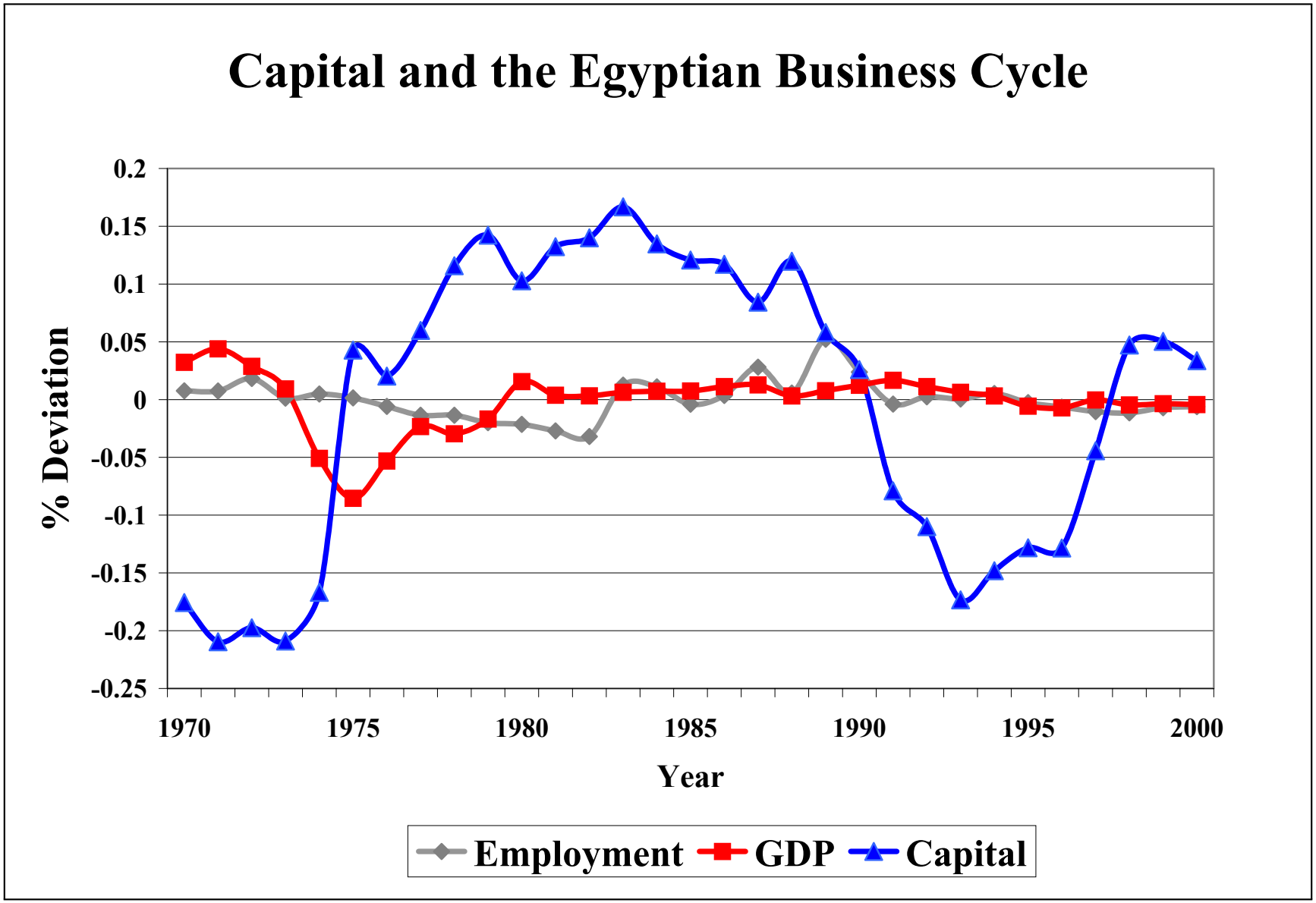

Figure 3. Capital and the Egyptian Business Cycle.

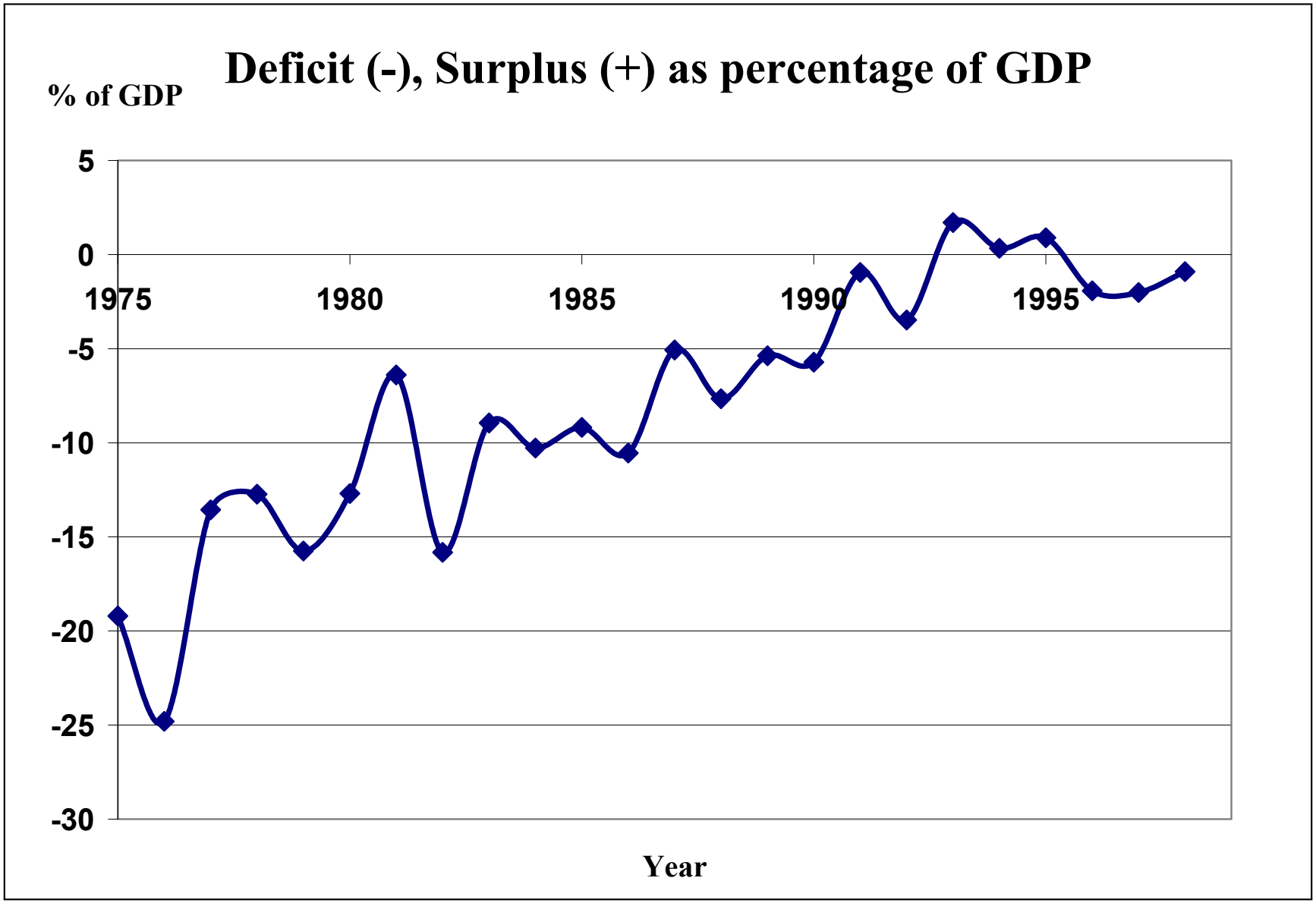

Figure 4. Deficit as percentage of GDP

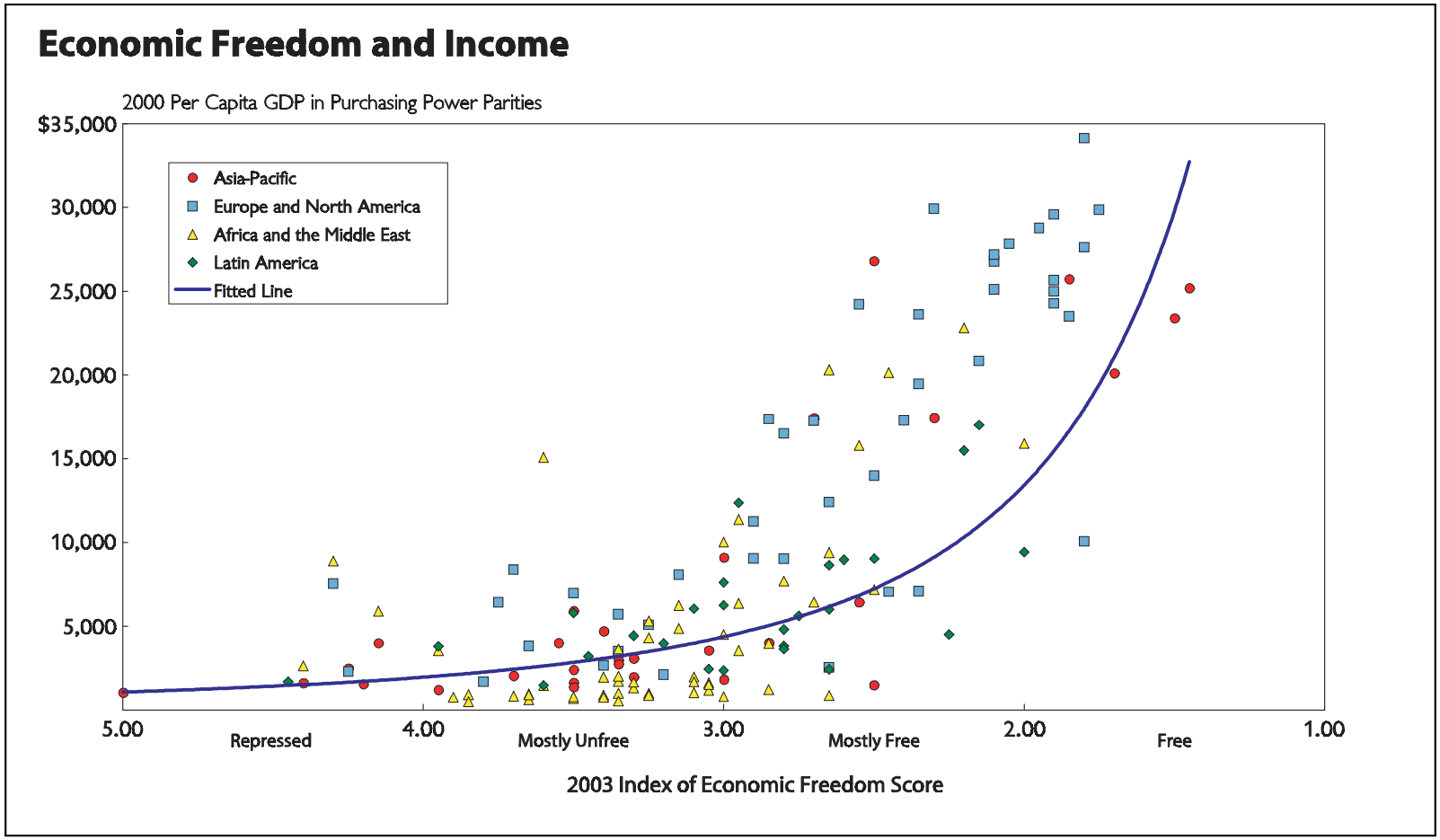

Figure 5. The World and Economic Freedom.(Source: 2003 Index of Economic Freedom, p. 38)

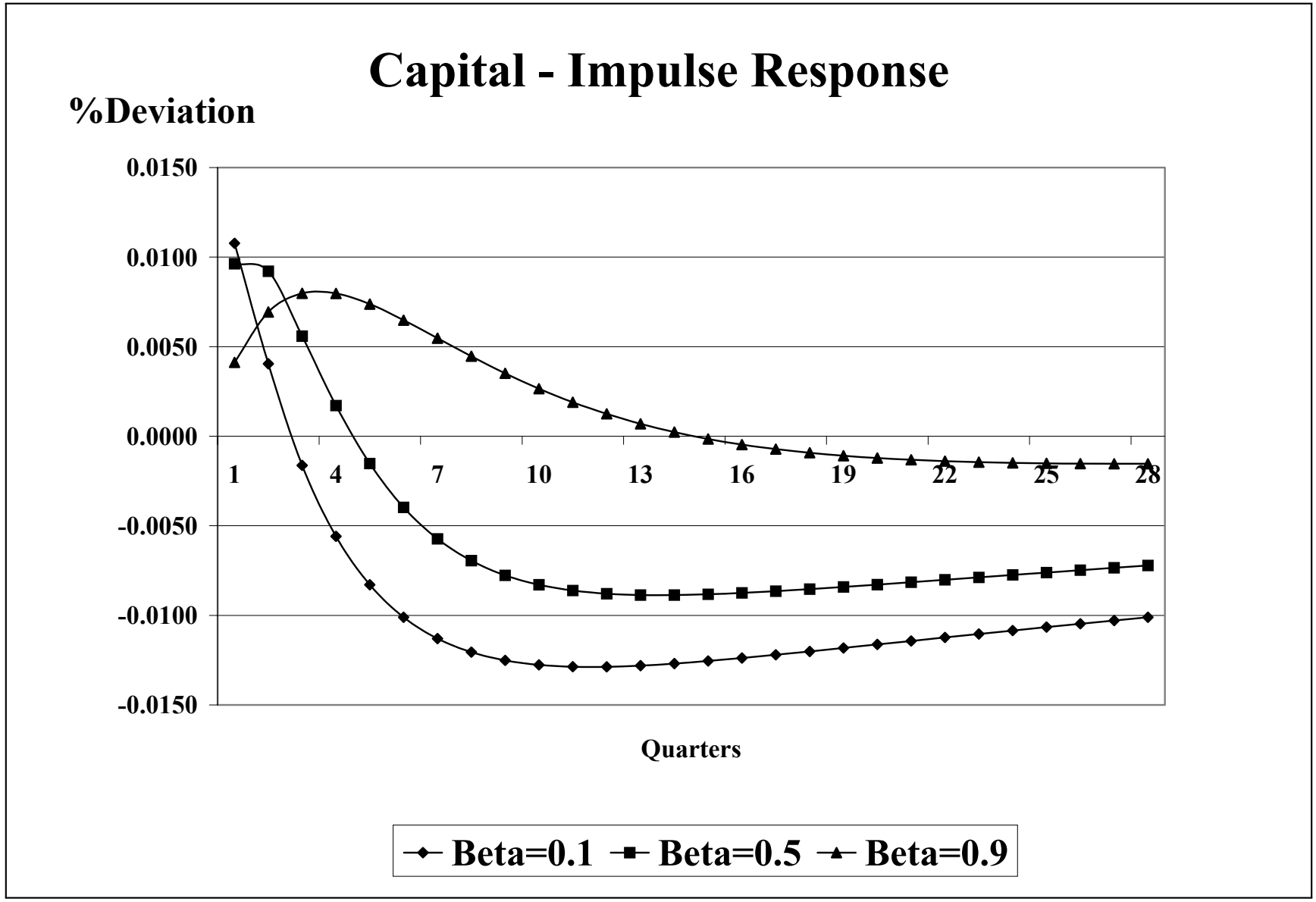

Figure 6. Impulse Response Capital - $\beta \in \{0.1, 0.5, 0.9\}$

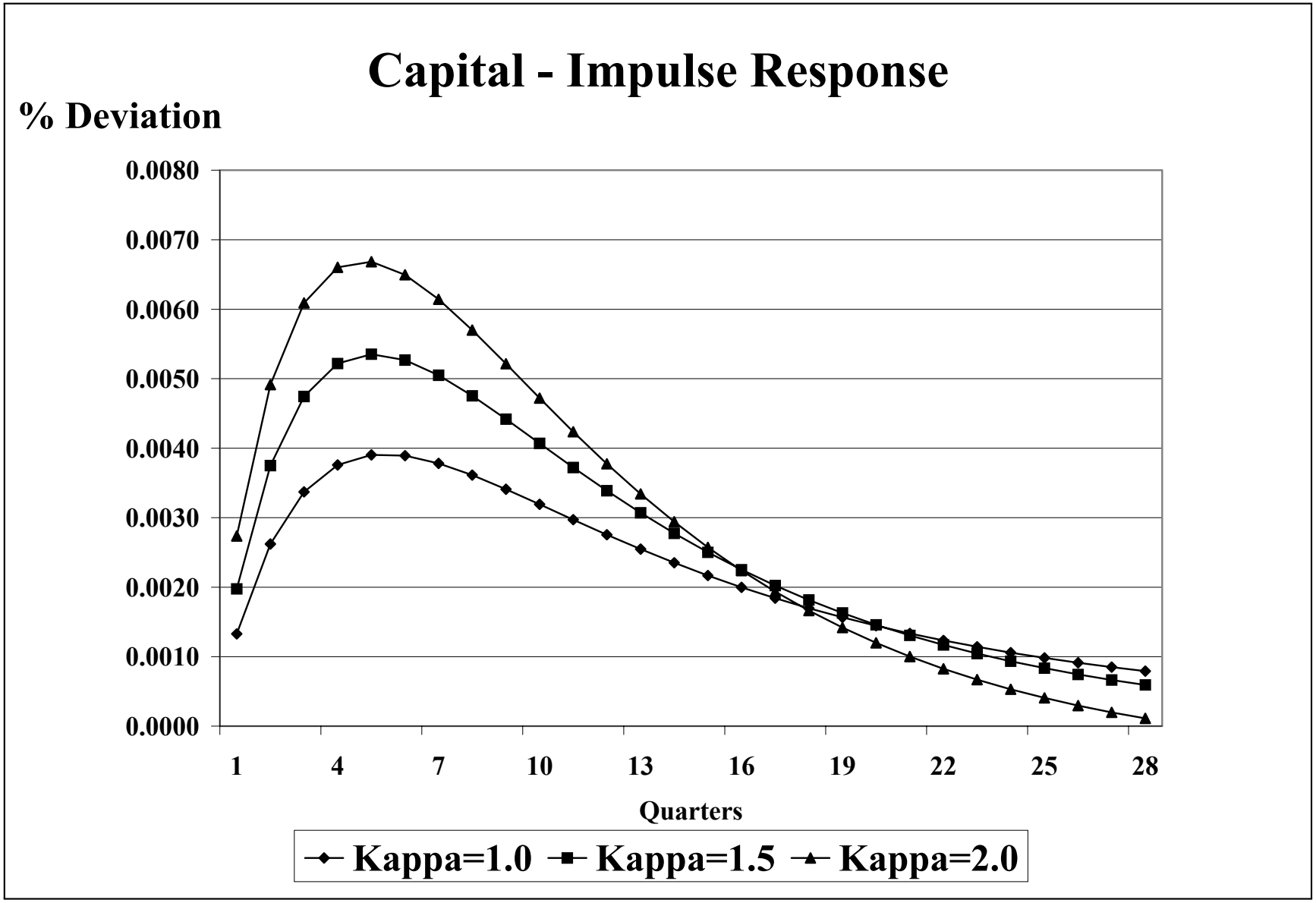

Figure 7. Impulse Response Capital - $\kappa \in \{1.0, 1.5, 2.0\}$

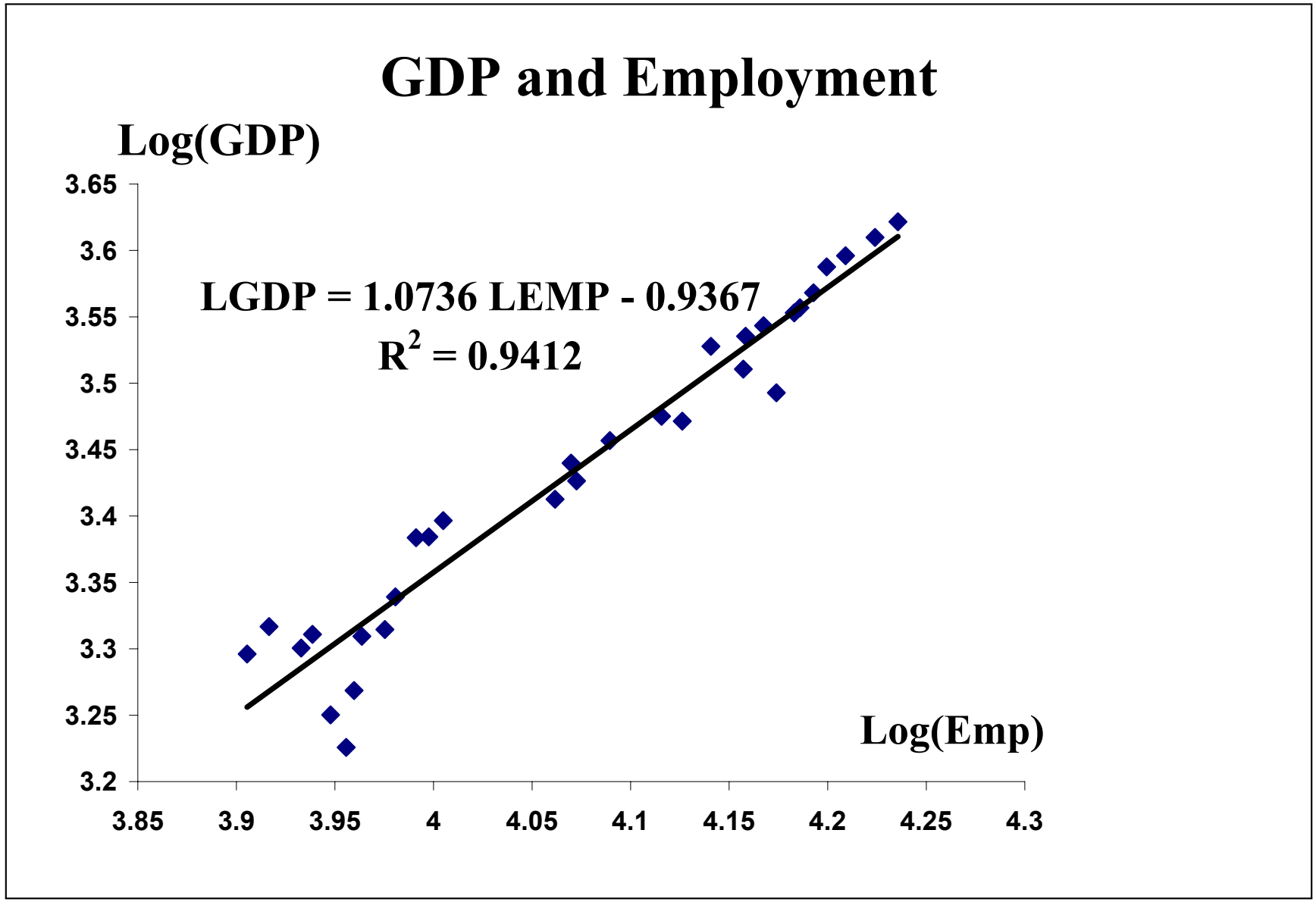

Figure 8. Egyptian GDP and Employment