RELATIVE PRICE ADJUSTMENT AND INFLATION DYNAMICS: THE CASE OF EGYPT

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Abstract

This paper examines the role of relative price adjustment (RPA) as a key determinant of inflation in Egypt during the two recent inflationary waves starting 2003. The first three moments (the mean, variance and skewness) of the cross-section distribution of the detailed components of the Consumer Price Index (CPI) are analyzed to show how an increase in the intensity of RPA led to higher inflation. The effect of the recent inflationary shocks (the exchange rate devaluation; floatation of the pound; energy price increases; and the outbreak of the avian flu virus) on overall inflation is analyzed through the role of RPA. In addition, a GARCH-in-mean model of the inflation process is utilized to shed further light on the interaction of RPA and inflation uncertainty to keep inflation on a higher and more volatile path in recent years.

ملخص

تتناول هذه الدراسة بالتحليل دور تعديل الأسعار النسبية كأحد المحددات الرئيسية للتضخم في مصر خلال الموجتين الأخيرتين من التضخم بدءا من عام ٢٠٠٣. وقد تم تحليل العزوم الثلاثة الأولى (المتوسط، والتباين، والالتواء) للتوزيع المقطعي للمكونات التفصيلية للرقم القياسي لأسعار المستهلكين، وذلك لتوضيح كيف أدت الزيادة في كثافة تعديل الأسعار النسبية إلى ارتفاع التضخم. كما تم تحليل تأثير الصدمات التضخمية الأخيرة (تخفيض سعر الصرف؛ وتعويم الجنيه المصري؛ والزيادات في أسعار الطاقة؛ وانتشار فيروس إنفلوانزا الطيور) على التضخم الكلي من خلال تعديل الأسعار النسبية. بالإضافة إلى ذلك، تم استخدام نموذج GARCH-in-mean لعملية التضخم لإلقاء مزيد من الضوء على التفاعل بين تعديل الأسعار النسبية وحالة عدم اليقين بشأن التضخم والذي أدى إلى استمرار زيادة معدل التضخم وتقلبه خلال السنوات الأخيرة.

1. INTRODUCTION

The recent surge in inflation in Egypt has stimulated a heated debate in academic and policymaking circles. After a period of stability in the second half of the 1990s, inflation rates hiked to double-digit levels and have been subject to higher volatility amid lack of a coherent understanding of its underlying dynamics. With this turbulent behavior of prices, there are doubts about the prospects for a containment of the associated negative impact.

High and volatile inflation tends to reduce economic efficiency and has a negative impact on income and wealth distribution. It disrupts saving and investment decisions with a negative impact on long-term growth and employment. In addition, it reduces the efficiency of the price system in allocating resources as it makes it harder to distinguish between relative and absolute price movements. It also penalizes fixed-income earners (wage earners as well as recipients of pension, interest and rent), and it tends to benefit debtors at the expense of creditors.

If high inflation is correctly anticipated by economic agents, some of its negative consequences could be mitigated through indexation of contracts. However, in a high-inflation environment, inflation rates tend to be more volatile, and hence less predictable. This entails that the negative impact of high inflation can hardly be avoided due to the uncertainty it creates about future inflation.

Various explanations have been put forward to explain the sudden and intense rise in inflation in Egypt in recent years. These include the effect of the exchange rate devaluation coupled with absence of a nominal anchor after the floatation of the pound; excessive monetary growth; demand-pull factors due to rising household spending; supply-side factors (due to price adjustment in energy-related products and the outbreak of the avian flu virus); the impact of continuing structural adjustments in the economy; increasing market concentration in some industries and lack of competition which drove up mark-ups; and increasing tendency towards ad hoc pricing strategies by producers. Another factor that seems to be playing a significant role more recently is the increase in world food prices.

The objective of this paper is to shed light on the dynamics inherent in the two recent inflationary waves. Reference here is to the periods July 2003–March 2005 and June 2006–

April 2007.[1] In particular, the aim is to assess the impact of an important factor that seems to be largely overlooked in the current debate, which is *relative price adjustment (RPA)*. The paper seeks to measure the extent (or degree of intensity) of RPA in recent years, and establish its impact on inflation. This impact is part and parcel of the observed robust interrelationship between the mean and variability of inflation in the case of Egypt. As shown below, RPA encompasses some of the above-mentioned factors such as (i) the effect of the devaluation, (ii) the impact of the floatation of the pound and absence of a nominal anchor, (iii) price increases in energy-related products, and (iv) the effect of the avian flu virus.[2]

This does not mean that RPA is the only stimulant to the recent inflationary waves. Other factors are possibly at the interplay in Egypt's current inflation upheaval; however, the empirical results of this study suggest the centrality of the role of RPA. The paper reconciles evidence from cross-section data on the detailed components of the consumer price index (CPI) with time-series analysis of the inflation process to establish that RPA adjustment is responsible for much of the recently witnessed inflation in Egypt.

With the CPI being the focus of the study, it is worth mentioning that it does not accurately measure the extent of RPA in the economy due to two reasons: first, by construction, the CPI does not cover all production and services sectors in the economy; it only covers those which are of direct relevance to household consumption. That is why the studies on RPA in developed economies tended to focus on the producer price index (PPI), but such statistics are not yet available in Egypt. Second, the prevalence of administered prices (and possibly other sources of bias in measurement) creates some bias in measures of RPA relying on the CPI. With these considerations in mind, the focus on the CPI is maintained not only due to data availability considerations but also because of (*i*) its relevance to consumer saving and contracting decisions; (*ii*) its importance as a target variable for

[1] The sample of data used in this paper ends in April 2007. Recent data on headline inflation (i.e., overall inflation in the Consumer Price Index) indicate that the second inflationary wave might be subsiding as overall inflation recorded 7.5 percent and 6.8 percent in October and November of 2007, respectively.

[2] RPA also encompasses the effect of the recent increase in world food prices, but this is not captured in this set of data as it ends in April 2007.

monetary policy; and (*iii*) the historical prevalence of many subsidized items in the CPI, which enables the analysis of the impact of price liberalization on RPA.[3]

The rest of the paper is organized as follows. Section 2 discusses the two recent inflationary waves and the associated role of RPA. Section 3 provides a review of the literature. Section 4 presents the empirical results. Section 5 concludes and discusses the ensuing policy implications. Appendix A summarizes the methodology for the empirical analysis.

2. The Role of Relative Price Adjustment in the Recent Inflationary Waves

A relative price is the price of one commodity (or service) relative to other commodities in the economy. It can also be thought of as the price of output of one industry (or sector) relative to other industries. If one observes that an individual price (i.e., the price of a particular commodity) has increased, it is usually not clear whether this increase represents an absolute or a relative price increase. In the former case, the observed price increase could be of the same magnitude as price increases in all other commodities, which means that it is rising proportionally with the price level, but its relative price remains unchanged. In the latter case, the observed price increase could be higher (lower) than the increase in the general price level, which means that the relative price of this commodity has increased (decreased).

The most basic explanation for RPA is changes in the determinants of demand and supply of particular commodities. On the demand side, changes in real income, tastes, and expectations about future prices are key determinants. On the supply side, changes in resource prices, the tax structure, trade policies, subsidies on inputs to production, technology, and expectations about future prices all play a key role in determining the relative price of goods. In a dynamic economy, all of these factors are always interacting to bring about continuous changes in relative prices (Vining and Elwertowski 1976; Coorey, Mecagni, and Offerdal 1996).

Glejser (1965) lists factors that may give rise to RPA documented by actual historical examples from the US and European economies. These factors are: (i) the coexistence of over- and under-capacity utilization in different industries which places pressures on the

[3] An alternative price index is the wholesale price index (WPI), which has the advantage of having no administered prices, but the disadvantage of excluding services, which makes it irrelevant for consumer decisions and also does not permit the analysis of the effect of price liberalization on RPA. See IMF (2005) for a recent assessment of the methodology for compiling CPI and WPI statistics in Egypt.

prices of scarce resources; (ii) the differential impact of demand pressures depending on the market structure in different industries, and the degree of market concentration; (iii) cost-push factors such as wage increases due to strong labor unions; and (iv) the liberalization of administered prices (such as removing rent controls or subsidies).

Also, for small open economies, the nominal exchange rate is a key relative price determining the value of the domestic currency relative to other currencies. It is a major determinant of demand and supply in a country's external sector, i.e., exports and imports. Changes in the nominal exchange rate have a direct impact on costs of production through imported components, and may temporarily change demand patterns towards (or away from) domestically produced commodities.

In some cases, inflation expectations play an important role in relative price variability due to uncertainty about future inflation. Differential inflation expectations (i.e., an increase in the variability of inflationary expectations) lead to higher relative price variability[4] (Cukierman and Wachtel 1979). This would be the case in a high inflation environment with information asymmetries or in case of absence of a nominal anchor.

For economies undergoing transition from central planning to a market-oriented structure, the extent of adjustment will be more vigorous due to significant changes in the structure of production and demand. During transition, these economies are bound to experience a higher rate of inflation beyond what is explained by the stance of macroeconomic policies (monetary and fiscal policies), wage-related pressures due to labor market adjustment, and exogenous supply-side shocks. The reason is that the inflation process becomes partly driven by a continuous adjustment of relative prices during the transition (Coorey, Mecagni, and Offerdal 1996).

In such a case, an adjustment in the price of tradables relative to non-tradables takes place in reaction to trade liberalization and corrections in the real exchange rate. Prices of various sectors also adjust at variable rates as subsidies are gradually eliminated, and as the economy moves from a highly distorted price structure to a market-determined one. The adjustment in relative prices is often experienced for prolonged periods due to the (often) slow pace of structural reforms, the changing structure of output and demand associated with

[4] Throughout this paper, *relative price variability* and *relative price adjustment* are used interchangeably. An increase in relative price variability means an increase in the intensity of relative price adjustment.

the gradual move to a market economy, and the fact that prices in some services sectors (such as housing, utilities and transportation) take several years to adjust even after comprehensive price liberalization. This persistence of RPA may also be exacerbated by the prevailing market structure, and whether lack of competition in some markets and relatively small menu costs[5] allow erratic price-setting behavior.

All of the above-mentioned factors imply that RPA is a continuous process as different prices respond to heterogeneous demand and supply shocks of varying intensities; indeed it is. The question then becomes: why would an increase in the intensity of RPA lead to a higher overall rate of inflation? The answer to this question is provided in Section 3 below, which reviews the relevant literature. It will be shown that the distribution of individual price changes has specific characteristics that give rise to a positive association between the degree of RPA and overall inflation.

In the case of Egypt, and in particular during the two recent inflationary waves, the prime shocks affecting relative prices were: (i) the successive devaluations in the exchange rate, (ii) the announcement of the floatation of the pound and absence of an alternative nominal anchor, (iii) the adjustments in prices of energy-related commodities, and (iv) the outbreak of the avian flu virus. The dating of these shocks is shown in Figure 1. This does not, of course, exclude the likelihood that other factors (from both the demand and supply sides) may have exerted influence on relative prices given that this period witnessed various structural changes at an unprecedented pace.[6]

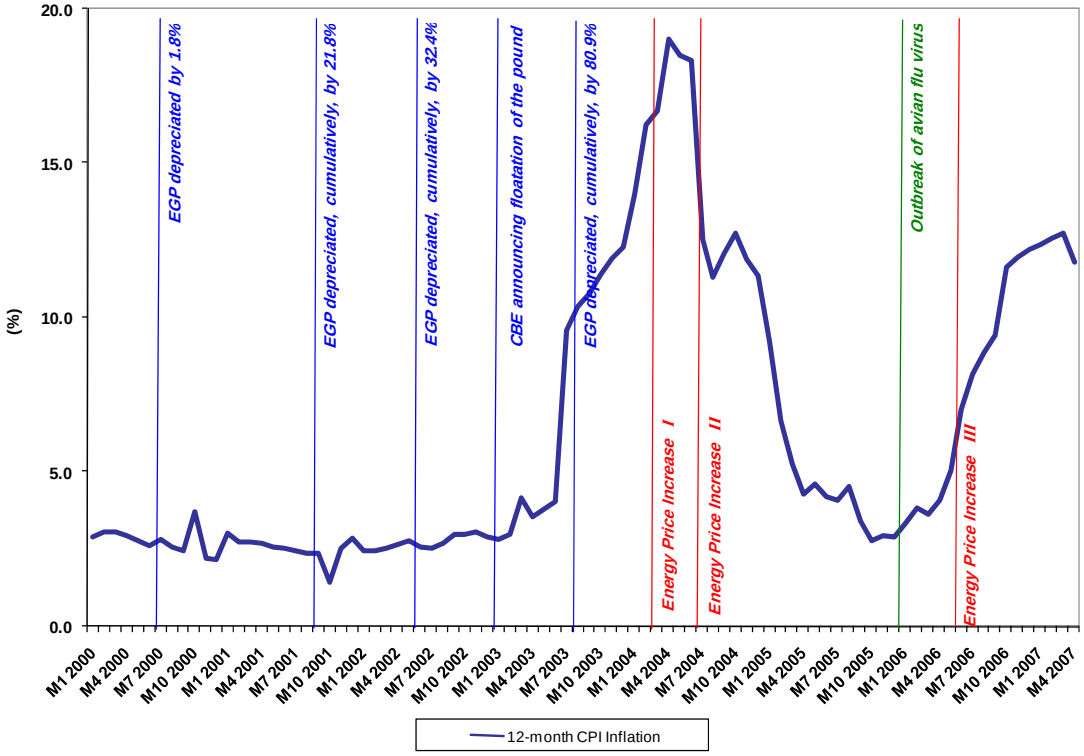
After a prolonged period of stability with inflation rates ranging between 2 and 3 percent, the rate of inflation started to accelerate with the first inflationary wave reaching a peak of 19 percent in April 2004. Afterwards, inflation rates gradually retreated to single-digit levels. Indeed, average inflation during the period April 2005–April 2006 was 3.7 percent. The second inflationary wave saw another run-up in the rate of inflation to peak in March 2007 at 12.7 percent. Recent data indicate that inflation is moderating as it reached 6.8 percent in November 2007; however, it is not yet clear if inflation will decline further given

[5] Menu costs refer to the cost to producers of changing the price of their output.

[6] These structural changes pertain primarily to the adoption of a new monetary policy regime, introducing a new income tax law, reforms in business regulations, trade policy reforms and a flourishing external sector with an influx of capital inflows.

the continued momentum from higher international food prices and expectations of the removal of food and energy subsidies due to the recent government announcements.

Figure 1. Dating of Shocks Triggering the Recent Inflationary Waves (January 2000–April 2007)



Source: Calculations based on monthly data from CAPMAS.
Notes: 1. EGP devaluation is calculated from a reference base of LE 3.4/USD. Calculations are based on the official—not the parallel market—exchange rate.
2. During this period, there were three adjustments in prices of energy-related commodities. Energy price increase I refers to the April 2004 increase in mazot prices by 37 percent. Energy price increase II refers to the August 2004 increase in asphalt prices by 37 percent, and the September 2004 increase in solar prices by 50 percent and mazot by 20 percent. Energy price increase III refers to the July 2006 increase in the prices of diesel by 25 percent, kerosene by 88 percent, and gasoline (octane 90) by 30 percent.

As shown in Figure 1, the first wave started to build momentum with the successive devaluations in the exchange rate. The Central Bank of Egypt (CBE) announcement of floating the pound seems to have been an unleashing factor that jump-started the first inflationary wave. This point in time is quite important as it marks a fundamental change in the mechanism of inflation-expectations formation. Historically, the exchange rate played an important role as a nominal anchor, and it is not surprising that the only period of low and stable inflation in the past 30 years was the period 1997-2001 when the official exchange rate was on a hard peg to the US dollar, and no parallel foreign-exchange market existed. With the

CBE announcement, the public lost their traditional, directly observable, and easily understood nominal anchor, and no alternative was put in place.[7]

In this context, the role of inflation uncertainty (due to absence of a nominal anchor) should receive due weight when discussing current inflation dynamics in Egypt. Uncertainty about future inflation leads to a wider spread of expectations about future inflation, which tends to increase relative price variability, and consequently increases overall inflation. As the rate of inflation increases, it also becomes more volatile, which may lead to an even higher dispersion in expectations.

On another front, the successive devaluations brought about significant corrections in the real exchange rate, which was misaligned from its equilibrium value; in particular, it was strongly appreciated in real terms prior to the devaluation. The devaluation also led to a direct increase in production costs.[8] This led to an immediate response in the prices of many goods and services including those not directly affected by the exchange rate. During the period 1997-2001, average inflation was 3.3 percent, and after the devaluation it reached an average of 7.9 percent during 2003-2004. It also induced intense RPA due to corrections in the nominal and the real exchange rate.

The peak of RPA (and also the peak for the rate of inflation) was reached in around May 2004, which is after the first energy price increase.[9] The first inflationary wave subsided by the end of 2005 as the cumulative effect of the devaluations and energy price shocks was fully adjusted for in the price level. The second inflationary wave started in early 2006 with the outbreak of the avian flu virus. The third phase of energy price adjustments also seems to have contributed to its momentum.

The increase in energy products' prices is considered a typical supply-side inflationary shock. This shock has an effect on consumer prices via two channels: (i) a direct increase in the prices of some goods and services (mainly the energy- and transportation-related items) due to an increase in costs; and (ii) an indirect increase in the prices of other goods and services that are not dependent on energy inputs. The latter effect occurs as the price of some

[7] It is worth noting that the exchange rate is de facto not floating as it remains managed by the CBE through interventions in the foreign-exchange market. So, the impact of the announcement pertains primarily to expectations formation, and this factor should be considered as distinct from the impact of the devaluation itself.

[8] Since about two-thirds of Egypt's imports are raw materials, intermediate, and investment goods.

[9] A measure of the extent of RPA is reported in Section 4, which presents the empirical results.

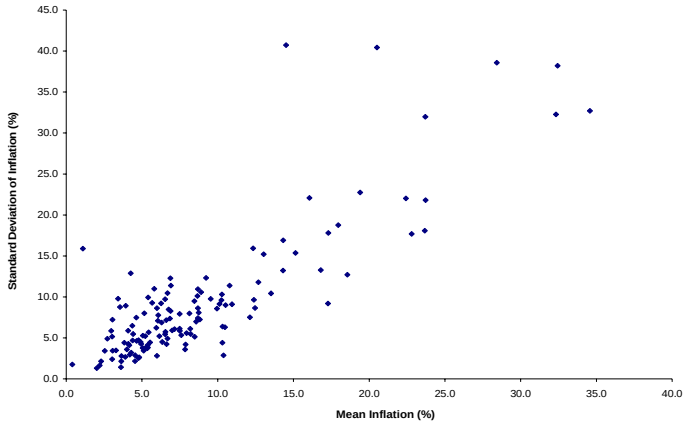
energy products—such as gasoline—is sort of a 'reference price' (or peripheral nominal anchor) for producers and consumers.[10]

3. LITERATURE REVIEW

To provide an appropriate background on the role of RPA in inflation dynamics, an appropriate starting point is the early studies, which discussed the interrelationship between the level and variability of inflation. Statistically speaking, there is no reason for the first two moments of a variable (that is, the mean and the variance) to be correlated; however, and as shown below, the peculiar features of the inflation process tend to give rise to this association.

The positive association between the mean and variability of inflation is a well-documented empirical regularity across countries and over time (Okun 1971; Logue and Willet 1976; Foster 1978; Fischer 1981; Ball and Mankiw 1995). Figure 2 shows the mean and standard deviation (as an indicator of variability) of the annual rates of inflation for 138 countries over the period 1959-2005.[11] The correlation coefficient between the mean and the standard deviation in the sample is 0.84 and is significant at the 1 percent level of significance. As highlighted below, this relationship is robust to both sample period and country coverage.

Figure 2. The Mean and Variability of Inflation for Selected Economies (1959-2005) Annual Percent Change (Based on Quarterly Data)



Source: Calculations based on quarterly data from the IFS online database.
Note: Sample range may differ across economies depending on data availability.

[10] The role that an item such as gasoline could play as a nominal anchor is amplified when its price remains unchanged for prolonged periods because of subsidies. See Ghali (1992) for a relevant discussion.

[11] This group of countries comprises developed and developing economies from all world regions, including Egypt. Countries, which have historically experienced hyperinflation (such as some Latin American economies, Lebanon and Turkey) have been excluded to preserve low-scaling of the chart and thus make it clearer. Adding those economies, however, does not alter the underlying pattern.

Okun (1971) was one of the earlier studies to document the association between the mean and variability of inflation. In many respects, his paper revived interest in this subject though it is by no means the first to document this observation.[12] Okun showed that there is a high and significant correlation between the mean and standard deviation of inflation across 17 OECD countries over the period 1951 to 1968. Gordon (1971) stated that Okun's results were sensitive to the chosen sample period. He argued that the observed association between the mean and variability of inflation is a feature of the selected economies during the 1950s but not the 1960s. Later on, the results of Gordon (1971) were refuted.

Logue and Willet (1976) used an extended sample of 41 countries (including developed and developing economies) over the period 1948-1970 to corroborate Okun's earlier findings. Foster (1978) used data on 23 countries over the period 1950-1975 and reached a similar finding even when measuring variability by first differences of the rate of inflation rather than the standard deviation.

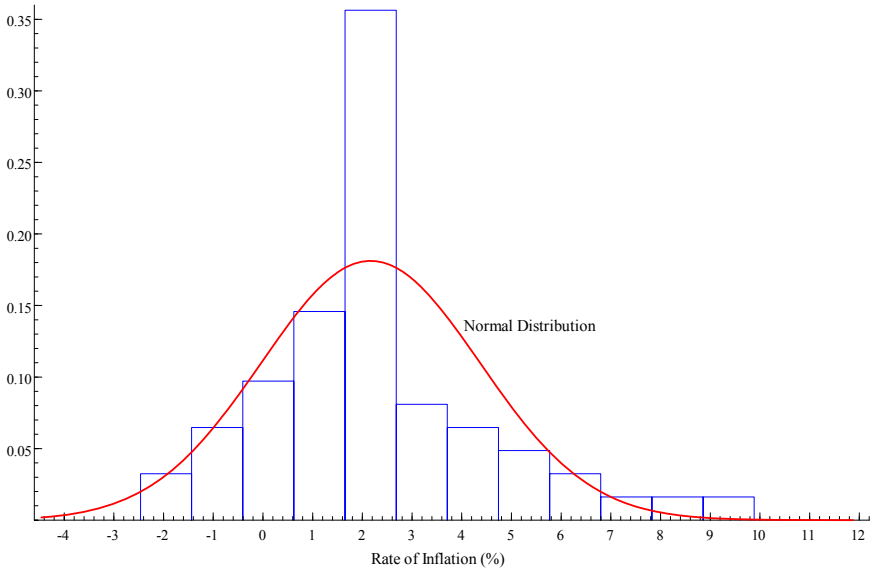
One interesting finding in Logue and Willet (1976) is that there seems to be a particular range of inflation (2-4 percent) where the positive association between the mean and variability of inflation ceases to exist. This indicates that as inflation rates go above this threshold, they tend to be more volatile and hence less predictable. One explanation they offer relates to the increase in variability in inflation expectations when actual inflation is above this threshold, a theme that is formally addressed in Cukierman and Wachtel (1979), and is discussed below.

In parallel to the interest in the relationship between the mean and variability of inflation, interest in the role of RPA in the inflation process gradually emerged. The paper by Vining and Elwertowski (1976) represents a seminal contribution on this subject. Using US data on the components of the wholesale price index (WPI) and the CPI over the period 1948-1974, they show that periods of inflation volatility tend to be accompanied by a high degree of dispersion in the rates of inflation of individual prices around the general rate of inflation. The latter is known as the *distribution of individual price changes*. An increase in the dispersion of this distribution is due to an increase in relative price variability (i.e., the intensity of RPA) in the economy.

[12] See Vining and Elwertowski (1976) and Scott (2000) for references on the subject dating back to the work of William Stanley Jevons in 1863. Glejser (1965) addressed the same subject by using cross-section data on 15 countries over the period 1953-1959.

To crystallize the concept of the *distribution of individual price changes*, Figure 3 below shows a hypothetical distribution of 60 commodities comprising a headline price index (say, the CPI). It is a frequency distribution that classifies all commodities into classes depending on the observed rate of inflation.

Figure 3. A Hypothetical Distribution of Individual Price Changes for 60 Commodities



Source: Constructed by the author.

According to this hypothetical distribution, the prices of most commodities have increased while those of some commodities have declined. About 35 percent of the included commodities (21 out of 60 commodities) had a rate of inflation between 1.6 percent and 2.6 percent. The mean of this distribution is roughly 2.2 percent. In comparison with the reference normal distribution, the distribution is positively skewed with a few commodities increasing at a much faster rate than the mean rate of inflation. If the spread (or variance) of this distribution increases, this is an indication of higher relative price variability, and this higher variability implies an increase in the intensity of RPA (Vining and Elwertowski 1976; Coorey, Mecagni, and Offerdal 1996).

Vining and Elwertowski (1976) also spotted an important feature of this distribution, which is its tendency to be asymmetrical (in particular, *positively skewed*) during periods of high and volatile inflation. This means that most commodity groups' price changes are below the mean rate of inflation and only a few are above the mean but at a great distance from it. In

other words, it is as if the mean rate of inflation is being 'pulled up' by a few leading commodity groups that have a dominant effect.

In reaction to the paper by Vining and Elwertowski (1976), a number of studies provided empirical support to the observed association. Parks (1978) reached a similar conclusion with evidence from the Netherlands (1921-1964) and the US (1930-1975). Extending the same US dataset used in Parks (1978), Fischer (1981) found a significant association between inflation and relative price variability, with the association being strongest in the sample containing post-1972 data.[13]

Blejer and Leiderman (1982) consider the distinction between tradables and non-tradables in the relationship between inflation and relative price variability. Using data from Mexico over the period 1951-1976, they find that the relationship between inflation and relative price variability is only significant in the tradable-goods sector. Pagan, Hall and Trivedi (1983) also find favorable evidence using Australian data for the period 1968-1982.[14] Coorey, Mecagni, and Offerdal (1996) uncover an important role for RPA in inflation dynamics in 21 transition economies, especially during the transition period.

With respect to the theories attempting to explain this relationship, Coorey, Mecagni, and Offerdal (1996) provide a useful taxonomy depending on the assumed direction of causality between inflation and relative price variability. The *first* class of theories postulates that higher inflation (or higher unanticipated inflation) leads to higher relative price variability (Sheshinski and Weiss 1977; Parks 1978). The rationale in these models is that firms are subject to menu costs, and when the overall rate of inflation rises, not all firms are able to adjust prices at the same time, which leads to a greater dispersion of relative price changes. The same result occurs in economies with administered prices; at high rates of inflation, liberalized sectors can adjust their prices while controlled sectors cannot, which tends to increase the dispersion of relative price changes.

The *second* approach assumes that the direction of causality runs from relative price variability to inflation (Fischer 1981; Ball and Mankiw 1995). The time framework in this

[13] This could be interpreted in light of the post-1972 shocks in international oil prices, which have probably induced a strong wave of relative price adjustment associated with higher inflation.

[14] This study utilizes econometric techniques that are consistent with the presence of heteroskedasticity in the data. Their approach is similar in spirit to that of Engle (1982), although the latter is superior as it allows for a direct estimation of the time-varying conditional variance of the error term in the inflation equation. A variant of the Engle (1982) model is used in Section 4.

context is in the short- to medium-term, as inflation in the long run is determined by monetary growth. Fischer (1981) discusses asymmetric price adjustment as a possible explanation for the relationship with a direction of causality running from relative price variability to inflation. Under this explanation, the dispersion in relative price changes increases with real sectoral shocks, and firms not directly affected by the shock tend to increase prices to avoid a decline in their own relative prices, and this adds to the momentum of inflation. Ball and Mankiw (1995) reach a similar result by incorporating the skewness of the distribution of individual price changes into the analysis.

The *third* class of theories assumes that both unanticipated inflation, the temporal variance of the general rate of inflation, and the dispersion of relative price changes are all simultaneously affected by aggregate and relative demand shocks (Cukierman 1979; Cukierman and Wachtel 1979; Geraats 2006). Other studies (Hercowitz 1981; Devereux 1989) introduced additional elements into the analysis such as money growth and the response of monetary policy to macroeconomic shocks.

Besides the discussion of the direction of causality between the mean and variability of inflation, another emerging focus in the literature was the positive association between the level of inflation and inflation uncertainty.[15] One explanation for this association is that in an inflationary environment, there will be more uncertainty regarding the future direction of government policy, which causes more uncertainty about future inflation (Okun 1971; Friedman 1977).

Another line of thought, which is more relevant to the present study, focuses on the impact of inflation uncertainty on relative price variability (Parks 1978; Blejer and Leiderman 1982). Because inflation uncertainty is a variable that is not directly observable, a number of methods have been devised to estimate it. These mostly focus on estimating the variance of the errors made in forecasting inflation. This is the approach adopted in Engle (1982), and Pagan, Hall, and Trivedi (1983).[16] Engle (1982) assumes that those errors are heteroskedastic and their time-varying conditional variance is jointly determined within the model. The approach in Pagan, Hall, and Trivedi (1983) was that of a regression model complemented by testing for heteroskedasticity in the residuals. The former approach is well-known as the

[15] In this context, an increase in inflation uncertainty is characterized by an increase in the dispersion of inflation expectations.

[16] See also Holland (1984) for an application to US data.

Autoregressive Conditional Heteroskedasticity (ARCH) model. It is also superior because it allows obtaining estimates of the variance of inflation shocks (whether shocks due to relative price variability or due to other factors).

In the present study, the model in Ball and Mankiw (1995) is adopted as it emphasizes the role of asymmetric price adjustment in reaction to real sectoral shocks due to the skewness of the *distribution of individual price changes*. Other theories, which propose an opposite direction of causality or joint determination of both RPA and inflation overlook the characteristics of this distribution although it is an important micro foundation for the observed association.

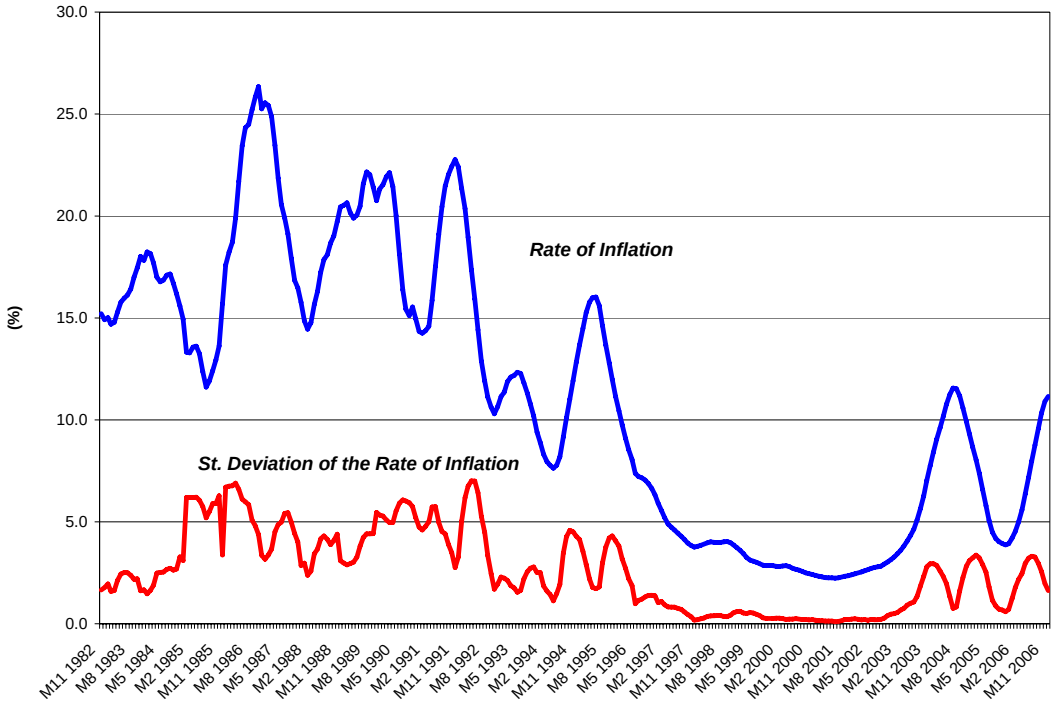
Ball and Mankiw (1995) show that an increase in the variance of the *distribution of individual price changes* leads to higher inflation only if this distribution is positively skewed. Their model shows how the first three moments of inflation (mean, variance and skewness) interact to create such dynamics where an increase in the variance of the distribution causes higher inflation. As indicated above, the variance of the distribution tends to increase at times of significant adjustment in relative prices. What is implied in this case is contemporaneous causality with no lag/lead impact.

The analysis of the *distribution of individual price changes* will be complemented with a time-series-based approach to study the variance of shocks to inflation in Egypt. The time-series-based approach will rely on estimates of the conditional standard deviation of shocks to inflation from a GARCH-in-mean model, which is a variant of the Engle (1982) model that was first introduced in Engle, Lilien, and Robins (1987). The GARCH-in-mean model allows for a direct test of the hypothesis that the direction of causality runs from RPA to overall inflation as demonstrated in Ball and Mankiw (1995). The results from both approaches will be reconciled to provide support to the research hypothesis of this study.

4. Empirical Results

The historical evolution of inflation in Egypt suggests that the mean and variability of inflation are positively associated. Figure 4 displays the mean and the standard deviation of the annual rate of inflation (based on monthly observations) over the period from November 1982 to December 2006. The robustness of the association is visually evident; the correlation coefficient between the two series is 0.76 and is statistically significant at the 1 percent level of significance.

Figure 4. The Mean and Variability of Inflation in Egypt (November 1982–December 2006), Annual Percent Change (Based on Monthly Data)



Source: Calculations based on monthly data from the IFS online database.
Notes: An 11-month centered moving average is taken as the mean of inflation at the specified point in time to dampen excessive volatility in inflation rates especially during the 1980s, but without changing underlying patterns. Similarly, the standard deviation is calculated as the spread of the rates of inflation of a period of 11 months around the centered month. This measure tracks the decrease/increase in the variability of the rate of inflation over time.

It is clear from Figure 4 that the only period of low inflation (which is 1997-2002) was concomitant with low inflation volatility. Before and after this period, high inflation was consistently accompanied by higher volatility.

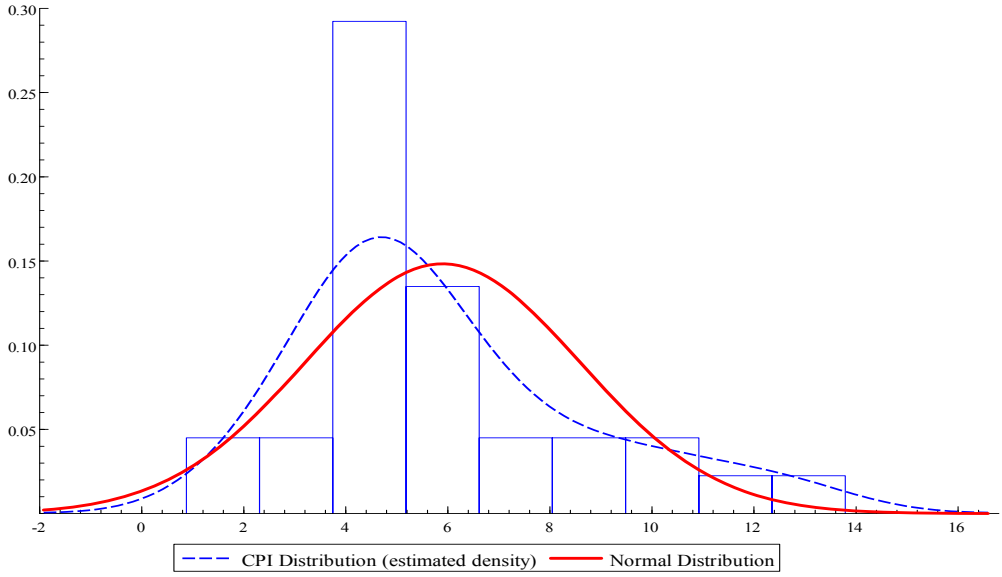
Following Ball and Mankiw (1995) and Coorey, Mecagni, and Offerdal (1996), the moments of the *distribution of individual price changes* are studied over the period January 2000–April 2007 to measure the extent of relative price adjustment and its interaction with the overall (mean) rate of inflation; this is undertaken in Section 4.1. Section 4.2 presents the estimation results of the GARCH-in-mean model.

4.1. The Impact of Relative Price Adjustment

As indicated above, an increase in RPA tends to increase the mean of inflation only if the *distribution of individual price changes* is positively skewed. Figure 5 shows the *distribution of individual price changes* of the 31 different commodity groups comprised in Egypt's CPI

over the period January 2000 to April 2007.[17] The listing of those items is in Table 1 below. Compared to the reference normal distribution, the distribution is positively skewed with a coefficient of skewness of 1.05; the normality of the CPI distribution is rejected at the 10 percent level of significance as indicated by the Jarque-Bera test statistic.

Figure 5. The Distribution of Individual Price Changes: Histogram and Estimated Density, Annual Percent Change (January 2000–April 2007)



Source: Calculations based on monthly data from CAPMAS.

Two observations are worth noting with respect to this distribution. First, the mean of the distribution is 5.9 percent, and the median is 4.9 percent. This means that the average tendency for inflation is somewhere in this range. This is a rather high average tendency and is not compatible with price stability as it implies that the price level will double approximately every 13 years. Second, the left-hand-side of the distribution is over positive rates of inflation, which confirms the widespread observation that prices in Egypt are characterized by downward stickiness; prices of various goods and services tend to increase and they rarely show declines.

[17] The dataset of index numbers of the different CPI components starts in 1999, but 12 observations are lost to compute the annual rate of inflation. Employing a longer time series was not possible due to changes in the definitions of the CPI components prior to 1999.

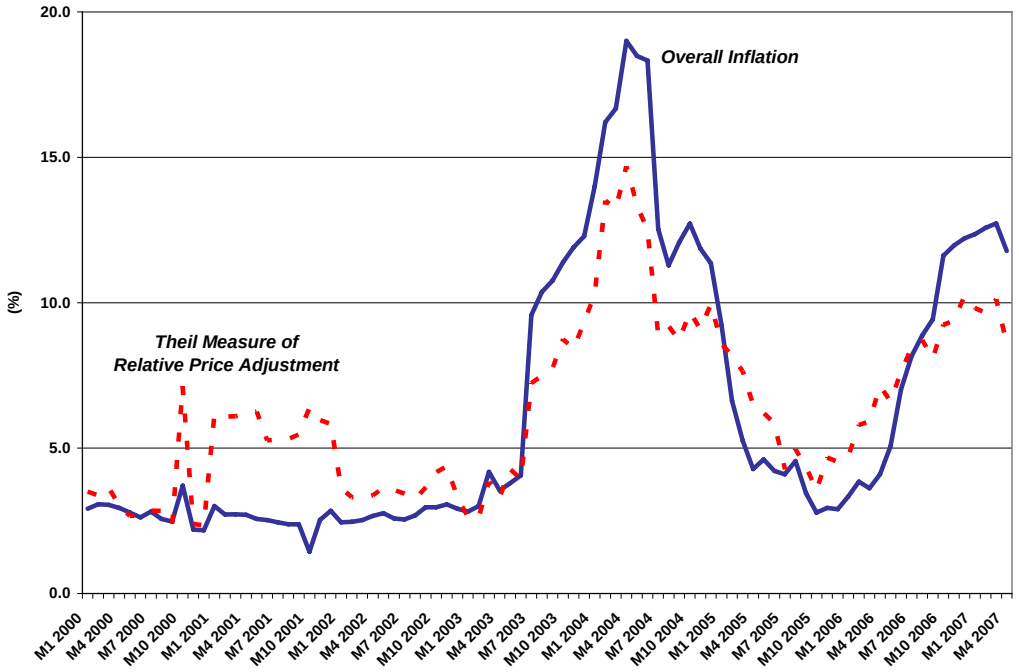
Table 1. Inflation Rates in the Detailed CPI Components

CPI Group	Weight (%)	Average Inflation Rate January 2000-April 2007
Vegetables	4.4%	12.9
Communications	1.2%	12.1
Fruits	3.6%	10.7
Fish	2.4%	9.9
Meat and Poultry	11.2%	9.3
Milk & Cheese	6.3%	8.7
Sugar & Sweets	1.8%	7.4
Domestic Services	1.0%	7.4
Recreational & Cultural Services	5.4%	6.6
Oil & Fats	3.5%	6.5
Pulses	0.8%	6.2
Mean Rate of Inflation at 5.9%		
Other Food Stuffs	2.2%	5.8
Cigarettes & Tobacco	3.1%	5.7
Private Transportation	4.0%	5.2
Fabrics	0.2%	4.9
Restaurants & Hotels	1.6%	4.9
Education	5.2%	4.8
Bread and Cereals	6.4%	4.7
Maintenance Products	2.5%	4.6
Clothing Tailoring	0.1%	4.5
Physicians & Hospitals	1.7%	4.5
Footwear	2.3%	4.4
Clothing	7.0%	4.4
Personal Care	5.2%	4.1
Public Transportation	3.1%	4.1
Beverages	1.5%	4.0
Fuel & Electricity	3.3%	3.9
Furniture & Carpets	1.4%	3.6
Medical Products, Appliances and Equipment	2.2%	2.6
Equipment	0.3%	2.3
Rent, Water & Maintenance	5.0%	2.1

Source: Calculations based on monthly data from CAPMAS.

The positive skewness of the distribution indicates that the inflationary process is led by relative price increases of a few commodity groups (with inflation rates above the mean), whereas the majority witnessed relative price declines (with inflation rates below the mean); see Table 1. The groups that witnessed relative price increases are mainly food items in addition to communications, domestic services, and recreational and cultural services. Given the relatively large weight of these food items in the consumer basket, their impact on overall inflation is rather significant.

Figure 6. Overall Inflation and the Theil Measure of Relative Price Adjustment (January 2000–April 2007)



Source: Calculations based on monthly data from CAPMAS.
Note: The Theil measure used in this figure is the standard deviation of the Theil variance to maintain same unit of measurement.

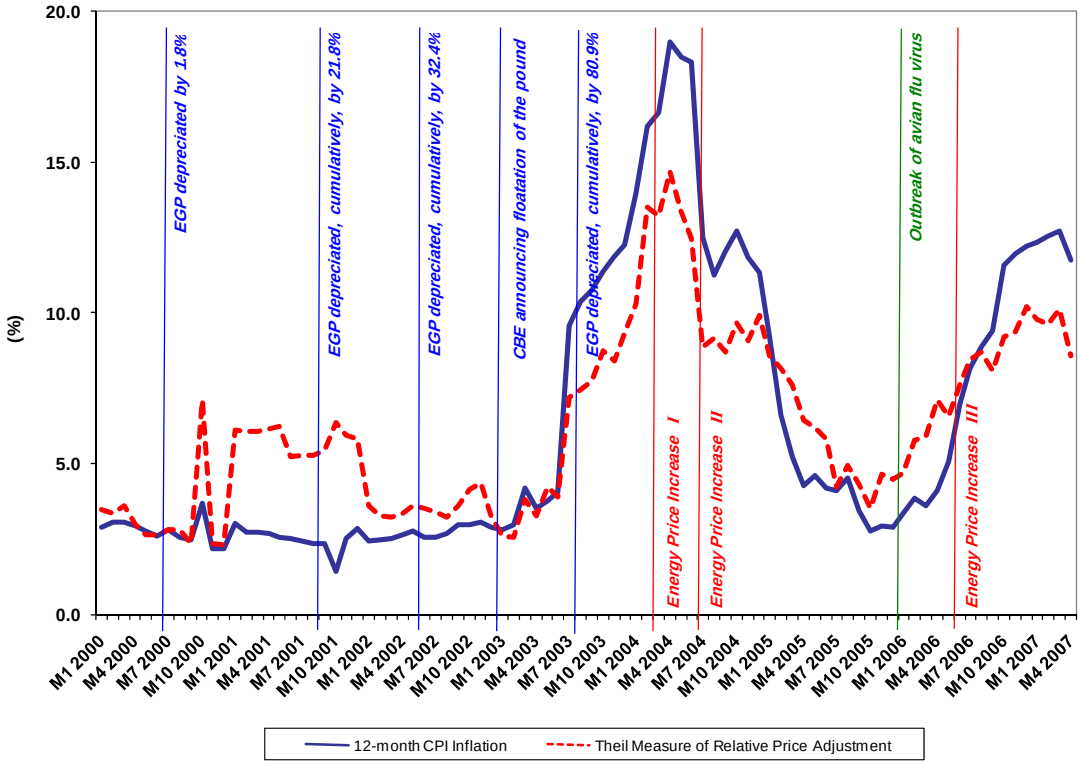
The positive skewness of the distribution also indicates that a positive association should exist between inflation and the extent (or degree of intensity) of relative price variability, where the latter is measured by the Theil measure of RPA.[18] As shown in Figure 6, the degree of association between the Theil measure of RPA and inflation is quite remarkable, which indicates that RPA has been a key stimulant in the recent inflationary waves.

Figure 7 uses the same dating of shocks presented earlier to show how these shocks induced higher RPA and consequently higher inflation. The successive devaluations immediately triggered some adjustment in relative prices (as can be seen from the increase in the Theil measure of relative price variability) but without significantly affecting the mean of inflation. This can be attributed to one of two factors (or both combined): (i) the increase in

[18] See Appendix A for computation methodology. The weights used in the calculation are those of the 1995/1996 Household Income-Expenditure Survey to maintain consistency of the dataset obtained from CAPMAS. The results are largely insensitive to the weights being used as the unweighted moments (i.e., the unweighted mean and unweighted Theil measure of RPA) show similar trends.

RPA was not large enough to affect the mean of inflation, which still exhibited inertia from the previous period; and (ii) the weight on the items that started to increase at faster rates was negligible.[19]

Figure 7. Dating of Shocks Conducive to Relative Price Adjustment (January 2000–April 2007)



Source: Calculations based on monthly data from CAPMAS.
Note: See notes on Figure 1 for further information about these shocks.

The impact of the CBE announcement of the floatation of the pound (and the adoption of inflation targeting as an alternative monetary policy regime) cannot be overstated. It coincides with the start of a vigorous process of RPA possibly due to a higher differential in inflation expectations, due in turn to higher uncertainty about future inflation in the absence of a nominal anchor. This conclusion is further confirmed by the estimation results of the GARCH-in-mean model presented in Section 4.2. In the two inflationary waves, energy price increases and the outbreak of the avian flu virus were exacerbating factors.

[19] The CPI components, which caused an increase in relative price variability immediately after the devaluation were mainly non-tradable services components. The combined weight of those components does not exceed 20 percent of the total CPI basket.

Looking deeper into the impact of these shocks on tradables and non-tradables, Table 2 shows the decomposition of the Theil measure of RPA into variance due to tradables (VT), variance due to non-tradables (VNT), and covariance between tradables and non-tradables (VTNT).[20]

Table 2. Decomposition of the Theil Index of Relative Price Adjustment

Period	Variance between Tradables	Variance between Non-Tradables	Covariance between Tradables and Non-Tradables	Total
2000	47.0	45.5	7.5	100
2001	12.2	75.9	11.9	100
2002	78.3	4.5	17.3	100
2003	55.6	17.1	27.3	100
2004	51.8	19.0	29.3	100
2005	59.3	38.0	2.7	100
2006	75.0	22.0	3.0	100
January - April 2007	80.5	19.0	0.4	100

Source: Calculations based on monthly data from CAPMAS.
*Note*s: Totals may not add up to 100 due to rounding. Calculations are based on calendar years.

It appears that the tradables sector is the dominant source of relative price variability during the two inflationary waves. This is the case because the tradables group is dominated by food items that have volatile rates of inflation. The weight of food items in the tradables group is about two-thirds and they constitute about 43 percent of the total CPI, which is a rather significant weight. In developed economies, the share of food items in the CPI is in the range of 10-15 percent, and in emerging-market economies (including China) is about 30 percent (Johnson 2007). This explains the sensitivity of the overall price level in Egypt to changes in food prices.

The year 2001 appears as an exception because it was actually a year of low inflation (with an average rate of inflation of about 2.5 percent); however, during this year, the prices of some non-tradable components (mainly, recreational and cultural services, education, restaurants and hotels, and clothing tailoring) had inflation rates that were markedly above the mean, and this explains the dominance of non-tradables as a source of relative price variability in 2001. However, their impact on overall inflation is subdued due to their small weight in the CPI basket.

[20] Of course, the distinction between tradables and non-tradables is tricky given that the increasing liberalization of trade in services implies that services, which are classified traditionally as non-tradables are becoming increasingly tradable across borders. However, for the purposes of this study, a traditional classification is maintained bearing in mind its limitations. The classification is included in Appendix A.

It is also to be noted that the low proportion of variability due to non-tradables is a feature of developing economies (Coorey, Mecagni, and Offerdal 1996). This is due to the fact that prices of non-tradables tend to be publicly administered either due to direct provision of those services through public entities with an implicit subsidy (such as health, education and transportation) or due to government regulation (for instance, rent controls). This also renders their relative weight in the CPI lower than its counterpart in industrialized countries as their relatively low prices indicate that a smaller share of household spending is allocated to these items.

These results have two important implications. On the one hand, the dominance of the tradables sector as a source of relative price variability implies that overall inflation is highly responsive to external shocks as they impact tradables more than non-tradables. This appears to be of relevance in the present time as the surge in international food prices seems to be creating further upward pressure on prices.[21] This may partially explain the recent move by the CBE to allow some nominal appreciation to moderate the impact of this shock.

On the other hand, as liberalization of the services sector proceeds, the prices of non-tradables will gradually increase, which will increase the relative weight of non-tradables in the CPI. As this component is more resilient to external shocks, the long-run outcome may be more resilience of relative price variability (and consequently overall inflation) to negative external shocks. However, during the period of liberalization of the services sector, mean inflation will inevitably be high compared to the range of 2-4 percent, which is considered as consistent with price stability in reference to the current literature on inflation targeting.

4.2. GARCH-in-Mean Model Estimates

The GARCH-in-mean model comes as a natural extension for the analysis above. It allows for the simultaneous modeling of a variable (in this case inflation) and the variance of its shocks (in this case the variance of shocks to the mean rate of inflation emanating from relative prices adjustment and other factors). GARCH-in-mean models also allow the variance (or standard deviation) of shocks to appear as a regressor in the mean equation, which enables inference about direction of causality. Details about the methodology are included in Appendix A.

[21] The significance of this factor started to take shape in the last few months. As the data on the detailed CPI components available for this study stops at April 2007, the impact of this shock cannot be quantitatively assessed.

The GARCH-in-mean model utilizes a larger sample from November 1981 to December 2006, with the terminating date dictated by the availability of data on reserve money. The following are estimates of equations (A.7) and (A.8) in Appendix A using maximum likelihood estimation for a GARCH (1,1) process with z-statistics in parenthesis:[22]

$$\pi_t = 0.20 + 0.88\pi_{t-1} + 0.002MON_{t-12} + 0.36\sigma_t$$
(z-stat) *(31.1)* *(3.0)* *(2.4)*

$$\sigma_t^2 = 0.00 + 0.35\varepsilon_{t-1}^2 + 0.76\sigma_{t-1}^2$$
(z-stat) *(6.9)* *(30.0)*

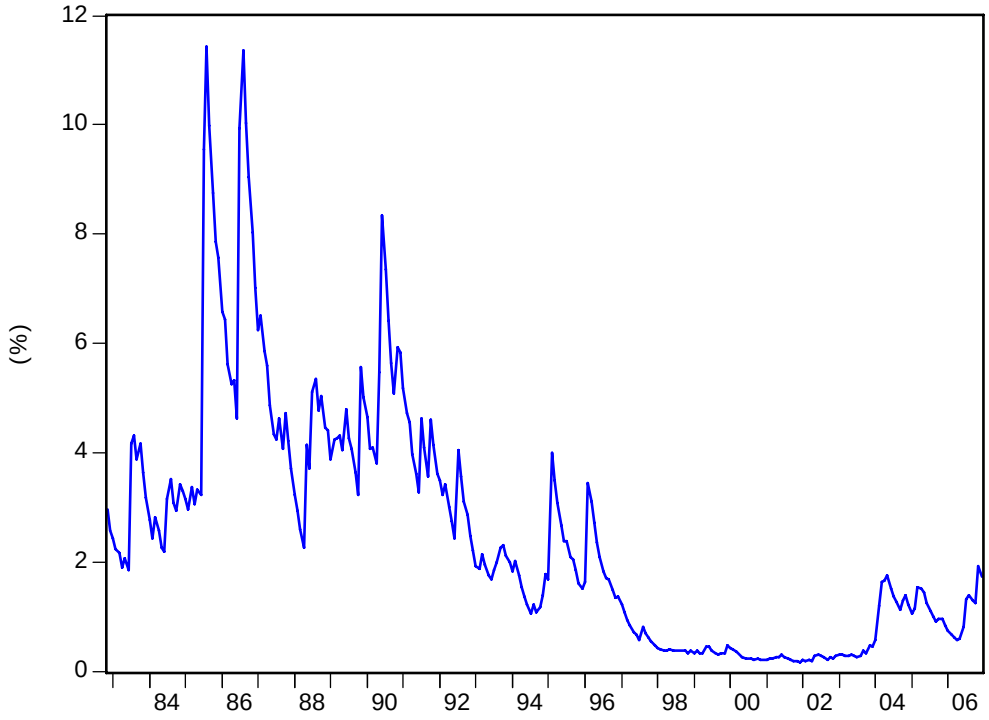
In the mean equation, inflation (π_t) appears as strongly inertial, and lagged money growth (MON_{t-12}) seems to be playing a negligible role in affecting inflation given its small coefficient. The coefficients of both variables are significant at the 1 percent level of significance. The conditional standard deviation (σ_t) appears with a positive sign (as expected a priori) and is significant at the 5 percent level of significance. Its magnitude suggests that a 3 percent increase in the variance of non-modeled inflationary shocks adds about 1 percent to mean inflation.

The estimates of the conditional standard deviation of the error in the inflation equation are shown in Figure 8. These can be interpreted as estimates of *inflation uncertainty* in the Egyptian economy during the period November 1982–December 2006 as 12 observations at the beginning of the sample are used to construct these estimates.[23] These estimates exhibit quite interesting dynamics in light of previous findings.

[22] See Appendix A for model specification and variable notation.

[23] See Engle (1983) and Evans (1991) among others.

Figure 8. Estimates of the Conditional Standard Deviation of Error in the Inflation Equation (November 1982–December 2006)



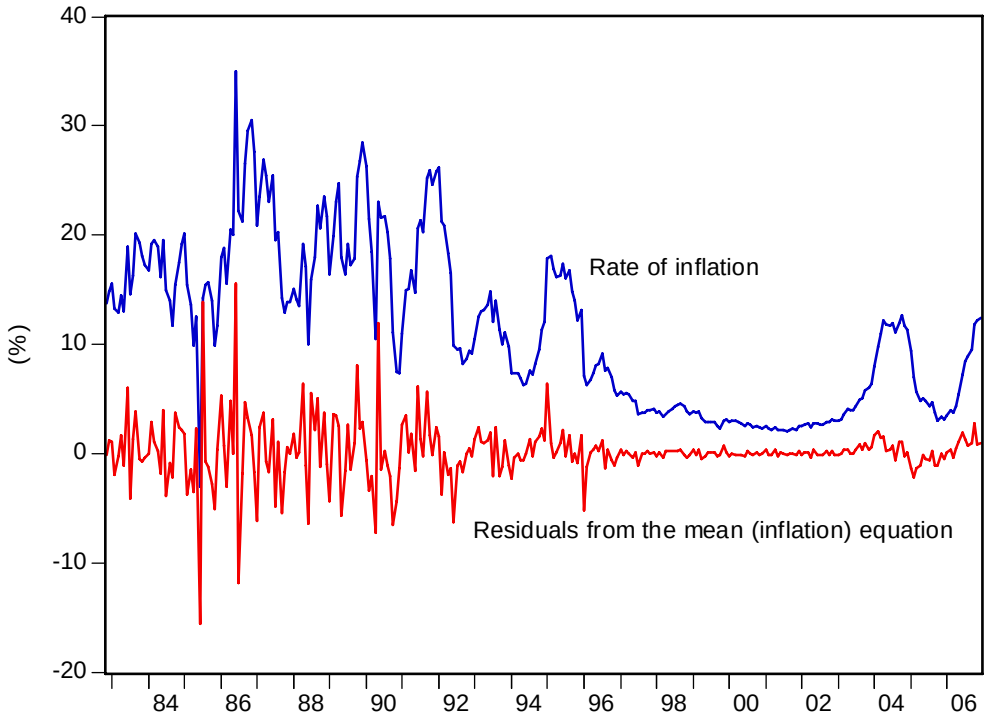
Source: Estimates based on the GARCH-in-mean model. Data source is the IFS online database.

It is clear that the period of the 1980s was characterized by high inflation uncertainty given high and volatile rates of inflation at that time which emanated from the monetization of the government budget deficit and de facto absence of a nominal anchor.[24] The second half of the 1990s witnessed remarkably low inflation uncertainty as inflation expectations stabilized with the successful peg of the pound to the US dollar. By the end of 2003, inflation uncertainty re-surfaced suggesting that the two recent inflationary waves were accompanied by a higher dispersion in inflation expectations due to absence of a nominal anchor. As shown

[24] Although the official exchange rate was stable during this period, most of the transactions took place in the parallel (black) market at which the exchange rate was continuously depreciating. See Noureldin (2006) for a discussion of inflation dynamics during the period 1980-2002.

in Figure 9, the residuals from the mean equation started to exhibit larger variability with the start of the first inflationary wave.[25]

Figure 9. Rate of Inflation and Residuals from the Inflation Equation (November 1982–December 2006)



Source: Estimates based on the GARCH-in-mean model. Data source is the IFS online database.

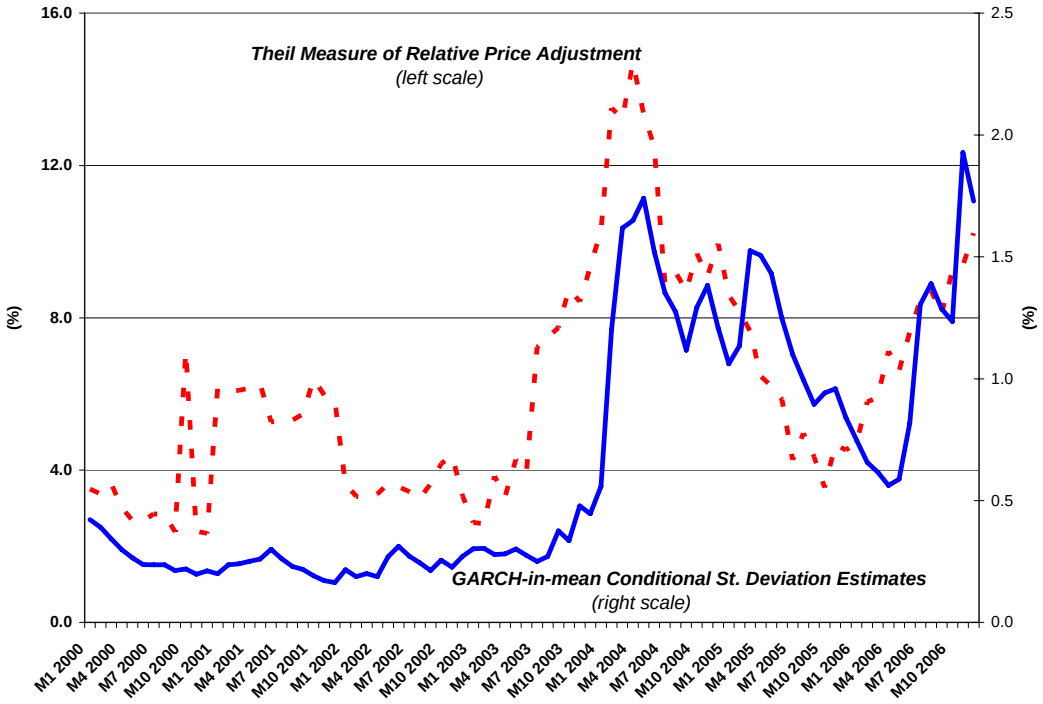
Figure 10 below plots the Theil measure of RPA along with the conditional standard deviation estimates from the GARCH-in-mean model for the period January 2000–December 2006 as the Theil measure of RPA is only available starting January 2000. Although the computation of each series is based on a different dataset and a different analytical approach, the two estimated series exhibit rather similar trends during the two inflationary waves.

The Theil measure of relative price variability is estimated based on the *distribution of individual price changes* using the detailed components of the CPI. Estimates of the

[25] It is important to note that according to the IFS data, the first inflationary wave starts in late 2003, with a lag of about 6 months compared to CAPMAS data. One possible reason for this anomaly is differences in methodologies to reconcile the effect of re-constructing the CPI index, which was undertaken by CAPMAS in the second half of 2003. This issue only affects the timing of the start of the inflationary waves with the main conclusions remaining intact.

conditional standard deviation from the GARCH-in-mean model represent estimates of the error undertaken when forecasting inflation with traditional determinants (such as past inflation and monetary growth); hence, it proxies inflation uncertainty in the economy. The two series are positively correlated with a correlation coefficient of 0.71, which is significant at the 1 percent level of significance.

Figure 10. Relative Price Adjustment and Inflation Uncertainty (January 2000–December 2006)



Source: Calculations based on monthly data from CAPMAS and the IFS online database.

Granger causality test[26] (including up to a lag of three months) indicates that changes in the Theil measure of RPA temporally preceded the increase in inflation uncertainty (or the increase in the spread of inflation expectations). This result indicates that the factor that triggered the process of RPA was initially the successive devaluations of the Egyptian pound, but the announcement of the floatation of the pound had a dual impact of intensifying the process of RPA as well as increasing inflation uncertainty.

Given the clear temporal association between the Theil measure of RPA and inflation uncertainty over the two inflationary waves, it could be argued that absence of a nominal

[26] It is to be noted that Granger Causality tests are merely tests of 'temporal precedence' rather than implying actual causation (Fischer 1981).

anchor has nested itself as an integral element in current inflation dynamics. Although the process of RPA was the initial factor leading to a rise in the rate of inflation, it seems that both RPA and inflation uncertainty are currently interacting to keep inflation rates at a higher and more volatile path.

5. Concluding Remarks and Policy Implications

Central bankers' catchphrase nowadays is 'low *and* stable' rates of inflation. Low inflation and its stability are essentially two faces of the same coin. This is strongly supported by the experience of other countries, and has been shown to hold in the case of Egypt.

The objective of this study is to uncover the role of RPA as an important factor in Egypt's current inflation dynamics. Empirical evidence supports this hypothesis with the following main findings: There is a strong positive association between the level and variability of inflation suggesting that currently high levels of inflation are bound to be more volatile, which exacerbates the negative impact of inflation. The distribution of individual price changes is non-normal and exhibits positive skewness, which implies a positive association between RPA and overall inflation. Along with the generally observed nominal downward stickiness, food prices (the main component of the tradables group) have been the dominant source of inflation during the recent two inflationary waves. Further, uncertainty about future inflation is positively associated with the increase in RPA, and it appears that significant increases in RPA tend to precede increases in inflation uncertainty. This emphasizes the amplified impact of supply-side shocks in the absence of a nominal anchor.

The factors that triggered a rather vigorous process of RPA in recent years were the successive devaluations of the pound, the announcement of the floatation of the exchange rate (and absence of an alternative nominal anchor), the increases in the prices of energy-related products, and the outbreak of the avian flu virus. It seems that the devaluation was the initial stimulant to RPA. Given the subsequent turbulence in relative prices, and the announcement of the floatation of the pound, this led to an increase in the variability of inflation expectations and hence more uncertainty about future inflation. What has probably deepened the sense of uncertainty is the inability of the CBE to 'guide' inflation expectations during this critical period of transition to full-fledged inflation targeting.

Undoubtedly, there are policy concerns regarding the current turbulent behavior of prices. The redistributive impact of inflation is unfavorable to fixed-income earners and

savers, and hence has negative socio-economic implications. For instance, recent price increases more than outstripped the rise in nominal public-sector wages, which renders the government initiative ineffective. It also implies a continued decline in real incomes with negative consequences for low-income groups. It may affect long-run growth and employment outcomes by diverting resources away from productive investment venues and into speculative channels. Further, it will neutralize the competitiveness gains from the successive devaluations of the pound as the higher inflation differential between Egypt and its trading partners leads to an appreciation in the real exchange rate. Despite current pressure on the nominal exchange rate to appreciate due to large capital inflows, the persistence of inflation at high rates implies that there may be some pressure on the pound to depreciate in the medium-term to restore competitiveness.

In this regard, the results of this study raise a number of policy implications that are worth highlighting. These pertain to (i) the role of the monetary authority to anchor inflation expectations during transition to full-fledged inflation targeting; (ii) the strategy for domestic price liberalization (or the removal of subsidies); and (iii) the implications of the evolution of the CPI composition (i.e., the relative weights of tradables and non-tradables) as Egypt completes its economic transition. Each issue is discussed further below.

Anchoring Inflation Expectations: the Role of the CBE

Given the evidence that inflation uncertainty has recently increased, it is the task of the CBE to devise appropriate measures to anchor inflation expectations. A future nominal anchor will naturally be the *announced target* rate of inflation that the CBE 'must' meet. The word 'must' in this context is defined loosely as there will likely be target misses, in case of which the CBE should actively engage in communication with the public about the underlying reasons and effective measures being taken to meet the target in subsequent periods. The success of the target rate of inflation as a nominal anchor is crucially dependent on the 'credibility capital' of the monetary authority. It is not an easy task to gauge the credibility of the CBE among the public, but one could assert that the current turbulence in prices does negatively affect its credibility.

With the target rate of inflation being the candidate nominal anchor in the future, the monetary authority could still steer inflation expectations in the mean time via a number of measures. The CBE should publish monthly (or quarterly) inflation reports discussing in

detail current inflation dynamics, the underlying drivers, and expectations of the CBE about the future course of inflation through a *numerical* inflation forecast based on its internal econometric model(s). The objective of the inflation forecast is just to highlight the CBE expected course of inflation without being formally committed to meeting it. Expectedly, there will be a large magnitude of uncertainty surrounding such a forecast given the current state of price developments; however, it will still serve as an authoritative *benchmark* for the market given the CBE's information advantage and its operational independence. Gradually, the inflation *forecast* will be replaced with a 'hard' inflation *target*, which will improve the CBE's capability of anchoring inflation expectations.

The choice of a price index upon which to base inflation projections and define an inflation target is an equally important issue. Current practice in inflation-targeting central banks is a choice between a headline price index (such as the overall CPI) or some measure of core inflation usually taken to be the overall CPI excluding volatile components such as food and energy. In the case of Egypt, opting for the second choice in the short term would be an ill-advised decision. Defining an inflation target based on the CPI excluding food means excluding about one half of the CPI basket (in expenditure terms); consequently, this will make it an irrelevant index for consumers as it becomes significantly detached from being a cost-of-living index.[27] Despite the difficulties associated with using an inflation target defined upon the overall CPI, this approach is bound to instill relevance and credibility into the whole regime given that it is accompanied by a successful communication strategy with the public to highlight what monetary policy *could* and *could not* do to affect inflation outcomes.

It is also important to note that the nominal exchange rate may still act as a nominal anchor for some market participants because: (i) it has historically been an easily observed and understood nominal anchor; (ii) it has been a successful nominal anchor during most of the 1990s; and (iii) it is currently almost fixed, which adds to its appeal as a nominal anchor. Therefore, it is important to avoid sizable fluctuations in the nominal exchange rate during this period of transition; however, it is equally important to work on gradually shifting the publics' eye towards the CBE's inflation forecast, and then eventually to the target rate of

[27] In the long term, as the weight of food items in the CPI basket gradually declines with price liberalization, defining the inflation target upon a core inflation measure that excludes food and energy items may be a feasible option.

inflation. This will only materialize through a successful communication strategy with the public about the objectives, instruments and strategies of monetary policy.[28]

The ability of the CBE to control inflation outcomes in the future is, of course, conditional upon having a well-functioning monetary policy transmission mechanism; in other words, the CBE policy instruments should be effective in influencing output and inflation developments. There may be some reservations regarding the effectiveness of the monetary policy transmission mechanism at present, which is a subject that is beyond the scope of this study. However, it is to be noted that a well-functioning transmission mechanism is fundamental to attain successful outcomes in terms of inflation control. It is hoped that the new interest rate corridor system, adopted by the CBE to activate the interest rate channel of the transmission mechanism, will be successful in this regard.

The Strategy for Domestic Price Liberalization

Forward-looking monetary policy can only address inflationary pressures arising from the demand side, and is incapable of controlling the first-round impact of supply-side shocks.[29] Supply-side shocks can be either internal or external. Internal supply-side shocks can be either policy-induced or due to some unforeseen random shock. The case of a policy-induced supply-side shock (such as removal of subsidies on food and energy prices) is our focus here.

The government is currently considering the removal of direct subsidies on food and energy prices, and adopting alternative means of targeting the poor through a cash transfer system. Proponents of this policy argue that it will ensure better targeting of the poor and prevent free-riding in the current system, which benefits both the poor and non-poor. It will also relieve the government budget from a burgeoning subsidy bill, which currently

[28] Chile's transition to full-fledged inflation targeting represents a successful model to be considered in this respect. In particular, the way the Central Bank of Chile successfully used its own inflation forecast (published in its monthly report) to gradually steer attention away from the nominal exchange rate to the announced inflation target as a nominal anchor. Progressively, the central bank's inflation forecast became a 'hard' inflation target that the central bank would be accountable for, if it is missed. Also, Chile remained—for a few years after introducing inflation targeting—attentive to exchange rate developments due to 'fear of floating' because of concerns related to pass-through effects and liability dollarization in the financial sector. See Mishkin (2004) for details.

[29] If a supply-side shock feeds through to a second-round or a third-round impact, monetary policy can intervene but at the expense of creating additional output instability. If the monetary authority is credible and is known to be an 'inflation nutter', then market expectations will be properly anchored and this will inhibit spill-over effects beyond the first-round impact. In the literature on inflation targeting, a central bank is said to be an 'inflation nutter' if it cares about inflation control more than it cares about output instability. In technical terms, more weight in the central bank's loss function is given to the deviation of inflation from its target relative to the deviation of actual output from its potential level.

constitutes about 26.3 percent of total government spending and 7.6 percent of GDP.[30] On the opponents' side, there are legitimate concerns regarding the inflationary impact of this policy as well as the pragmatic complications of identifying poor households that will be eligible for cash transfers.

Undoubtedly, the correction of the numerous price distortions created by administered prices is an important step in Egypt's economic transition, and it has been one area where reforms were excessively slow due to socio-economic and political considerations. However, there is a need for the formulation of a comprehensive strategy to guide these reforms and moderate their negative inflationary impact. The strategy should address the timing and frequency of price adjustments as well as tackling market imperfections (uncompetitive practices and supply-side bottlenecks) to ensure that the cost of adjustment will not be borne solely by consumers.

Management of market expectations is also an important element in such a strategy. Recent government announcements about these expected reforms have already created turbulence in the market and may have been partially the reason for some recent unjustified price increases. Given that the issue has already become a public debate, it is important to speed up the process of strategy formulation and implementation. Ongoing government efforts to address uncompetitive market practices (through the newly-created Competition Authority) are welcome but do not seem enough. More effort is needed to fully understand the scale of market imperfections and enact pragmatic rectifying measures.

On another level, international experience[31] suggests that it is possible—after price liberalization—to undertake rapid disinflation (i.e., bring down rates of inflation to moderate levels) only in the presence of strong nominal anchor in the form of a hard exchange rate peg or a credible inflation target with clear commitment from the monetary authority to fight inflation. In the case of Egypt, and with current commitment to gradual transition to inflation targeting, the success of rapid disinflation after price liberalization requires speeding up the process of moving towards full-fledged inflation targeting. Equally important, the CBE should work on establishing a reputation of being an 'inflation nutter'. This will help the CBE in acquiring the credibility capital needed to achieve rapid disinflation.

[30] These figures are based on the 2007-2008 government budget; it includes subsidies, grants and social benefits.

[31] Namely, the experience of the transition economies of Central and Eastern Europe during and after their price liberalization drive in the early 1990s.

This means that the CBE should be ready to vigorously fight inflation at the expense of short-term output losses. This may require putting a temporary brake on economic growth by undertaking a contractionary course for monetary policy to achieve rapid disinflation. While such a policy may sound unpopular, its medium- and long-term gains certainly outweigh its short-term losses. With low and stable rates of inflation, and an undistorted price system, economic growth will be higher and more robust in the medium- and long-term. Such short-term output losses are inevitable; this is the price to pay to undertake successful price liberalization with a strong containment of its inflationary impact. Finally, and as international experience suggests, a consistent macroeconomic policy mix (of monetary, fiscal and exchange rate policies) is crucial to ensure successful disinflation. This requires further consolidation on the fiscal policy front coupled with short-term stability in the nominal exchange rate.

The Evolution of the CPI Composition with Complete Economic Transition

With complete economic transition, relative prices will reach a stage of maturity with no considerable corrections taking place unless they react to a major shock. This process may in fact take quite some time to be completed after full price liberalization, as the prices of some sectors (such as health, education, housing and transportation) exhibit strong inertia and also under the assumption that these sectors are likely to remain under strong government regulation relative to other sectors. This implies that the weight of these sectors in household spending will gradually increase with the increase in their prices.

The policy implication of this development is twofold. On the one hand, this is a favorable development as the economy will become more resilient to supply-side inflationary shocks if the relative weight of non-tradables in the CPI is larger. And this is what is currently observed in industrialized economies where the share of household spending on non-tradables is considerably larger than in the developing world. On the other hand, to enable households to adjust to the price increase of these basic services, it is important for income growth to be high enough (in real terms) to avoid a gradual decline in living standards. Higher income growth is synonymous with higher output growth, and the latter can only be achieved in a low-and-stable-inflation environment.

This is to say that the task of achieving low and stable inflation is a pre-condition for high and robust economic growth in the long run. This pre-condition will not only guarantee

an increase in the living standards to cope with the adjustment costs of economic liberalization, but it is also an integral element of complete economic transition.

APPENDIX A. METHODOLOGY FOR THE EMPIRICAL ANALYSIS

Measuring Relative Price Adjustment

Using disaggregated CPI data from the Central Agency for Public Mobilization and Statistics (CAPMAS) over the period January 1999–April 2007, RPA is estimated using the Theil measure of RPA, which is a weighted sum of the squared deviations of individual commodity inflation from the overall rate of inflation of the CPI.[32] The Theil measure of RPA (also known as the Theil variance - TVAR) is computed as follows:

$$TVAR = \sum_{i=1}^{n} w_i(\pi_i - \bar{\pi})^2 \quad \text{where } \bar{\pi} = \sum_{i=1}^{n} w_i \pi_i \qquad \text{(A.1)}$$

and π_i is the year-on-year rate of inflation in the ith component of the CPI

$\bar{\pi}$ is the weighted average of the inflation rates of all components of the CPI

w_i is the weight on the ith component in the CPI

n = 31 (i.e., a total of 31 components in the CPI)

It is clear from the formula that TVAR assumes a value of zero when rates of inflation of all components of the CPI are equal, and increases with the dispersion of these rates around the mean. TVAR can also be decomposed into sources of variability due to tradables versus non-tradables.[33] To achieve this, a starting point is to decompose the CPI basket into tradables and non-tradables. The first group comprises all of the food and beverage items, fabrics and footwear, medical products, furniture and equipment, with a total of 19 items. The second group comprises rent and housing, utilities, healthcare, education, transportation and communications, with a total of 12 items. So, the overall rate of inflation becomes a weighted average of the inflation rates in each group as follows:

$$\bar{\pi} = \alpha \bar{\pi}_T + (1-\alpha) \bar{\pi}_{NT} \qquad \text{where } \alpha = \sum_{i=1}^{g} w_i \qquad \text{(A.2)}$$

and $\bar{\pi}_T$ and $\bar{\pi}_{NT}$ represent the weighted inflation rates in tradables and non-tradables, respectively, and α represents the share of traded goods in the CPI, which is the sum of

[32] See Theil (1967); Parks (1978); Blejer and Leiderman (1982) and Coorey, Mecagni, and Offerdal (1996).

[33] See Blejer and Leiderman (1982) and Coorey, Mecagni, and Offerdal (1996). Blejer and Leiderman (1982) undertake a similar decomposition for Mexico.

weights of the commodities i = 1,…,g which are considered traded goods, and the rest are non-traded goods.

Thus, TVAR can be decomposed into three components:

$$\text{TVAR} = \alpha\text{VT} + (1-\alpha)\text{VNT} + \text{VTNT} \quad \text{(A.3)}$$

where VT is the variance due to tradables

VNT is the variance due to non-tradables

VTNT is the covariance between tradables and non-tradables

The constituent variances and covariance are computed as follows:

$$\text{VT} = \sum_{i=1}^{g} \frac{w_i}{\alpha}(\pi_i - \bar{\pi}_T)^2 \quad \text{(A.4)}$$

$$\text{VNT} = \sum_{i=g+1}^{n} \frac{w_i}{(1-\alpha)}(\pi_i - \bar{\pi}_{NT})^2 \quad \text{(A.5)}$$

$$\text{VTNT} = \alpha(\bar{\pi}_T - \bar{\pi})^2 + (1-\alpha)(\bar{\pi}_{NT} - \bar{\pi})^2 \quad \text{(A.6)}$$

Hence, the proportion of total variance accounted for by variance within tradables is (VT/TVAR); by variance within non-tradables is (VNT/TVAR); and by covariance between tradables and non-tradables is (VTNT/TVAR).

GARCH-in-Mean Model

The GARCH-in-mean model follows the following standard specification:

$$\pi_t = X_t\beta + \varepsilon_t \qquad \varepsilon_t \sim N(0, \sigma_t^2) \quad \text{(A.7)}$$

$$\sigma_t^2 = \alpha + \sum_{i=1}^{p} \varepsilon_{t-i}^2 + \sum_{i=1}^{q} \sigma_{t-i}^2 \quad \text{(A.8)}$$

where π_t is inflation at time t, X_t is a vector of contemporaneous and lagged explanatory variables known at time t, β is a vector of parameters, and ε_t is the shock to inflation that cannot be forecasted with information available at time t. ε_t is assumed to be normally

distributed with mean zero and a time-varying conditional variance specified as a linear function of past squared errors (the ARCH terms) and past variances (the GARCH terms).[34]

The variables included in X_t are past inflation (to account for inflation inertia), money growth, and the estimated conditional standard deviation of the error term. The inclusion of the estimated conditional standard deviation of the error term—as an explanatory variable for inflation—is what relates this model to the family of GARCH-in-mean models. Monthly data for the CPI and reserve money over the period November 1981 to December 2006 is used for estimating model parameters, and the data source is the International Monetary Fund IFS online database. The model is estimated using maximum likelihood.

[34] See Bollerslev (1986) for extending Engle's (1982) ARCH model into the GARCH model. See Engle, Lilien, and Robins (1987) for the development of the ARCH-in-mean model.

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