INFLATION AND GROWTH IN EGYPT: IS THERE A THRESHOLD EFFECT?

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Abstract

This paper addresses the relationship between inflation and growth in Egypt for the last quarter century. Two distinct sub-periods are observed: somewhat higher and more volatile GDP growth rate is associated with higher inflation prior to 1990/91; from this year onwards, lower and less volatile growth is associated with significantly lower inflation. It was found that the impact of inflation on GDP growth is not significantly different between the two periods. Testing for non-linear effects of inflation on growth in Egypt, it appears that inflation at 15 percent and higher has negative effects on growth. However, this estimated threshold has been found to vary within a broad confidence interval. Considering that low inflation could harm growth whereas high inflationary expectations would run the risk of inflation going out of control, adversely affecting economic growth, it is proposed that the central bank targets an inflation rate in the 9–12 percent range, corresponding to the lower bound of the estimated threshold interval.

ملخص

تتناول هذه الدراسة العلاقة بين التضخم والنمو في مصر وذلك استنادا إلى بيانات سنوية للربع قرن الماضي. وتحديدا، تقوم الدراسة برصد التطورات خلال فترتين فرعيتين: الأولى قبل عام ١٩٩١/١٩٩٠ ويرتبط فيها معدل النمو المرتفع والأكثر تقلبا في الناتج المحلي الإجمالي بارتفاع معدل التضخم؛ أما الفترة الثانية فتأتي بعد ١٩٩١/١٩٩٠ ويرتبط فيها النمو المنخفض والأقل تقلبا بانخفاض ملموس في معدل التضخم. ويُلاحظ أن تأثير التضخم على نمو الناتج المحلي الإجمالي لا يعد مختلفا بشكل معنوي في الفترتين. وباختبار الآثار غير الخطية للتضخم على النمو في مصر، يُلاحَظ أن التضخم، في حالة تثبيت كافة محددات النمو الأخرى، له آثار سالبة على النمو عند بلوغ الأول ١٥% أو أكثر. غير أنه يُلاحظ أن هذا الحد يتغير في نطاق فترة ثقة عريضة. ونظرا لأن انخفاض التضخم يمكن أن يعود بآثار ضارة على النمو، في حين تنطوي توقعات التضخم المرتفع على خطر خروج معدل التضخم عن نطاق السيطرة، مما يؤثر سلبا على النمو الاقتصادي، فمن المقترح أن يقوم البنك المركزي باستهداف معدل تضخم يتراوح بين ٩%–12%.

"Historically, all possible combinations have occurred: inflation with and without development, no inflation with and without development."

(Friedman 1973)

1. INTRODUCTION

The purpose of this paper is to investigate the relationship between two of the most important and most closely watched macroeconomic variables: inflation and growth. The question of the existence and nature of the link between inflation and growth has been the subject of considerable interest and debate. The empirical literature has shown varying relationships across countries and across time. Theoretical analysis has discussed channels through which inflation may positively or negatively impact growth. Significant feedbacks from economic growth to inflation have also been addressed, highlighting the effect of fast economic growth (or heating up of the economy) on inflation.

Given that inflation affects growth, the sign of this effect is checked to determine whether the inflation coefficient has been positive or negative in Egypt during the period 1981/82 to 2005/06. The hypothesis of a non-linear relationship between inflation and growth is also tested. It helps to determine whether there exists a *threshold level of inflation* above which inflation significantly reduces growth. It is generally agreed in the literature that inflation has an adverse effect on economic growth only after it crosses a threshold limit below which inflation has a positive effect on growth. Harmful effects of inflation are not universal, but appear only beyond the threshold level of inflation. Thus the paper tries to investigate whether there is such a threshold for Egypt.

To address these issues, the paper comprises five sections in addition to this introduction. Section 2 presents a brief overview of both theoretical and empirical literature to examine the nature of the relationship between inflation and growth. Section 3 presents a descriptive background about inflation and growth in Egypt over the period of study. Section 4 highlights the sign of inflation impact on growth as well as the effects of other determinants of GDP growth. Section 5 investigates the presence of a threshold beyond which inflation significantly reduces growth. Section 6 concludes.

2. THEORETICAL AND EMPIRICAL EVIDENCE OF THE RELATION BETWEEN INFLATION AND GROWTH

Starting with the Latin American experience of the 1950s, the issue of the relationship between inflation and growth generated an important debate between *structuralists* and *monetarists*. The first believe *that inflation contributes positively to economic growth* (Felix 1961; Seers 1962; Baer 1967; Georgescu–Roegen 1970; Taylor 1979, 1983), whereas the latter consider *inflation as detrimental to growth* (Campos 1961; Harberger 1963; Vogel 1974). A third possibility is that inflation may be *neutral*, in the sense of having no relation to growth, as in the Lucas supply framework where anticipated inflation has no effect on output (Lucas 1973).

The *structuralist view* that inflation has a positive effect on growth is based on the contention that inflation induces savings through a number of channels. *First*, the government of a developing country faced with inadequate public revenues may resort to borrowing from the central bank to finance expenditures. This inflationary finance transfers resources to the government, which may increase capital formation if the government uses increased seigniorage or inflation tax to finance real investment (the Kalecki effect). As long as this does not lead to crowding out private investments, this inflationary finance would contribute to economic growth. *Second,* nominal wages may lag behind prices because of slowly adjusting expectations, sluggish wage bargaining or governmental wage repression. Thus, inflation may increase growth by shifting income distribution in favor of higher saving capitalists and hence increasing savings and growth (the Kaldor effect). From a more Keynesian perspective, inflation may stimulate growth by raising the profit rate, thus enhancing private investment. *Third*, inflation reduces real returns from financial investment, thus shifting the portfolio of investment from the financial sector to the real sector. This raises capital intensity and promotes real growth, or what is known as the Tobin effect, (Tobin 1965; Sidrauski 1967). This effect is further associated with the belief that inflation serves as a necessary lubricant for the wheels of the economy, making inflation an unavoidable component of economic growth.

Economists of *monetarist persuasion* believe that inflation negatively affects economic growth by creating various output-reducing inefficiencies. *First,* high and volatile inflation gives confusing signals to economic agents and increases the cost and riskiness of productive

investment, leading to lower investment and growth. *Second,* inflation creates uncertainty about future earning streams and hence adversely affects investment. *Third*, different sectoral prices rise at different rates during inflation, causing distortions in investment decisions and hence misallocation of resources. *Fourth,* inflation reduces the real value of financial assets and encourages people to save in unproductive assets such as precious metals or real estate, thus lowering the growth rate. *Fifth,* inflation is likely to reduce the efficiency of the financial system. As governments often control nominal interest rates, inflation stimulates excess demand for loanable funds, forcing tightening of credit by financial institutions and leading to various inefficiencies. *Finally,* inflation causes real appreciation of domestic currency and hence adversely affects exports. In a country with a fixed exchange rate, inflation would lead to a deterioration of the trade balance and to speculative capital outflows in anticipation of devaluation. If the government responds by introducing or strengthening exchange controls, the resulting inefficiencies would reduce output and growth.

In sum, particularly in the short term, the sign of the relationship between inflation and growth will depend on whether inflation is predominantly driven by demand shocks or by supply shocks. In an economy where demand shocks dominate, the relationship between inflation and growth is likely to be positive as a result of the dominant movement along the aggregate supply curve. Conversely, where supply shocks dominate, the relationship between the two variables is likely to be negative as a result of the movement along the aggregate demand curve.

What is the empirical evidence for either side of the inflation-growth debate? There are two aspects to this debate, namely: the nature of the relationship between the two macroeconomic variables and the direction of causation.

Earlier works (Bhatia 1960-61) failed to establish any meaningful relationship between inflation and growth. Based on data from the 1950s, the 1960s and until the early 1970s, many studies found the relationship between inflation and growth to be either non-significant or positive. Furthermore, examination by Paul, Kearney, and Chowdhury (1997) involving 70 countries (of which 48 are developing) for the period 1960-1989 found no causal relation between inflation and growth in 40 percent of the countries; the authors reported bi-directional causality in about 20 percent of countries and unidirectional (either inflation to growth or vice

versa) relationships in the rest. Of greater interest, the relationship was found to be positive in some cases, but negative in others.

The change in view came after many countries experienced severe episodes of high and persistent inflation in the 1970s and the 1980s. As more data became available on these episodes, studies confirmed repeatedly that inflation has a significant negative effect on economic growth. Currently, there is consensus that inflation negatively impacts medium and long term growth (Fischer 1983; Jung and Marshall 1986; Barro 1991; Bruno and Easterly 1998). The link between low inflation and high growth has also been identified in various regional studies (e.g., De Gregorio 1992, for Latin America; Fischer, Sahay, and Vegh 1996, for transition economies; Gillman, Harris, and Matyas 2004, for OECD and APEC countries). In these studies, inflation impedes efficient resource allocation by distorting the signaling role of relative price changes and producing a variety of output reducing inefficiencies.

If inflation is harmful to growth, it follows that policymakers should aim at a low rate of inflation. But how low should inflation be? More generally, at what level of inflation does the relationship between inflation and growth become negative?

Several recent empirical studies have examined this issue focusing specifically on whether the relationship between inflation and long-run growth is a nonlinear one. In other words, at some (low) rate of inflation, the relationship is positive or non-existent, but at higher rates it becomes negative. If such a nonlinear relationship exists then it should be possible to estimate the *threshold* at which the sign of the relationship between the two variables would switch. The possibility of such a nonlinear relationship was identified by Fischer (1993), who noted the existence of a positive relationship at low levels of inflation and a negative one as inflation rose. Sarel (1996) specifically tested for the existence of a structural break in the relationship between inflation and growth, and found evidence of a structural break at an annual inflation rate of 8 percent. Below that rate, inflation does not have a significant effect on growth, or it may even show a slightly positive effect. For inflation rates greater than 8 percent, the effect is negative, statistically significant, and strong. Ignoring the existence of this threshold substantially biases the effect of inflation on growth. Ghosh and Phillips (1998) using a larger sample than Sarel's, find a substantially lower threshold effect at 2.5 percent annual inflation rate. They also find that inflation is one of the most important statistical determinants of growth. Christoffersen and Doyle (1998) estimate the threshold level at 13

percent for transition economies. Bruno and Easterly (1998) argue that the negative relationship between inflation and growth, typically found in cross-country regressions, exists only in high frequency data and with extreme inflation observations. They find no cross-sectional correlation between long-run average rates of growth and inflation in the full sample, but detect a negative effect of inflation on growth for inflation rates higher than 40 percent. A useful discussion of previous work on this issue is given in Ghosh (2000).

Khan and Senhadji (2001) examine the existence of threshold effects in the relationship between inflation and growth, using new econometric techniques that present appropriate procedures for estimation and inference. The threshold level of inflation above which inflation significantly slows growth is estimated at 1-3 percent for industrial countries and 11-12 percent for developing countries. The negative and significant relationship between inflation and growth for inflation rates above the threshold level is quite robust.

3. GDP GROWTH AND INFLATION IN EGYPT (1981/82-2005/06)[1]

During the period of study and using data for Egypt, the annual rate of growth of real GDP, as given in the World Development Indicators (WDI), averaged 4.79 percent. GDP growth was characterized by frequent fluctuations around this modest average, with values ranging between a minimum of 1.08 percent in 1990/91 and a maximum of 9.91 percent in 1981/82, with a standard deviation of 1.84 percent (Table 1 and Figure 1). Comparing the growth performance up till 1989/90, which marks a key turning point in Egypt's modern economic history with the initiation of an economic reform and structural adjustment program (ERSAP), starting 1990/91, it appears that the first sub-period witnessed a slightly higher average real GDP growth (5.68 percent) compared to the second sub-period (4.29 percent). The first sub-period also reflected relatively sharper fluctuations than the second.[2]

[1] Years refer to fiscal years (FY), which start in Egypt on the first of July and end on June 30th the following year.

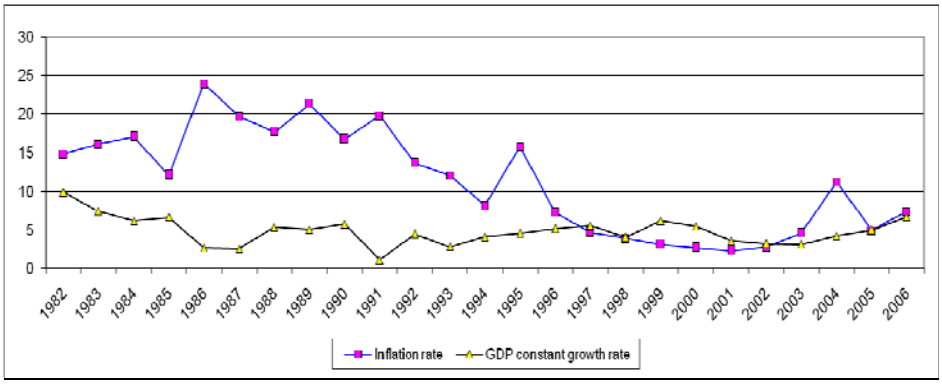
[2] In the first sub-period, sharper fluctuations in real GDP growth rate, between a minimum of 2.52 percent in 1986/87 and a maximum of 9.91 percent in 1981/82 with a standard deviation of 2.28 percent were observed compared to a range between a minimum of 1.08 percent in 1990/91 and a maximum of 6.62 percent in 2005/06 with a standard deviation of 1.38 percent during the second sub-period.

Table 1: Description of Inflation and GDP Growth (1981/82-2005/06)

Period	*Variable*	*Mean*	*St. D.*	*Min*	*Max*
81/82 – 05/06	INF	11.325	6.739	2.270	23.864
	GDP_GR	4.789	1.841	1.079	9.907
81/82 – 89/90	INF	17.698	3.503	12.107	23.864
	GDP_GR	5.683	2.283	2.519	9.907
90/91 – 05/06	INF	7.74	5.295	2.270	19.749
	GDP_GR	4.286	1.377	1.079	6.620

Source: Calculations based on World Development Indicators (WDI).

Figure 1: Inflation and Real GDP Growth Rates in Egypt (1981/82–2005/06)



Source: Calculations based on WDI.

Note: Years refer to fiscal years, e.g., 1982 refers to FY 1981/82.

Inflation rates over the whole period, measured by the annual change in urban consumer price index (CPI) calculated from WDI, also featured sharp fluctuations around an average annual rate of 11.33 percent, within a range of 2.27 percent in 2001/02 and 23.86 percent in 1985/86 and with a large standard deviation of 6.74 percent. During the first sub-period, the annual inflation rate never went below the two digit level and exceeded on average 17.7 percent, with a moderate standard deviation of 3.50 percent, while inflation was on average significantly lower after ERSAP (7.74 percent), with a higher variability, as reflected by a standard deviation of 5.30 percent.

The beginning of the first sub-period and until the mid-1980s, witnessed a continuation of the new policies adopted in 1974 under *Infitah* (open-door policy). These policies attempted to encourage private sector initiatives, to develop and upgrade the infrastructure, to

expand new urban and industrial clusters in the desert and to control population expansion. They were supported by a continued large inflow of foreign exchange resources associated with rising world petroleum prices, a resulting regional boom that stimulated inflow of worker remittances from the Gulf countries, reopening of the Suez Canal and expansion in tourism. The level of investment rose and remained on average comparatively high until the mid-1980s, stimulating a relatively high GDP growth rate. Costly policies were maintained providing wide-ranging production and consumption subsidies, free social services and public employment to all university and secondary school graduates (Kheir-El-Din and Moursi 2007).

After the sharp decline in oil prices in 1985/86, these policies appeared to be too expensive and required revision. Macroeconomic imbalances, partly brought about by the high cost of implementing these policies, threatened the stability of the economy. Toward the end of the 1980s and until 1990, investment started to fall sharply because of the collapse of international prices of petroleum and domestic market distortions that undermined efficient allocation of investment across sectors and activities. Inflationary pressures mounted. Investment decline was reflected in the decline in growth rates of real output. The economic slowdown of the mid-1980s was accompanied by a sharp rise in annual inflation rate reaching a maximum of 23.9 percent in 1985/86.

The situation appeared to be unsustainable. The government, supported by international financial institutions, started implementing, in 1990/91, a stabilization and structural adjustment program[3] aimed at removing macroeconomic imbalances and promoting economic efficiency. One of the main achievements of the 1990s stabilization program was the significant reduction in the inflation rate, which fell gradually from 21.3 percent in 1988/89 to 4.6 percent in 1996/97 to reach 2.3 percent in 2000/01, with occasional rebounds as reflected in 1994/95.

During the first half of the 1990s, the Central Bank of Egypt (CBE) adopted a tight monetary policy coupled with sterilization measures to neutralize the expansionary impact of capital inflows. This resulted in rapid accumulation of foreign exchange reserves early in the

[3] The program was based on applying market-oriented strategies based on: elimination of price distortions, relieving government budget from consumption subsidies, foreign trade deregulation, intensifying the role of private sector in economic activity, financial and capital market reform, encouraging trade openness and improving Egypt's potentials for exports.

stabilization program and reduced inflation expectations. While the program was successful in reducing both internal and external imbalances, its impact on economic growth in the early 1990s has been disappointing, as it could not raise the average growth rate back to the pre-ERSAP levels. This is not surprising. It has been shown that macroeconomic stabilization and reform are only necessary, but not sufficient prerequisites for growth (Fischer 1993). After the sharp decline of the growth rate in 1990/91, following the stabilization effort, the reform program managed to reduce macroeconomic imbalances and to establish conditions for sustainable growth. The growth rate of GDP picked up in 1994/95 to reach a local peak exceeding 6 percent in 1997/98, as shown in Figure 1.

Starting 1997/98, the Egyptian economy suffered from the combined effect of three external shocks: the emerging economies' crises, the Luxor incident and the sharp decline in oil prices in 1998. These external factors put negative pressure on the current account in the balance of payments, further aggravated by external capital outflows. The situation was worsened by the global economic fallout from the September 11 attacks in 2001, and further by the war on Iraq, the consequent uncertain political conditions in the region and the sluggish global environment. As reflected in Figure 1, the growth rate of GDP started to decline in 1998/99, and continued its downward trend until 2001/02 and further in 2002/03. Economic activity was constrained by a shortage of foreign currency, inactive monetary policy, high real interest rates and a depressed regional and global environment. Real GDP growth reached around 3 percent, which is far below the economy's potential. However, growth started to pick up, rising to 4.1 percent in 2003/04, and to around 4.5 percent in 2004/05; it further exceeded 6.8 percent by the end of 2005/06; and was announced to exceed 7 percent in 2006/07.

In the meantime, inflation declined in 1995/96 and remained stable in the rest of the second half of the 1990s, but it started to increase again in 2001/02 with the successive devaluations of the Egyptian pound. A further increase in inflation was witnessed following the depreciation of the pound accompanying its announced floatation in January 2003, resulting in a depreciation of its value exceeding 30 percent. These inflationary pressures were driven by the increase in import prices as well as the negative expectations regarding the stability of the pound. However, maintenance of explicit and implicit subsidies on several items mitigated the pass-through effect of the exchange rate. Increases in the consumer price index reached about 11.3 percent in 2003/04. Yet, it is believed to understate inflation due to the inclusion of subsidized products and possibly other compilation problems. In 2004/05

inflation was again brought under control due to significant reforms in the foreign exchange market which restored stability to this market and stopped speculative transactions in foreign currency. The Egyptian pound started appreciating.[4] The inflationary pressures due to the pass-through effect of earlier depreciations of the currency were relieved.

Inflationary pressures started to build up again. Public statements referred, as an explanation, to external factors associated with rising world prices of imports, the negative impact of the avian flu outbreak on domestic food prices and the probable "heating" up of the economy due to increasing GDP growth rates.

The previous discussion highlights that the relationship between inflation and GDP growth during the period 1981/82-2005/06 does not appear to be obvious. Two distinct periods are observed: somewhat higher, and more volatile GDP growth rate is associated with higher inflation rate prior to the application of ERSAP, while lower and less volatile GDP growth is associated with significantly lower inflation post ERSAP. Thus, a question remains to be addressed, concerning the sign of this relationship.

4. ESTIMATION OF GROWTH EQUATION WITH INFLATION

This section analyzes various determinants of GDP growth including inflation. Following the work of Barro (1991) and the empirical literature on economic growth, e.g., Levine and Renelt (1992) and Sala-i-Martin (1997a, b), a number of variables that are partially correlated with the rate of economic growth has been identified. Variables like the initial level of income, the investment rate, various measures of education, population growth and terms of trade, and some stability indicators like inflation, black market premium, fiscal surplus and many other variables have been found significant in these studies. The basic methodology of such studies consists of running a cross-sectional regression of the following form:

$$GDP\_GR = c + \sum_{i=1}^{K} \beta_i x_i + \varepsilon \qquad (1)$$

where GDP_GR represents a vector of growth rates in various countries within the cross-section, c is a constant, x_i represents a vector of the ith explanatory variable in the regression, β_i is the corresponding parameter and ε is a statistical error term. This model can be applied to a single country time series data with specific consideration to the characteristics of the

[4] From 6.13 LE/$ in 2004, to 5.73 LE/$ in 2005, and further to 5.70 LE/$ in 2006 (end of period, IFS/IMF).

country under study. It is proposed to include inflation along with other right-hand-side variables to explain GDP growth and then systematically vary the other variables to test the robustness of the inflation coefficient (Singh and Kalirajan 2003). The figures for various variables have been taken from both the World Development Indicators and the International Financial Statistics.

The regression model considers several aggregate explanatory variables: government consumption expenditures (GOV) as a proxy for aggregate domestic demand, gross fixed capital formation as a proxy for capital accumulation (GFCF), credit to the private sector (CRPRV) reflecting the increased share of private sector participation in economic activities, exports (EXP) and imports (IMP) of goods and services, each defined as a percentage of GDP. Inflation (INF) and its natural logarithm (LNINF) have alternatively been incorporated in the regression to represent macroeconomic stability. Three dummy variables (DERS, D98 and D03) and a constant term have also been added to the list of regressors. The dummy variable DERS takes on the value 1 in 1990/91 and zero otherwise; it is designed to account for the influence on growth of introducing stabilization measures at the beginning of the 1990s. The dummy D98, set to unity in 1997/98 and 0 otherwise, is meant to reflect the impact of the three major external shocks encountered by the Egyptian economy in 1997/98. The last dummy D03 set to unity in 2001/02 and 2002/03 and 0 otherwise captures the destabilizing effect of the successive devaluations of the Egyptian pound at the beginning of the millennium.

To reflect the observed differences in growth rates and inflation rates shown in Table 1 and Figure 1, two additional dummies D82 and D91 (defined successively as equal to 1 from 1981/82 up till 1989/90 and zero otherwise, and equal to zero prior 1990/91 and 1 starting 1990/91 till the end of the period) have been introduced in a multiplicative way with inflation to account for differences in the regression parameter of growth on inflation.

The regression is estimated by means of ordinary least squares (OLS).[5] The estimated coefficients and related standard errors are shown in Table 2. The reported results indicate that the adjusted R^2 varies between 0.47 and 0.62 and the related F-statistic is, in all cases, significant at the 1 percent level. This further reflects a significant association between the

[5] A Dickey–Fuller statistic has been computed to test for a unit root in the time series of each explanatory variable. All the test results (not reported) significantly reject nonstationarity of the selected control variables.

level of inflation, or to a lesser extent its natural logarithm (not reported) and other reported macroeconomic variables and the observed GDP growth rate. The estimated Durbin-Watson (DW) statistic either rejects the hypothesis of serially correlated errors or is inconclusive.

In general, the estimated relationship between the explanatory variables in the regression and GDP growth is economically sensible. Moreover, the reported standard errors indicate that most of the estimated parameters are significantly different from zero at conventional levels.

According to the surveyed literature, inflation (INF) may reduce growth through its negative effect on investment and productivity expansion. It is further argued that the inflation rate provides a reasonable measure for uncertainty of the macroeconomic environment. On average, the level of inflation over the period considered (11.3 percent) and its variance (45.4 percent) may be above what would be desired for providing a stable macroeconomic environment. Uncertainty proceeding from inflation-induced distortions in the foreign exchange market frequently led to increases in real exchange rate, and to a reallocation of resources towards production of non-tradable goods and against export promotion. Such pattern of resource allocation reduced Egyptian producers' competitiveness in both international and domestic markets, with consequent negative effects on productivity and domestic investment and hence on GDP growth. Inflation is significantly inversely correlated with GDP growth. The estimated inflation (INF) coefficients—shown in models 1 to 3—imply that a rise in yearly inflation rate by 1 percent is associated with a decline in GDP growth (GDP_GR), varying between around 0.16 percent and 0.30 percent. The coefficients are further highly significant and robust in alternative models presented. Using LNINF instead of INF (not reported) also reflected a negative relationship between GDP_GR and LNINF.[6]

Testing for differentiated responses of growth rate to inflation before and after ERSAP, D82 and D91 have been introduced in the estimated regression. The estimated coefficients are significant for both periods as reflected in models 4 through 6, but they did not appear to be

[6] Based on 1965-1979 data for Egypt, Jung and Marshall (1986) estimated the impact of inflation on GDP growth for Egypt. It was found to be positive as one of only two cases among 56 countries considered in the study. This suggests that, over this period, inflation in Egypt was predominantly driven by demand factors.

significantly different.[7] This implies that although the observed trends of both inflation and GDP growth appear to be different in the two sub-periods, the impact of inflation on GDP growth is not significantly different.

During the period 1981/82–2005/06, government consumption expenditures (GOV) were generally allocated to pay wages and salaries for a massive number of civil employees and to ensure social welfare (subsidizing basic commodities consumed by low- and middle-income groups and securing social services for a considerable fraction of the population). These uses of GOV are not likely to result in significantly positive impact on GDP growth, as reflected by the unstable value of the corresponding estimated parameter which showed high fluctuations in its level as well as in its significance.

Gross fixed capital formation, as a percentage of GDP (GFCF) reflects public and private investments in plant and equipment, in industrial buildings, schools, hospitals, construction of roads and railways … and in land improvements. These investments play a catalytic role in boosting the development process. The productivity of public and private investments differs. It would have been useful to capture the impact of these differences on GDP growth, but unavailability of appropriate data rules out this option. According to the regression results, the expansion of domestic fixed investments has a stable positive correlation with GDP growth. The corresponding parameter varies between 0.16 and 0.37, and is generally significant at conventional levels, confirming the importance of investing in infrastructure and new machinery and equipment for stimulating GDP growth.[8]

The contribution of the private sector in economic activities in Egypt increased over the period of study. This was reflected on the amount of credit available to the private sector as a ratio of GDP (CRPRV) which increased persistently. The increase was not entirely beneficial. A large part of this credit was indulged in unnecessary, high-return activities including investments in the construction and contracting industry, speculation on land and real estate,

[7] A t-test for equality of the coefficients of D82 INF and D91 INF in models 4 through 8 did not support the hypothesis of non-equality of the estimated parameters, hence implying that we cannot reject that the coefficients of inflation in the GDP growth equation are equal over the whole period considered.

[8] Testing for differences in impact of GFCF on growth in the two sub-periods of study, this explanatory variable has been multiplied by D82 and D91. It appeared that the impact of GFCF on growth has been significant and relatively stable (hovering between 0.23 percent and 0.26 percent) during the first sub-period compared to the second sub-period where the impact of GFCF on growth was insignificant (models 7 and 8). This is mainly attributable to the contraction of public investment after 1990/91 and the failure of the private sector in replacing it.

and importation of luxury goods. Moreover, corruption, lax judicial system and absence of a regulatory mechanism to control capital outflows permitted illegal transfer of part of these credit funds abroad. Such transfers had perverse effects on economic performance as well as on the credibility of the private business environment in Egypt. We find therefore that credit to the private sector as a ratio of GDP is negatively correlated to GDP growth in all estimated models, with some parameters significantly different from zero.

Table 2: Estimated Models of GDP Growth

Dependent variable	GDP_GR	GDP_GR	GDP_GR	GDP_GR	GDP_GR	GDP_GR	GDP_GR	GDP_GR
Model number	*Model 1*	*Model 2*	*Model 3*	*Model 4*	*Model 5*	*Model 6*	*Model 7*	*Model 8*
Const	2.039	-4.453**	-4.559**	1.638	-3.088	0.4925	0.5005	-0.1682
	(2.595)	(1.925)	(2.108)	(4.762)	(2.180)	(4.400)	(4.038)	(3.919)
INF	-0.298***	-0.156***	-0.202**					
	(0.077)	(0.0545)	(0.056)					
D82INF				-0.3003**	-0.1425**	-0.1734**	-0.2642*	-0.2575*
				(0.08380)	(0.06286)	(0.07112)	(0.1313)	(0.1267)
D91INF				-0.2907**	-0.2783**	-0.3422**	-0.2334**	-0.1580
				(0.1036)	(0.06873)	(0.09688)	(0.08067)	(0.09170)
GOV	0.517**			0.5258**				
	(0.208)			(0.2323)				
GFCF	0.163*	0.33***	0.371**	0.1715	0.2539**	0.2039*		
	(0.087)	(0.071)	(0.076)	(0.1222)	(0.09832)	(0.1121)		
D82GFCF							0.2308**	0.2577**
							(0.1005)	(0.09845)
D91GFCF							0.09202	0.1192
							(0.1821)	(0.1765)
CRPRV	-0.095**			-0.09304*		-0.03909		
	(0.041)			(0.04524)		(0.04168)		
EXP		0.173***	0.153**		0.2085**	0.1946**	0.1703**	0.1581**
		(0.0514)	(0.055)		(0.06164)	(0.06358)	(0.07136)	(0.06928)
DERS		-3.129**						-2.496
		(1.372)						(1.605)
N	25	25	25	25	25	25	25	25
Adj. R^2	0.469	0.568	0.4811	0.5574	0.5274	0.6236	0.5301	0.5627
F-statistic	6.29***	8.87***	8.42***	4.786***	7.697***	6.296***	6.415***	6.148***
DW †	1.747	1.09	1.363	1.759	1.334	1.518	1.308	1.128
AIC	90.0869	84.9387	88.7136	92.0733	87.153	88.0217	87.7304	86.5791

Source: Authors' estimation.
Standard errors in parentheses: * indicates significance at the 10 percent level, ** indicates significance at the 5 percent level, and *** indicates significance at the 1 percent level.
† AIC (Akaike's Information Criterion) is an alternative criterion to R^2 or to the adjusted R^2 as a goodness of fit measure. In comparing two or more models with the same dependent variable, the model with the lowest value of AIC is preferred.

To capture the relation between foreign trade and GDP growth, export and import ratios to GDP were introduced separately in the regression. Import ratios to GDP (IMP) showed positive, significant, but unstable impact on GDP growth (not reported), whereas export ratios (EXP) showed positive, robust and significant impact on GDP growth. It appeared that a 1 percent increase in EXP would boost GDP growth by around 0.15 percent to 0.21 percent as shown in Table 2. This supports the evidence that output growth is significantly affected by growth of export markets.

The two dummies—D98, reflecting the impact of external shocks that hit the Egyptian economy by late 1990s, and D03, which attempts to capture the destabilizing effect of the Egyptian pound devaluations—showed no significant effect on GDP growth. Whereas DERS, the dummy accounting for the influence on growth of the stabilization program, showed a robust and significant negative impact on GDP growth (reflected by a coefficient varying between – 2.5 and – 3.1, as shown in Table 2). As previously noted, this result reflects the contractionary impact of stabilization measures on the economy's growth performance.

In sum, these findings confirm a negative relationship between growth and contemporaneous inflation in all cases considered, whether inflation is entered as an explanatory variable, including both high and low-inflation sub-periods equally, or when differentiating between the two sub-periods. However, there appeared to be no significant difference between the two sub-periods.

Finally, as previously mentioned, inflation has an adverse effect on economic growth only after it crosses a threshold limit below which inflation has a positive or no effect on growth. This issue is investigated in the following section.

5. Is There a Threshold Level of Inflation for Egypt?

5.1. Methodology

Model specification

In this section, an attempt is made to explore the non-linearity of the inflation-output growth relationship in the case of Egypt. Specifically, the questions that are addressed here are: (1) is there any threshold level of inflation in the case of Egypt below which inflation is a desired phenomenon? (2) Is such a structural break statistically significant? The estimation technique applied in Khan and Senhadji (2001) is used here with some modification in implementation,

given the differences in data structure.[9] To test for the existence of a threshold effect, the following model was estimated:[10]

$$GDP\_GR_t = c + \gamma_1 \left(1 - d_t^{INF^*}\right)\left[\ln(INF_t) - \ln(INF_t^*)\right]$$

$$+ \gamma_2 d_t^{INF^*}\left[\ln(INF_t) - \ln(INF_t^*)\right] + \beta' X_t + \varepsilon_t \qquad (2)$$

$$d_t^{INF^*} = \begin{cases} 1 \text{ if } INF > INF^* \\ 0 \text{ if } INF \leq INF^* \end{cases} \qquad t = 1,2, \ldots\ldots, T$$

where GDP_GR_t is the growth rate of GDP in year t, c is a constant, INF_t is contemporaneous inflation based on the CPI of urban population, INF_t^* is the threshold level of inflation, $d_t^{INF^*}$ is a dummy variable that takes a value of one for inflation levels greater than the estimated threshold INF_t^* and zero otherwise, X_t is a vector of control variables as specified in models 1 and 2 of Table 2, hence it includes gross fixed capital formation (*GFCF*), credit to the private sector (*CRPRV*) and exports (*EXP*), all measured as a share of GDP, and a dummy variable for the change in policy in 1990/91 associated with stabilization measures (*DERS*). The index "*t*" is the time-series index.

The use of a logarithmic transformation of inflation in equation (2) can be justified by the fact that its implications are more plausible than those of a linear model. In particular, the linear model implies that *additive* inflation shocks will have identical effects on growth for low- and high-inflation levels, while the logarithmic specification implies that *multiplicative* inflation shocks will have identical effects on low- and high-inflation levels. The effect of inflation on GDP growth is given by γ_1 for the years in which inflation is less than or equal to INF^*, and γ_2 for years with inflation rates higher than INF^*.

Estimation method

If the threshold were known, the model could have been estimated by ordinary least squares (OLS). Since INF^* is unknown, it has to be estimated along with the other regression parameters. The appropriate estimation method in this case is nonlinear least squares (NLLS). Furthermore, since INF^* enters the regression in a nonlinear and non-differentiable manner,

[9] The dataset used by Khan and Senhadji (2001) includes a cross-section of 140 industrial and developing countries and generally covers the period 1960-98, with a shorter span for a number of developing countries. Whereas, the dataset for this study is composed of time series for Egypt extending over 25 years, from 1981/82 to 2005/06.

[10] Since the test for equality of inflation coefficients before and after ERSAP has supported this equality, this model tests for the existence of a unique threshold over the whole period of analysis.

conventional gradient search techniques to implement NLLS are inappropriate. Instead, estimation has been carried out using a method called *conditional least squares,* which can be described as follows. For any INF^*, the model is estimated by OLS, yielding the sum of squared residuals as a function of INF^*. The least squares estimate of INF^* is found by selecting the value of INF^*, which minimizes the sum of squared residuals. Stacking the observations in vectors yields the following compact notation for equation (2):

$$GDP\_GR = X\theta_{INF} + \varepsilon, \qquad INF = \underline{INF}, \ldots, \overline{INF}$$

where $\theta_{INF} = (c\ \gamma_1\ \gamma_2\ \beta')'$ is the vector of parameters and X is the corresponding matrix of observations on the explanatory variables. Note that the coefficient vector θ is indexed by INF to show its dependence on the threshold level of inflation, the range of which is given by $\underline{INF}$ and $\overline{INF}$. Define $S_1(INF)$ as the residual sum of squares with the threshold level of inflation fixed at INF. The threshold estimate level INF^* is chosen so as to minimize $S_1(INF)$, that is:

$$INF^* = \underset{INF}{\operatorname{argmin}}\{S_1(INF), \qquad INF = \underline{INF}, \ldots, \overline{INF}\}$$

Inference

It is important to determine whether the threshold effect is statistically significant. In equation (2), to test for no threshold effects amount to testing the null hypothesis H_0: $\gamma_1 = \gamma_2$. However, under the null hypothesis, the threshold INF^* is not identified, so classical tests, such as the *t*-test, have nonstandard distributions. Hansen (1996, 1999) suggests a bootstrap method to simulate the asymptotic distribution of the following likelihood ratio test of H_0:

$$LR_0 = (S_0 \quad S_1)/\hat{\sigma}^2$$

where S_0, and S_1 are the residual sum of squares under H_0: $\gamma_1 = \gamma_2$, and H_1: $\gamma_1 \neq \gamma_2$, respectively; and $\hat{\sigma}^2$ is the residual variance under H_1. In other words, S_0 and S_1 are the residual sum of squares for equation (2) without ($\gamma_1 = \gamma_2$) and with ($\gamma_1 \neq \gamma_2$) threshold effects, respectively. The asymptotic distribution of LR_0 is nonstandard and strictly dominates the $\chi 2$ distribution. The distribution of LR_0 depends in general on the moments of the sample; thus critical values cannot be tabulated. Hansen (1999) shows how to bootstrap the distribution of LR_0.

5.2. Results of Estimating the Threshold Effect

The first step is to test for the existence of a threshold effect in the relationship between GDP growth and inflation using the likelihood ratio, LR_0, sketched above and more detailed in Khan and Sinhadji (2001). This involves estimating equation (2) and computing the residual sum of squares (RSS) for threshold levels of inflation ranging from $\underline{INF}$ to $\overline{INF}$. The threshold estimate is the one that minimizes the sequence of RSSs. The test for the existence of threshold effects has been conducted using time series data for the period 1982 to 2006. The results are summarized in Table 3.

Table 3: Test of Threshold Effect

Model	Search Range for Thresholds	Threshold Estimate (%)	LR_0	Significance Level
1	{2.27, 3 ,4 ,5 , …, 24}	15	13.397	0.002
2	{2.27, 3, 4, 5, …, 24}	15	3.296	0.103

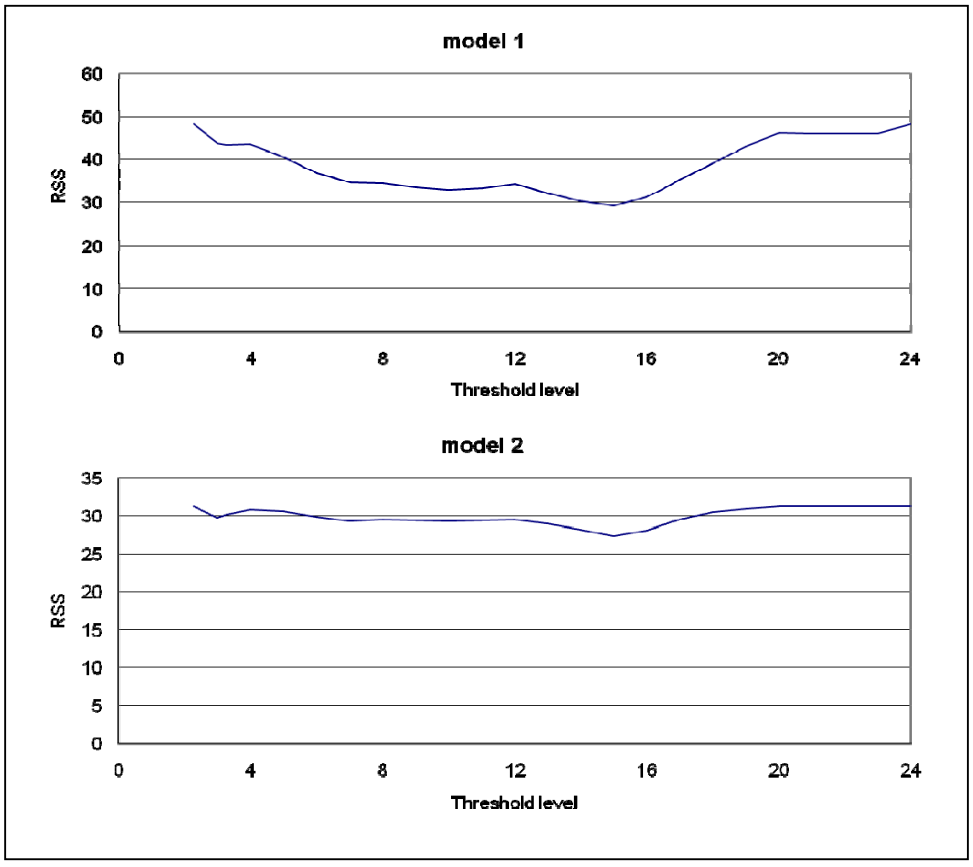
Source: Authors' estimation.

The second column gives the range over which the search for the threshold effect is conducted. The range is that of actually observed inflation in Egypt over the period of study. It extends from $\underline{INF}$ = 2.27 percent to $\overline{INF}$ = 24 percent with an increment of 1 percent. This yields 23 regressions for each specification of equation (2). The minimization of the vector of 23 RSSs occurs at the threshold inflation level. Applying this procedure for the previously estimated models 1 and 2 yields a threshold estimate of 15 percent for both models. The column LR_0 in Table 3 gives the observed value of the likelihood ratio. The significance levels (corresponding to both models) have been computed using the bootstrap distributions of LR_0. The null hypothesis of no threshold effects can be rejected at conventional levels of significance for both model 1 (at 1 percent significance level) and model 2 (at slightly more than 10 percent). Thus the two models support the existence of threshold effects at an inflation level of 15 percent (see Figure 2), although at different degrees of significance.

Table 4 provides the estimation results of equation (2) for the two models. For both models, all coefficients have the expected sign. For the years when inflation is less than or equal to 15 percent, the effect of inflation on growth is not significant. However, this effect is significantly negative for years when inflation rates exceed 15 percent. More specifically,

when inflation exceeds the estimated threshold by 1 percent, GDP growth would decline by 0.68 percent, according to model 1, and by 0.40 percent, according to model 2. [11]

Figure 2: Residual Sum of Squares as a Function of the Threshold Level



Source: Authors' estimation.

Recall that the existence of a threshold effect cannot be inferred simply from a classical test of equality between γ_1 and γ_2 as the distribution of the *t*-statistic for this variable is highly nonstandard under the null hypothesis of no threshold effect. This is why the null hypothesis has been tested using the bootstrap distribution of the likelihood ratio $LR_0(INF)$. However, the distribution of the *t*-values of all explanatory variables retains their usual distribution under the alternative hypothesis of a threshold effect.

[11] These declines in GDP growth rate correspond to an increase in inflation from 15 to 16 percent annually. Due to non-linearity of the relationship between GDP growth and inflation shown in Equation (2), GDP growth is expected to decline at a decreasing rate as inflation increasingly exceed the estimated threshold.

Table 4: Non-linear Least Squares Estimation

	Model 1	*Model 2*
Constant	-2.393	-4.383
	(-1.006)	(-1.408)
$(1 - d_t^{INF^*})\,[ln(INF_t) - ln(INF_t^*)]$	-0.096	-0.535
	(-0.136)	(-0.989)
$d_t^{INF^*}\,[ln(INF_t) - ln(INF_t^*)]$	-10.483***	-6.269**
	(-4.302)	(-2.379)
GOV	0.32	
	(1.716)	
GFCF	0.196**	0.2996***
	(2.203)	(3.278)
CRPRV	-0.0118	
	(-0.262)	
EXP		0.125*
		(2.08)
DERS		-2.6***
		(-3.713)
Threshold (%)	15***	15*
	[9.816]	[4.797]
N	25	25
R^2	0.642	0.663
AIC	86.783	85.232

Source: Authors' estimation.

† Dependent variable: GDP_GR.

† The t-statistics are in parentheses; Standard errors in square brackets.

* indicates significance at 10 percent level, ** indicates significance at 5 percent level, and *** indicates significance at the 1 percent level.

After establishing the existence of a threshold for the two models, the next important question is: how precise are these estimates? This requires the computation of the confidence region around the threshold estimate. While the existence of threshold effects in the relationship between inflation and growth is well accepted, the precise level of the inflation threshold is still subject to debate. Indeed, as highlighted earlier (see Section 2), based on existing studies, the range could be between 1 percent and 40 percent. If the confidence region shows that the threshold estimate is not significantly different from a large number of other

potential threshold levels, this would imply that there is substantial uncertainty about the threshold level. The confidence intervals here are indeed very wide, which implies that the thresholds are not precisely estimated. The 95 percent confidence intervals for models 1 and 2 are [12.028, 17.972] and [9.033, 20.967], respectively.

In sum, various models have been used to estimate the threshold above which inflation becomes detrimental to growth. In all cases, the estimated threshold was about 15 percent, but the threshold was found to revolve within a wide confidence interval ranging from 12 percent to 18 percent according to model 1 and from around 9 percent to 21 percent according to model 2. Thus inflation may start being harmful to growth starting around 9 percent to 12 percent. Non-linearity of the estimated GDP growth-inflation relationship indicates that exceeding the threshold level of inflation at its lower bound is more detrimental to growth than when exceeding the threshold level at its upper bound. This further implies that for a country targeting inflation, the target level of inflation should not exceed the lower limit of the threshold intervals.[12] Actually a non-zero level of inflation is preferable to take care of measurement errors and to secure to the monetary authorities the option of reducing real interest rates to negative levels. When real output is below its potential and when there are excess capacities, a very low inflation rate coupled with a recession and a very low nominal interest rate is a challenge for monetary policy as it deprives central banks from an important tool for stimulating the economy and increasing aggregate demand, as negative real interest rates become a non-feasible policy instrument. The remaining tools are to increase the monetary base and improve on financial intermediation and/or stimulate demand through fiscal expansion and its multiplier effect.

As shown in the literature, the effect of inflation on savings, investment and growth is ambiguous. According to the Tobin effect, higher inflation leads to lower real interest rate and induces portfolio adjustment away from real money balance towards real capital, and hence increases real investment and promotes GDP growth. However, in the case of developing countries with immature financial markets, the portfolio adjustment would be—as observed in Egypt—from real money to real estate (particularly land and consumer durables, which are

[12] Egypt has announced its intention to adopt inflation targeting as an objective to its monetary policy and is currently preparing for applying it, for more details see Al-Mashat (2008)

not usually considered as private investment) or to assets denominated in foreign currencies through capital flight.

It is also important to note that imperfect financial markets and structural rigidities emanating from protective labor laws constrained credit policy, and government intervention in commodity markets distort the signaling effects of prices and lead to inefficient allocation of resources, which in turn negatively affects growth. Hence the need for considering a realistic inflation target, falling within a wider range than that adopted in developed countries, such as 9 percent to 12 percent. Such a larger band would help maintain credibility of the Central Bank of Egypt (CBE), particularly in case of fiscal dominance in money creation and prevalence of structural constraints affecting the inflationary process.

Inflation in Egypt may not be considered an entirely monetary phenomenon. It is believed that inflationary pressures emanate from supply shocks, demand pull as well as structural constraints. Therefore, there are limitations on the capacity of CBE to fully control inflation. Hence, the recommendation of adopting a relatively wide band for the inflation target to ensure feasibility and establish the credibility of the CBE in conducting monetary policy is proposed.

6. CONCLUDING REMARKS

In this study, the inflation-growth relationship in Egypt has been analyzed. The main conclusion is that contemporaneous inflation has a robustly estimated negative impact on GDP growth.

The paper finds evidence that inflation above 15 percent has been associated with output losses. This estimate is higher than what has been found in studies using a similar functional form for inflation for longer panel datasets for both industrial (1-3 percent) and developing (11-12 percent) countries (Khan and Senhadji 2001). However, the estimated threshold for Egypt has been found to vary within a broad confidence interval with a lower bound ranging from 9 percent to 12 percent depending on the model considered for explaining GDP growth. Thus, like any other central bank, the CBE faces a *policy dilemma* in the decision making process. On the one hand, if monetary policy tends to be accommodative, it would create high inflationary expectations and would run the risk of inflation going out of control, eventually affecting economic growth adversely. On the other hand, if the policy is tightly directed at attaining inflation target and exchange rate stability, it is also feared to constrain economic

recovery and growth. A cautious course of action for the CBE is to keep inflation as low as possible, and at the same time observe to keep it not too far from the inflation rates of its major trading partners to avoid real appreciation and overvaluation of the Egyptian pound. Hence, the recommendation of keeping the inflation target around the lower bound of the estimated confidence interval of the estimated threshold (9 percent to 12 percent) is suggested.

Finally, price stability is emphasized as the major goal of central banks. Nevertheless, central banks in developing countries, including the CBE, being the dominant institutions in the financial market of their respective economies, bear other responsibilities, including structural development of the financial system, adequate credit creation for the private and public sectors, and external balance. In addition, when GDP is below its potential, monetary policy should avoid being restrictive to the extent of hindering output growth. These considerations constrain the ability of the CBE in controlling inflation, and threaten its functional independence and possibly its credibility.

REFERENCES

Al-Mashat, R. 2008. "Monetary policy in Egypt: A retrospective and preparedness for inflation targeting." *ECES Working Paper no. 134, June*. Cairo, Egypt: the Egyptian Center for Economic Studies.

Baer, W. 1967. "The inflation controversy in Latin America: A survey." *Latin American Research Review 2*, (February): 3-25.

Barro, R.J. 1991. "Economic growth in a cross-section of countries." *Quarterly Journal of Economics 106*(2): 407-433.

Bhatia, R. 1960-61. "Inflation, deflation and economic development." *IMF Staff Papers 8*: 101-114.

Bruno, M., and W. Easterly. 1998. "Inflation crises and long-run growth." *Journal of Monetary Economics 41* (February): 3-26.

Campos, Roberto de Oliveira. 1961. "Two views on inflation in Latin America." In *Latin American Issu*es, edited by Albert O. Hirschman, 69-79, New York: Twentieth Century Fund.

Christoffersen, P. F., and P. Doyle. 1998. "From inflation to growth: Eight years of transition." IMF Working Paper 98/99. Washington, D.C.: International Monetary Fund.

De Gregorio, J. 1992. "Effects of inflation on economic growth: Lessons from Latin America." *European Economic Review 36* (April): 417-425.

Felix, D. 1961. "An alternative view of the monetarist-structuralist controversy." In *Latin American Issues,* edited by Albert O. Hirschman, 81-93, New York: Twentieth Century Fund.

Fischer, S. 1983. "Inflation and growth." NBER Working Paper No. 1235*,* (November), Cambridge, Massachusetts: National Bureau of Economic Research.

———.1993. "The role of macroeconomic factors in growth." *Journal of Monetary Economics* 32: 485-512

Fischer, S., R. Sahay, and C. Vegh. 1996. "Stabilization and growth in transition economies: The early experience." *Journal of Economic Perspectives 10*, (Spring): 45-46

Friedman, M. 1973. *Money and economic development*. Toronto: Lexington Books (41).

Georgescu-Roegen, N. 1970. "Structural inflation - lock and balanced growth." *Economies et Societés* 4, (March): 557-605.

Ghosh, A. 2000. "Inflation and growth." IMF Research Bulletin 1: pp. 1-3.

Ghosh, A., and S. Phillips. 1998. "Warning: Inflation may be harmful to your growth." IMF Staff Paper, International Monetary Fund 45 (4): 672-710.

Gillman, M., M. Harris, and L. Matyas. 2004. “Inflation and growth: Explaining a negative effect.” *Empirical Economics 29* (1): 149-167.

Harberger, A. C. 1963. “The dynamics of inflation in Chile.” In *Measurement in economics: Studies in mathematical economics and econometrics in memory of Yehada Grunfeld*, by Carl Christ et al., 219-250. Stanford: Stanford University Press.

Hansen, B.1996. “Inference when a nuisance parameter is not identified under the null hypothesis.” *Econometrica 64*: 413–430.

———. 1999. “Threshold effects in non-dynamic panels: Estimation, testing, and inference.” *Journal of Econometrics 93*(2): 345–368.

International Monetary Fund. International Financial Statistics, online database. Washington D.C.: IMF/IFS.

Jung, W.S., and P.J. Marshall. 1986. “Inflation and economic growth: Some international evidence on structuralist and distortionist positions.” *Journal of Money, Credit and Banking 18* (May): 227-232.

Khan, M. S., and Senhadji, A. 2001. “Threshold effects in the relationship between inflation and growth.” *IMF Staff Papers 48* (1). Washington, D.C.: International Monetary Fund.

Kheir-El-Din, H., and T. A. Moursi. 2007. “Sources of economic growth and technical progress in Egypt: An aggregate perspective.” In *Explaining growth in the Middle East,* edited by J. Nugent and H. Pesaran, Elservier, chapter 7, 197-236.

Levine, R., and D. Renelt. 1992. “A sensitivity analysis of cross-country growth regressions.” *The American Economic Review 82*(4): 942-963.

Lucas, R. E. 1973. “Some international evidence on output - inflation trade-offs.” *American Economic Review* 63 (June): 326-334.

Paul, S., C. Kearney, and K. Chowdhury. 1997. “Inflation and economic growth: A multi-country empirical analysis.” *Applied Economics* 29: 1387-1401.

Pritchett, L. 1996. “Population growth, factor accumulation, and productivity.” Policy Research Working Paper, R/1567. Washington, D.C.: the World Bank.

Sala-i-Martin, X. X. 1997a. “I just ran four million regressions.” NBER Working Paper 6252. Cambridge, MA: National Bureau of Economic Research.

———. 1997b. “I just ran two million regressions.” *The American Economic Review 87*(2): 178–183.

Sarel, M. 1996. “Nonlinear effects of inflation on economic growth.” IMF Staff Papers 43 (March), 199-215. Washington, D.C.: International Monetary Fund.

Seers, D. 1962. “A theory of inflation and growth in under-developed economies based on the experience of Latin America.” *Oxford Economic Papers* 14 (June): 173-195.

Sidrauski, M. 1967. “Inflation and economic growth.” *Journal of Political Economy* 75 (December): 796-810.

Singh, K., and K. Kalirajan. 2003. “The inflation-growth nexus in India: An empirical analysis.” *Journal of Policy Modeling 25:* 377-396.

Taylor, L. 1979. *Macro models for developing countries*. New York: McGraw-Hill.

———. 1983. *Structuralist macroeconomics: Applicable models for the Third World*. New York: Basic.

Tobin, J. 1965. “Money and economic growth.” *Econometrica 33* (October): 671-684.

Vogel, R. C. 1974. “The dynamics of inflation in Latin America, 1950-1969.” *American Economic Review* 64 (March): 102-114.

World Bank. World Development Indicators, online database. Washington, D.C.: World Bank.