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ASHGATE

Inflation and Disinflation in Turkey

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PART I
INTRODUCTION

Chapter 1

Introduction: Turkey's Disinflation Struggle

Aykut Kibritçioğlu, Libby Rittenberg and Faruk Selçuk

1. Macroeconomic Background

In 1980 Turkey embarked on an extensive program of economic stabilization and liberalization. Over the ensuing 20-year period, the Turkish economy moved from being inward-oriented and fairly isolated to being export-oriented and well integrated into world trade and financial markets.

Overall, Turkey's economic performance, summarized by an average annual rate of growth of real GDP of about 4.5% from 1980 to 2000, can be characterized as adequate but not outstanding. As discussed in greater depth in Chapter 2, which details the behavior of the Turkish economy in the past two decades, more troubling is the fact that the economic dynamism unleashed by the initial reforms in the 1980s gave way in the 1990s to lower growth on average and an economy characterized by cycles of boom and bust. Rather than reducing the already high inflation of the second half of the 1980s, which averaged around 60%, inflation in the 1990s averaged around 80%.

The result is that the gap between Turkey and the poorest economies of the European Union, such as Greece and Portugal, increased. Per capita income was $2412 in Portugal and $1289 in Turkey in 1982 (based on nominal GDP at current prices). The poorest economy of the European Union (Portugal) increased its per capita income five fold to $12,000 in 20 years while the figure on the Turkish economy stalled between $2000–$3000 during the same period. The contrast in economic performance with many Asian countries, whose growth in the 1990s averaged in the 5% to 7% range, is also striking.

While the 1990–91 Persian Gulf crisis, the 1998 Russian financial crisis, and two major earthquakes in 1999 must share some of the responsibility for rising output volatility and overall poorer economic performance, internal policy decisions also played a major role. In

particular, the internal reason for this less than satisfactory economic performance rests on the inability to put in place and sustain a series of policies that would bring the initial reforms to maturity. The enduring symbol of the incompleteness of the structural reform process is the persistent and high inflation. While the high double-digit inflation did not turn into hyperinflation, as is so often the case, it is clear that its persistence has, among other things, wreaked havoc on government finances and borrowing, stymied investment, and created another obstacle in Turkey's path toward joining the European Union.

2. Disinflation Programs

Hence, in the latter half of the 1990s, Turkey undertook a series of disinflation programs. Following the financial crisis in 1994, Turkey entered into a stand-by arrangement with the IMF but it was quickly abandoned, as the governments of that period chose to follow relatively expansionary policies. In 1998, the government again began talks with the IMF, but this program gave way to pressures emanating from the Russian financial crisis in the summer of 1998, the April 1999 general elections, and the devastating earthquakes in August and October of 1999.

Somewhat paradoxically, these same shocks may have also contributed to a broader consensus in the society on the importance of completing the reform process. A more far-reaching restructuring and reform program, conceived of in the summer and fall of 1999, had the specific target of reducing inflation to single digits by the end of the year 2002. The program gained further momentum after the country signed a stand-by agreement with the IMF in December 1999. A main tool of the disinflation program, designed to decrease imported inflation and inflationary expectations, was the adoption of a crawling peg regime; i.e., the percent change in the Turkish lira value of a basket of foreign exchanges was fixed for a period of a year and a half. To support the disinflation goal, the program also called for: stringent fiscal policy, obtained through tax increases and changes in public sector wages and agricultural price supports in line with the inflation targets; structural reforms in the areas of banking, social security, agriculture, and energy; and a renewed privatization drive. It was hoped that these moves would not only bring down inflation, but do so in an environment that would encourage foreign direct investment, improve productivity, and hence have minimal negative effects on economic growth.

The program was "pre-loaded" in the sense that several measures towards restructuring the economy took place before the program commenced. This conditionality increased the probability of success of the program. However, success of the pre-announced crawling peg rested on progress on the other aspects of the program so as to avoid substantial appreciation of the Turkish lira and to generate enough capital inflows, especially in the form of foreign direct investment, to finance the current account deficit.

During the first half of the year 2000, the economy enjoyed a rapid decline in real interest rates and an increase in the real GDP growth rate. The monthly inflation rate also gave the impression that it was converging to the monthly percent change in the exchange rates. However, given the past record of the country in implementing IMF programs, there was increasing concern among market participants about the government's willingness to carry out the program. These concerns stemmed from the fact that there were several delays in implementing most of the structural measures, mainly in the areas of privatization and financial sector reforms. In other words, the Turkish authorities gave the impression that they were reluctant to solve the long-standing fundamental problems of the economy. In addition, one of the strong assumptions of the program, a substantial increase in long-term foreign direct investment, was not realized and the financing of the increasing current account deficit, in light of surging demand, became another major concern.

An extremely risky position of a small private bank (with a capital of USD *300 million* and carrying a government bond portfolio of USD *7 billion* financed from the short term money market) caused a short-term crisis in November 2000. The actions taken by the monetary authorities during the initial period of this crisis (and actions *not taken* by the regulatory and supervisory bodies before and during the crisis) increased doubts about the success of the program. Nevertheless, IMF backing of the program, with an additional promise of USD 7.5 billion, calmed the markets down. February 2001 became a litmus test for the future of the program. A domestic debt auction aimed at borrowing USD 5 billion was scheduled on February 20, the day before the maturing of USD 7 billion of domestic debt. Suddenly, on February 19, the Prime Minister Bülent Ecevit stormed out of a meeting of top military and political leaders, including President Ahmet Necdet Sezer, stating that "this is a serious crisis". Indeed, the seemingly minor political rift was all the encouragement the financial markets needed to test the authorities' commitment to the exchange rate regime.

The stock market plunged 18% and the central bank sold one third of its foreign currency reserves the same day. Record interest rates during the following days forced the government to abandon the crawling peg regime. The Turkish lira was allowed to float starting on February 22, 2001. This was the end of the program in its initial conception. Over the next few months, the Turkish lira lost about half of its value and there was a resurgence of inflation.

While the Turkish policy makers had gained some credibility during the early phase of the program, they lost it in a very short period of time. In order to re-gain some credibility and to restore confidence in the market again, a well-known World Bank executive, Kemal Derviş, was appointed as the minister in charge of economic affairs. Mr. Derviş prepared a new program, mainly a summary of previously promised but not fulfilled structural reform measures. The new program gained IMF support once again. At the time of this writing, the government was fully backing the program and taking the necessary measures as much as it could. However, market confidence was not yet restored. One of the reasons for this lack of credibility is the domestic debt situation of the public sector. The February crisis with its impact on banks, which were depending heavily on short-term financing to meet their obligations, and rising real interest rates during and afterwards, due to growing risk, made it clear that the sustainability of the domestic debt needed extraordinary measures which would definitely put the whole economy into a stall. Indeed, the economy is expected to shrink by about 9% in 2001.

It is against this backdrop of Turkey's repeated attempts to complete its structural reforms, and in particular to finally rid itself of high inflation, that the current volume was conceived. Following a review of the performance of the Turkish economy since 1980, Part II examines the experience of Turkey with its high and persistent inflation and thus constitutes a review of inflation over the post-liberalization period. Part III, in contrast, is more forward-looking in that the chapters in this part consider more directly the consequences of disinflation on various aspects of the Turkish economy.

3. Overview of the Chapters

Chapter 2, by Ahmet Ertuğrul and Faruk Selçuk, reviews the macroeconomic performance of the Turkish economy from 1980 to 2001. The body of the chapter was written prior to the financial crisis of February

2001, and the epilogue serves as an update on that crisis and the early government response to it, i.e., the putting into place of a new IMF-supported program. The body of the chapter focuses on overall macroeconomic performance, with particular attention to real GDP and inflation; the external sector, including analysis of the balance-of-payments, the exchange rate, and external debt; fiscal policy, with a focus on the public sector borrowing requirement (PSBR) and its financing; and the banking sector, with emphasis on the relationship between the banks and the various stabilization programs over the years.

The authors argue that Turkey experienced its greatest success macroeconomically over the first 8 years of the export-led growth strategy from 1981–88. Since then, growth has been more sluggish and volatile and policies that have sought to control inflation have been largely unsuccessful. Similarly, the current account improved in the early years as the export-led growth strategy led to a substantial increase in exports, which was greater than the increase in imports. This section also shows that with regards to the capital account, foreign direct investment has overall been disappointing and the economy depends on short-term capital flows. In addition, external debt is not only on the rise, but the percentage with short-term maturity has risen. Inspection of the public sector reveals rising domestic debt, related at least in part to deteriorating public enterprise performance and delays in privatization, alongside a largely accommodating Central Bank. As the authors explain, the 1980 reforms also ushered in liberalization of the banking sector and greater efficiency in that sector. However, over time, the banks resorted to earning profit primarily through short-term borrowing from abroad and lending at home to government to finance the PSBR. The authors refer to this as "hot money policy" because of its reliance on short-term capital inflows and highlight the vulnerability of the banking sector to exchange rate risk. Indeed, before the launching of the 2000 disinflation program, a new banking law was enacted to create an independent banking supervisory agency. This and other banking reform steps, however, still left in place a fragile financial system that depended on short-term capital flows.

In the epilogue of Chapter 2, which briefly covers policies undertaken after the February 2001 crisis, the authors emphasize that despite stronger commitments to structural reforms, the new program does not address the issues of domestic debt sustainability or overhauling of the banking system. They repeat their conclusion from the body of the chapter that "unless the Turkish economy creates an environment in which foreign direct investment finds itself comfortable, unless the domestic debt dynamics are

put onto a sustainable path, and unless there is a major overhaul in the banking system, the program is destined to fail like the previous programs".

Leading off Part II, Aykut Kibritçioğlu has provided a concise review of the various theories of inflation from the general literature on the topic. He shows that the causes of inflation stem from: demand-side (or monetary) factors, supply-side (or real) factors, inertial (or adjustment) factors, political (or institutional) factors, or some combination of these. In reviewing empirical studies on Turkish inflation, he notes that most examined demand-side causes, with some attention to supply-side causes. Most studies of inflation covering the post-1980 period found that exchange rate devaluations, monetary growth, and public sector borrowing were causes of inflation and that oil-price shocks played a negligible role. While a few studies of inflation in Turkey have looked at the role of inertia, he argues that more attention should be paid to this potential source. He adds that the possible contribution of the political process and institutions to the Turkish high and persistent inflation also needs to be investigated in more detail in the future.

Chapter 4, by O. Cevdet Akçay, C. Emre Alper, and Süleyman Özmucur, investigates the relationship between inflation and the budget deficit and debt sustainability. After testing for stationarity in the discounted debt to GNP ratio from 1970 to 2000, they conclude that the fiscal outlook does not appear to be sustainable. While noting that lack of sustainability does not imply insolvency, this finding nonetheless suggests the importance of a change towards fiscal austerity to avoid insolvency in the future. They also find that increases in the public-sector borrowing requirement (PSBR) lead to higher inflation and that the PSBR is a better indicator of Turkey's fiscal position than is the consolidated budget deficit. They suggest that previous studies that have focused on the more transparent budget deficit may have drawn erroneous conclusions between Turkey's fiscal policies and inflation.

Chapter 5, by Haluk Erlat, examines the extent to which inflation is persistent or inertial and the nature of that persistence. Erlat employs a series of estimation techniques to conclude that inflation is generally stationary but has a strong long memory component. From a policy perspective, he reasons that a disinflation program will eventually achieve its aim but that there will initially be a great deal of resistance on the inflation front.

Part III's articles on aspects of disinflation begin with Selahattin Dibooğlu's rather optimistic suggestion that the output loss associated with Turkish disinflation could be minimal. This conclusion hinges on how

inflationary expectations are formed. To the extent that forward-looking elements outweigh backward-looking ones, a credible disinflation program will entail a small sacrifice of output. In a quarterly model covering 1980 to the middle of 2000, he finds that the weight attached to forward-looking elements (56%) exceeds that of backward-looking ones. Further evidence of the potential for costless disinflation stems from Dibooğlu's VAR model of aggregate demand over the same 20-year period which shows that aggregate demand shocks have had a negligible effect on output. Hence a disinflation program aimed at stabilizing aggregate demand would be expected to entail little output loss. The key then to a successful disinflation program is government commitment, according to Dibooğlu.

In Chapter 7, Tevfik F. Nas and Mark J. Perry test the relationship between inflation and inflation uncertainty and between inflation uncertainty and real output growth. Using a GARCH-M system of equations and analyzing a nearly 40-year period (1963–2000), they find a direct relationship between inflation and inflation uncertainty and an inverse relationship between inflation uncertainty and real GDP growth. Thus a benefit of disinflation in Turkey should be higher real growth.

Faruk Selçuk's chapter entitled "Seigniorage, Currency Substitution and Inflation in Turkey" addresses the question of whether the seigniorage tax from Turkey's currently high inflation economy creates a benefit for government in the form of higher revenues. His initial approach to estimating the seigniorage maximizing inflation rate is based on a Cagan-type money demand function. The results of this model show that an annual inflation rate of over 500% would have maximized seigniorage revenue. However, this approach does not account for currency substitution, i.e., the fact that domestic residents may substitute foreign for domestic currency when they expect a relative increase in the cost of holding domestic currency balances. Using a money-in-the-utility function model, which allows for currency substitution, he shows that in Turkey, where there is a high degree of currency substitution, the seigniorage-maximizing rate of inflation cannot deviate from the world inflation. In contrast to the (misleading) result from the Cagan-type money demand model, the Turkish economy is on the wrong side of the seigniorage Laffer curve so long as inflation in Turkey exceeds world inflation and so long as there is some degree of currency substitution. This finding suggests yet another benefit from a successful disinflation program – higher real fiscal revenue in the form of seigniorage.

The final chapter in the book, by C. Emre Alper, M. Hakan Berument, and N. Kamuran Malatyalı, examines whether the structure of the financial

system is compatible with a more stable, lower inflation environment. Based on descriptive and regression analyses of the Turkish banking sector, they conclude that a successful disinflation program, including continued privatization or "autonomization" of public banks, will result in bank consolidation and a growth in the size of foreign banks (either through opening new branches or through mergers and acquisitions). They predict that as outstanding government debt stock falls and banks compete with each other for asset management, economies of scale will become important and small banks will disappear. Efficiency should also increase in this sector and the installation of fee-based services will become more common. Because in this new environment, management of credit risk, as opposed to sovereign risk, will grow in importance and banks will return to core banking activities, the development of secondary securities markets will be critical in shoring up Turkey's fragile banking system. Further progress on bank restructuring is critical, the authors argue, to the success of the current disinflation program.

4. What's Next?

The economic policies for achieving disinflation are not, as the saying goes, a matter of rocket science. Other countries have been able to move to sustainable low inflation environments, albeit often at the cost of slower or negative growth in the short term. So, the real issue for Turkey and other countries struggling with inflation is one of political economy. As Thomas Friedman (1999) has written, countries must decide if they want to don the "Golden Straitjacket", i.e., to abide by the set of rules that global financial investors will reward with stable capital inflows. These policies include not only appropriate fiscal and monetary policies, but also transparency and rule-based accountability.

Figure 1 shows the erratic nature of short-term capital inflows into Turkey over the past 25 years. One indication that Turkey's policies are on the right track would be a return to positive short-term inflows at a steady and sustainable level. But the real indication would be a substantial increase in longer term capital inflows.

Policies pursued following the February 2001 financial crisis – from new banking laws aimed at greater transparency to stepped-up privatization – suggest a renewed commitment to move in the direction required for success. However, this already difficult challenge has been made more so by the economic and political circumstances at the end of 2001.

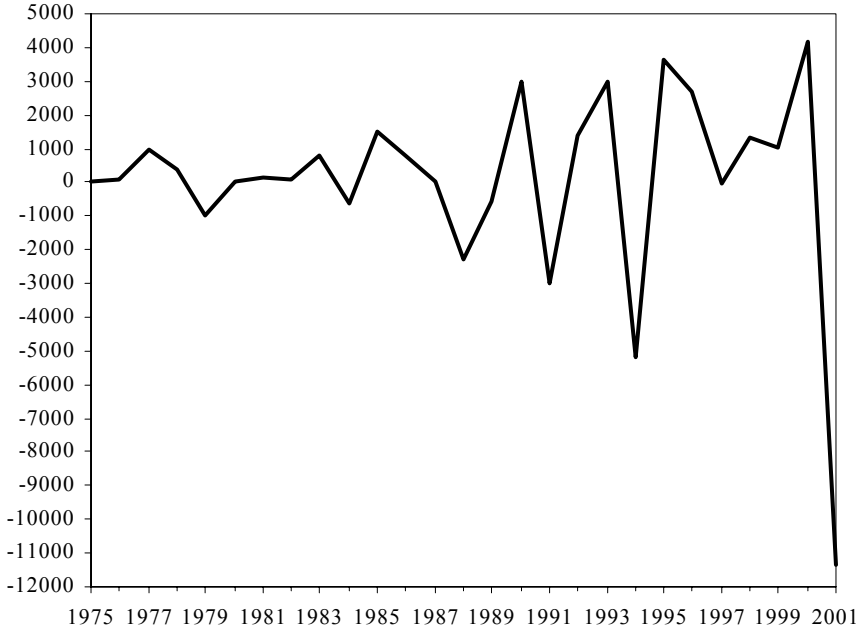

Figure 1: Annual Net Short-Term Capital Inflows (million US$, 1975–2001)
Source: Central Bank of the Republic of Turkey.

In particular, it was hoped that the devaluation of the Turkish lira would spur exports and tourism. The slowdown in growth, possibly even recession, amongst Turkey's largest trading partners will offset, at least in part, devaluation-induced export growth, while the tensions following the September 11, 2001 terrorist attacks against the United States are likely to suppress tourism. Against this backdrop, sticking to any set of reforms will be more difficult.

However, in October 2001, Turkey seemed to be sticking to its reform program and the IMF seemed to be moving towards increased financial backing. Barring further unforeseen circumstances, we are inclined to think that the authorities will take the right path this time.

Reference

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Chapter 2

Turkish Economy: 1980–2001*

Ahmet Ertuğrul and Faruk Selçuk

Abstract: In this chapter we provide a brief account of the Turkish economy during the last twenty years. After the implementation of a structural change and reform program in 1980, the economy experienced a relatively high growth rate of gross domestic product, a healthy balance of payments situation and relatively low inflation in early 1980s. Towards the end of the 1980s, the annual inflation started to rise in a stepwise fashion and the growth performance was poor afterwards. Due to exchange rate policy preferences of the authorities, the economy became dependent on short-term capital flows – so called hot money – for the last ten years. As a result, the exemplary economy of the 1980s became a textbook case of a "boom-bust" economy with relatively lower GDP growth and with high volatility in the 1990s. Recently, the government launched another restructuring and reform program. The aim of the program is to reduce annual inflation to single digits by the end of year 2002. A short-lived financial crisis during the course of the program showed that the financial system is very fragile. Ironically, the latest crisis made it clear that the continuation of the disinflation program and the stability of the banking system in the short run depend on short-term capital inflows.

1. Introduction

The Turkish economy has experienced relatively high inflation coupled with unsuccessful disinflation programs during the past 30 years. Although yearly inflation was over 100% in certain years, it never reached hyperinflationary levels but increased in a stepwise fashion over time: the average annual inflation rate was 20% in the 1970s, 35–40% in the early 1980s, 60–65% in the late 1980s and early 1990s, and around 80% before the government launched yet another disinflationary program in 1998 (see Figure 1).

An early attempt to reduce inflation on a permanent basis and to put the economy on a sustainable growth path began on January 24, 1980. The government declared its intention to liberalize the economy, and to pursue an export-led growth policy. After the implementation of the program, a

military regime was installed in September 1980. The January 24 program reached its initial targets very soon in terms of a lower inflation, a higher GDP growth, and a relatively liberalized external trade regime and financial system. However, after the general elections and a new parliament in 1984, inflation started to rise again.

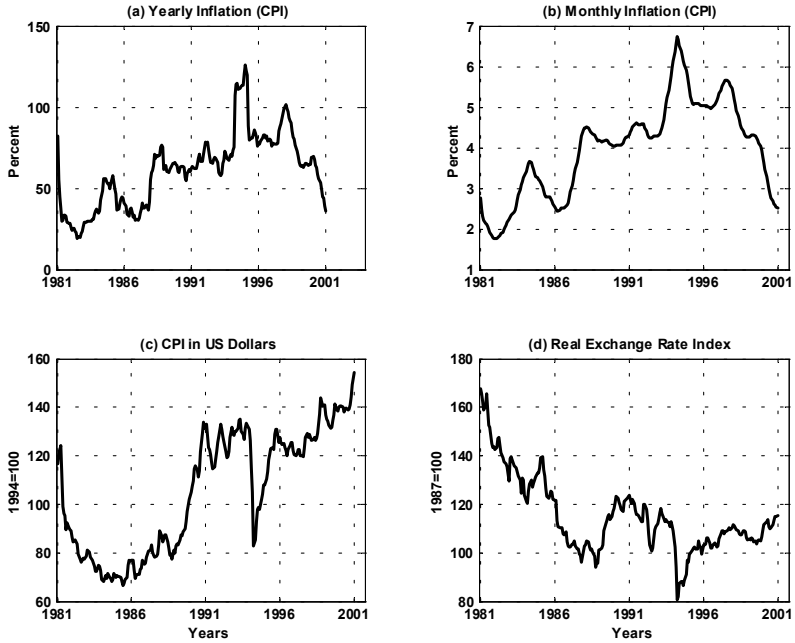

Figure 1: Inflation and Real Exchange Rate in Turkey
(a) Annual inflation, CPI (percent).
(b) Monthly inflation, CPI (seasonally adjusted, percent).
(c) Consumer price index in USD terms, 1994=100.
(d) Real exchange rate index, TRTWIN, 1987=100. An increase in the real exchange rate index indicates an appreciation of the Turkish lira.
Sources: Central Bank of the Republic of Turkey, State Institute of Statistics and Reuters.

The basic elements of disinflation efforts in the late 1980s were in various forms of nominal anchoring and monetary tightening without any serious effort to reduce the public sector borrowing requirement. This policy combination necessitated a higher interest rate on domestic assets and a lower depreciation rate in order to secure short-term capital inflow. Especially after 1989 (the year the capital account was liberalized), the new disinflationary strategy pronounced itself strongly. However, the

government did not take necessary measures on the fiscal front and the disinflationary attempts were futile. Due to the unsustainable nature of the fiscal policy and the external deficit, the economy experienced a major crisis in early 1994. The Government announced a new stabilization program on April 5, 1994 and a stand-by arrangement was approved by the International Monetary Fund (IMF) Board two months after the program started. However, it soon became clear that the government was not strongly behind the April 5 program and the stand-by agreement came to an end in 1995. During the following two years, there was no serious attempt to stabilize the economy and to reduce inflation.

In July 1998, the Turkish government started another disinflation program under the guidance of an IMF Staff Monitored Program (SMF). The program achieved some improvements concerning the inflation rate and fiscal imbalances but it could not relieve the pressures on the interest rates. The Russian crisis in August 1998, the general elections in April 1999 and two devastating earthquakes in August and October 1999 led to a deterioration of the fiscal balance of the public sector.[1]

The government started implementing another far-reaching restructuring and reform program after the general elections in April 1999. The aim of the program was to reduce inflation from its current 60–70% per year to single digits by the end of year 2002. The program gained further momentum after the country signed a stand-by arrangement with the IMF in December 1999. The main tool of the disinflation program was adoption of a crawling peg regime; i.e., the percent change in the Turkish lira value of a basket of foreign exchanges (1 US dollar plus 0.70 Euro) is fixed for a period of a year and a half. Although there was turmoil in financial markets in late November and early December 2000, the program seems to be on track as of February 2001 thanks to a substantial infusion of additional funds from the IMF after the crisis in December 2000. This short-lived financial crisis showed that the financial system is very fragile. Ironically, the crisis made it clear that the continuation of the disinflation program and the stability of the banking system in the short run depend on short-term capital inflows. Therefore, unless the government creates an environment in which foreign direct investment finds itself comfortable, the program is probably destined to fail and inflation might start to rise again.

The aim of this chapter is to give an overall account of the Turkish economy during the 1980–2000 period.[2] The growth performance of the economy is presented in Section 2. The external balance and foreign trade developments are reported in Section 3. The fiscal position and domestic

debt dynamics are reviewed in Section 4. After a detailed overview of the Turkish banking sector in Section 5, we conclude in Section 6.

2. Growth Performance: Boom-Bust Cycle

The export-led growth strategy of the early 1980s was quite successful. The average annual growth rate of real gross domestic product (GDP) was an impressive 5.8% between 1981–88 and the economy did not experience any recession, making the country an exemplary one in annual reports of international financial institutions such as the IMF. Also, the real increase in industrial value added was above the GDP growth rate; it averaged 8.1% during the same period.

Starting in 1988, the economy entered into a new phase and the growth performance has been sluggish since then, with two minor and two major recessions. The annual real GDP growth averaged 3.7% during this period. The average annual growth rate of industrial value added was slightly higher at 4.4% (see Figure 2). The exemplary economy of the 1980s became a textbook case of "boom-bust" growth performance with a relatively lower average growth rate and high volatility in the 1990s.

The dynamics of the growth performance of the Turkish economy after 1989 can be linked to unsuccessful disinflationary efforts and debt financing policies of the government. The Turkish policy makers started to slow down the depreciation rate of the Turkish lira, in part to control the inflation, but mainly to be able to borrow easily from the domestic markets in 1989. Although there was a crisis in 1994 which interrupted this policy, the authorities have pursued the same exchange rate policy for the last ten years. As Calvo and Végh (1999) and Guidotti and Végh (1999) show, the credibility of a slowed down devaluation in fighting inflation in moderate to high inflation economies is almost always low, both because of inflation inertia and because of the failure of the previous disinflation programs. The developments in the Turkish economy after 1987 are in line with stylized facts from exchange rate-based stabilization programs in different economies, as summarized in Calvo and Végh (1999):

(1) Slow convergence of the inflation rate (measured by the CPI) to the rate of change in exchange rates.
(2) Initial increase in real activity – particularly, real GDP and private consumption – followed by a counteraction.
(3) Real appreciation of the domestic currency.
(4) Deterioration of the current account balance.

(5) A decrease in domestic ex-post interest rates in the initial stages.

Possible explanations for an initial increase in real activity, followed by counteraction, in exchange rate-based stabilization programs are given in Calvo and Végh (1999). At the initial stage of slowed down depreciation, the interest rate parity condition leads to a lower domestic interest rate. If the convergence of inflation is slow, the real interest rate will fall as well, leading an increase in domestic demand, especially in private durable and semi-durable goods consumption and private investment. Eventually, a reduction in consumption and investment, and a real depreciation is inevitable because of resource constraints.

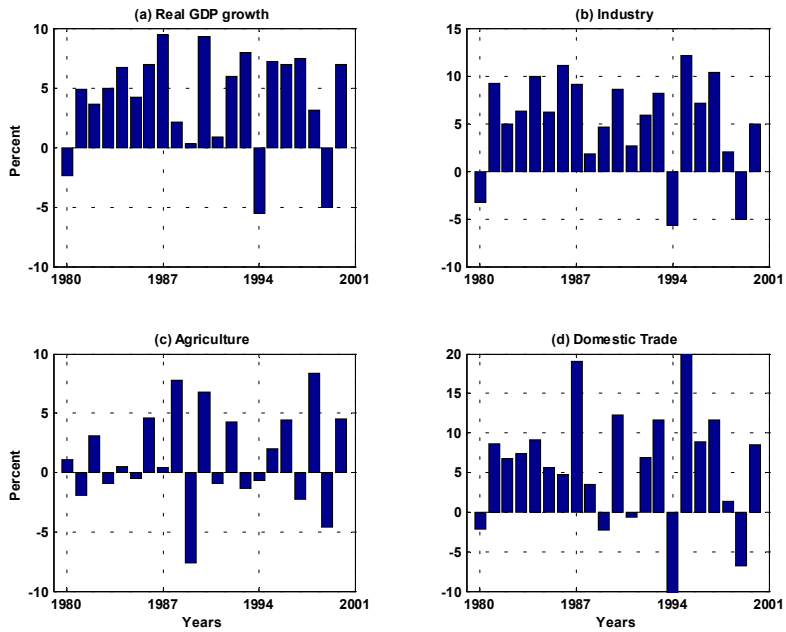

Figure 2: Real Growth in the Turkish Economy: Percentage Change in Gross Domestic Product and Economic Activities at Producers' Prices (at 1987 prices)
(a) Real GDP growth (percent).
(b) Industrial production.
(c) Agriculture.
(d) Domestic trade.
Source: State Institute of Statistics.

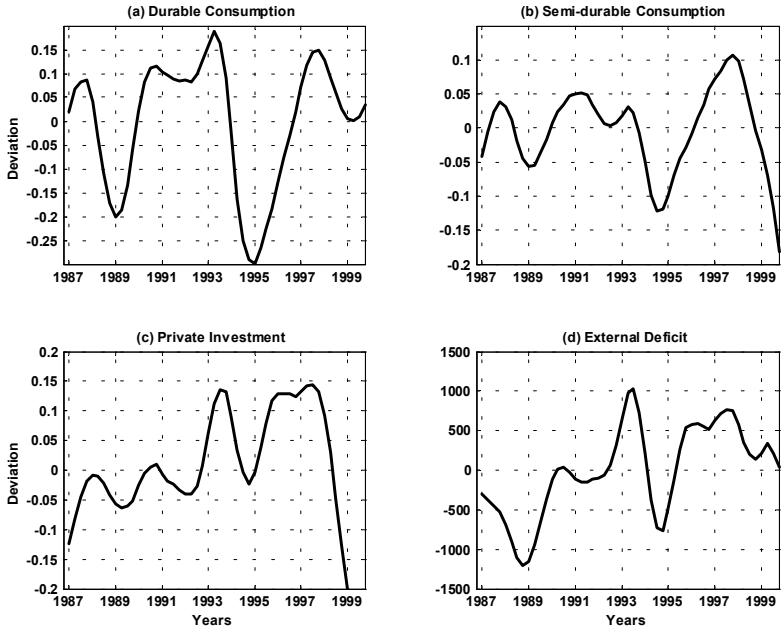

Figure 3: Cyclical Movements of Real GDP Components in Turkey
(a) Private sector durable goods consumption (deviations from logarithmic trend).
(b) Private sector semi-durable goods consumption (deviations from logarithmic trend).
(c) Private sector investment expenditure (deviations from logarithmic trend).
(d) External deficit (deviations from the sample mean). Calculated from the expenditure side of gross domestic product (at 1987 prices). Series are filtered to remove seasonalities.
Source: State Institute of Statistics.

As a result, the economy experiences a recession right before or immediately after the program ends. If the economy goes through several "slowed down depreciation-correction" cycles, the overall economic activity will also experience boom-bust cycles. The amplitude of these cycles will be higher if the intertemporal elasticity of substitution is high in the economy.[3]

With regard to economic growth after 1987; there were four recessions in Turkey (see Figure 2). Both the 1991 and 1994 recessions were preceded by a substantial increase (appreciation) in the real exchange rate, as shown in Figure 1. Also, private durable and semi-durable goods consumption and private investment were well-above their trend values before those recessions (see Figure 3).

The last recession in 1999 was mainly caused by the response of monetary authorities to the Russian crisis in late 1998 and two devastating earthquakes in 1999. The real interest rates were kept higher to defend the Turkish lira for a considerable period of time after the Russian crisis. Nevertheless, it is worth noting that there was a small appreciation (approximately 10%) from January 1996 up until the Russian crisis in July 1998. During this period, we observe again a boom in both private consumption and private investment. Since the recent disinflationary program also relies on a slowed-down depreciation policy, it is reasonable to expect another boom-bust cycle in economic activity starting 2000, regardless of the outcome of the program. If the slow-down in economic activity arrives relatively early, it might be a real concern for the Government and the program might come to an unexpected end.

3. External Balance

With the introduction of a comprehensive stabilization program in January 1980, an outward oriented development strategy was accepted and external balance became a major concern of governments as protracted current account imbalances made the Governments more sensitive about the sustainability of external imbalances.

The export-led growth policy was quite successful in the early stages of its implementation. The openness of the economy increased immediately: the total exports-GDP ratio increased from 4.1% to 13.3% during the period of 1980–88. The total imports - GDP ratio also increased but the rate of increase was smaller as it went up from 11.3% to 16.4% during the same period. Therefore, the external balance situation improved significantly. The external deficit-GDP ratio went down from 7% in 1980 to negative 1% (surplus) in 1988. The real depreciation of the Turkish lira (approximately 40%) and several tax incentives to exporters in this period were the major driving forces of the export-led growth policy.[4]

The policy reversal after 1987 had an adverse effect on the external balance situation of the economy. Because of the slowed-down depreciation, the Turkish lira appreciated in real terms 22% in 1989 and continued to appreciate in 1990 at a slower rate. Consequently, the rate of increase in the total exports slowed down and that of total imports jumped up. The external deficit - GDP ratio increased to 2% in 1989 and to 4% in 1990. Although there was a slight decrease in 1991 and 1992, the external deficit reached to approximately 6% of the GDP in 1993 (see Figure 4).[5]

Towards the end of 1993, it was clear that both fiscal policy and external balance situation was not sustainable. In January 1994, international credit rating agencies lowered Turkey's sovereign debt rating to below investment grade. This triggered a panic in financial markets. The Turkish lira was devaluated twice, in January and in April of 1994. Total exports increased dramatically while total imports contracted. As a result, the external balance was positive in 1994 at 1% of GDP.

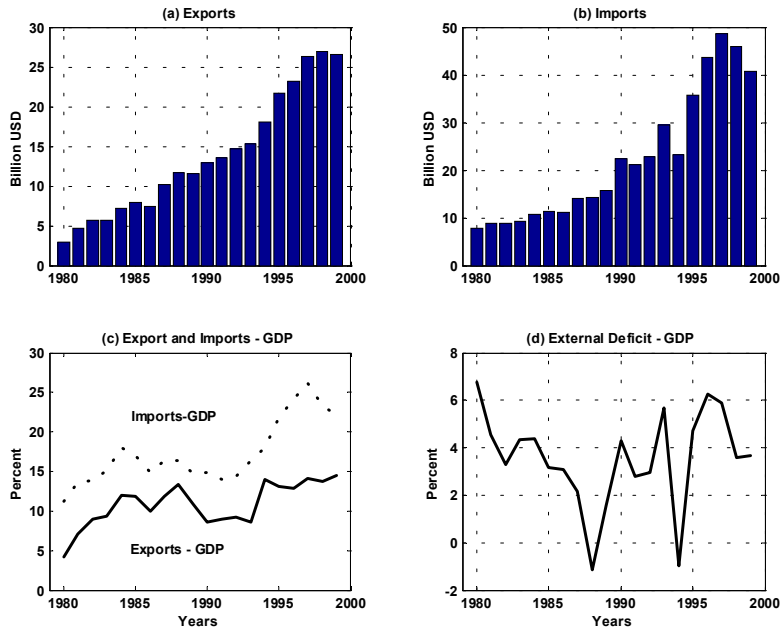

Figure 4: External Trade
(a) Exports (in billion USD).
(b) Imports (in billion USD).
(c) Exports and Imports to GDP Ratios (in percent).
(d) External deficit to GDP ratio (in percent).
External deficit figures are taken from the national income accounts of the State Institute of Statistics. Export figures do not contain the shuttle trade estimates of the Central Bank. See Footnote 3 on unofficial exports and imports.
Source: State Institute of Statistics.

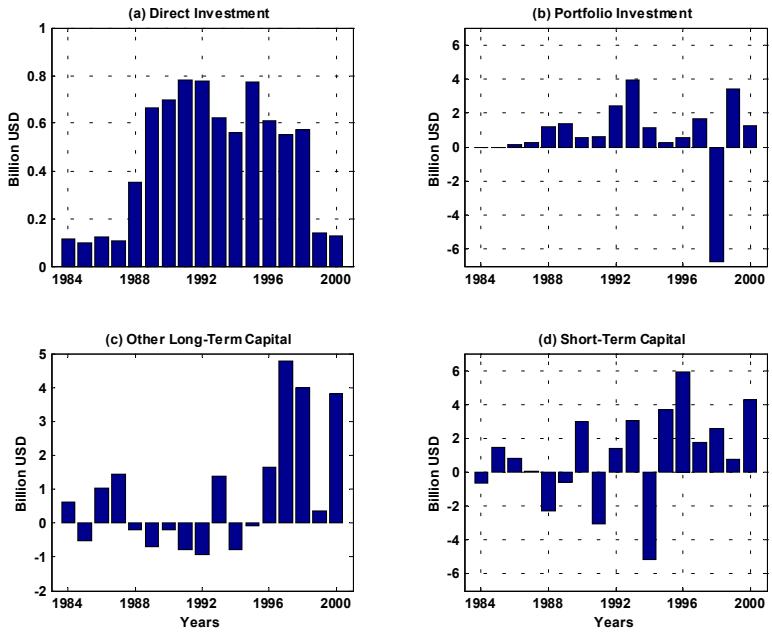

Figure 5: Capital Flows
(a) Foreign direct investment (in billion USD).
(b) Portfolio investment (in billion USD).
(c) Other long-term capital (in billion USD).
(d) Short-term capital (in billion USD). All figures are net.
Source: Central Bank of the Republic of Turkey.

Between April 1994 and December 1994, the Turkish lira appreciated in real terms significantly (22% in five months) and the corrective nature of the devaluation during the first half of the year disappeared. According to the national income statistics, the external deficit was 5% of the GDP in 1995 and approximately 6% in 1996 and 1997. However, the worsening external balance situation did not result in large current account deficits in these years.[6] The external deficits in 1998 and 1999 were relatively low, thanks to extremely high real interest rates after the Russian crisis and a shrinkage in total demand. Total exports have been stagnant for the last four years at around USD 26 billion and changes in total imports are dominating the current account dynamics.

The capital account of the balance of payments indicates that the Turkish economy became dependent on short-term capital flows, especially after 1989 (see Figure 5). Foreign direct investment (net) was extremely

low up until 1988. Then, there was a surge in foreign direct investment, reaching USD 800 million in 1992 from USD 100 million in 1987. The foreign direct investment averaged USD 600 million between 1993 and 1998 and became low again during the last two years as a result of long-term capital outflows, in particular in the category of investment by domestic residents abroad. Overall, it is safe to conclude that the Turkish economy has not been able to attract significant foreign direct investment for the last 20 years. The total foreign direct investment during the last fifteen years was 7.7 billion, roughly equivalent to total long-term borrowing by the private sector (excluding banks) in just one year (1999). Another noticeable development in long-term capital figures is the surge in the "Other Long Term Capital" item, starting in 1996 (see Figure 5). A close inspection of the statistics reveals that the private sector (excluding banks) has increased its external borrowing for the last five years. This development signals that the foreign exchange exposure of the country is increasing. Total external debt figures confirm this conclusion. The outstanding external debt was USD 79.6 billion in 1996 and 106.9 billion in 2000(Q3), indicating a 34% increase in four years. The composition of the external debt has also changed. In 1996, only 21% of the total debt had a short-term maturity while 25% did in 2000(Q3). The share of commercial banks in short-term external debt is 60% (USD 15.6 billion). The private sector, excluding banks, carries 38% (10.5 billion) of the short-term debt. Incidentally, the total short-term external debt of the country is roughly equivalent to the total reserves of the Central Bank.

4. Fiscal Balance and Domestic Debt

The public sector borrowing requirement (PSBR) in Turkey consists of six components: central government, extra-budgetary funds, local authorities, state economic enterprises, social security institutions and revolving funds.[7] Following the January 24, 1980 program, the PSBR as a percent of GNP decreased immediately from 9% in 1980 to 4.5% in 1981 and stayed less than 5%. After 1986, the PSBR started to increase in a steady fashion and reached 12% in 1993. Although there was a correction in 1994 and 1995, it kept increasing again and reached over 15% in the year 1999 (see Figure 6).

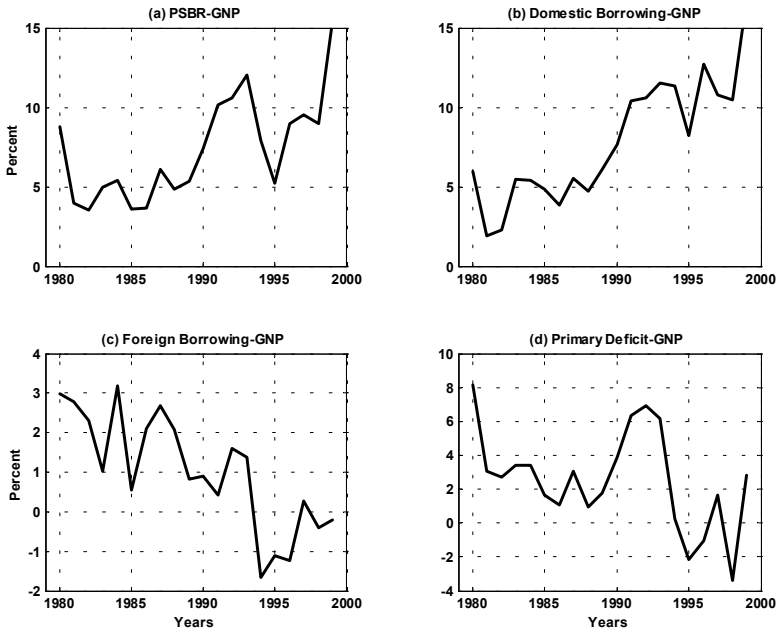

Figure 6: Public Sector Borrowing Requirement and Financing
(a) Public sector borrowing requirement in percent of GNP.
(b) Domestic borrowing in percent of GNP.
(c) Foreign borrowing in percent of GNP.
(d) Primary deficit in percent of GNP.
Source: State Planning Organization.

There was not only a change in deficit dynamics, but also in deficit financing policies of the governments after 1987. The share of domestic borrowing in PSBR financing kept increasing and the share of foreign borrowing declined. After 1993, the share of foreign borrowing in PSBR financing was negative. As a result, the domestic debt started to increase. Right from the beginning of 1990, the total domestic debt dynamics in Turkey clearly indicated that the fiscal policy was on an unsustainable path (see, for example, Selçuk and Rantanen, 1996). Total domestic debt of the government in 1988 was a mere USD 4 billion. As of December 2000, the stock reached USD 53.8 billion. The ratio of domestic debt to GNP also increased from 6% in 1988 to 30% in 1999. Note that this figure does not include some other public liabilities such as unpaid duty losses of the state banks (approximately USD 20 billion). It is hard to imagine that the domestic debt problem can be solved in a smooth fashion.

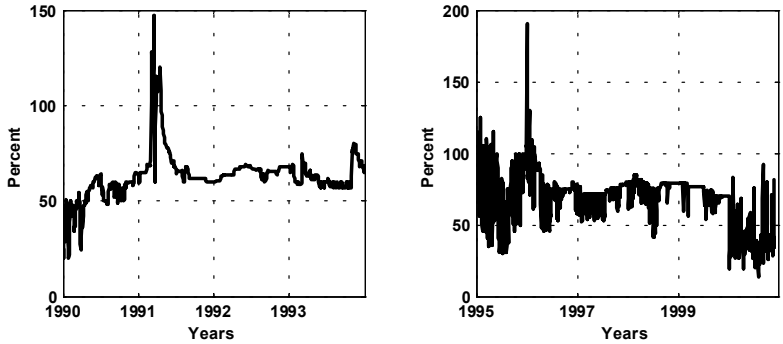

Figure 7: Daily Weighted Average of Overnight Interest Rates (simple annual, percent)
The overnight interest rates reached to extreme levels in 1994 and in late 2000. Therefore, these periods are excluded.
(a) January 2, 1990 – December 31, 1993.
(b) January 2, 1995 – November 17, 2000.
Source: Central Bank of the Republic of Turkey.

The role of the Central Bank's monetary policy in debt management in recent years was one of accommodation.[8] A close inspection of the daily overnight interest rates in Figure 7 preceding the IMF program reveals two distinct periods. There was a volatile period after 1994 crisis (June 1, 1994 – April 16, 1996) followed by a relatively less volatile period (April 17, 1996 – December 31, 1999).[9] During the first period, the sample mean and the standard deviation of the overnight rates were 73.6% and 26.3%, respectively. The second period had almost the same sample mean (72.3%) but much lower standard deviation (7.4%). During the stand-by period in 2000, the sample mean of overnight interest rate decreased. Also, the standard deviation of interest rates increased, as to be expected. The mean of overnight rates between January 3, 2000 and November 17, 2000 was 39% and the standard deviation was 14%.[10] Clearly, the Central Bank had an implicit ceiling on overnight borrowing rates starting April 1996, especially after the Russian crisis in 1998 until January 2000. This implicit ceiling provided a cushion for the commercial banks against the interest rate risk in the market, reducing their risk management capabilities. However, the average interest rate during this "controlled interest rates" period indicates that it was not profitable to buy domestic debt instruments and to fund them from the money market. It was still "borrowing abroad-lending home" strategy, which left a hefty profit margin in dollar terms (see Figure 9).

State economic enterprises are another contributing factor to the public sector borrowing requirement. Zaim and Taşkın (1997) compare the performance of the public enterprise sector to the private sector in Turkey and show that the public enterprise sector performance deteriorated in the 1980s. Although it was always on the agenda of every government, privatization performance of Turkey was quite weak until 2000. The existing legal framework, and populist policies of the governments were probably the main reasons for this result.[11]

5. The Turkish Banking System

One of the main aims of the January 24, 1980 structural adjustment program was the liberalization of the repressed financial system. Concerning the financial deregulations, the governments started to liberalize the foreign exchange regime, certain restrictions on capital movements were removed, and the convertibility of the Turkish Lira was provided. Meanwhile, restrictions on interest rates were removed, a short-term money market was established, the Central Bank was allowed to engage in open market operations and most of the regulations concerning the financial markets were eliminated in the context of liberalization and globalization. These deregulation efforts speeded up the linking of the domestic financial market to the rest of the world, and provided more competitive working conditions to the commercial banks. Liberalization and integration occurred more rapidly than expected, partly due to advances in the telecommunications sector.

It may be asserted that liberalization and integration might improve the overall efficiency in the economy. However, increasing interdependence makes the international linkage of policy implementations more important than before. A boom or a recession in one country spills over to other countries through trade flows and changes in interest rates and capital movements. Hence, the liberalization and integration of the financial sector may also increase the vulnerability of an economy to adverse shocks from the rest of the world. In this section, we investigate the developments in the Turkish banking system in three distinct periods: early liberalization efforts in the 1980s and developments especially after 1987 leading to the 1994 crisis, the 1994 crisis and afterwards, and the 2000 disinflation program. The last subsection also includes an account of the November 2000 crisis in the financial markets.

5.1 Liberalization and the Banking System

The structural adjustment program, which was implemented in the early 1980s, produced substantial changes in the banking sector. Starting in 1980 total assets of the banks increased from USD 18.5 billion (31% of the GNP) to USD 134 billion (68% of the GNP) by the end of 1999. The total deposits - GNP ratio also increased from 15.4% to 61% during the same period (see Figure 8).[12] During this period, the market share of the state banks (in terms of their share in total assets) gradually decreased from 44% to 35% and the share of private banks increased from 41% to 50%. However, the state banks increased their share in total deposits (see Figure 8).

Liberalization and integration efforts created important structural changes in the balance sheets of banking system, especially after 1987. Starting from 1987, when the government slightly changed its exchange rate and debt policy, the relative share of non-deposit funds in total liabilities of private banks permanently increased and reached a peak in 1993. In other words, during this period, the Turkish private banks tried to substitute non-deposit funds for deposits.

After 1987, the share of foreign currency denominated assets and liabilities of the banking sector started to increase. The share of foreign currency denominated assets in total assets rose from 26% in 1988 to 38% in 1999. Similarly, the share of foreign currency denominated liabilities in total liabilities rose from 25% in 1988 to 48% in 1999. Short-term borrowing-based deficit financing policies of the governments increased the interest rates and encouraged short-term capital flows into the economy. The policy facilitated managing the public deficit and helped the central bank to build up its foreign currency reserves. These deficit financing and reserve accumulation policies led commercial banks to open short positions in foreign currencies. The short positions in the banking system increased from 1.8 billion in 1990 to USD 5 billion in 1993. Although there was a decrease in 1994 as a result of a financial crisis in that year, the short positions of the banking system kept increasing and reached USD 13.2 billion at the end of 1999 (see Figure 9).

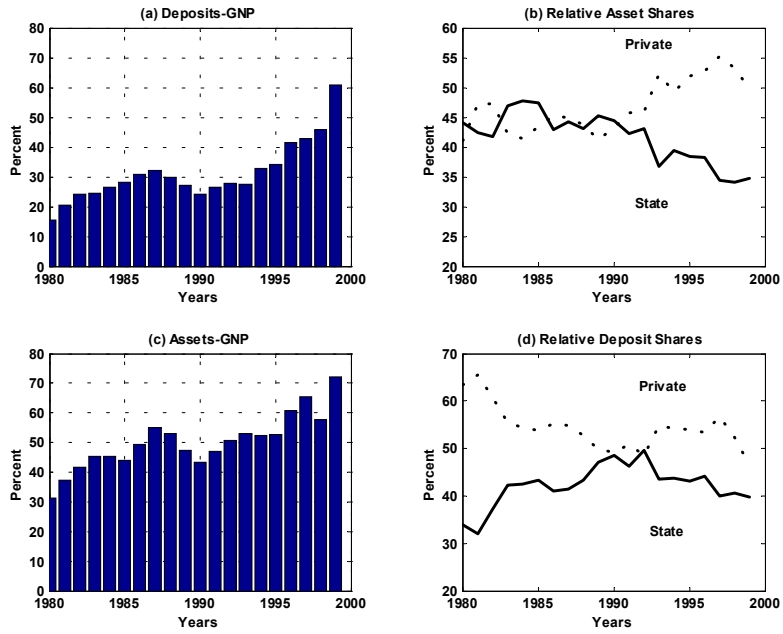

Figure 8: Selected Banking Sector Indicators
(a) Total deposits in commercial banks – Nominal GNP ratio (in percent).
(b) The share of state banks (straight line) and the share of private banks (dotted line) in total assets.
(c) Total assets of commercial banks – Nominal GNP ratio (in percent).
(d) The share of state banks (straight line) and the share of private banks (dotted line) in total deposits.
Source: The Banks Association of Turkey.

The short-term borrowing-based deficit financing policy of the government also led the commercial banks to change their asset management policies: they shifted from direct loan extensions to purchasing government securities. The share of security investment of the banks in total assets increased from 10% in 1988 to 17.2% in 1999 (see Figure 9).

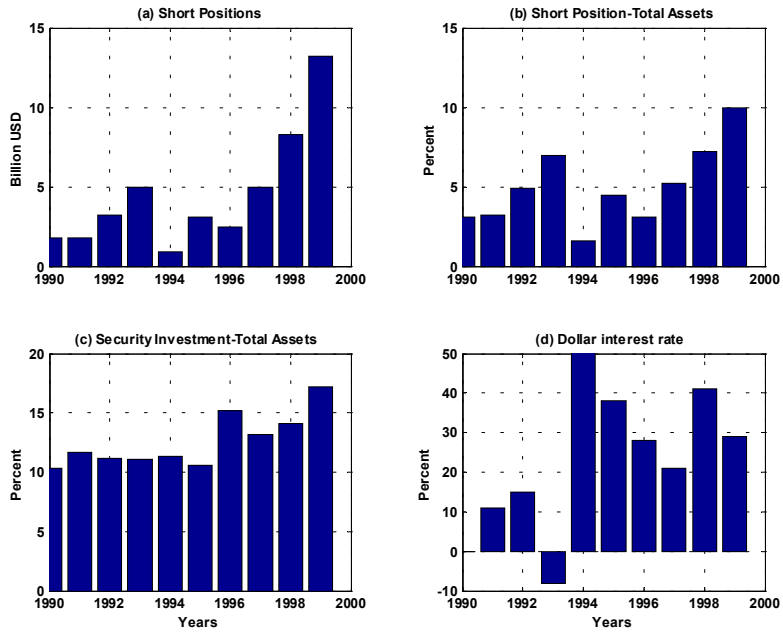

Figure 9: Hot Money and Turkish Banking Sector
(a) Foreign exchange short position of commercial banks. Short position: The difference between foreign exchange denominated liabilities and assets.
(b) Short position - total assets ratio.
(c) Security investment - total assets ratio for commercial banks.
(d) Weighted average of dollar return (ex-post) from TL-denominated Turkish treasury bills and Government bonds (domestic debt). The weighted rate of return was 140% in 1994. We restricted the vertical axis from above to make all years visible in plot (d).
Source: The Banks Association of Turkey and the Undersecretariat of the Treasury.

A combination of disinflationary efforts and short-term borrowing-based deficit financing policies made the banking system more vulnerable against foreign exchange and interest rate risks. The higher interest rate commitment on domestic assets, lower depreciation rate, and increase in the public sector borrowing requirement built up the foreign exchange reserves of the Central Bank but also opened up the banking sector to speculative attacks. The more risk-taking behavior of the privately owned banks and their large short positions in foreign currency raised the question about the sustainability of the external balance policy based on short-term capital inflow.

The financial sector liberalization was completed to a great extent with the demise of restrictions on capital movements in 1989. In the same year, the Central Bank also launched a new monetary program, which prevented easy access of the public sector to the Central Bank's credit lines. However, the government did not accommodate the new monetary policy by taking necessary measures in the fiscal area and the Treasury kept getting involved in external, as well as internal, borrowing activities. High interest rates, lower depreciation and heavy internal and external short-term borrowing were the typical characteristics of the financial environment between 1989–94. A lower credit risk and a high rate of return on government bonds made the privately owned banks weak in managing the market risks. As we mentioned above, private banks changed their global asset-liability management strategies and started to operate in short positions in foreign currency denominated assets since the existing policy provided large profit margins for them (see Figure 9). The net profit-equity ratio and the net interest earnings - net interest expenses ratio increased remarkably in the early 1990s (see Table 1).

Table 1: Net Interest Earnings - Net Interest Expenses Ratio (NIE-NIEX); Net Profit in Percent of Shareholders Equity (NP-NSE) of Private Commercial Banks, in Percent

	1990	1991	1992	1993	1994
NIE-NIEXPrivate Banks	1.41	1.55	1.57	1.86	1.66
NP-NSEPrivate Banks	33.5	37.3	32.1	43.2	42.1

Source: The Banks Association of Turkey.

Because of profitable short-positions, the dollarization in the banking system started to increase. The share of foreign currency denominated assets in total assets went up from 26% in 1988 to 38% in 1999. Also, the share of foreign currency denominated liabilities in total liabilities increased from 25% to 48% during the same period. Because of the currency substitution in the economy, the deposit collection activities of the sector concentrated on foreign currency denominated deposits. In private banks, the share of foreign currency denominated deposits in total deposits reached 72% in 1999.

In general, the privately owned banks in Turkey prefer to increase their capital by adding retained earnings to net worth rather than by new equity participation. Between 1989–93, relatively higher returns on domestic assets helped to increase retained earnings and consequently the net worth

of the banking system. As a result, the capital adequacy ratio in the sector was at internationally acceptable levels.[13]

5.2 The Effects of the 1994 Crisis on the Banking Sector

Towards the end of 1993, the policy reversal of the government, namely, a lower interest rate - higher depreciation policy, and the cancellation of the Treasury auctions compelled the banking system to an urgent re-arrangement of foreign currency denominated assets and liabilities. This very hasty adjustment provoked the demand for foreign currency and started the events, which eventually led the economy to the 1994 crisis. In January 1994, the TL was devaluated around 13%. However, it did not help much to curb the extra demand for foreign currency and the Central Bank increased its lending rates. Although the devaluation was small, it destroyed the balance sheet of commercial banks. In order to alleviate the heavy burden of the short positions of commercial banks, the Central Bank and the state banks started to sell foreign currency to the privately owned banks. After three months of turmoil, the government launched a stabilization program on April 5, 1994 and devaluated in nominal terms the TL by another 65%. The shift in the policy stance and accumulated structural defects of the vulnerable banking system were the apparent reasons for the hard landing.[14]

Almost all of the short positions of privately owned commercial banks were removed before April 5, 1994. Therefore, the effect of devaluation on these banks was limited. In addition, there was a substantial increase in interest income of commercial banks; the ratio of net interest earnings to net interest expenses reached 2.5 in this period. The higher interest margin helped to cover the difference between non-interest expenses and non-interest income, and provided a reasonable net income for private banks. Also, a full coverage insurance scheme for bank deposits was put into effect after launching the stabilization program on April 5, 1994. In spite of all those measures, the burden of the crisis on commercial banks was very destructive. Many banks came to the brink of losing their net worth and three of them were liquidated. Capital adequacy ratios of all banks substantially diminished and the state banks lost 90% of their net worth. Credit expansion activities of the sector almost ceased and non-performing loans increased 65%.

The financial crisis in 1994 was a turning point for the state banks. Ertuğrul and Zaim (1996) investigate the efficiency in the Turkish banking sector within the framework of neoclassical theory using nonparametric

techniques. The study shows that there was a significant increase in the global efficiency of the system in terms of credit extension and deposit collection between 1980–93 and a decrease in 1994. These findings point out the positive impact of the liberalization efforts on the efficiency in the system. The study also indicates that the state banks were more efficient than the private banks in terms of credit extension and deposit collection during 1981–93. Under the constant-returns-to-scale assumption, the inefficiency index of the state banks decreased from 10.7% to 4.1% and the inefficiency index of the privately owned banks went down from 24.5% to 13.7%. The inefficiency index of private banks in general is above the state banks. However, the speed of improvement in private banks was remarkable.

After the crisis in 1994, private banks became more efficient than the state banks in terms of credit extension and deposit collection. The inefficiency of the state banks stems from the implicit resource allocation decisions of the government. As it was mentioned before, the state banks lost almost 90% of their net worth during the 1994 crisis. Devaluation and the new measures taken by the government negatively affected the income statement of these banks. The ratio of net income to total assets declined from 3.1% in 1993 to -0.1% in 1994 and remained well below the same ratio for the private banks in the following years (see Table 2). The net interest margin of privately owned banks was roughly three times larger than the net interest margin of the state banks.

Table 2: Net Income - Average Total Assets Ratio (NI-ATA); Net Interest Income - Average Total Assets Ratio (NII-ATA), in Percent

	1993	1994	1995	1996	1997	1998	1999
NI-ATA							
Privately owned	.39	3.8	5.7	5.8	4.8	5.6	5.6
The state banks	3.1	-0.1	0.2	0.9	0.8	0.8	0.5
NII-ATA							
Privately owned	11.2	12.4	11.5	12.5	13.2	14.9	12.3
The state banks	8.7	7.9	2.9	6.2	4.2	4.9	3.7

Source: The Banks Association of Turkey.

The state owned commercial banks extended concessionary credits to the agricultural sector, to small- and medium-sized enterprises, and to the housing sector. In spite of the increasing market interest rates, these banks were not able to change their traditional loan extending policies and could

not reduce the volume of concessionary loans. The total burden of this credit policy and some quasi-fiscal duties on the state banks reached up to USD 20 billion at the end of year 2000. These so called "duty losses" were slightly above 10% of GDP and 14% of the total assets of the banking system. An inadequate reimbursement of the Undersecretariat of the Treasury concerning the duty losses increased the liquidity needs and exacerbated capital adequacy problems of the state owned banks. The practice of extra interest offerings by the state banks to attract deposits created distortions in the market.

In sum, the measures taken during and after the 1994 stabilization program could not relieve the vulnerability of the banking system. The government and the commercial banks returned to the alluring hot money policy immediately after the 1994 crisis; i.e., short-term borrowing from abroad and lending at home as a result of hefty profit margins on the Treasury bills and government bonds in dollar terms (see Figure 9). Due to large fiscal deficits and extensive Government borrowing, higher interest rates induced the banking sector to get heavily involved in deficit financing, neglecting market risk, exchange rate risk, and proper management of assets and liabilities. The excessive risk-taking behavior of privately owned banks increased the vulnerability of the system to even small shocks. Protracted fiscal imbalances, inadequate regulation and supervision of banking system, poor risk management, and implicit and explicit government guarantees prevented the provision of the preconditions of a sound financial system.

5.3 Stabilization Program in the Year 2000 and the Banking Sector

In July 1998, the Turkish government started to implement a disinflation program under the guidance of an IMF Staff Monitored Program (SMF). The program achieved some improvements concerning the inflation rate and fiscal imbalances but it could not relieve the pressures on the interest rates. The Russian crisis in August 1998, the general elections in April 1999 and two devastating earthquakes in August and October 1999 led to a deteriorating fiscal balance of the public sector. The relative share of primary surplus in GDP decreased and the public debt - GDP ratio kept increasing. Another IMF-backed disinflation program was launched in December 1999. The program was preloaded with several structural changes. Among other measures, a new banking law was enacted in June 1999, and later modified in December 1999 before the program was launched. An independent Banking Regulation and Supervision Agency

(BRSA) was established with this law. The new banking law stipulates many rules and principles, which are compatible with the regulation and supervision standards of the Basel committee. In this regard, qualifications and responsibilities of the main shareholders were rearranged, new provisions concerning credit extension and the raising of funds were accepted, the minimum capital requirement and capital adequacy were redefined in accordance with the BIS regulations and actions which will be taken by the BRSA for bank failures were determined. Just before launching the stabilization program, five privately owned insolvent banks were taken under the control of the Savings Deposits Insurance Fund (SDIF).

In *The Letter of Intent* dated December 9, 1999, a special emphasis is given to the restructuring of the banking sector. Under the title of "Strengthening the Banking System and Banking Regulation", the government committed to carry out necessary amendments for providing full autonomy to the BRSA and strengthening the prudential standards for lending. Furthermore, the government declared the new regulations about capital adequacy, loan-loss provisions and foreign exchange exposure limits. All these measures aim at providing the appropriate prudential requirements in line with international standards.

In addition to these new regulatory efforts, the government undertook some measures to remove the distortions created by the state owned banks. Commercialization of Ziraat Bank, Halk Bank, and Emlak Bank, and eventually privatization of them tied up to a special action plan.

Most of the actions which will be taken to strengthen the banking system were considered as performance criteria for the stand-by arrangement and the government was expected to fully implement them according to a special time-table.

5.3.1 Crisis in the Middle of the Road Despite the fact that the program achieved some remarkable results in a short period of time, the Turkish financial system experienced a short-lived crisis at the end of year 2000. During the second half of the year 2000, the slow down in economic reforms in general and the opposition to the privatization of certain state enterprises from inside the government increased the suspicion in the market that the program was about to end.

It was very well known in the market that one of the commercial banks, Demirbank, had an extremely risky position. The bank had a substantial government securities portfolio, financed through short term borrowing from the money market.[15] Due to difficulties in borrowing from the money

market on November 20, 2000, Demirbank started a fire-sale on government bonds in order to obtain liquidity. Similar actions by the market makers in government securities pushed the interest rates up further and the market makers stopped posting prices. The turmoil in the market promoted expectations of an immediate devaluation and triggered an inverse movement of short-term capital.[16] Liquidity pressure as a result of the heavy capital outflow and a decrease in the Central Bank reserves rocketed interest rates. The Central Bank started to provide liquidity to the market violating the rule set by the Stand-by Agreement for net domestic assets. However, the additional liquidity bounced back in the form of additional demand for foreign currency. Therefore, the Central Bank stopped providing liquidity and the overnight interest rate (simple annual) reached its peak of 800% on December 4, 2000.[17] The financial turmoil forced a set of urgent measures. The government requested the completion of the third and fourth program reviews and asked for access to the Supplemental Reserve Facility of the IMF. The IMF "emergency" team in Ankara and the government officials announced on December 5, 2000 that the IMF was considering an additional USD 7.5 billion loan to Turkey to support the on-going program. The same day before the markets opened, Demirbank was taken by the SDIF, ten days after the crisis started.

With an additional letter of intent to the IMF, the government committed to take additional actions on public finance, privatization, the agriculture sector, income policy, monetary and exchange rate policies. Most of the new steps, policy formulations and regulations are parallel to those stipulated in the first letter of intent, dated December 9, 1999. However, the new letter stresses the importance of the policies and specifies the dates of almost each additional measure. The letter also emphasizes the restoration of confidence in the banking and financial system. In this regard, it is promised that a comprehensive system of guarantees for depositors and other creditors to the banks will be established, necessary measures will be taken to resolve the situations of ten banks which are under the management of the SDIF, appropriate regulation and supervision mechanisms will be put into effect for keeping the banking system sound and necessary actions will be taken for commercialization and privatization of state owned banks.

On December 22, 2000, the request of the Turkish government was accepted by the IMF Board and additional financial support was assumed in terms of access to the SRF. Specifically, the Board announced that an additional USD 7.5 billions would be provided to Turkey in several installments. The reverse capital flow took place immediately, especially in

the beginning of the year and the Central Bank reserves returned to their pre-crisis level. Interest rates decreased, albeit stabilizing at a higher level than the pre-crisis average.

Preliminary developments in the money market and the bond market indicate that the confidence in the economy has been restored. However, dependency on the short-term capital flows and the vulnerability of the banking sector signals the possibility of a new crisis. The liquidity creation mechanism stipulated in the stand-by arrangement requires sizable capital inflows. The poor performance of the economy in attracting long-term capital in the form of a direct investment makes the short term capital flows and external borrowing more important than before. Ironically, the success of the disinflation program and the stability of the banking system now depend on short term capital inflow, although the program aimed to put the economy on a sustainable growth path. Clearly, this creates a very fragile financial system as it is unsustainable to rely on short term capital flows in the long run.

6. Conclusion

The history of the Turkish economy for the last 20 years might be analyzed in two distinct periods: an export-led growth period (1980–88) characterized by sustained growth and a volatile growth period during which the economy became dependent on the short-term capital flows, thanks to an alluring "hot money policy" (1989–99) initiated by the monetary authorities of the Central Bank in 1989. The recent restructuring and reform program aims at reducing the inflation to single digits and putting the economy into a sustainable growth path. A financial crisis during the course of the program showed that the financial system is very fragile. Ironically, the latest crisis also made it clear that the continuation of the disinflation program and the stability of the banking system in the short run depend on short-term capital inflows. Unless the Turkish government creates an environment in which foreign direct investment finds itself comfortable, the program is destined to fail like the previous programs.

Epilogue

One week after the final version of this chapter was written there was a scheduled domestic debt auction of the Treasury on February 20, 2001, the

day before the maturing of USD 7 billion domestic debt. The auction aimed at borrowing approximately USD 5 billion (around 10% of the total domestic debt) and the market participants were nervous about the outcome as it would indicate the level of confidence in the market about the ongoing stabilization program.

Suddenly, the day before the auction, Turkish Prime Minister Bülent Ecevit stormed out of a key meeting of top political and military leaders stating that "a serious crisis had arisen between himself and the country's president". He further emphasized that "of course, this is a serious political crisis". This development was perceived as a blunt statement that the ongoing stabilization program had come to an end. The news hit the market and the stock market dived 18% in one day. The same day, the Central Bank sold USD 7.5 billion (approximately one-third of the total official reserves) for the next day delivery. The next day, two state banks (Ziraat and Halkbank) were not able to meet their obligations in the markets and the Central Bank refused to provide Turkish lira liquidity to the banks. Therefore, the banks were not able to fulfill their TL obligations to buy foreign exchange from the Central Bank and they were forced to cancel USD 5 billion portion of their foreign exchange buying contracts with the Central Bank. The daily weighted average overnight interest rates rocketed up to 2000% on a simple annual base on February 20, and 4000% in the following day. The government responded by dropping its exchange-rate controls early on February 22, 2001. The Turkish lira fell 40% in value against the US dollar. The change in the exchange rate between February 19 and May 30, 2001 is around 65%. Consequently, monthly inflation in March (calculated from wholesale price index) was 10%, followed by a monthly inflation of 14% in April.

After long turmoil on the financial markets, Prime Minister Bülent Ecevit appointed World Bank Vice President Kemal Derviş to a cabinet post in charge of the Treasury, with responsibilities for overseeing the Central Bank and state banks on March 2, 2001. Since then, Derviş has in fact been in charge of all economic affairs. After meeting with officials from the International Monetary Fund, the World Bank and the U.S. Treasury, Kemal Derviş prepared a new letter of intent, emphasizing a major overhaul in the banking system and a promise of further acceleration of structural reforms outlined in earlier letters of intent. On May 15, 2001, the IMF approved this revision of the Turkey's three-year Stand-By arrangement by US $8 billion which put the overall IMF support to a total of US $19 billion since the beginning of the program in year 2000. The

World Bank also announced that there would be additional credit lines to Turkey to support the new program.

Table 3: Selected Items from the Balance Sheet of the Deposit Banks in Turkey, in billions of USD

	September 2000	December 2000	February 2001
Total Assets	*131,340*	*142,001*	*139,322*
Securities Portfolio	14,988	16,913	15,159
Interest Income Accruals	9,205	5,654	10,797
Tied Securities Portfolio	6,279	7,800	12,810
Special Duty Account	17,129	22,490	16,626
Total Liabilities	*131,340*	*142,001*	*139,322*
Interest & Expense Redisc.	3,404	4,157	5,324
Shareholder's Equity	8,261	9,113	4,491
Paid-up Capital	6,812	7,078	(538)
Reserve Funds	1,675	6,601	6,036
Profit (Loss)	(457)	(4,663)	(4,455)

Note: Some of the securities in the banks' portfolio are classified under "tied securities portfolio" which is valued with "internal rate of return" methodology, not with the "mark-to-market" approach. Under optimistic assumptions, the total loss of the deposit banks would increase to USD 7 billion if "mark-to-market" approach was adopted in calculations for some of these assets. Also notice that the Treasury issued government bonds to recapitalize some of the banks operating under the Saving Deposits Insurance Fund. These bonds are classified under "reserve funds". Excluding these bonds and adopting "mark-to-market" approach for some of the securities in "tied securities portfolio" would result in a shareholders' equity of negative US $ 4 billion.
Sources: Central Bank of the Republic of Turkey and Dışbank Research Department.

Although there is substantial support from international financial institutions, the economic situation in Turkey is more fragile than before. Particularly, there is nothing substantial in the new program to resolve the sustainability problem of the domestic debt and there is no sign of a major overhaul in the banking system (see Table 3). The political structure, which is the main cause of the recurrent crisis, is still in power. Recent developments have showed that most of the current cabinet members are reluctant to support the ongoing program. Unfortunately, we have to conclude this epilogue with a similar sentence we concluded the original article above: "Unless the Turkish economy creates an environment in which foreign direct investment finds itself comfortable, unless the domestic debt dynamics are put onto a sustainable path, and unless there is

a major overhaul in the banking system, the program is destined to fail like the previous programs".

Ankara, May 29, 2001

Notes

* Revised and reprinted with M. E. Sharpe's permission from *Russian and East European Finance and Trade*, 37 (6): 6–28.

1 See, OECD (2000) and Selçuk and Yeldan (2001) for an evaluation of the macroeconomic impact of the August 1999 earthquake.

2 Tezel (1994) is a standard reference on Turkish economic history up to 1950. See Arıcanlı and Rodrik (1990) and Öniş and Riedel (1993), and the references therein, for a detailed account of the Turkish macroeconomic experience during 1951-1987. For recent years, see Selçuk (1997) and other chapters in Rittenberg (1998). Yeldan (1997, 1998) analyzes the Turkish economy with computable general equilibrium (CGE) models from a political economy viewpoint. Similarly, Öniş and Aysan (2000) conduct a comparative analysis of financial crises in Turkey, Mexico and the East Asian economies from a political economy perspective.

3 Selçuk (1997) shows that Turkey was not able to smooth consumption after 1987 and the realized consumption was more volatile then an estimated optimum consumption.

4 See Togan (1995) for a review of the trade policy of Turkey. More recently, Togan (2001) reviews the openness of the Turkish economy in relation with the European Union. For the real exchange rate developments, see Agénor *et al.* (1997) and Erlat and Erlat (1998).

5 The external balance figures are taken from the GDP components of the national income statistics, estimated by the State Institute of Statistics. The current account of the balance of payments statistics may give different results. For example, the large inflow of official unrequited transfers in 1990 and 1991 reduced the otherwise large current account deficit. These and similar unrequited transfers should be excluded from the external balance analysis of an economy, unless they have a permanent nature.

6 Especially after 1993, there was a substantial foreign exchange flow into the economy and the source of this flow is officially unknown. The Central Bank views this unknown inflow as current account income. It was classified under "Other Income, Other" item in the balance of payment statistics for a long period of time. Recently, a new category – shuttle trade – was added to the balance of payments. This item includes estimated unofficial exports, mainly to the former Soviet Union countries. However, there is no estimate of unofficial imports in the balance of payments of Turkey. The total amount of unofficial exports *and* imports as well as unofficial foreign exchange transfers from external services are difficult to estimate. A recent letter of intent to the IMF points out this problem: "In the period ahead, the institutional capacity to compile balance of payment statistics needs to be strengthened, in light of the difficulties in this area encountered in recent years (especially regarding the external service accounts)". [*The Letter of Intent*, December 18, 2000, paragraph 61.]

7 For a measure of the overall public sector deficit and borrowing requirement, the losses of the state banks and the Central Bank must also be included in the PSBR definition above. For example, accumulated duty losses of the state banks reached to USD 20

billion in year 2000 (approximately 11% of the GDP) and the state banks have registered significant losses in recent years. Developments in the banking sector will be investigated in Section 5.

[8] See Berument and Malatyalı (2000) for an analysis of the Central Bank policies in recent years.

[9] The second period corresponds to the tenure of current Governor Gazi Erçel. He was appointed on April 17, 1996.

[10] In terms of the sample coefficient of variation CV, the volatile period had a CV of 0.36 and the less-volatile period had a CV of 0.10. The same statistic for the program period is 0.36.

[11] Celasun (2001) reports the privatization policies and the privatization performance of Turkey between 1985-1995.

[12] Sudden jumps in these ratios in 1999 were direct consequence of a deep recession, and consequently a drop in GDP.

[13] According to the Basel accord, if the ratio of total capital to borrowed resources is over 8%, the capital adequacy ratio is generally accepted as satisfactory.

[14] See, Özatay (1996) for an analysis of 1994 crisis from a public mismanagement point of view.

[15] It is estimated that Demirbank (paid capital USD 300 millions) had approximately USD 7.5 billion of government securities (almost 15% of the total domestic debt stock).

[16] Dornbusch (2001) claims that a large number of bad banks and the banking system's short term funding caused the crisis in Turkey. Stanley Fischer, first deputy managing director of the IMF, relates the crisis in Turkey to banking sector problems and the failure to undertake corrective fiscal actions against the widening current account deficit. See Fischer (2001).

[17] This rate is a weighted average of interest rates in the money market. The highest and the lowest (simple annual) overnight interest rates were 300% and 1950%, respectively, during this period.

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PART II

SOURCES OF INFLATION IN TURKEY

Chapter 3

Causes of Inflation in Turkey: A Literature Survey with Special Reference to Theories of Inflation*

Aykut Kibritçioğlu

Abstract: Turkey has experienced high and persistent inflation for more than twenty years. This chapter attempts firstly to survey the extremely broad literature on theories of inflation, in order to be able to classify, understand and discuss the dynamics of inflation more carefully. In this chapter, it is mainly argued that inflation may be interpreted as a net result of sophisticated and continuous interactions of demand-side (or monetary) shocks, supply-side (or real) shocks, price-adjustment (or inertial) factors and political processes (or institutional factors). The second aim of the chapter is to compare the existing empirical studies on Turkish inflation, by considering their sample period, data frequency, empirical methods, modeled macroeconomic variables and main results. Most of the studies reviewed here seem to have focused primarily on demand-side determinants (e.g., monetary growth and budget deficits), and partially on some supply-side factors (e.g., nominal exchange rates and oil prices). On the other hand, the components, degree and effects of inflation inertia need to be investigated in more detail. In the future, the modeling attempts of the inflationary dynamics in Turkey would profit from the so-called "new political macroeconomics" because the role of the political process and institutions is not a weak explanatory factor of Turkish inflation.

1. Introduction

High and persistent inflation has been a major characteristic of the Turkish economy for more than two decades (see Figure 1), and several disinflation attempts since 1980 seem to have failed. There exists still a number of potential causes for ongoing inflationary process.

In Turkey, it is *commonly* argued that sustainability of high and persistent inflation rates since the late 1970s has been "fed" by:

(1) high public sector budget deficits,
(2) monetization of public sector budget deficits,

(3) massive infrastructure investments of the various governments, such as for the Southeastern Anatolian Project,
(4) high military expenditures associated with geopolitical reasons,
(5) political instability which results in inflationary pressures due to populist policies that have ensued prior to each general election,
(6) persistent inflationary expectations of economic agents,
(7) inflationary effects of changes in exchange rates via increases in prices of imported inputs,
(8) occasional increases in world prices of major imported inputs (particularly, crude-oil),
(9) increases in regulated prices of public sector products which are mainly used as input by the domestic private sector, and/or
(10) rising interest rates resulting from the crowding-out effect of public sector borrowing in a shallow domestic capital market.

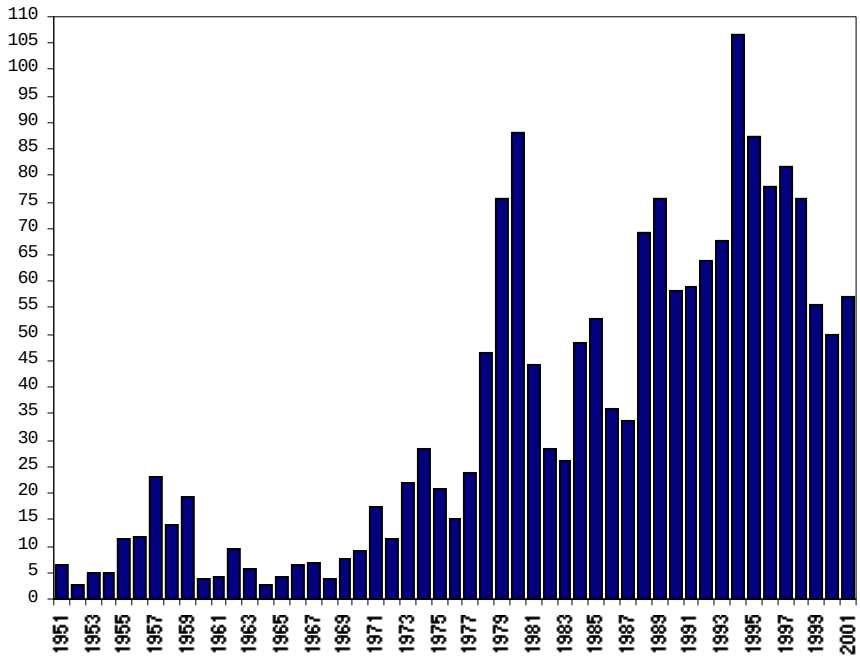

Figure 1: Inflation in Turkey (annual percent changes in the GDP deflator, 1951–2001)
Source: State Institute of Statistics and State Planning Organization; author's own calculations.

In reality, however, most of these "possible" causes discussed *publicly* may be condensed into a smaller number of determinants in order to better understand the dynamics of inflation in Turkey. There are many reasons to do so. First of all, some of these factors are closely interrelated, or may be seen as stemming from the same macroeconomic category. Some other factors cannot be accepted as real causes of inflation if we consider the relevant debates in the theory. Furthermore, to be able to propose a successful disinflation program, one should rank these broader factors according to their relative importance. Given the current focus on disinflation in Turkey, it seems very timely to survey both the main developments in inflation theories and the empirical studies on sources of inflation in Turkey. This type of a study may also be illuminating for the formation of a new agenda for future research on analyzing the current dynamics of inflation and/or disinflation in Turkey.

In this chapter, I mainly attempt selectively to review the existing large body of empirical literature on causes of Turkish inflation. Since every empirical study must be based on a theoretical background, I firstly present a brief history of theories of inflation in Section 2. Following this review of competing or complementary theories of inflation, in Section 3, I compare selected empirical studies of Turkish inflation in terms of their sample period, data frequency, empirical methods, modeled macroeconomic variables, and main results. Finally, Section 4 is devoted both to summarizing the main conclusions of the survey and to discussing briefly possible directions of further research with special reference to recent developments in inflation theory.

Note that the emphasis in this study will be, in general, on "causes" of inflation rather than on possible "costs and cures" of inflation. That is to say, a number of highly relevant topics, such as disinflation, core inflation, inflation targeting, policy credibility and inflation variability, remain outside the framework of the present study.

2. A Brief History of Inflation Theories

Inflation is usually defined as sustained increases in the general price level for goods and services in an economy. Note that this definition excludes clearly *one-time* increases in the price level.[1] If equilibrium price level in a domestic market for goods and services rises continuously as a result of continued excess demand conditions in successive time periods, then economists speak in general from *demand-pull inflation*. In this case

aggregate demand grows faster than the level of aggregate supply and "pulls" prices higher. But if firms' costs increase continuously as in the cases of rising wages, interest rates, taxes, imported input prices, or exchange rates, then some economists prefer to use the term *cost-push inflation* to describe this phenomenon.

In practice, however, it is not always easy to decompose the observed inflation into its demand-pull and cost-push components. The process is dynamic, and the shocks to prices are mixed. Furthermore, inflation itself, or inertia in inflation, may also cause future inflation. Finally, some theories include both demand-side and supply-side channels of feedback in explaining inflation. Therefore, we need other criteria, besides demand-pull and cost-push, to classify theories of inflation. There are many alternative possibilities to distinguish various types of inflation theories. For example, we may differentiate between short-run vs. long-run inflation theories, closed vs. open economy models of inflation, theories of low-, high- or hyper-inflation, perfect competition (market-clearing) vs. imperfect (monopolistic) competition models, theories with assumptions of perfect or imperfect information, fiscal vs. monetary theories of inflation, etc. For the purposes of the present study, it seems to me more appropriate to classify and compare theories of inflation according to major debates between competing schools of economics in a more or less chronological order.[2] This section ends with a four-blocked categorization of the causes of inflation.

2.1 Monetary vs. Keynesian Inflation Theories

Classical (e.g., David Hume, Adam Smith, David Ricardo and John Stuart Mill) and *neoclassical* (e.g., Leon Walras, Alfred Marshall and Arthur C. Pigou) economists all used mainly the so-called *quantity theory of money* (QTM) to explain inflation. In its transactions version, the QTM states that the value of all sales of goods must necessarily equal the value of all purchases:

$$M \cdot V = P \cdot T \tag{1}$$

where M is money supply, V is the velocity of money, P is the general price level, and T represents the real volume of transactions. In this framework, aggregate supply in the goods market is given while aggregate demand is defined as follows:

$$AS = T\ . \tag{2}$$

$$AD = (M \cdot V) / P\ . \tag{3}$$

Now, T may be interpreted to represent real output which is determined according to the production function in the long run. Equilibrium in the goods market requires here that $AS = AD$, and hence,

$$T = (M \cdot V) / P\ . \tag{4}$$

If one assumes, following the classical economists, that V and T are constant in the short run, the transactions equation in (4) can be rewritten to yield a price equation for the economy as follows:

$$P = (\overline{V} / \overline{T}) \cdot M\ . \tag{5a}$$

Equation (5a) states simply that doubling the money supply doubles *ceteris paribus* the price level. That is, the general price level is solely an increasing function of money supply, or in other words, an excess supply in the money market causes, other things being equal, an excess demand in the goods market. It should be added that the relative version of the equation (5a) can simply be interpreted as the *inflation equation* of the QTM:

$$\pi \approx (v - g) + m \tag{5b}$$

where π, v, g and m represent the percentage changes in P, V, T, and M, respectively, while v and g are assumed to be zero.

In its extreme interpretation, this simple classical or neoclassical relationship states that inflation is *only* a monetary phenomenon if one ignores the possible changes in V and T. Therefore, in a classical or neoclassical economy, the money supply should be reduced to fight against inflation.

O'Brien (1975) argues that there are some differences between transmission mechanisms in classical and neoclassical versions of the QTM. The neoclassical model is based on the assumption of full employment, and it is characterized by a dichotomy between the real and monetary sectors. Real wages will be determined in the real sector (labor

market) while nominal prices are a function of the money supply. Therefore, increases in the money supply increase the general price level by leaving the volumes of goods demanded and supplied, and hence, real output unchanged. On the other hand, O'Brien writes, some classical economists like David Hume do not assume full employment and there is no room for a dichotomy. According to Hume, an increase in the money supply does increase the general price level through a different transmission mechanism. The increase in nominal cash balances of economic units initially results in higher expenditures for goods, and hence, in higher production. Then, under the assumption of underemployment, prices start to adjust to risen money supply. As a result, money is not neutral as in the neoclassical model; it has also some real effects in the short run. In other words, Hume's monetary approach differs in describing the process of inflation in the short and long run by allowing to some price rigidities in the short run.

John Maynard Keynes' (1936) revolutionary book, *The General Theory of Employment, Interest and Money*, was based mainly on the assumption of underemployment equilibrium with a fixed general price level. That is, it was not designed to analyze the dynamics of inflation. As an alternative to monetary model of inflation, Keynes (1940) developed a different demand-side model of inflation with *price rigidities* mainly in the labor market. In his model of "inflation gap", Keynes describes a *redistribution* process in which "inflation acts like a pump that transfers income from wage earners who have a low propensity to save and a low marginal tax rate to the entrepreneurial sector with a higher propensity to save and a higher marginal tax rate" (Frisch, 1983: 230). An unexpected increase in aggregate demand (inflationary gap), as in the case of a war, leads to a price increase under full employment conditions, and this, in turn, creates unanticipated profits for firms while nominal wages remain temporarily constant. Rising profits create an additional excess demand in the goods market. However, the lagged attempt of firms to satisfy the initial excess demand in the goods market creates an excess demand in the labor market. Resulting competition among entrepreneurs for fully employed labor pushes nominal wages higher until restoring real wages to their initial level. The increase in real wages induces a new demand pressure in the goods market. Prices increase again. If the wage-lag mechanism still continues to work, an inflation spiral occurs which can be defeated only by reducing aggregate demand (e.g., tax increases and/or cuts in government spending) and/or reducing rigidities by, for example, implementing an appropriate income policy.

2.2 Neo-Keynesian vs. Monetarist Approach to Inflation: The Philips-Curve Debate

Keynes' (1940) inflationary gap model was mainly a demand-side model with wage rigidities in the short-run but without any explicit remarks about the money market developments as in the QTM. Furthermore, his non-monetary, demand-pull approach to inflation was influenced also by some cost-push arguments for inflation, even in his some earlier studies as mentioned by Humphrey (1981). In spite of accepting the possibility of inflationary effects originating from supply-side shocks, most *Keynesian* economists such as A. Smithies, G. Ackley, S. Maital and J. A. Trevithhick treated demand-side shocks as the primary cause of inflation. Arthur Smithies (1942) and the others formalized Keynes' verbal analysis of inflationary gap and their explanations prevailed until the mid-1970s. In Section 2.3, I will return to the Keynes-Smithies line of theories with special emphasis on the role of distributional effects in the process of inflation when summarizing the cost-push theories of inflation developed by structuralists, post-Keynesians, disequilibrium economists and neo-Marxian economists.

The Neo-Keynesian macroeconomics, or so-called *Keynesian neoclassical synthesis*, is based primarily on

(1) the *IS-LM* closed-economy model developed mainly by John R. Hicks and Franco Modigliani in the late 1930s and 1940s,
(2) the *Phillips curve* developed by Alban W. Phillips and Richard Lipsey in the late 1950s, and popularized by Paul Samuelson and Robert Solow in the early 1960s,[3] and
(3) the *Fleming-Mundell* (F-M) small-open-economy model developed in the 1960s.[4]

The proposed income redistribution mechanism, which fed sustainable price increases in the Keynes-Smithies model, was not included in the standard IS-LM context. That is, there was no room for *continuous* price increases, or inflation, in the neo-Keynesian IS-LM world. On the other hand, the difference between Keynesian and classical theories of income determination was reduced to differences in interest-rate sensitivity of money demand, and hence, to the shape of the curve for money market equilibrium (LM). Therefore, the Keynesian neoclassical synthesis incorporated labor market dynamics into the IS-LM model by taking into account the so-called Phillips curve (PC) to eliminate the missing wage/price block, or inflation equation, in the system:

$$\pi = \alpha \cdot U \tag{6a}$$

where π represents the inflation rate and U is the unemployment rate. The trade-off, or negative correlation, between inflation and unemployment was stated by $\alpha < 0$. That is, the higher the inflation rate the lower is the unemployment rate, and *vice versa*. Furthermore, an increase in the inverse of U, or simply a decrease in U, was interpreted as an indication for *excess demand* in labor and hence in goods markets, following the tradition of the demand-pull explanation for inflation.

The demand-side determination of inflation within the IS-LM-PC framework, however, failed to explain *stagflation* in the late 1960s and 1970s. Particularly, the dramatic oil-price shocks in 1973–74 and 1978–79 created worldwide recessionary and cost-push inflationary effects at the same time. The observed evidence on incompatibility between the PC relationship and the co-existence of stagnation and inflation was actually predicted by *monetarist economists* such as Milton Friedman and Edmund Phelps who proposed a so-called *expectations-augmented PC* in the late 1960s:

$$\pi = \alpha \cdot U + \beta \cdot \pi^e \tag{6b}$$

where π^e is inflation expectations while β represents the expectation adjustment parameter. In the short-run, there is still a negative relationship between inflation and unemployment for a given π^e. That is, inflation expectations act as a shift variable in the model. However, assuming that $\beta=1$ and $\pi^e = \pi$ in the long-run, the PC must be vertical according to the monetarist critique of the standard PC. In other words, there is no trade-off between π and U in the long run, and the vertical long-run PC represents a kind of "natural rate of unemployment".

According to the monetarist economists, the formation of inflation expectations is *backward-looking*, or *adaptive*, in the sense that not all information is available to economic agents during their formation of price expectations:

$$\pi_t^e = \lambda \cdot \pi_{t-1} + (1-\lambda) \cdot \pi_{t-1}^e \tag{7}$$

where λ and $(1-\lambda)$ are the adjustment parameters, or weights. Here, equation (7) states that the expected rate of inflation at time t is only a weighted average of the actual inflation rate and the expected inflation rate in the

previous period. This equation, which shows how expectations are formed, is interpreted by many economists as an appropriate measure of *inflation inertia*.[5] Notice that the concept of backward-looking, or less informed, expectations is also used by Phillip Cagan (1956) as a major determinant of money demand in his famous analysis of hyperinflation.[6]

2.3 Monetarist-Structuralist Debate: Demand-Pull vs. Cost-Push Inflation

The discussions on causes of inflation in the 1960s and early 1970s were dominated by the debate between the monetarists and structuralists as to whether inflation is a demand-pull or cost-push issue.

Cost-push theories of inflation largely attribute inflation and disinflation to non-monetary, supply-side effects that change the unit-cost and profit-markup components of the prices of individual products (Humphrey, 1998). The *structuralist* approach to inflation is one of the major versions of the cost-inflation theories. The idea linking inflation to *country-specific structural factors*, such as the coexistence of a "progressive" (industrial) sector and a "traditional" (agricultural or the export) sector, dates back to the influential studies of Streeten (1962) and Baumol (1967).[7] The first-generation of structuralist inflation models developed in the 1960s explained Latin American inflation with the productivity differences between the industrial and agricultural sectors. In general, they argued that the traditional sector responds to monetary, or aggregate-demand, shocks with a lag. This lag is accompanied by a partial increase in industrial output and employment in the short run, which in turn increases wages and hence the demand for agricultural products. This increase implicates a change in *relative prices* in favor of foodstuffs. Higher agricultural prices lead to higher wage demands in this sector. Increasing wages increase the demand for industrial products, and the mechanism continues to work. In this model, aggregate supply chronically *lags behind* aggregate demand as a result of the temporary output rigidities in one of the sectors. Therefore, the structuralist model is accepted as a cost-push theory.

In the 1970s, the so-called *Scandinavian model* of inflation[8] was one of the popular versions of the structuralist approach. A special feature of the sophisticated Scandinavian theory is that wages in Scandinavian countries such as Norway and Sweden are set through nationally supervised collective bargaining from which nearly uniform wage increases for all union workers emerge:

> Wages rise in the more progressive and profitable industries, which can afford to pay more and prefer to do so rather than lower prices or announce higher profits, which

> would invite public criticism and eventually the entry of competitive firms; the wage increases are next extended to the less progressive and profitable industries; the latter must raise their prices since their low profits make it impossible to absorb the costs; important components of the cost of living, such as rents, thus move up; the wage earners who had made the first gains find that they need a catch-up to hold their previous advantage in terms of purchasing power; and the spiral continues. (Whitney, 1982: 80)

The so-called *post-Keynesian* theory of inflation developed particularly in the 1970s,[9] and the short-lived *disequilibrium economics* in the tradition of Don Patinkin and Axel Leijonhufvud provided other well-known types of cost-push theories of inflation with a special emphasize on the role of markup pricing, income claims, and relative price changes. It should be added that some variants of the neo-Marxian and Latin American neo-structuralist inflation theories are still based on the idea of the cost-push inflation, which stems from similar *distributional conflicts*.[10]

Keynesian, structuralist, post-Keynesian, and neo-Marxian versions of cost-push theories seem to have similar distributional mechanisms which imply changes in relative prices, and which produce continuous increases in the general price level, i.e., a sustainable inflationary process. Nevertheless, another group of the supply-side theories of inflation intends to explain only a one-time increase in the price level caused by an exogenous shock such as an oil-price shock and/or devaluation of the national currency. The "imported inflation thesis" which is based on *one-time* shocks, however, cannot explain inflation because it does not include a "mechanism", which can produce *sustained* price increases in an open economy. The temporary nature of most of the oil-price shocks allows only transitory changes in relative prices, output, and employment, while leading to a one-time pressure on general price level. Nevertheless, it should be noted that, in the literature, there are also some sophisticated modeling attempts proposing alternative mechanisms in which, for instance, the causation runs from exchange-rate depreciations or balance-of-payments crises to inflation through increases in inflationary expectations, government deficits and/or the money supply.[11]

The modern QTM in the tradition of Milton Friedman accepts that the inflation occurs when the rate of growth of the money supply exceeds the growth rate of the real aggregate output in the economy. According to the monetarists, the QTM implies that inflation is always, everywhere and solely a monetary and demand-side phenomenon. In their view, cost-push arguments for inflation are misleading because they primarily are based on some *micro*economic observations on the supply-side. Monetarists believe in general that the firm- or industry-specific cost increases cannot be

inflationary as long as they are not related to, or accommodated by, increases in the money supply. Thus, the causation runs from inflation to costs, and not vice versa.

2.4 Rational Expectations Revolution: Forward vs. Backward Looking Expectations

Macroeconomics in the 1970s is dominated by a revolutionary idea of the so-called *Rational Expectations* (RE) economists, such as Robert E. Lucas, Thomas J. Sargent, Neil Wallace, Robert J. Barro and Bennett T. McCallum. Starting with the monetarist assumptions of continuous market-clearing and imperfect information, the RE school, or the first generation of the *new classical macroeconomics*, argued that people do not consistently make the same forecasting errors as suggested in the adaptive expectations idea: Economic agents form their macroeconomic expectations "rationally" based on all past and current relevant information available, and not only on past information as in the case of backwards-looking, or adaptive, price expectations. According to the traditional monetarist approach from the 1960s, the errors in price expectations were related to each other. Here, however, they are totally random, or independent of each other.

The RE approach to the business cycle and prices generated a vertical PC both for the short- and the long-run. If the monetary authority announces a monetary stimulus in advance, people expect that prices rise. In this case, this fully anticipated monetary policy cannot have any real effects even in the short-run as argued by monetarists. Thus, the central bank can affect the real output and employment only if it can find a way to create a "price surprise". Otherwise, the "forward-looking" expectation adjustments of economic agents will ensure that their pre-announced policy fails. Similarly, if a policymaker announces a disinflation policy in advance, this policy cannot reduce prices if people do not believe that the government will really carry it out. That is, in the new classical framework, price expectations are closely related to the necessity of *policy credibility and reputation* for successfully disinflating the economy.

According to monetarist and new classical economists, the growth in the money supply stems typically from the ongoing public sector deficits that are primarily financed by the central bank. In the "unpleasant monetarist framework" presented by Sargent and Wallace (1981), *the government budget constraint* is essential to understanding the time path of inflation.[12] Alternative financing methods for current government deficits only

determine the timing of unavoidable inflation in the future, under the assumption that fiscal policy dominates monetary policy.[13]

2.5 New Keynesian vs. New Classical Economics

In the 1980s, the second generation of the new classical macroeconomists such as Edward C. Prescott, Finn E. Kydland and Charles I. Plosser argued that upswings and downswings in economic activity originate from *real (or aggregate supply) shocks* rather than monetary (or aggregate demand) shocks. Assuming that the aggregate demand curve is fixed, and by keeping the assumptions of continuous market-clearing, imperfect information, and rationality of expectations, the so-called *real business cycle* (RBC) theorists investigate the effects of supply shocks (e.g., process and production innovations, discovery of new sources of raw materials, changes in relative prices of foods and energy, bad weather, and nominal effective exchange rate changes) on the business cycle.

To a large extent, RBC theorists do not attempt explicitly to explain price level changes or inflation; rather, they focus particularly on real-output effects of adverse, or negative, supply shocks such as deviations of factor productivity from trend or relative price changes caused by oil price shocks. However, one can easily argue that the main contribution of RBC economists is that they call our attention to the possibility of the important role of supply shocks in explaining inflation. In terms of the variables in equation (5b), that is, persistent and negative supply-shocks ($g < 0$) may cause inflation, assuming that $v=m=0$. This statement is, actually, also in accordance with the monetarist inflation explanation because m exceeds g even in this case. Note that RBC theory implies that persistent technological improvements may contribute significantly to the disinflation process in an inflationary environment.

Assuming that all markets clear continuously due to speedy price and quantity adjustments, neoclassical, monetarist and new classical line of thinking about causes and cures of inflation mostly ignore the possibility of adjustment lags which may stem from *rigidities* in wages and prices in the *short*-run. Since the late 1970s, however, the *new Keynesian* economists, such as George Akerlof, Janet Yellen, Joseph E. Stiglitz, Robert J. Gordon, John B. Taylor, N. Gregory Mankiw, Guillermo Calvo, Olivier Blanchard and Julio Rotemberg, have investigated the possible microeconomic causes of these rigidities to eliminate the Keynesian "arbitrary" assumption of fixed wages and prices in the short run. The new Keynesian attack on the new classical macroeconomics is concentrated principally on the

assumption of "continuous market-clearing", accepting that inflation is still a monetary phenomenon in the long run. According to the new Keynesians, *wage and price stickiness* in the short run can be explained by factors like "small menu costs" or "staggered (or non-synchronized) wage and price changes". For many firms, particularly under low inflation conditions, it may be costly to change their prices continuously as a response to each demand shock (see, for example, Mankiw, 1985). Another argument is that staggering may slow the process of general price (or wage) level adjustment, even when individual prices (or wages) change frequently.[14]

Obviously, the idea of price rigidities is not applicable to "auction markets" where prices change continuously. Its validity is apparently limited to some posted-price "customer markets" where prices of final products are more responsive to changes in the costs of intermediate inputs than they are to changes in aggregate demand (Taylor, 1998). Moreover, the possibility of intermittent or non-synchronized price and wage adjustments, as a source of an inertia generating mechanism under imperfect competition conditions in hyper- or high-inflation economies, significantly diminishes because, under such conditions, small menu costs do not matter, and the length of contracts dramatically shrinks. Nevertheless, rigidity arguments related to factors such as the overlapping degree of wage contracts may contribute to understanding the short-run dynamics of inflation even in these type of economies, particularly taken together with the notions that expectations may be formed economy-wide, may be forward- or backwards-looking, and may be accompanied by a lack of policy credibility.

2.6 New Neoclassical Synthesis: Toward a Better Understanding of the Dynamics of Output and Price Fluctuations

Since the early 1990s, the sharp difference between the emphasis of new Keynesian and new classical economists on the major origins of business cycles and price movements has been increasingly softening, and a *new neoclassical synthesis* (NNS) is now on the agenda of macroeconomics.[15] According to Goodfriend and King (1997), the new generation of quantitative models of economic fluctuations has two central elements:

(1) systematic application of intertemporal optimization behavior of firms and households, and rational expectations, and
(2) incorporation of imperfect competition and costly short-run price adjustments into dynamic macroeconomics.

In the NNS, monetary, or demand, shocks are a key determinant of business cycles, as a result of the incorporated new Keynesian assumption of price stickiness in the short run. At the same time, however, the NNS assigns a potentially large function to supply shocks, such as changes in productivity, changes in tax policy or relative price shocks, in explaining real economic activity, as suggested in the new classical RBC theory.[16] The highly complex models of the NNS allow that Keynesian and RBC mechanisms operate through somewhat different channels. The so-called *new IS-LM-PC* version of the NNS makes the price level an endogenous variable. The NNS also views expectations as critical to the inflation process, but accepts expectations as amenable to management by a monetary policy rule.[17] King (2000: 87) summarizes:

> The distinguishing characteristic of the New IS-LM model is that its key behavioral relations can be derived from underlying choice problem of households and firms and that these relations consequently involve expectations about the future in a central manner. The IS curve relates expected output growth to the real interest rate, which is a central implication of the modern theory of consumption. The aggregate supply/Phillips curve component of the model relates inflation today to expected future inflation and output gap. This relationship can be derived from a monopoly pricing decision that is constrained by stochastic opportunities for price adjustment together with a consistent definition of the price level.

2.7 New Political Macroeconomics of Inflation

The theories reviewed so far focus mainly on macroeconomic determinants of inflation (e.g., monetary and real shocks, and inertia in inflation) and simply ignore the role of *non-economic factors* such as institutions, political process and culture in the creation or acceleration process of inflation. They also overlook the possibility that sustained government deficits, as a potential cause for inflation, may be partially or fully endogenized by considering the effects of the political process and possible lobbying activities on government budgets, and thus, on inflation.

The so-called *new political economy* is the study of how the political nature of decision-making affects policy choices and, ultimately, economic outcomes.[18] That is to say,

> (…) in the real world, economic policy is not chosen by the social planner who safely inhabits economics textbooks, sheltered from agents with conflicting interests while he calculates optimal policy. Economic policy is the result of a decision process that balances conflicting interests so that a collective choice may emerge. (…) In order to study political economy, that is, to study the effects of politics on economic outcomes,

> we must therefore begin with some political and economic building blocks. (Drazen, 2000: 20)

Therefore, the new political economy literature provides fresh perspectives on the relations between timing of elections, policymaker performance, political instability, policy credibility and reputation, central bank independence and the inflation process itself.

2.8 Summing Up: On Classifying the Possible Determinants of Inflation

The economy-wide price-level is the relative price of goods and services in terms of money, as implied in the definition of inflation in the first sentence of this section. Therefore, inflation must be a phenomenon that results from the interaction of *monetary* (demand-side) and *real* (supply-side) factors.[19]

The primary source of shocks in the demand-side is seen commonly as sustained public sector deficits. Modeling the role of government deficits and their financing methods is one of the major challenges faced by economists. The modification of an inflation model to allow for feedbacks, or "eroding" effects, from the inflation to the real value of government revenues due to the existence of tax-collection lags (*Olivera-Tanzi effect*),[20] and/or to the real value of the government's liabilities (*inflation tax*), leads to an increase in the complexity of the structure of the proposed model.

The study of inflationary effects stemming from real shocks is closely related to the economics of technology, long-run growth theory, and theory of exchange-rate determination, since they arise in the form of, e.g., negative productivity shocks, stagflationary relative-price shocks related to imported raw materials, or depreciations in the domestic currency.

But, this is not the whole story. The time path of prices may also be influenced by the expectations, stickiness of prices/wages, and possible indexation experiences in the economy. Therefore, these *inertial* factors should be considered as a third block of explanatory factors of inflation.[21]

The last block of explanatory factors of inflation seems to be offered by the new political macroeconomics. To model the dynamics of inflation more realistically, the political process, or the role of institutions, must also be considered explicitly. Most of the theoretical discussions on causes of inflation above are based on the assumption that financial markets are highly developed and functioning very well in the presence of necessary laws and rules. However, this is not the case in many high-inflation developing countries. Thus, the political or institutional approach to economics suggests that one should take into account the institutional,

political and cultural changes in such economies, and modify the model to explain high-inflation accordingly.

In my view, as a conclusion, the complex and dynamic interactions of four groups of factors (i.e., demand shocks, supply shocks, inertial factors and the political process) come together to explain inflation in any economy.

3. Empirical Studies on Turkish Inflation

After reviewing the theoretical discussions on causes of inflation in the previous section, I attempt now to survey the large empirical literature on determinants of inflation in Turkey. This survey is limited to those empirical studies that investigate *explicitly* the sources of Turkish inflation while the plentiful contributions on disinflation processes are consciously excluded.[22]

This section is divided into two subsections to discuss the evidence on the causes and dynamics of pre-1980 and post-1979 inflations separately. There are many reasons for this. First, Turkey experienced a radical structural change in the 1980s, as discussed more fully by Ertuğrul and Selçuk in Chapter 2 in this book. Second, the world economy was characterized by two major oil-price shocks in the 1970s, but stagflationary effects of oil-price shocks weakened in the last two decades. In addition, developments in econometrics and time series techniques accelerated since the early 1980s while the computing possibilities dramatically improved within the same period.

3.1 Empirical Evidence on Dynamics of Inflation Prior to 1980

Turkey experienced a short period of high inflation in the second half of the 1950s but the history of today's high and persistent inflation goes back to the first half of the 1970s at the earliest (see also Figure 1 above). The acceleration of inflation after 1953 is explained by the fact that the money supply started to grow faster than real output (Fry, 1980) while the decade of the 1970s is characterized by both the frequent devaluations of the Turkish lira, and the stagflationary effects of two major oil price shocks in 1973–74 and 1978–79.

To my knowledge, Akyüz (1973) is the first analytical attempt to study the causes and dynamics of inflation in Turkey. For the 1950–68 period, he investigates the relations between the money supply and prices in terms of

a combined "adaptive expectations - demand for money" model, and concludes that inflation is not self-generating, and it can be explained by the present and past changes in the money supply, real income, and the non-monetization ratio. His further analysis shows that the monetary growth in Turkey is largely attributable to the expansion in the monetary base, which in turn is closely related to the agricultural price policies followed by the government through the State Economic Enterprises in the mid 1950s. He stresses that the *political* reason for these economic policies was the populist tendency of the first elected government after the transition to a multi-party parliamentary system in 1950.

Ertuğrul's (1982) comprehensive study departs from the statistical analysis of causality between money and prices prior to 1980. The author develops then step-by-step a *self-generating* inflation model with six equations which is based on the statistical endogenity of money supply and on the assumption of adaptive inflation expectations in Turkey. Notice that he models government deficits as a function of relative agricultural support prices. Ertuğrul's macroeconometric simultaneous-system estimations based on deseasonalized quarterly data for 1970–78 show that increases in real income have a remarkable negative effect on the general price level. He concludes that inflationary expectations variable is the major determinant of inflation in Turkey.

Aksoy (1982), on the other hand, aims to test the monetarist and structuralist theories of inflation by using Turkish annual data for the period of 1950–79. He mainly concludes that the relationship between the money supply and prices is not proportional, but depends on both the inflationary expectations and the nature of foreign exchange availability. Furthermore, he finds little evidence on the cost-push effects of relative prices, i.e. the relative price shocks work through the money supply mechanism rather than creating cost-push pressures.

In the late 1970s, two major phenomena seem to contribute substantially to the increase in inflationary pressure in the financially-repressed Turkish economy: first, the fast domestic credit expansion, particularly to government and public sector enterprises, and second, the sharp recession caused by the foreign exchange shortage, which in turn stemmed from two oil-price shocks. After his analysis using quarterly data for 1962–77, Levy (1981: 370) adds:

> Since the prices of oil and other raw materials are still rising, Turkey's terms of trade can be expected to deteriorate further. In order to ease the adjustment of the economy to the higher world price of petroleum and raw materials, their domestic prices must be increased. Although *political and social pressures* do not make this an easy task, Turkey's inability to pay for its imports and *pressure* by the International Monetary

> Fund have recently forces the Turkish government to announce an increase in the price of oil and oil products. [*Italics* are added.]

Finally, using annual data to estimate a simple model for the demand for money, Togan (1987) reports that the time path of money and interest rate determined the movements in the rate of inflation from 1960 to 1983.

3.2 Sources of Inflation in the 1980s and 1990s

There is a much larger literature focusing on specific aspects of post-1979 inflation in Turkey. The sharp acceleration of inflation in 1980 and the increased availability of statistical data for shorter frequencies after 1980 appear to have contributed to this enrichment in the empirical literature.

Table 1 presents a detailed comparison of selected empirical studies on the sources of sustained inflation from 1980 to today in Turkey. The empirical studies reviewed here differ unsurprisingly in their sample period, structure, methods, and hence, in their conclusions.

For many authors, Öniş and Özmucur (1990) is a common starting point to survey the studies on causes of Turkish inflation after 1979. Using monthly data from 1981–87, Öniş and Özmucur (1990) explore inflationary dynamics in Turkey. The authors reject a pure monetary explanation of inflation based on a vector-autoregression analysis (VAR) and a simultaneous equation model. They find that devaluations of the Turkish lira have a strong impact on domestic inflation while supply-side factors seem to have in general significant effects on inflation. Rittenberg (1993) argues contrarily that Granger causality tests show that causality runs from price level changes to exchange rate changes but that there is not feedback causality in the opposite direction.

Yeldan (1993) analyzes the political economy of inflation and disinflation in Turkey, by focusing particularly on distributional and structural aspects. His computable general equilibrium analysis with some Keynesian features shows that public sector expenditures act as an important and strong source of demand-pull inflation in Turkey. Furthermore, the distributional conflicts among socio-economic classes have a direct impact on the formation of price movements in the 1980s. He observes that the profit/rent inflation, which is based on increases of monopolistic producer mark-ups over prime costs, has a relatively strong inflationary impact on the cost-side, as compared to wage inflation. Finally, Yeldan refers to devaluationist exchange-rate policy as a major source of imported inflation due to the import-dependent character of the Turkish industry.

Metin (1995) concludes by using a broader data set with annual and quarterly frequencies that fiscal expansion dominated the determination of Turkish inflation from 1950 to 1988. Excess money demand influences inflation positively in the short run. That is, to reduce inflation successfully, governments have to eliminate public sector budget deficits. Furthermore, devaluations also have some inflationary effects. İnsel (1995), Erol and van Wijnbergen (1997), Lim and Papi (1997), Agénor and Hoffmaister (1997), Darrat (1997) and Akyürek (1999) also provide results supporting the inflationary effects of depreciations. For many authors, this conclusion implicates the necessity to design an exchange-rate-based stabilization program to reduce the inflation in Turkey.

In 1984, domestic citizens were allowed to open foreign exchange deposit (FED) accounts in Turkish banks. The subsequent increase in FED-accounts to money-supply ratio after 1984 may be interpreted as a gross indication of rising *currency substitution* in Turkey. The capital account liberalization in 1989 also seems to have contributed to this development. In the presence of strong currency substitution, it is theoretically expected that the exchange rate instability significantly increases and that the government's ability to collect seigniorage revenue is limited. Currency substitution, which may create inflationary effects by reducing the seigniorage revenue of the government, is closely related to the credibility of economic policies or inflation expectations. If, for example, economic agents perceive that the government will pursue a lax fiscal policy, then they flee from domestic currency to avoid future inflation tax. In this case, both the money demand and the exchange rate become unstable. The effects of currency substitution on exchange rate instability and seigniorage-maximizing rate of inflation in Turkey are empirically investigated by Selçuk (1994, 1997 and 2001), Scacciavillani (1995) and Akçay, Alper and Karasulu (1997). Scacciavillani (1995) mainly reports that the share of foreign currency holdings in liquid assets exhibits a strong and stable relationship with exchange rate fluctuations. Furthermore, he finds that the relationship between the inflation rate and currency substitution is statistically insignificant. Selçuk (2001), on the other hand, concludes that, as long as there is some degree of currency substitution in the economy, the Turkish government cannot collect more seigniorage revenue to finance budget deficits by simply setting the growth rate of monetary base at a higher level.

In Turkey, it is common for politicians and bureaucrats to blame crude-oil price increases for inflation. Özatay (1992), Kibritçioğlu and Kibritçioğlu (1999), and a few studies cited in Kibritçioğlu (2001) discuss

the potential once-and-for-all price effects of increases in crude-oil and oil-product prices. By using the 1990 input-output table for Turkey, Kibritçioğlu and Kibritçioğlu (1999) calculate that a hypothetical 20% increase in the dollar price of imported crude-oil leads to a cumulative increase in the general price level of only 1.1% within ten months. Furthermore, they estimate that a 20% increase in the nominal dollar price of the Turkish lira contributes to inflation in the amount of 2.8% within the same time frame. Finally, their VAR model estimations indicate the importance of both nominal exchange rate increases and past values of inflation itself as main determinants of inflation for the period 1986–98.

The negligible role of a crude-oil price increase as a determinant of Turkish inflation may be explained principally by both the absence of a dynamic mechanism which generates continuous increases in the price level, and the gradually decreasing oil-dependency of many industries after 1980 as in the rest of the world. But, the substantial swings in the crude-oil prices since the late 1980s are usually followed by fiscal-conditional increases in prices of oil-products in Turkey. Obviously, this phenomenon makes the analysis of net inflationary effects of crude-oil price increases more complicated.

Recently, Akçay, Alper and Özmucur (1997), Lim and Papi (1997), Agénor and Hoffmaister (1997), Alper and Uçer (1998), Akyürek (1999), Cizre-Sakallıoğlu and Yeldan (1999), and Baum *et al.* (1999) have emphasized in particular the increasing role of *inertia* in the process of inflation in Turkey. Erlat (2001), for instance, states that both Turkish consumer and wholesale price indexes each have a significant long-run memory component. The expectational component of inflation inertia may result from the lack of credibility of government policies. Nonetheless, the degree and potential determinants of inertia as a whole should be investigated in more detail for Turkey.

Table 1: Selected Empirical Studies on Causes of Inflation in Turkey

Author/s and Publication Year	Frequency and Period of Data	Empirical Method/s	Main Variables	Main Results
Togan (1987)	Annual data from 1960 to 1983	Ordinary Least Squares (OLS) Regressions, Cochrane-Orcutt (CORC) iterative procedure, first-moving moving average process and simulations	Implicit GNP deflator, real GNP, M2, and nominal average rate of interest on demand and time deposits	Using a simple model for the demand for money, Togan shows that the time path of money and interest rates does determine the movements in the rate of inflation in Turkey.
Öniş and Özmucur (1990)	Monthly data from 1981 to 1987	A four-variable vector autoregression (VAR) model and three-stage least squares	WPI, monetary base and nominal exchange rate	Non-monetary, supply-side factors have significant effects on inflation in Turkey. Devaluations are strongly inflationary. A pure monetary interpretation of the Turkish inflation is rejected.
Özatay (1992)	Monthly data from Jan. 1982 to Sept. 1990	Econometric modeling based on input-output relationships (estimation of sectoral price equations), Granger causality tests, and simulations	Selected manufacturing price indexes for public and private sectors, nominal exchange rate, nominal medium term lending rate, domestic and imported inputs, and sectoral outputs	Public sector prices are generally not super-exogenous because they stem from various big and infrequent shocks. Only prices of electrical energy, refinery products, and mining are strongly exogenous. Lending rates, agricultural prices, and import prices are also found as strongly exogenous. The responses of private manufacturing prices to such shocks are remarkably high and persistent. Hence, there is a considerable amount of inertia in the private sector prices. Wages seem to be negligible as a source of inflation.
Rittenberg (1993)	Monthly data from Oct. 1982 to Aug. 1989	Granger causality tests	Nominal exchange rates, WPI and money supply for Turkey and trading partners	Granger-causality runs from price level changes to exchange rate changes but there is not feedback causality. This conclusion is not altered by the inclusion or exclusion of the money supply variable. Thus, exchange rate adjustment does not seem to have created a vicious cycle of currency depreciation leading to inflation as is often feared.

Table 1: Selected Empirical Studies on Causes of Inflation in Turkey (*cont.*)

Author/s and Publication Year	Frequency and Period of Data	Empirical Method/s	Main Variables	Main Results
Yeldan (1993)	1980–90	Computable general equilibrium analysis	CPI, public and private manufacturing producer prices indexes, interest rates, wages, value added in manufacturing, fiscal expenditures, nominal exchange rates, etc.	Public sector expenditures act as an important and strong source of demand-pull inflation in Turkey. The distributional conflicts among socio-economic classes have a direct impact on the formation of price movements in the 1980s. The profit/rent inflation fed by increases in monopolistic producer mark-ups over prime costs has a relatively strong impact on cost-push inflation. Devaluationist exchange-rate policy creates a remarkable cost-push pressure in Turkey.
De Santis (1993)	Annual data from 1950 to 1991	Multivariate cointegration technique of Johansen and a monetary model in error correction form	CPI, per-capita M2, per-capita real GNP, and opportunity cost of holding a unit of money and its return	In the short run, the difference between the interest rate on money and the interest rate on loans has a fundamental role in controlling inflation in Turkey. The per-capita money supply affects the price level in the short run as well as in the long run.
Ateşoğlu and Dutkowsky (1995)	Annual data from 1960 to 1988	Ordinary Least Squares (OLS) Regressions	Implicit GDP deflator, real GDP, M1, M2, and the rate of interest on time deposit	Turkish economy behaves consistent with predictions of a simple real business cycle model. Output follows an autoregressive structure with trend. Monetary policy is neutral. Elasticity between money and prices is unitary.
Metin (1995)	Quarterly and annual data from 1949 to 1988	A multivariate cointegration model based on the joint disequilibrium analysis of both long and short run behavior	Implicit GNP price deflator, CPI, real GNP, M1, base money, nominal exchange rate, Central Bank's nominal discount rate, etc.	Excess demand in the government sector is the main determinant of inflation. The excess demand for money affects inflation positively but only in the short run. Imported inflation and the excess demand for assets in capital markets have some effect on consumer price inflation. There is no significant effect from the excess demand for goods. As a result, inflation could be reduced rapidly by eliminating the fiscal deficit.

Table 1: Selected Empirical Studies on Causes of Inflation in Turkey (*cont.*)

Author/s and Publication Year	Frequency and Period of Data	Empirical Method/s	Main Variables	Main Results
İnsel (1995)	Annual data from 1977 to 1993	Cointegration approach to analyze the one to one relationship between inflation and monetization	Inflation rate, PSBR, monetary base, M2, real GDP growth, GNP	The public finance view of inflation is not supported. Monetization of public sector deficits is an important, but not the only reason for high inflation. Inflation in Turkey is mainly determined by exchange rate policy, real interest rates and inflationary expectations.
Akçay, Alper and Özmucur (1997)	Annual data from 1948 to 1994 and quarterly data from 1987 to 1995	Unrestricted vector autoregression (VAR) and Vector Error Correction (VER)	Annual model: implicit GNP deflator, currency in circulation, consolidated budget deficit over GNP; quarterly model: WPI, Central Bank money, consolidated budget deficit over GDP	Calculations with annual data show that a significant impact of budget deficits on inflation cannot be refuted under the assumption of long-run monetary neutrality. However, quarterly data implies a weakened link from other variables to inflation. The inertia in the inflation was increasing due to the accumulation of inflationary expectations in the period 1987–95. The availability of bond financing after 1986 might be the reason for the weakening causality from budget deficits to inflation to a certain extent.
Murinde and Eren (1997)	Quarterly data from 1972 to 1990	Two-Stage Least Squares (2SLS)	CPI, nominal official exchange rate, UK's CPI, real government expenditure, reserve money, official interest rate, real loans, real gross domestic investment, real GDP, official reserves, and income-tax rate	The main transmission mechanism via which monetary and other policy instruments influence inflation in Turkey involves corporate sector activities. Both monetary and corporate sector factors are useful in underpinning Turkish inflation.

Table 1: Selected Empirical Studies on Causes of Inflation in Turkey (*cont.*)

Author/s and Publication Year	Frequency and Period of Data	Empirical Method/s	Main Variables	Main Results
Erol and van Wijnbergen (1997)	Quarterly data from 1980 to 1993	Simulation experiments with a macro-econometric model	38 variables including CPI, nominal exchange rates, etc.	A real exchange rate policy based on the relative purchasing power parity rule caused moderate inflationary effects. Real exchange rate appreciations are contractionary for the demand-determined output case. Exchange rate policy can provide an anchor for price stability only if it is credible.
Lim and Papi (1997)	Quarterly data from 1970 to 1995 (Subperiods: 1970–80 and 1981–95)	A multi-sector macro-econometric model with short- and long-run dynamics (OLS estimations and cointegration tests)	WPI, CPI, nominal and real GNP, M2Y, reserve money, nominal and real exchange rates, wages, public sector borrowing requirement, etc.	Monetary variables (initially money, and more recently the exchange rate) play a role in the inflationary process. Public sector deficits also contribute to inflationary pressures. Inertial factors are quantitatively important.
Agénor and Hoffmaister (1997)	Quarterly data from 1980 to 1994	A generalized VAR model to analyze short-run links between five variables for four countries	CPI, ratio of current industrial output to potential output, M2, nominal effective exchange rate, and nominal manufacturing wages	At short forecast horizons, historical shocks associated with inflation itself are the main factor explaining movements in inflation. Nominal exchange rate depreciation also plays a substantial role in the Turkish inflationary process. Wage shocks have relatively little inflationary impact. Monetary shocks have at best a tertiary importance in explaining movements in the rate of inflation. Finally, shocks resulting from changes in output gap are not important determinants of inflation.
Darrat (1997)	Annual data from 1960 to 1963	Multivariate cointegration analysis and error-correction model	CPI, M1, a proxy for import prices, real GDP and nominal exchange rate	Monetary growth is an important source of inflation in Turkey. The empirical results reveal also a significant effect of the depreciation of the Turkish Lira in provoking inflation in Turkey.

Table 1: Selected Empirical Studies on Causes of Inflation in Turkey (*cont.*)

Author/s and Publication Year	Frequency and Period of Data	Empirical Method/s	Main Variables	Main Results
Metin (1998)	Annual data from 1950 to 1987	Multivariate cointegration analysis	CPI, real GNP, base money, and general budget deficit	The scaled budget deficit significantly affects inflation in Turkey. Real income growth and monetization of public sector deficits also affect inflation positively.
Alper and Uçer (1998)	Monthly data from 1985 to 1997	Unrestricted VAR model	CPI, WPI, M1, M2, M2Y and nominal exchange rate basket	The empirical link between fiscal imbalances and inflation is weaker than one might think. Inflation has increased side-by-side with a visible erosion in TL-denominated monetary aggregates with seigniorage revenue somewhat declining. Inertia was what drives inflation in the short run.
Kibritçioğlu and Kibritçioğlu (1999)	Annual data for 1979, 1985 and 1990, and monthly data from 1986 to 1998	Iterations based on Turkish input-output tables from 1979, 1985 and 1990 & a five-variable VAR model	1990 input-output data, WPI, price of imported oil, nominal exchange rate, M2 and interest rate	By using the 1990 input-output table for Turkey, the authors calculate that a hypothetical 20% increase in the dollar price of imported crude-oil causes a cumulative increase in the general price level only in the amount of 1.1% within ten months. Most part of this effect occurs within the first two or three months after the oil-shock. The VAR model estimations indicate the importance both of nominal exchange rate increases and past values of inflation itself as main determinants of inflation for the period 1986–98.
Akyürek (1999)	Monthly data from 1981 to 1998	VAR, moving average representation (MAR) and cointegration tests	CPI, base money, nominal exchange rate and output	Monetary and nominal exchange-rate shocks have been significant sources of inflation in Turkey. The results also indicate that inflation feeds itself.

Table 1: Selected Empirical Studies on Causes of Inflation in Turkey (*cont.*)

Author/s and Publication Year	Frequency and Period of Data	Empirical Method/s	Main Variables	Main Results
Cizre-Sakallıoğlu and Yeldan (1999)	Quarterly data from 1987 to 1996	Hodrick-Prescott Filtering method to decompose the quarterly variations of consumer prices into a trend component and cyclical deviations around the trend & Political economy approach	CPI, WPI, private manufacturing producer prices and real exchange rates	In Turkey, much of the behavior of price dynamics is governed by inertial expectations rather than shifts in the monetary variables such as money supplies, and the fiscal deficit.
Baum *et al*. (1999)	Monthly data from 1971 to 1995	Semi-parametric and maximum likelihood estimation methods	CPI	Long memory in the CPI-based inflation rate is a general phenomenon also for Turkey. The persistence in inflation rates worldwide can arise from (1) the aggregation of constituent processes, each of which has short memory, (2) time-varying coefficient models or non-linear models, or (3) money growth.
Erlat (2001)	Monthly data from 1987 to 2000	Unit root tests and autoregressive fractionally integrated moving average (ARFIMA) models	CPI and WPI	The monthly inflation rate is essentially stationary but has generally a significant long memory component. 2000–02 disinflation and economic restructuring program of the government has to deal with a process which is mainly not non-stationary but has a strong long-memory component and will exhibit a great deal of resistance initially. However, if this policy is successful, would yield long-lived results.

Table 1: Selected Empirical Studies on Causes of Inflation in Turkey (*cont.*)

Author/s and Publication Year	Frequency and Period of Data	Empirical Method/s	Main Variables	Main Results
Dibooğlu and Kibritçioğlu (2001)	Quarterly data from 1980 to 2000	A dynamic open-economy aggregate supply - aggregate demand model with imperfect capital mobility and structural vector-autoregressions	CPI, GDP, crude-oil prices, M1 and nominal exchange rate	A major component of inflation in Turkey has been "aggregate demand-driven" or "core" inflation. Real oil price, supply and balance-of-payments shocks had no significant effect on inflation while the real aggregate-demand shocks, which stemmed from changes in the money stock and autonomous aggregate-demand, can be interpreted as a combined result of changes in high public sector budget deficits and devaluations of the TL. Finally, output is mainly explained by supply shocks within the model.

Abbreviations: CPI: consumer price index; GDP: gross domestic product; GNP: gross national product; M1: narrow money supply; M2: broad money supply; M2Y: M2 plus foreign demand deposits, PSBR: public sector borrowing requirement, and WPI: wholesale price index.

4. Concluding Remarks

Any attempt to survey the extremely broad literature on theories of inflation in merely a few pages is confronted with the risk of incompleteness and superficiality. However, this type of an effort may also be regarded as a necessary first step if one intends to organize, understand, model and explain the dynamics of inflation carefully. The theoretical survey in Section 2 yields, among other things, a four-blocked schematization of origins of inflation: Demand-side (or monetary) shocks, supply-side (or real) shocks, adjustment (or inertial) factors, and political processes (or the role of institutions). It appears that inflation is the net result of sophisticated dynamic interactions of these four groups of explanatory factors. That is to say, inflation is always and everywhere a macroeconomic *and* institutional phenomenon.

The survey of the empirical studies in Section 3 on the dynamics of high and persistent inflation in Turkey shows that the existing modeling experiences seem to have focused mainly on demand-side factors, such as

the money supply and government deficits. Some studies are limited solely to investigate the possible effects of *one-time* shocks, such as occasional increases in oil prices. However, the *persistent* nature of high inflation requires a more integrated framework to explore the *dynamics* of inflationary *mechanism* in Turkey. Therefore, the possible sources and the degree of inflation inertia need to be investigated further. The consideration of inertia in existing empirical studies is generally limited to the role of inflationary expectations. However, the study of the short-run adjustment dynamics of the general price level should also be examined further as attempted recently by Çağlayan and Filiztekin (2001).

The role of the political process in explaining Turkish inflation has been in general ignored in empirical modeling efforts. To my knowledge, there are some political economy approaches to explain Turkish inflation (e.g., Öniş, 1997 and Özatay, 1999), but empirical studies in the tradition of *new* political economy are far from adequate. Recently, Ergun (2000) and Tutar and Tansel (2001) focus particularly on institutional and electoral determinants of government budget deficits in the country. Apparently, it is crucial to consider institutional explanatory factors in understanding the dynamics of inflation in Turkey.

The ongoing high and persistent inflation in Turkey still offers to economists, political scientists, sociologists, and historians a good opportunity to investigate its causes and dynamics both empirically and in an interdisciplinary fashion.

Notes

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1 For many economists today, an adequate approach to explain the process of high and long-lasting increases in the general price level of goods and services requires a concentration on sources of *core*, or *underlying*, inflation, and not on changes in *relative* prices caused by factors such as one-time increases in administered prices or unfavorable weather conditions.

2 For detailed surveys of inflation theories see, for example, Whitney (1982: 59-87), Frisch (1983), McCallum (1987), Beckerman (1992: 27-49) and Siklos (ed.) (1995: 3-34). Humphrey (1998) specifically surveys the historical origins of cost-push inflation theories.

3 For more information on the past and current Phillips-curve debates see Fischer (1983: 20-150), Humphrey (1986: 91-133) and King (2000).

4 The closed-economy IS-LM model and its open-economy version the F-M model are used particularly to analyze how changes in monetary and fiscal policy shift the

aggregate demand curve, and whether they affect the level of output and prices in the short- and long-run. The literature on the so-*called open economy macroeconomics*, or *international macroeconomics*, which is originating particularly from the F-M model, is listed on the web at: http://politics.ankara.edu.tr/~kibritci/oem.html.

5 If we assume for simplicity that $\lambda=1$, then the equation (7) can be written as $\pi^e=\pi_{t-1}$. Note that many economists consider this definition of backward-looking inflation expectations when they need a proxy of inflation inertia. From this point of view, inflation inertia can be interpreted as continuous upward shifts in both the aggregate demand and aggregate supply curves. That is to say, the actual inflation is caused by inflation expectations, and one expects inflation because it was experienced in the past.

6 Subsequently, the one-way statistical causality running from money to prices in Cagan's *hyper*inflation model is substituted by the assumption of two-way causality which allows to model a *self-generating* inflation process; see, e.g., Olivera (1967), Dutton (1971), Jacobs (1977) and Aghevli and Khan (1978). Notice that Siklos (ed.) (1995: 3-34) discusses in detail the issue of the endogenity of money supply in hyperinflation periods with special reference to the rational-expectations revolution. Finally, for two interesting studies in the tradition of Cagan's money-demand model, see Ball (1993) and Ruge-Murcia (1999) who analyze particularly the dynamics of *high* inflation in developing economies.

7 For more information on the theoretical background of the structuralist inflation theory, see Kirkpatrick and Nixon (1976), Frisch (1983: 153-186), and Beckerman (1992: 32-36).

8 See Edgren *et al.* (1973), Aukrust (1977), and Calmfors (1977).

9 The post-Keynesian arguments to explain inflation can be found mainly in studies of Michal Kalecki, Nicholas Kaldor, Paul Davidson, Hyman P. Minsky, and Sidney Weintraub.

10 See, for example, Bresser-Preira and Nakano (1987), and Saad-Filho and Mollo (1999).

11 See, for example, Montiel (1989), Calvo and Végh (1999), Fielding and Bleaney (2000), and the cited references therein.

12 For more information on the discussions about the idea of "unpleasant monetarist arithmetic" presented by Sargent and Wallace (1981), you may visit the following web page: http://politics.ankara.edu.tr/~kibritci/sargewall.html.

13 The so-called "fiscal theory of price level" developed by Eric Leeper, Christopher A. Sims, John H. Cochrane, and particularly by Michael Woodford in the 1990s mainly argues that money is completely *secondary* in determining the price level, which is instead driven by the sequence of primary government deficits and surpluses. For more information on this theory and discussions about its validity, see Woodford (2000) and the references cited therein.

14 For two detailed literature surveys on the sources of staggered prices, see Nadiri (1987) and Taylor (1998). Calvo (2000) is devoted particularly to discussion of the implication of price stickiness in emerging market economies.

15 For a discussion of the origins and emergence of the NNS, see Goodfriend and King (1997), Woodford (1999), and King (2000).

16 For a discussion of inflationary effects, which may result from temporary or persistent oil-prices shocks within the NNS framework, see Goodfriend and King (1997: 40-47).

17 Goodfriend and King (1997: 50) state: "Economists working within the synthesis of the 1960s were pessimistic about taming inflation, viewing inflation as having a momentum of its own and fluctuating with unmanageable shifts in the psychology of price setters".

[18] For more information on the emergence of the literature on new political macroeconomy, see Alesina *et al.* (1997) and Drazen (2000).

[19] Traditionally, macroeconom(etr)ic models posit that monetary shocks have an effect on the economy only through a *demand* channel of transmission. In recent years, however, some economists argued that monetary shocks may also create important *supply*-side, or *cost*-side, effects on output and prices. For various theoretical models of monetary transmission mechanisms which allow monetary policy shocks to have both supply-side and demand-side effects, see Barth and Ramey (2001) and references cited therein.

[20] See Olivera (1967) and Tanzi (1977, 1978).

[21] This classification of the determinants of inflation has a broad similarity with Robert J. Gordon's (1977, 1997) "triangle model of inflation" which is limited to the first three factors mentioned so far.

[22] Needless to say that the selection of studies here is unintentionally influenced by the availability of them. However, a large list of publications on inflation and disinflation in Turkey is available on the web at: http://politics.ankara.edu.tr/~kibritci/inflation/.

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Chapter 4

Budget Deficit, Inflation, and Debt Sustainability: Evidence from Turkey, 1970–2000*

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Abstract: The conditions from which inferences can be drawn regarding sustainability of fiscal stance on the one hand, and a long-run relationship between inflation and budget deficits on the other are investigated. These issues have assumed even greater importance in the aftermath of the collapse of the 1999 stabilization program in February 2001 that was designed to achieve sustainability in debt dynamics and produce a permanent reduction in inflation rates. The first set of findings indicates nonstationarity in the discounted debt to GNP ratio during 1970–2000, implying an unsustainable fiscal outlook. The inference does not imply insolvency, but points to the necessity of a policy change towards fiscal austerity. The second set of findings pertaining to the long-run relationship between the inflation rate, budget deficit and real output growth suggests two important results. The first of these is that, unlike the inflation rate, the consolidated budget deficit does not have a long-run component, suggesting that changes in the consolidated budget deficit have no permanent effect on the inflation rate. On the other hand, the PSBR does have a long-run component and is cointegrated with the inflation rate, which implies that the PSBR is a better indicator of fiscal deficits in comparison to the consolidated budget deficit.

1. Introduction

Turkey embarked on yet another disinflation and structural reform program in December 1999 that failed drastically after the two crises in November 2000[1] and February 2001. Prior to the crises, the government had been sending very dim fiscal signals, even counter-effective ones, in the forms of lack of commitment for durable fiscal measures and increased transparency in public accounts. These weak signals had led to the contention by the domestic and foreign holders of the government debt that the government would not be able to reduce real interest rates and hence the interest burden, and fiscal credibility stood at an all time low since the initiation of the

program in December 1999. Lackadaisical fiscal performance had prevailed for an extended time period, and the tolerance limits of the markets were being tested presumably without being too aware of them. The program has been given another push by substantial foreign financial backing and the IMF Executive Board has initiated a second phase after the approval of *The Letter of Intent* in May 2001.

The primary focus of the 1999 stabilization program was the rehabilitation of fiscal balances through structural reforms, a natural by-product of which would have been disinflation. Despite substantial progress on both fronts, the program nevertheless failed due mainly to inadequate fiscal adjustment through structural reforms, which exacerbated the sustainability outlook in the medium term. What are the features of the predicament the Turkish economy is in, after the collapse of the exchange rate based stabilization program, and how prevalent are they expected to be in the foreseeable future? The inflation threat seems to be alive and well, and the debt/GDP ratio has taken a substantial turn for the worse, undermining the debt dynamics seriously. Tough choices and unforgiving tradeoffs, it seems, will be the high on the agenda than ever.

During the past two decades, Turkish inflation experience has been a particularly interesting one for its high and chronic nature and for the absence of any hyperinflationary episodes. It jumped to different plateaus and displayed varying degrees of persistence at these plateaus, but hyperinflation never materialized.[2] The consensus view has been that the main culprit behind the inflationary process is fiscal imbalances, but the latest understanding on the nature of inflation is that it is a highly inertial process.[3] Alper and Uçer (1998) demonstrate the nominal dimension of the inflationary process in Turkey and assert the need for a sufficiently credible and elegantly designed disinflation program that could dislodge the inertial component substantially. Using 1948–85 annual data Metin (1998) finds a significant link from higher deficits to higher inflation, while Akçay *et al.* (1996) find a weakened link in the post-1985[4] period from budget deficit and money growth to inflation.

The empirical link from budget deficits to monetary expansion and then to inflation is usually weak, leading some people to hastily jump to the conclusion that deficits may indeed be less crucial than one may think in determining the course of inflation. These very same advocates of "inflationary processes detached from budget deficits" point to declining or intact seigniorage revenues, i.e., lack of monetization in the face of increasing budget deficits, and provide that as further empirical support for their position. Yet, even when a central bank does not monetize the deficit, adjustments in the private sector to higher deficit policies may very well

lead to inflation. The transmission can be through the real and/or financial sectors or through the "unpleasant monetarist arithmetic".[5] The real sector will suffer the consequences of higher deficit policies financed by the issuing of bonds in the form of crowded out investment in plant and equipment, culminating in reduced output growth. With money supply intact and output falling, prices will start to increase. In the financial sector, on the other hand, innovations in the form of new financial instruments are encouraged through high interest rates, and repos are typical examples of such innovations in chronic and high inflation countries. People are thus able to hold interest-bearing assets that are almost as liquid as money, and monetization is effectively done by the private financial sector instead of the government. The final transmission mechanism leading to higher inflation now is based on expectations of higher future inflation. The impact of reduced seigniorage and increased borrowing increases the debt, implying that either the deficit will have to increase or that government will have to print money to keep the deficit/GDP ratio intact. If future deficits are to be avoided at some stage to ensure sustainability of the debt/GDP ratio, then monetization will have to be resorted to, leading to the expectation of higher future inflation. Thus the link between budget deficits and inflation is not very straightforward, and high inflation equilibrium may very well be one of the equilibria corresponding to the same fundamentals. A proper analysis of the budget deficit-money growth-inflation link will have crucial policy implications. If inflation is found to be a "nominal" problem with a strong inertial component, then the costs of disinflation are presumably being overemphasized. Hence our motivation to explore some basic issues regarding the inflationary process in Turkey is also to contribute to the debate pertaining to the appropriateness of the chosen disinflation strategy at the end of 1999. An overwhelmingly nominal nature for inflation would legitimize the choice of a nominal anchor, inevitably the exchange rate in the case of Turkey. It goes without saying that the very same nature of inflation would make credibility an indispensable ingredient of any disinflation program.

Macroeconomic effects of budget deficits, their financing, and the ensuing debt dynamics have enjoyed substantial attention in macro theory recently, particularly in the light of different growth performances displayed by developing countries (see Easterly, 2001). The link from sound fiscal policies to macroeconomic stability and ultimately to sustainable growth is now fully recognized and a group of countries, most of which constitute the emerging markets segment of the world economy, spend all their efforts to put themselves on the sustainable growth path. The size of the budget deficit a country registers and the means of financing it

determine the debt dynamics and the fiscal constraints the country will be subject to in the medium to long term.

Unstable debt dynamics have dire implications for budgetary policy. When the public perceives the unsustainability of fiscal policy, it will relinquish its holdings of government debt, which will necessitate a change in policy. The intention of the governments should be to pre-empt this and conduct a change of policy before the holders of debt impose the change on them. The Turkish government has been taking fairly drastic measures in the first half of 2001 following the devaluation in February 2001, but how and if these will lead to a change in the public's expectations, still remains as a question. An inference of unsustainability would shift the market sentiment drastically towards a pessimistic outlook and throw the economy into the bad equilibrium it tried to avoid in the first place.

Intuitively, sustainability of a given fiscal policy will be determined by projections of the future path of the debt/GNP ratio. It is ultimately the willingness and appetite of the creditors that will determine the sustainability of the ratio.

Formal tests of sustainability are based on the *accounting* and *present value constraint* (PVC) approaches.[6] In the accounting approach, sustainability of a primary deficit (or surplus) is measured by its capability to generate a constant debt/GDP ratio given a growth target and unchanging real interest rate. Liabilities are allowed to grow at the output growth rate, leaving debt/GDP growth constant, and the role of lenders in defining the sustainability of fiscal policy is questionable. The PVC approach is based on the "no Ponzi game" (NPG) condition, which effectively requires that the presented discounted value of expected future surpluses be equal to the outstanding debt stock at any instance for sustainability of the debt/GDP ratio. Anand and Wijnbergern (1989) conduct an analysis pertaining to the sustainability of fiscal deficits in Turkey whereby they seek levels of "financeable deficit", which are compatible with sustainable internal and external borrowing. Simultaneous sustainability of current account deficits and budget deficits has also been investigated under an extension of the PVC approach in Ahmed and Rogers (1995).

Testing of the NPG or the transversality condition has been mostly applied to the US and G-7 data due to demanding data requirements (See for example, Flavin and Hamilton, 1986; Trehan and Walsh, 1991; Ahmed and Rogers, 1995; and Uçtum and Wickens, 2000). Tests involve checking for stationarity in series such as the fiscal deficit and debt, discounted debt or the real deficit inclusive of real interest payments, or cointegration between government revenue and spending, between real government revenue, expenditure and real interest payments, etc. Unit root and

cointegration techniques require fairly long time series over a constant fiscal regime and such requirements can naturally be putting developing countries in a handicapped position for long-term analysis purposes. There are possible compromises as indicated in Cuddington (1996), such as utilizing fiscal rules to be implemented in the foreseeable future, and then using these to obtain the implied time path for the internal and external debt with current debt levels as the initial conditions. We are aware of these and other data limitations, but have chosen to explore the sustainability issue with the actual data we have been able to put together after making certain corrections and transformations.

In this chapter, the sustainability of fiscal policies in Turkey as well as the existence of a stable long-run relationship between budget deficits and inflation are investigated empirically using annual data for the 1970–2000 period.

The first set of findings indicates nonstationarity in the discounted debt to GNP ratio during 1970–2000, implying an unsustainable fiscal outlook. The inference does not imply insolvency, but points to the necessity of a policy change towards fiscal austerity. The second set of findings pertaining to the long-run relationship between the inflation rate, budget deficit, and real output growth suggests two important results. The first of these is that unlike the inflation rate, the consolidated budget deficit does not have a long-run component, suggesting that changes in the consolidated budget deficit have no permanent effect on the inflation rate. On the other hand, the PSBR does have a long-run component and is cointegrated with the inflation rate, which implies that the PSBR is a better indicator of fiscal deficits than is the consolidated budget deficit.

The chapter is organized as follows. In Section 2, the analytical framework for the analysis of the economics of government budget constraint is presented. The condition for checking the sustainability of fiscal policy for a high nominal growth country like Turkey is explicitly derived, and the theoretical long-run relationship between inflation and the scaled budget deficit to be used for empirical analysis is provided. Section 3 describes data and presents the empirical results. Section 4 concludes.

2. The Analytical Framework

This section presents the framework that will be used in the empirical analyses. Two important issues pertaining to a high nominal growth economy will be tackled: sustainability of fiscal policy and the

characterization of the long-run relation among the budget deficit, money and inflation.

From national income identities, the simple definition of the budget deficit of the consolidated public sector equals the sum of private sector savings less private sector investment expenditure, and the current account deficit. The identity merely states the possibility of crowding out of private investment in the face of a budget deficit increase in an open economy; a rise in the budget deficit leads to a reduction in private investment for given private savings and current account deficit.[7] The impact of budget deficits on private investment is unequivocal, mostly with dire repercussions on output growth and further worsening of fiscal balances through reduced tax revenues.

The financing of the deficit can be done through money printing, internal and/or external borrowing and use of central bank's foreign reserves. External borrowing and use of reserves combined would correspond to the link between budget and current account deficits, and money printing and use of central bank's reserves combined would emphasize credit extension by central bank. Each financing mechanism would entail different macroeconomic repercussions; money printing would be linked to inflation, use of reserves with exchange rate movements and possible balance of payments crises, foreign borrowing with external debt crises, and internal borrowing with higher interest burden and potentially explosive debt dynamics.

2.1 Sustainability of Fiscal Policy for a High Nominal Growth Economy

All public debt is assumed to consist of one period debt, and primary government budget deficit can be financed in two different forms: money printing and/or bond financing (internal and external). The nominal one-period intertemporal government budget deficit can be written as:

$$G_t - T_t + i_t B_{t-1} = \Delta M_t + \Delta B_t \tag{1}$$

where G_t is government expenditure, T_t is tax revenue, B_t is the total stock of domestic and foreign debt[8] at the end of period t, M_t is reserve money and i_t is the nominal interest rate on government debt. Dividing each term in the equation by the nominal output, Y, and rearranging one can obtain:

$$g_t - t_t + i_t b_{t-1} \frac{Y_{t-1}}{Y_t} = m_t - m_{t-1} \frac{Y_{t-1}}{Y_t} + b_t - b_{t-1} \frac{Y_{t-1}}{Y_t} \tag{2}$$

where the lower-case variables (excluding i_t) denote the ratio of corresponding upper-case variables to nominal output. Using the growth rate of the nominal output, $g_{Y,t}$, and rearranging the right hand side, one can obtain:

$$g_t - t_t + \frac{i_t b_{t-1}}{(1+g_{Y,t})} = \Delta m_t + \Delta b_t + (m_{t-1} + b_{t-1}) \left(\frac{g_{Y,t}}{(1+g_{Y,t})} \right). \tag{3}$$

Collecting b_{t-1} on the left hand side,

$$g_t - t_t + b_{t-1} \frac{(i_t - g_{Y,t})}{(1+g_{Y,t})} = \Delta m_t + \Delta b_t + m_{t-1} \left(\frac{g_{Y,t}}{(1+g_{Y,t})} \right) \tag{4}$$

and rearranging,

$$g_t - t_t + b_{t-1}\rho_t - \Delta m_t - m_{t-1} \left(\frac{g_{Y,t}}{(1+g_{Y,t})} \right) = \Delta b_t \tag{5}$$

is obtained where $\rho_t = (i_t - g_{Y,t})/(1+g_{Y,t})$ and stands for the nominal interest rate adjusted for the nominal output growth. Alternatively, considering the "exact" relationship between the growth rate of nominal output, $g_{Y,t}$, of real output, $g_{Q,t}$, and of the inflation rate, π_t, $(1+g_{Q,t})(1+\pi_t) = (1+g_{Y,t})$, one can obtain

$$\rho_t = (i_t - \pi_t - g_{Q,t} - \pi_t g_{Q,t})/(1+g_{Q,t})(1+\pi_t)$$

which can be interpreted as the *ex-post* real interest rate adjusted for real output growth. It is important to note that for countries with low inflation rates, the real output approximation given by $g_{Q,t} = g_{Y,t} - \pi_t$ may be valid. However, for a high-inflation country like Turkey, one has to use the exact relationship.

Equation (5) can be expressed more compactly as

$$d_t + b_{t-1}\rho_t = \Delta b_t \tag{6}$$

where

$$d_t = g_t - t_t - \Delta m_t - m_{t-1}\left(g_{y.t}/\left(1+g_{y.t}\right)\right)$$

and denotes the primary deficit less the reserve money change and seigniorage, each term scaled by nominal output. Solving for b_{t-1}, equation (6) can be written in discounted terms as

$$b_{t-1} = \frac{1}{\left(1+\rho_t\right)}\left(b_t - d_t\right). \tag{7}$$

The discounted debt-output ratio can be calculated using

$$X_t = b_t \prod_{k=1}^{t}\left(1+\rho_k\right)^{-1} \tag{8}$$

where the time-varying discount rate, ρ_t, is used in the compounded sense in transforming the nominal debt to GNP ratio, b_t. Uçtum and Wickens (2000) show for the general case, where ρ_t is stochastic and d_t is allowed to be either strongly or weakly exogenous, that a necessary and a sufficient condition for sustainability is that the *discounted* nominal debt-nominal output ratio, X_t, be stationary.

2.2 Long-Run Relation Between Budget Deficits, Money Growth and Inflation

The nominal one-period intertemporal government budget constraint to be used in this section is a slightly modified version of the one used in the sustainability section where the budget deficit, D_t^*, now is inclusive of interest payments:

$$D_t^* = \Delta M_t + \Delta B_t \tag{9}$$

where B_t and M_t are defined in the previous section. Our purpose is to express inflation as a function of the terms in the budget constraint for a long-run estimable relationship.

Rewriting equation (9) as

$$D_t^* = \frac{\Delta M_t}{M_{t-1}} M_{t-1} + \frac{\Delta B_t}{B_{t-1}} B_{t-1} \tag{10}$$

and noting that in a steady-state growing economy,

$$\frac{\Delta M_t}{M_{t-1}} = \frac{\Delta B_t}{B_{t-1}} = \frac{\Delta Y_t}{Y_{t-1}} = g_{y,t} = \left[g_{Q,t} + \pi_t \left(1 + g_{Q,t}\right)\right] \tag{11}$$

where the nominal output growth is expressed in terms of the real output growth and the inflation rate. Substituting equation (11) into (10) and solving for the inflation rate, the following long-run relation between inflation, the scaled budget deficit and real output growth is obtained.

$$\pi_t = \frac{D_t^*}{\left(M_{t-1} + B_{t-1}\right)\left(1 + g_{Q,t}\right)} - \frac{g_{Q,t}}{\left(1 + g_{Q,t}\right)}. \tag{12}$$

Equation (12) is the estimable equation for analyzing the long-run relationship between the inflation rate, the scaled deficit and real output growth.

3. Data and Empirical Results

3.1 Data

Finding reliable and consistent data on public sector fiscal accounts, even for annual frequency, proved to be a challenging task. This is merely a reflection of the traditional lack of accountability and transparency in the fiscal accounts.[9] Fiscal accounts data from various sources like the State Institute of Statistics, the Treasury, the Ministry of Finance, and the State Planning Organization, more often than not, turned out to be inconsistent. Moreover, the consolidated budget balance, which includes the balances of general government as well as the annexed institutions, came out to be less

than 50% of the public sector borrowing requirement.[10] Since consolidated budget balance data is the only available high frequency data released with a minor lag, reliance on this content-wise deficient data source would lead to misleading inferences. Taking these limitations into account, an attempt is made to form a database, which would entail expenditure and revenue figures consistent with the financing of the public fiscal accounts. Tables A1-A4 present annual fiscal accounts data in stock and flow forms expressed in terms of million USD.[11] At this point a caveat is in order; the stock of duty losses of the state banks, which have been proclaimed as 16.7% of the total debt stock of the public sector (external plus domestic) in April 2001, is not included in these figures since information regarding the evolution of the duty loss stock is unavailable.

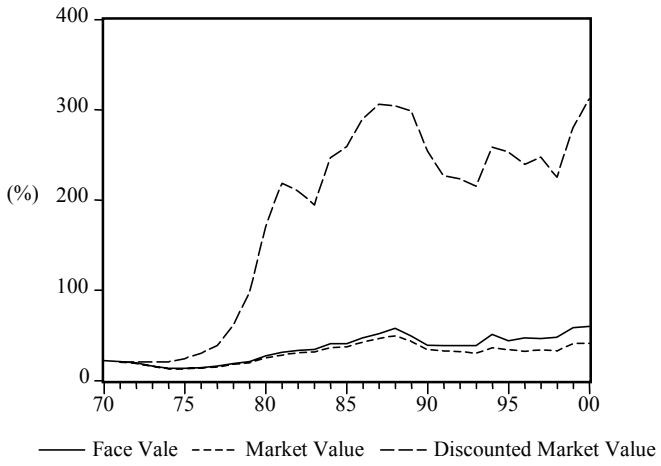

Figure 1: Turkey's Total Public Debt to GNP Ratio (1970–2000)
Source: Turkish Audit Court and the Undersecretariat of the Treasury; authors' own calculations.

Next, the issue of calculating the market value of discounted debt using government debt data measured at par is taken up. First, an estimate of the market value of the debt is obtained by dividing the face value of each period's debt stock by one plus the yield on government debt. Yield on government debt is difficult to obtain due to its heterogeneity with respect to maturity. An approximate value for the yield on government debt is obtained by dividing total interest payments in this period by the face value of last period's stock of outstanding public debt (using TL values of Table A4). Calculation of the discount rate entails the nominal GNP growth rate

as well as the weighted average interest rate on 12-month deposits using the formula $\rho_t = (i_t - g_{Y,t})/(1 + g_{Y,t})$.[12] Finally, the discounted market value of the debt to GNP ratio is calculated using equation 8. For expository purposes, the face value, the market value and the discounted value of the public debt to GNP ratio are displayed in Figure 1. Two things are apparent from Figure 1. First, the market value of the debt is less than the face value. This is also consistent with the findings of Uçtum and Wickens (2000). Second, the discounted market value of debt lies always above the undiscounted value, which is observed for high nominal growth countries such as Spain, Italy, Ireland and Portugal by Uçtum and Wickens (2000). It can be observed that the discounted total public debt - GNP ratio is increasing suggesting an unsustainable fiscal stance.

Data on the wholesale price index, gross national product, reserve money stock and the annual weighted average of 12-month saving deposit interest rates are obtained from the web site of the Central Bank of the Republic of Turkey and the *International Financial Statistics*, published by the IMF.

3.2 Empirical Results

As stated in Section 2.1, a necessary and sufficient condition of fiscal policy sustainability in Turkey is that the market value of the discounted debt to GNP ratio be stationary. In this section, the results of Augmented Dickey Fuller unit root tests as well as the Phillips-Perron unit root tests for the variables defined in the analytical section are presented. Our findings, shown in Table 1, indicate that each of the three definitions of the debt to GNP ratio is nonstationary and integrated of order 1, implying that the current fiscal policy is unsustainable.

The results obtained from the unit root tests are in line with the visual conjecture provided by Figure 1 that the debt to GNP ratio has a nonzero mean, and that the process seems to be non-mean reverting. At this point a caveat is in order; stationarity test results may be interpreted as indicators of sustainability and not of solvency. A reduction in the discounted deficit-GNP ratio due to primary surpluses, the monetization of the debt, a reduction in the nominal interest rate below the nominal output growth rate due to a boost in the market confidence or voluntary consolidation of the debt may change the current unsustainable outlook.

Table 1: Testing the Order of Integration

		Constant	Trend	# of lags	ADF Test	PP Test
b_t^f	Level	Yes	No	0	-0.36	-0.49
	Difference	Yes	No	0	-4.85*	-4.85*
b_t	Level	Yes	No	0	-1.32	-1.09
	Difference	Yes	No	0	-3.87*	-3.87*
X_t	Level	Yes	No	1	-1.33	-1.15
	Difference	Yes	No	0	-3.66*	-3.65*
π_t	Level	Yes	Yes	1	-3.26	-3.76
	Difference	Yes	No	0	.6.06*	-6.44*
CD	Level	Yes	Yes	0	-4.27*	-4.39*
	Difference	-	-	-	-	-
PSBR	Level	Yes	No	0	-2.84	-2.80
	Difference	Yes	No	0	-5.66*	.6.29*
η_Q	Level	Yes	No	0	-5.63*	-5.69*
	Difference	-	-	-	-	-

Data definitions: b_t^f : face value of the public debt-GNP ratio; b_t : market value of the public debt-GNP ratio; X_t : discounted market value of the public debt-GNP ratio; π_t : wholesale price inflation; *CD*: scaled consolidated deficit; *PSBR*: Scaled public sector borrowing requirement; η_Q is the real output growth divided by one plus the real output growth. "*" indicates rejection of the null hypothesis of non-stationarity at 5% level of significance. Nonstationarity implies an unsustainable fiscal stance.

Next, the existence of a stable long-run relationship between the inflation rate, the scaled deficit and the real growth rate are investigated. Stationarity test results indicate that even though the inflation rate and the scaled PSBR series are integrated of order 1, implying the existence of long-run components, the scaled consolidated budget deficit and the real output growth related variable are not. In other words, the scaled consolidated budget deficit process does not have a long-run component and hence cannot be related to the inflation rate process. This result confirms our aforementioned proposition that the consolidated budget deficit, even though easily available, is not a good indicator of public account balance.

Next, the existence of a stable relationship between the inflation rate and the scaled PSBR is tested for, by checking if the two variables are cointegrated. In other words, whether short-run deviations from their long-term relation are temporary or not is formally tested. Likelihood ratio test statistics indicate the existence of a single cointegrating vector when a

Vector Error Correction mechanism of order 2 with a constant in the cointegrating equation is estimated. Moreover, the error correction mechanism is validated for the inflation equation but not the scaled deficit equation, implying that the cointegrating vector should be normalized for inflation.

The estimated cointegrating vector is given below:

$$\hat{\pi}_t = \underset{[2.45]}{0.36} + \underset{[2.39]}{1.134} \; PSBR_t$$

The cointegrating vector suggests that a 1-percentage point increase in the scaled PSBR increases the long-run value of the inflation rate by 1.13-percentage points. The t-statistics obtained from the asymptotic standard errors are given in brackets.

For short-run dynamics, the estimated vector error correction mechanism is:

$$\Delta\hat{\pi}_t = \underset{[0.87]}{0.18} \; \Delta\hat{\pi}_{t-1} + \underset{[0.57]}{0.11} \; \Delta\hat{\pi}_{t-2} - \underset{[0.60]}{0.23} \; \Delta PSBR_{t-1}$$

$$- \underset{[2.0]}{0.73} \; \Delta PSBR_{t-2} - \underset{[1.84]}{1.36} \; \eta_{Q,t} - \underset{[3.28]}{0.72} \; ECM_{t-1}$$

The error correction equation and the t-values given in brackets imply that the error correcting term is negative and significant, (validating the error correction mechanism) and the magnitude of 0.72 implies a rather fast convergence to equilibrium. On the other hand, the term involving the real output growth is increasing in the real growth rate and as expected, *ceteris paribus* an increase in the real output growth reduces the inflation rate.

4. Conclusions

In this study, the conditions from which one could draw inferences regarding sustainability of fiscal stance on the one hand and a long-run relationship between inflation and budget deficits on the other are examined. These issues have assumed even greater importance in the aftermath of the collapse of the stabilization program that had been designed to achieve sustainability in debt dynamics and produce a permanent reduction in inflation rates. The latter of these two goals would

conceivably be achieved by dislodging the inertial component in the inflationary process, which was strictly conditional on success on the former goal.

Our first set of empirical findings indicates that the discounted debt to GNP ratio during 1970–2000 is inherently nonstationary, implying an unsustainable fiscal outlook. Our findings do not point to insolvency at this point in time, but point to the necessity of a policy change towards fiscal austerity if insolvency is to be avoided in the medium to long term.

The second set of findings pertaining to the long-run relationship between the inflation rate, the budget deficit, and real output growth suggests two important results. The first of these is that, unlike the inflation rate, the consolidated budget deficit does not have a long-run component, suggesting that changes in the consolidated budget deficit have no permanent effect on the inflation rate. On the other hand, the PSBR does have a long-run component and is cointegrated with the inflation rate. In non-technical terms, changes in the PSBR lead to permanent effects on the inflation rate. Hence, the PSBR should be deemed a better indicator of fiscal deficits in comparison to the consolidated budget deficit.

Lack of accountability and transparency regarding that portion of the PSBR in excess of the consolidated budget deficit has been frequently referred to as endangering the medium to long- term fiscal sustainability. However, supportive empirical work has been lacking, and our intention was to contribute to filling this gap.

Data Appendix

Table A1: Public Sector Borrowing Requirement and Components (million USD)

Years	Consolidated Budget Deficit	Central Budget Deficit	PSBR	Interest Payments	GNP
1970	-14.2	-	-	-	13,994.3
1971	453.0	-	-	-	18,648.0
1972	25.9	-	-	-	22,438.5
1973	158.3	-	-	-	28,506.3
1974	282.2	-	-	-	38,821.5
1975	365.4	330.4	2,235.3	234	47,169.8
1976	639.0	633.6	3,605.5	240	53,468.8
1977	2,621.7	2,570.5	4,988.4	288	61,137.5
1978	1,017.6	1,121.4	2,159.8	305	66,456.8
1979	2,768.8	2,843.3	6,324.1	545	88,023.1
1980	2,230.7	2,786.1	6,242.1	423	71,180.6
1981	1,029.1	1,055.0	2,657.0	627	66,817.6
1982	955.7	1,020.2	2,273.0	531	64,485.3
1983	1,369.2	1,686.5	3,016.6	926	61,033.7
1984	2,651.2	2,094.4	3,235.3	1,195	60,049.0
1985	1,521.9	757.0	2,414.5	1,287	67,390.1
1986	2,070.2	805.8	2,741.7	1,952	75,072.6
1987	3,025.7	2,428.8	5,295.3	2,630	87,057.3
1988	2,776.1	2,386.4	4,338.1	3,463	89,870.7
1989	3,608.8	3,698.5	5,777.3	3,885	108,355.5
1990	4,577.7	5,480.4	11,268.8	5,348	152,087.1
1991	8,011.2	10,642.8	15,409.7	5,754	151,636.7
1992	6,886.3	11,667.5	16,939.3	5,850	160,217.6
1993	12,105.3	17,261.0	21,685.6	10,533	180,627.7
1994	5,098.5	8,445.0	10,283.3	9,993	130,256.6
1995	6,890.3	9,216.5	8,884.6	12,537	170,936.7
1996	15,136.9	17,338.4	16,391.6	18,307	183,116.0
1997	14,663.5	15,359.7	15,196.3	14,993	192,358.1
1998	14,203.3	15,725.6	20,607.2	23,547	204,031.5
1999	21,489.6	23,847.1	26,503.9	25,396	185,341.8
2000	18,433.5	17,408.4	30,552.4	32,614	201,002.4

Sources: The State Planning Organization's *Economic and Social Indicators*, Turkish Audit Court's *Year 2000 Fiscal Report*, Ministry of Finance, and authors' own calculations. Consolidated budget consists of the general budget and the annexed institutions. Central Government consists of the balances of the consolidated budget, local authorities, Revolving Funds, Social Security Institutions as well as the Extra-budgetary Funds and State Economic Enterprises under privatization. The Public Sector Borrowing Requirement includes the balances of Central Government as well as the State Economic Enterprises.

Table A2: Domestic Public Debt (million USD)

Years	Borrowing	Principal Repayment	Net Flow	Interest Payments	Debt Service	Net Transfer	Cumulative Net Transfer	Debt Stock
	A	B	A-B	C	B+C	A-(B+C)		
1970		155		38	193			1,241
1971	679	285	394	41	326	353	353	1,710
1972	808	617	191	82	699	109	462	1,902
1973	123	268	-145	100	368	-244	218	1,757
1974	420	170	250	116	286	134	354	2,026
1975	1,654	410	1,243	164	575	1,079	1,414	3,159
1976	1,782	513	1,269	161	675	1,107	2,383	4,119
1977	2,463	888	1,575	193	1,081	1,382	3,516	5,263
1978	3,179	963	2,216	202	1,165	2,014	4,587	6,068
1979	3,307	562	2,745	389	951	2,356	5,832	7,344
1980	1,477	367	1,110	297	665	812	3,370	4,331
1981	4,344	1,346	2,998	342	1,688	2,656	4,747	5,685
1982	2,744	1,383	1,362	208	1,590	1,154	4,617	5,509
1983	1,677	585	1,092	350	935	742	4,071	5,063
1984	7,486	2,562	4,923	478	3,040	4,445	6,963	8,055
1985	4,626	2,208	2,418	471	2,680	1,947	6,847	8,086
1986	7,807	2,799	5,008	951	3,751	4,057	9,324	11,229
1987	10,993	6,155	4,838	1,460	7,615	3,378	10,755	13,723
1988	14,377	4,250	10,127	2,197	6,448	7,930	14,378	18,354
1989	10,674	4,534	6,139	2,400	6,934	3,740	13,460	18,548
1990	11,432	5,734	5,698	3,682	9,416	2,016	12,974	20,798
1991	13,819	7,667	6,152	4,046	11,713	2,107	10,205	19,135
1992	21,999	11,728	10,271	4,430	16,158	5,841	12,039	21,892
1993	31,597	19,358	12,239	8,308	27,666	3,931	11,430	25,876
1994	28,164	19,613	8,551	7,780	27,393	771	5,005	18,137
1995	39,394	25,729	13,665	10,276	36,006	3,389	6,640	25,446
1996	68,088	48,764	19,324	16,208	64,973	3,115	6,845	33,619
1997	41,519	21,128	20,391	14,854	35,982	5,537	9,201	38,387
1998	55,765	33,855	21,910	21,440	55,295	470	5,831	44,273
1999	63,689	36,904	26,785	23,438	60,342	3,347	6,970	54,293
2000	51,808	30,266	21,542	29,690	59,956	-8,148	-3,453	58,114

Sources: Turkish Audit Court's *Year 2000 Fiscal Report*, the Undersecretariat of the Treasury, and authors' own calculations. The debt stock includes outstanding stock of government bonds and treasury bills. Short-term advances to the Treasury by the Central Bank and the duty losses of the state banks are excluded.

Table A3: External Public Debt (million USD)

Years	Borrowing	Principal Repayment	Net Flow	Interest Payments	Debt Service	Net Transfer	Cumulative Net Transfer	Debt Stock
	A	B	A-B	C	B+C	A-(B+C)		
1970	-	-	-	-	-	-	-	1,844
1971	401	109	292	53	162	239	239	2,224
1972	337	157	180	63	220	117	356	2,454
1973	415	126	289	80	206	209	565	2,866
1974	326	147	179	92	239	87	652	3,136
1975	293	156	137	106	262	31	683	3,182
1976	583	165	418	145	310	273	956	3,619
1977	849	196	653	168	364	485	1,441	4,438
1978	1,259	289	970	176	465	794	2,235	6,464
1979	4,410	445	3,965	266	711	3,699	5,934	11,030
1980	2,400	564	1,836	486	1,050	1,350	7,284	15,007
1981	1,887	768	1,119	960	1,728	159	7,443	15,241
1982	2,050	1,154	896	1,137	2,291	-241	7,202	16,066
1983	1,577	1,114	463	1,194	2,308	-731	6,471	16,042
1984	2,435	1,125	1,310	1,138	2,263	172	6,643	16,541
1985	2,745	2,229	516	1,295	3,524	-779	5,864	19,539
1986	3,553	1,916	1,637	1,461	3,377	176	6,040	24,291
1987	4,324	2,772	1,552	1,851	4,623	-299	5,741	31,541
1988	7,199	3,762	3,437	2,386	6,148	1,051	6,792	33,563
1989	4,465	3,503	962	2,593	6,096	-1,631	5,161	34,859
1990	4,634	3,664	970	2,816	6,480	-1,846	3,315	38,684
1991	5,307	4,242	1,065	2,735	6,977	-1,670	1,645	39,703
1992	6,214	4,600	1,614	2,865	7,465	-1,251	394	40,360
1993	7,069	3,987	3,082	3,004	6,991	78	472	44,259
1994	4,122	4,727	-605	2,882	7,609	-3,487	-3,015	48,519
1995	4,487	6,063	-1,576	2,916	8,979	-4,492	-7,507	49,958
1996	7,394	4,770	2,624	2,775	7,545	-151	-7,658	52,582
1997	3,301	4,724	-1,423	2,768	7,492	-4,191	-11,849	51,159
1998	8,761	6,451	2,310	2,661	9,112	-351	-12,201	53,469
1999	7,781	6,800	981	2,880	9,680	-1,899	-14,100	54,450
2000	16,276	8,510	7,766	3,428	11,938	4,338	-9,762	62,216

Sources: Turkish Audit Court's *Year 2000 Fiscal Report* and the Undersecretariat of the Treasury.

Table A4: Total Public Debt (million USD)

Years	Borrowing	Principal Repayment	Net Flow	Interest Payments	Debt Service	Net Transfer	Cumulative Net Transfer	Debt Stock
	A	B	A-B	C	B+C	A-(B+C)		
1970	-	-	-	-	-	-	-	3,085
1971	1,080	394	686	94	488	592	592	3,934
1972	1,145	774	371	145	919	226	818	4,356
1973	538	394	144	180	574	-35	783	4,623
1974	746	317	429	208	525	221	1,006	5,162
1975	1,947	566	1,380	270	837	1,110	2,097	6,341
1976	2,365	678	1,687	306	985	1,380	3,339	7,738
1977	3,312	1,084	2,228	361	1,445	1,867	4,957	9,701
1978	4,438	1,252	3,186	378	1,630	2,808	6,822	12,532
1979	7,717	1,007	6,710	655	1,662	6,055	11,766	18,374
1980	3,877	931	2,946	783	1,715	2,162	10,654	19,338
1981	6,231	2,114	4,117	1,302	3,416	2,815	12,190	20,926
1982	4,794	2,537	2,258	1,345	3,881	913	11,819	21,575
1983	3,254	1,699	1,555	1,544	3,243	11	10,542	21,105
1984	9,921	3,687	6,233	1,616	5,303	4,617	13,606	24,596
1985	7,371	4,437	2,934	1,766	6,204	1,168	12,711	27,625
1986	11,360	4,715	6,645	2,412	7,128	4,233	15,364	35,520
1987	15,317	8,927	6,390	3,311	12,238	3,079	16,496	45,264
1988	21,576	8,012	13,564	4,583	12,596	8,981	21,170	51,917
1989	15,139	8,037	7,101	4,993	13,030	2,109	18,621	53,407
1990	16,066	9,398	6,668	6,498	15,896	170	16,289	59,482
1991	19,126	11,909	7,217	6,781	18,690	437	11,850	58,838
1992	28,213	16,328	11,885	7,295	23,623	4,590	12,433	62,252
1993	38,666	23,345	15,321	11,312	34,657	4,009	11,902	70,135
1994	32,286	24,340	7,946	10,662	35,002	-2,716	1,990	66,656
1995	43,881	31,792	12,089	13,192	44,985	-1,103	-867	75,404
1996	75,482	53,534	21,948	18,984	72,518	2,964	-813	86,201
1997	44,820	25,852	18,968	17,622	43,474	1,346	-2,648	89,546
1998	64,526	40,306	24,220	24,101	64,407	119	-6,370	97,742
1999	71,470	43,704	27,766	26,318	70,022	1,447	-7,131	108,743
2000	68,084	38,776	29,308	33,118	71,894	-3,810	-13,215	120,330

Sources: Turkish Audit Court's Year 2000 Fiscal Report, the Undersecretariat of the Treasury, and authors' own calculations. The total debt stock of the public does not include the duty losses of the state banks or the short-term advances to the Treasury.

Notes

* We would like to thank İsmail Sağlam and Hakkı Hakan Yılmaz for helpful comments and suggestions. The usual disclaimer applies.

1 See Alper (2001) for details.

2 For detailed analyses of the inflationary process in Turkey, see Alper and Uçer (1998) and Ertuğrul and Selçuk (2001).

3 The inertial nature of inflation in Turkey had been emphasized for the first time by monetary authorities in the monetary program announced at the time of signing of the 17th stand-by arrangement with the IMF in December 1999. Akçay *et al.* (1996) demonstrated the increasingly inertial nature of the inflationary process in the post-1985 bond-financing era.

4 Primary market auctions of government securities started in June 1985.

5 For the first two mechanisms, see Miller (1983) and Sargent and Wallace (1981) for the third.

6 For an excellent and exhaustive survey on this issue, see Cuddington (1996).

7 The rise in the budget deficit could alternatively lead to a deterioration in the current account with private investment staying intact, but the link is a bit ambiguous in this case as the monetary policy accompanying the fiscal expansion becomes crucial. If monetary policy is contractionary, that increases the interest rate and pushes up the exchange rate as well, leading to a depreciation of the currency. That in turn improves the current account balance, rather than worsening it along with the higher budget deficit.

8 All the variables entering the government budget constraint are expressed in TL. For brevity, it is assumed that lenders are indifferent between borrowing TL denominated government securities and Turkish Eurobonds.

9 The very issue has been vociferously phrased in the Turkish Audit Court's *Year 2000 Fiscal Report*.

10 See Appendix Table A1.

11 Even though the data given in the tables are quoted in million USD, the data used in the empirical part is in terms of TL. The average TL/USD exchange rate is used for the conversions.

12 Ideally, we would have liked to use the yield on government securities, had they been available. The implied yield obtained for the purpose of calculating the market value of public debt generated negative discount rates after adjusting for nominal output growth. Hence the 12-month deposit rates are used.

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Chapter 5

Long Memory in Turkish Inflation Rates

Haluk Erlat

Abstract: Turkey is a country that has experienced high inflation but not hyperinflation over the past two decades; i.e., inflation has not reached large three-digit levels annually, but has remained around a figure which is, consistently, greater than 50% but has never gone beyond a 100% except for a couple of months in 1994. This observation implies that inflation in Turkey may have a highly persistent nature. The question is whether this persistence is due to the inflation rate having a unit root or whether it is stationary but exhibits long-memory. Thus, we first tested for the presence of additive outliers (AO) in the inflation rates and, having identified the statistically significant ones, we applied the ADF test with AO dummies included in the regression and the modified Phillips-Perron test, as suggested by Vogelsang (1999), since it is expected to be robust against AOs. The results of these first-stage investigations indicated that the presence or absence of a unit-root cannot be established unequivocally except for the CPI-based inflation rates where it was found to be present and the public-sector WPI-based inflation rates where it was found to be absent. Given this situation, we turned to investigating long-memory in the inflation series using ARFIMA models and obtained values for the fractional integration parameter between 0 and 0.5, indicating that the monthly inflation rate is essentially stationary but has, in general, a significant long memory component. These results indicate that the two recent, IMF-backed attempts by the government to reduce inflation have to deal with a process which, essentially, is stationary but has a strong long-memory component and will exhibit a great deal of resistance initially, but if the anti-inflationary policy is successful, would yield long-lived results.

1. Introduction

Turkey is a high inflation country but, as opposed to other countries like Argentina, Brazil and Israel where periods of high inflation occurred, the inflation in Turkey has not turned into hyper-inflation; in other words, it has not reached large three-digit levels annually but has remained around a figure which is consistently greater than 50% but has never gone beyond

100% except for a couple of months in 1994. This observation implies that inflation in Turkey may have a highly persistent nature. The question is whether this persistence is due to the inflation rate being nonstationary, i.e., having a unit root, or whether it is stationary but exhibits long memory.

If the inflation series has a unit root, then the response to any shock to the series will not disappear over time but will approach a nonzero permanent level (see Section 1 of the Appendix). If this shock is the result of policy measures to reduce inflation, then persistence of this nature will imply "inertia"[1] in prices. On the other hand, if inflation is stationary but exhibits long-memory, then it will take a considerable amount of time for the effects of a shock to die out. Thus, what we have here is a weaker form of inertia which is more conducive to the success of anti-inflationary measures.

Investigations on the nature of persistence in inflation rates have been undertaken for developed countries like the U.S.A., the U.K., France, Germany and Italy, etc., by Hassler and Wolter (1995), Ooms (1996), Ooms and Doornik (1999) and Bos, Franses and Ooms (1999). Baillie, Chung and Tieslau (1996) have added high inflation countries like Argentina, Brazil and Israel to this list while Baum, Barkoulas and Çaglayan (1999) also consider developing countries. The latter paper includes Turkey and investigates long-memory, via fractional integration, in CPI-based inflation using monthly series for the period 1971–95. In the present study, we depart from Baum *et al*. (1999) (i) by considering the January 1988 – January 2000 period for which the 1987-based series exists, thereby avoiding spurious jumps in the data due to splicing different series[2] and (ii) by also investigating WPI-based inflation for the January 1987 – January 2000 period.

Our research consists of two stages. We first look for the presence of a unit-root in the CPI-based and WPI-based monthly inflation rates. The plots of these rates indicate that there may be one or more outliers so that we test for the presence of additive outliers (AO), using procedures developed by Vogelsang (1999) and by Perron and Rodriguez (2000). Based on the outcome of these tests, we utilize (i) the Augmented Dickey-Fuller (ADF) test with AO dummies introduced into the regression equation in the manner suggested by Franses and Haldrup (1994), and (ii) the modified Phillips-Perron test within the context of the Elliot, Rothenberg and Stock's (1996) local-to-unity framework (Ng and Perron, 2001a) which is shown by Vogelsang (1999) to be robust against the presence of AOs. Our objective in using several tests for the same purpose is to, unequivocally, establish the presence or absence of a unit root in the inflation rates. But, our

findings do not indicate such a clear-cut result. Thus, in the second stage, we undertake Autoregressive Fractionally Integrated Moving Average (ARFIMA) modeling to find out the nature of the persistence component in the inflation rates.

Since the objective was not to simply estimate the fractional integration parameter, we utilised a predominantly parametric approach to estimation. We used two parametric estimation procedures; one, due to Sowell (1992), is the Exact Maximum Likelihood (EML) estimator, and the other, due to Beran (1994), is called the conditional sum-of-squares estimator by Chung and Baillie (1993) and the nonlinear least squares (NLS) estimator by Ooms and Doornik (1999). We implemented these procedures using the ARFIMA package for the Ox program (Doornik and Ooms, 1999). The initial estimates for the fractional integration parameter were obtained using the nonparametric Geweke and Porter-Hudak (1983) (GPH) estimator, so we provide these initial estimates as a third set of results. Again, the objective for using several estimators is to see if the results are robust to the use of alternative procedures.

The plan of the chapter is as follows. In the next section, we introduce the data and present their time series plots. The third section on empirical results will both contain descriptions of the unit root tests and ARFIMA modeling procedures and the empirical results based on these procedures. The final section will contain our conclusions. We shall provide some technical information about the relation between the idea of persistence, unit roots and long memory, and on the modified Phillips-Perron test in the Appendix.

2. The Data

We measure monthly inflation as the first difference of the natural logs of price indexes. The price indexes we use are the Consumer (CPI) and Wholesale (WPI) Price Indexes. They are 1987 based and CPI covers the period January 1988 – January 2000 while the WPI covers the period January 1987 – January 2000. The series were obtained from the State Institute of Statistics (SIS) database where the 1987 figures for CPI were not available. The series are, in fact, available up to September 2000 but we shall use the period February 2000 – September 2000 for prediction purposes.

In Turkey, the WPI series is formed as a weighted average of two series; one for the private sector (WPIPRIV) and the other for the public sector

(WPIPUB). While WPIPRIV-based inflation is regarded as the more important indicator, we decided to carry out our calculations for both aggregated WPI-based inflation (IWPI) and inflation based on its components (IWPIPRIV and IWPIPUB).

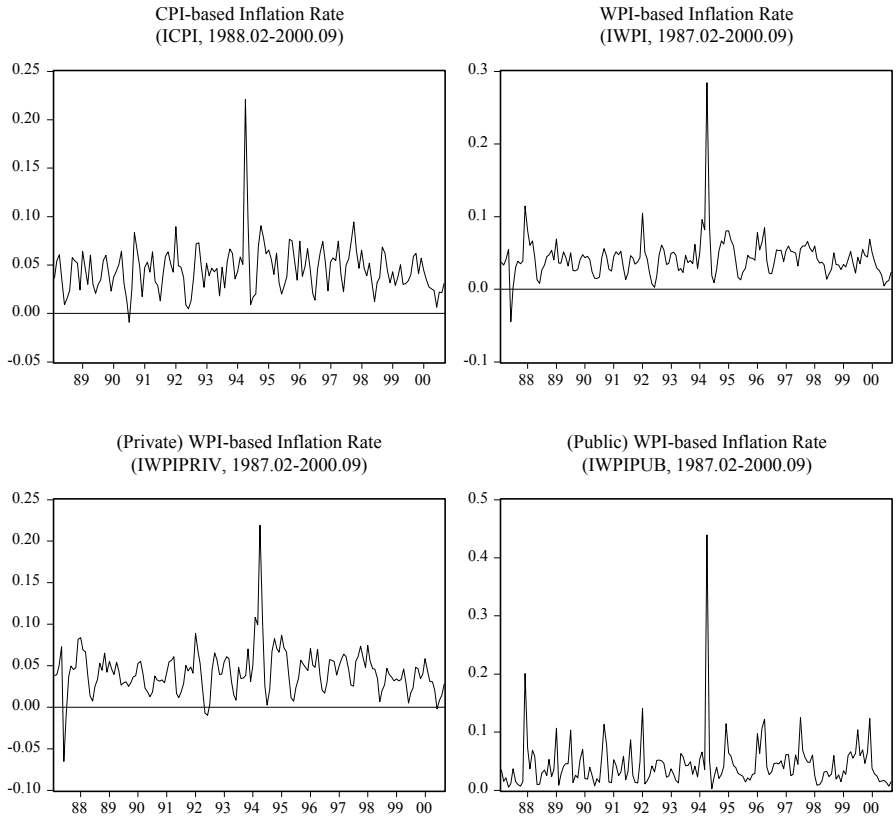

Figure 1: Monthly Inflation Rates in Turkey (1987–2000)
Source: State Institute of Statistics; author's own calculations.

Plots of these inflation series are given in Figure 1. We note that (a) all four series fluctuate around a nonzero constant, (b) there may be a significant seasonal component in some or all of them, and (c) there appears to be significant additive outliers that need to be dealt with.

The implication of (a) is that all regressions used to test for a unit root will contain an intercept but no linear trend.

To deal with (b), we ran regressions for each inflation series using centred seasonal dummies and found that for the CPI (ICPI), WPI and WPIPRIV-based series there was significant seasonality while IWPIPUB

did not appear to have any significant seasonality. Thus, in what follows, we use the deseasonalised series based on these regressions, for ICPI, IWPI and IWPIPRIV (denoting them by ICPISA, IWPISA and IWPIPRIVSA, respectively) and the unadjusted series for IWPIPUB.

From the plot of the series we observe one unmistakable outlier in April 1994. There seem to be other ones as well. We need to take such outliers into account since they (a) tend to bias downward the coefficient of the lagged dependent variable in the autoregressions used to test for unit roots, thereby leading to the conclusion that the time series is stationary (Franses and Haldrup, 1994), and (b) change the asymptotic distribution of the ADF statistic if they are not introduced into the test equation in an appropriate manner. Thus, our empirical applications in the next section will start by testing for the presence of outliers.

3. Empirical Results

As we mentioned in the introduction, we shall first undertake the task of testing for a unit root in the four inflation series to see if, in fact, there is unequivocal evidence that a unit root does exist.

3.1 Testing for a Unit Root

Since we expect additive outliers to be present in the data, we shall first apply two systematic testing procedures to the data to determine them and then apply two unit root tests, which take the presence of outliers into account. The first procedure is due to Vogelsang (1999) and is based on estimating

$$y_t = \alpha_0 + \alpha_1 D(T_{ao})_t + u_t \tag{1}$$

where $D(T_{ao})_t$ is an AO dummy that takes on the value 1 if $t = T_{ao}$ and is zero otherwise. The u_t are assumed to be generated by $u_t = u_{t-1} + \varepsilon_t$. The statistic to test for an additive outlier is simply based on the t-ratio to test for $\alpha_1 = 0$, namely, $t_{\hat{\alpha}_1}(T_{ao})$ and is obtained as

$$\tau_c = \max_{T_{ao}} \left| t_{\hat{\alpha}_1}(T_{ao}) \right| . \tag{2}$$

The procedure is applied as follows: First, $t_{\hat{\alpha}_1}(T_{ao})$ is calculated for the entire series and if a statistically significant value for τ_c is found at, say T_{ao}, then the outlier and the corresponding row of the regressors are dropped from equation (1)[3] and the equation is re-estimated sequentially to test for a new outlier. These steps are repeated until no additional outlier is found.

The null distribution of τ_c, which is nonstandard, was established by Vogelsang (1999) and taken to be the same for each step of this procedure. Perron and Rodriguez (2000) have shown that this does not hold and have tabulated critical values for each step separately. But, they also note that, when this correction is made, the Vogelsang procedure looses a great deal of power. They suggest an alternative statistic based on the first difference of equation (1);

$$\Delta y_t = \alpha_1[D(T_{ao})_t - D(T_{ao})_{t-1}] + \varepsilon_t \tag{3}$$

where $D(T_{ao})_t$ is as defined above and $D(T_{ao})_{t-1}$ = 1 if $t = T_{ao}$-1 and 0 otherwise. The OLS estimate of α_1 is now obtained as

$$\hat{\alpha}_1 = (\Delta y_t - \Delta y_{t-1})/2$$

and is equal to $(u_t - u_{t-1})/2$ under the null hypothesis that there is no outlier ($\alpha_1 = 0$). The variance of $\hat{\alpha}_1$ is then obtained as

$$Var(\hat{\alpha}_1) = [2(R_u(0) - R_u(1))]/4$$

where R_u(j) is the autocovariance of u_t at lag j. Using the OLS residuals from equation (3), $\hat{\varepsilon}_t$, R_u(j) may consistently be estimated as $\hat{R}_u(j) = T^{-1}\sum_{t=1}^{T-j}\hat{\varepsilon}_t\hat{\varepsilon}_{t-j}$. The t-ratio for $\hat{\alpha}_1$ then becomes,

$$t_{\hat{\alpha}_1} = \frac{\Delta y_t - \Delta y_{t-1}}{[2(R_u(0) - R_u(1))]^{1/2}}$$

and the test statistic is again obtained using equation (2) but now we denote it by τ_d. The Vogelsang stepwise procedure is applied using τ_d but its asymptotic distribution remains the same for every step.

Table 1: Outlier Detection Test Results

	τ_c	$\hat{T}_{ao}$	τ_d	$\hat{T}_{ao}$
ICPISA	13.373**	1994.04	8.023***	1994.04
	5.211**	1994.05	4.251***	1994.03
			4.084***	1994.05
IWPISA	13.017**	1994.04	7.445***	1994.04
	4.263**	1987.06	4.255***	1994.03
IWPIPRIVSA	9.325**	1994.04	4.727***	1994.04
	4.667**	1987.06	4.367***	1987.06
	4.828**	1994.05		
IWPIPUBSA	13.157**	1994.04	7.297***	1994.04
	5.818**	1987.12	4.472***	1994.03
			3.477**	1987.12

Notes: The critical values for the τ_c test are from Table 1 and those for the τ_d test are from Table 2 of Perron and Rodriguez (2000).

Asymptotic Critical Values for the τ_c Test:

α	# of Outliers	Critical Value
0.10	1	2.81
	2	3.38
	3	3.88
0.05	1	2.99
	2	3.69
	3	4.29

Finite Sample Critical Values for the τ_d Test:

α	T=100	T=200
0.10	3.44	3.56
0.055	3.65	3.78
0.025	3.86	3.95
0.01	4.13	4.15

*: significant at the 10% level. **: significant at the 5% level. ***: significant at the 1% level.

The results of these two procedures, as applied to the four inflation series, are given in Table 1. We note that, as expected, there is a highly significant outlier in April 1994 for all series. This is a period of exchange rate crisis and its effects appear to be observed in the month prior (March 1994) to it (in ICPISA, IWPISA and IWPIPUBSA, according to τ_d) and following it (1994.05) (in ICPISA and IWPIPRIVSA, according to both τ_c and τ_d). In any event, all outliers are found to be significant at the 5% level, at least.

We take account of outliers in testing for a unit root using two different procedures. The first one is the ADF statistic with AO dummies added to the test equation in such a way that the asymptotic null distribution is not changed. The second procedure is to use the Modified Phillips-Perron GLS statistic (MZ_tGLS), as suggested by Vogelsang (1999), since it is robust against the presence of outliers.

The ADF statistic with impulse dummies for additive outliers is based on the OLS estimation of

$$\Delta y_t = \beta_0 + \beta_1 y_{t-1} + \sum_{i=1}^{p} \gamma_i \Delta y_{t-i} + \sum_{r=1}^{m} \sum_{i=0}^{p} \delta_{ri} D(T_{aor})_{t-i} + \varepsilon_t \tag{4}$$

where 'm' is the number of outliers. Thus, for each outlier, p+1 dummy variables are added to the regression so that their effect on the Δy_{t-i} terms are removed and the distribution of the ADF statistic remains unchanged (Franses and Haldrup, 1994). In practice, AO dummies which are defined for adjacent periods will lead to collinearity and others may yield lagged values which consist of all zeroes if $\hat{T}_{aor}$ is close to the beginning of the period and p is large. These dummies, of course, need to be dropped from equation (4).

In choosing the lag length for equation (4) we use the Akaike Information Criterion (AIC), the Schwartz Information Criterion (SIC) and the sequential testing of the coefficient of the last lag. We, initially, see if, at least two of them agree upon a lag length.[4] If there is no agreement, then we use the outcome of that criterion which provides us with the longest lag length since the whole purpose of this exercise is to remove any autocorrelation that may exist in the residuals. Finally, after choosing the lag length, we test for autocorrelation in the residuals and add more lags if we find that there is still some autocorrelation left over. All through this procedure, we start by choosing a maximal lag length, p_{max}, set the sample size as T-p_{max} and keep it fixed as we reduce the lag length one at a time.[5] Testing for autocorrelation is done by using the Ljung-Box portmanteau statistic.

The results of the ADF test are given in Table 2. They contain the outcomes of the tests with and without AO dummies. The ADF tests without dummies imply that ICPISA has a unit root, while a unit root is strongly rejected for IWPISA and IWPIPUB but weakly rejected for IWPIPRIVSA. We were only able to add the AO dummy for April 1994 to the equations for ICPISA, IWPISA and IWPIPRIVSA, due to the reasons discussed above. We were, however, able to add two dummies and their lags for IWPIPUB. In any event, when AO dummies are added, we find that all WPI-based inflation series strongly reject a unit root in every case. For ICPISA, on the other hand, the null of a unit root is, again, not rejected.

Table 2: ADF Test Results

	T	*p*	ADF	LB(24)	AO Dummies
*With*out *AO Dummies*					
ICPISA	144	8	-2.503	7.716 (0.999)	
IWPISA	156	7	-3.632***	9.352 (0.997)	
IWPIPRIVSA	156	8	-2.781*	21.492 (0.610)	
IWPIPUB	156	0	-11.045***	10.985 (0.989)	
With AO Dummies					
ICPISA	144	8	-2.291	17.633 (0.820)	D(94.04)
IWPISA	156	7	-4.281***	13.844 (0.950)	D(94.04)
IWPIPRIVSA	156	8	-3.737***	19.802 (0.708)	D(94.04)
IWPIPUB	156	8	-9.059***	17.849 (0.810)	D(94.04), D(87.12)

Notes: LB stands for the Ljung-Box statistic which has an asymptotic chi-square distribution with *k-p* degrees of freedom under the null hypothesis, with k = number of autocorrelations. In the present case, k = 24. The figure in parentheses next to the LB statistic is its p-value.
The critical values for the ADF statistic are based on the response surface results due to Cheung and Lai (1995a) where both the sample size, *T-p*-1, and the lag length, *p*, are taken into account. They are:

T	*p*	*T-p*-1	0.10	0.05	0.01
144	8	135	-2.539	-2.838	-3.428
156	8	147	-2.541	-2.839	-3.427
156	7	148	-2.545	-2.843	-3.432
156	0	155	-2.575	-2.875	-3.465

*: significant at the 10% level. **: significant at the 5% level. ***: significant at the 1% level.

Our second statistic, MZ_tGLS, is obtained by applying the modified Phillips-Perron statistic (MZ_t), as discussed by Perron and Ng (1996), to the framework introduced by Elliot *et al.* (1996). The Elliot *et al.* (1996) framework involves expressing y_t as

$$y_t = \beta_0 + \eta_t, \qquad \eta_t = \rho\eta_{t-1} + u_t \tag{5}$$

where ρ is assumed to take on values local to unity, $\rho=1+(c/T)$. Equation (5) is first estimated by GLS, taking $\bar{\rho}=1+(-7/T)$ and regressing $\{y_1, y_2-\bar{\rho}y_1, \ldots, y_T-\bar{\rho}y_{T-1}\}$ on $\{1, 1-\bar{\rho}, \ldots, 1-\bar{\rho}\}$. Then, using the residuals, $\tilde{y} = y_t - \hat{\beta}_0$, we consider estimating

$$\Delta\tilde{y}_t = \beta_1\tilde{y}_{t-1} + e_t \tag{6a}$$

$$\Delta\tilde{y}_t = b_1\tilde{y}_{t-1} + \sum_{i=1}^{p}\gamma_i\Delta\tilde{y}_{t-i} + v_t. \tag{6b}$$

The DFGLS statistic of Elliot *et al.* (1996) is simply the t-ratio of $\hat{b}_1$ obtained from equation (6b). MZ_tGLS, on the other hand, is obtained by using the estimates from equations (6a) and (6b), to yield

$$MZ_tGLS = \left(\frac{\hat{\sigma}_e}{\hat{\sigma}_{vR}}\right) t_{\hat{\beta}_1} - \frac{1}{2}\frac{\hat{\sigma}_{vR}^2 - \hat{\sigma}_e^2}{\left[\hat{\sigma}_{vR}^2 (T-1)^{-2} \sum_{t=2}^{T} \tilde{y}_{t-1}^2\right]^{1/2}} + \frac{1}{2}\left[\sum_{t=2}^{T} \frac{\tilde{y}_{t-1}^2}{\hat{\sigma}_{vR}^2}\right]^{1/2} (\hat{\beta}_1 - 1)^2 \tag{7}$$

where

$$\hat{\sigma}_e^2 = \sum_{t=2}^{T} \hat{e}_t^2 \Big/ (T-1) \text{ and } \hat{\sigma}_{vR}^2 = \sum_{t=p+2}^{T} \hat{v}_t^2 \Big/ (T-p-1)(1 - \sum_{i=1}^{p} \hat{\gamma}_i)^2 .$$

Now, Ng and Perron (2001a), where the MZ_tGLS statistic is developed,[6] show that its nominal size approximates its finite sample size much better than the DFGLS statistic, which has better power properties. This improvement in size is particularly relevant when the disturbances in the unit root test equations contain a moving average component with a root close to -1. On the other hand, Franses and Haldrup (1994) show that systematic additive outliers induce such a MA component in the disturbances, which leads to the suggestion by Vogelsang (1999) that it be used as a test robust to the presence of additive outliers.

Note that we again face the problem of choosing the lag length, now in (6b). In this case, however, we shall use the Modified AIC and SIC (MAIC and MSIC) criteria, due to Ng and Perron (2001a), together with the sequential testing procedure. The modified information criteria may be expressed as,

$$MIC(p) = \ln \hat{\sigma}_p^2 + \frac{C_T(\varphi_T(p) + p)}{T - p_{\max}} \tag{8}$$

where

$$\hat{\sigma}_p^2 = \sum_{t=p_{\max}-1}^{T} \hat{v}_{tp}^2 \Big/ (T - p_{\max}) \text{ and } \varphi_T = \hat{b}_1^2 \sum_{t=p_{\max}+1}^{T} \tilde{y}_{t-1}^2 \Big/ \hat{\sigma}_p^2 .$$

We obtain MAIC when $C_T = 2$ and MSIC when $C_T = \ln(T\text{-}p_{max})$.

Table 3: DFGLS and MZ_tGLS Test Results

	T	*p*	DFGLS[2]	MZ_tGLS[3]	LB(24)[1]
ICPISA	144	8	-1.418	-1.171	8.699 (0.998)
IWPISA	156	8	-2.011**	-1.739*	9.590 (0.996)
IWPIPRIVSA	156	8	-1.409	-1.265	21.979 (0.581)
IWPIPUB	156	11	-3.749**	-7.173***	9.230 (0.997)

Notes: See the notes to Table 2. The critical values for the DFGLS statistic are based on the response surface results due to Cheung and Lai (1995b) where both the sample size, *T-p*-1, and the lag length, *p*, are taken into account. They are:

T	*p*	*T-p*-1	0.10	0.05
144	8	135	-1.705	-2.011
156	8	147	-1.700	-2.007
156	11	144	-1.676	-1.981

Vogelsang (1999) points out that the MZ_tGLS statistic will have the same asymptotic null distribution as the ADF statistic obtained from a regression with no deterministic terms. Hence, the critical values are based on the response surface results due to Cheung and Lai (1995a). They are:

T	*p*	*T-p*-1	0.10	0.05	0.01
144	8	135	-1.594	-1.921	-2.557
156	8	147	-1.595	-1.922	-2.557
156	11	144	-1.590	-1.915	-2.549

*: significant at the 10% level. **: significant at the 5% level. ***: significant at the 1% level.

The results for the DFGLS and MZ_tGLS tests are presented in Table 3. They appear to be quite similar. Both indicate that ICPISA and IWPIPRIVSA have unit roots while IWPISA and IWPIPUB do not. Thus, there is no conflict with the ADF results for the latter two series and for ICPISA; the ADF results, however, are stronger for IWPISA. The IWPIPRISA results, on the other hand, are definitely in conflict with the ADF results.

Thus, the results in Tables 2 and 3 cast a great deal of doubt about the presence of a unit root in the inflation series considered; the evidence appears to favor the hypothesis that they, in fact, are stationary. Hence, looking for evidence of long-memory becomes even more important.

3.2 ARFIMA Modeling

Our final set of results are based on estimating the ARFIMA(p,d,q) model

$$\Phi(L)(1-L)^d(y_t - x_t'\beta) = \Theta(L)\varepsilon_t \tag{9}$$

where *d* is the differencing parameter which may take any value on the real line, $\Phi(L)$ and $\Theta(L)$ are polynomials in the lag operator *L* of degrees *p* and

q, respectively, and x_t is an mx1 vector of regressors that explain the mean of y_t which, in the present case, will consist of an intercept, AO dummies[7] and, in three cases, seasonal dummies. As shown in the Appendix, we will be interested in values of d less than unity. Now, if all roots of $\Phi(L)$ and $\Theta(L)$ lie outside the unit circle and $-0.5<d<0.5$, then y_t is stationary and invertible. On the other hand, if $0.5\leq d<1$, then y_t is nonstationary because it has infinite variance (Granger and Joyeux, 1980). However, since d is still less than one, the process is mean reverting. As to the values lying between -0.5 and 0.5, if $0<d<0.5$ then y_t is said to exhibit long-memory, if $-0.5<d<0$, y_t is said to have intermediate memory. Of course, for $d = 0$, the process exhibits short-memory. Thus, in our empirical work we shall try to find out if d lies in the interval (0, 0.5).

We assume that $y_t \sim N(x_t'\beta,\Sigma)$ and, based on this assumption, we use two Maximum Likelihood (ML) methods to estimate equation (9).

The *first* one is the EML method due to Sowell (1992). Let $z = y - X\beta$ where y and z are Tx1, X is Txm and $\Sigma = \sigma^2 R$. Then, the loglikelihood function becomes

$$\lambda = c - \tfrac{1}{2}\ln|R| - \tfrac{T}{2}\ln\sigma^2 - \tfrac{1}{2\sigma^2} z' R^{-1} z \tag{10}$$

where $c = -(T/2)\ln(2\pi)$. Note that, for a given R matrix, the ML estimators of β and σ^2 are given by the familiar expressions, $\hat{\beta} = (X'R^{-1}X)^{-1}X'R^{-1}y$ and $\hat{\sigma}^2 = z'R^{-1}z/T$. Substituting these in equation (10) yields the concentrated loglikelihood, λ_c,

$$\lambda_c = c - \tfrac{1}{2}\ln|R| - \tfrac{T}{2}\ln\left(\frac{\hat{z}'R^{-1}\hat{z}}{T}\right) \tag{11}$$

where $\hat{z} = y - X\hat{\beta}$. The elements of R, which include d and the parameters of the polynomials $\Phi(L)$ and $\Theta(L)$, are then estimated by maximising λ_c. This is a highly nonlinear problem which was solved by Sowell (1992) but was rarely implemented because of its complexity. We use the interactive Ox program due to Doornik and Ooms (1999) which makes its implementation quite easy.

The *second* method, which we call NLS following Ooms and Doornik (1999), was suggested to reduce the complexity in the use of EML. Assuming $\Theta(L)$ to be invertible, we may obtain, from equation (9),

$\varepsilon_t = \Pi(L)z_t = z_t - \sum_{i=1}^{\infty} \pi_i z_{t-i}$ where $\Pi(L) = \Theta(L)^{-1}\Phi(L)(1-L)^d$. Since the ε_t are iidN(0, σ^2) their loglikelihood function may be written as

$$\lambda = c - \tfrac{T}{2}\ln\sigma^2 - \tfrac{1}{2\sigma^2}\sum_{t=1}^{T}\varepsilon_t^2 .$$

But ε_t is based on an infinite number of past observations whereas we only have a finite number. Thus, let $e_t = z_t - \sum_{i=1}^{t-1}\pi_i z_{t-i}$, $t = 2,\mathrm{K},T$, estimate σ^2 as

$$\hat{\sigma}_e^2 = \tfrac{1}{T-m}\sum_{t=2}^{T} e_t^2$$

and approximate the concentrated loglikelihood function by

$$f = -\tfrac{1}{2}\ln\hat{\sigma}_e^2 = -\tfrac{1}{2}\ln\left(\tfrac{1}{T-m}\sum_{t=2}^{T} e_t^2\right). \tag{12}$$

The estimators for all the parameters are obtained by minimizing *f*.

Both of these nonlinear procedures are started off by using the GPH estimate of *d* as its initial value, where *p* and *q* are both set equal to zero. It is obtained from the OLS estimation of

$$\ln\{I(\lambda_{j,T})\} = a + b\ln\{4\sin^2(\lambda_{j,T}/T) + \upsilon_j, \qquad j = 0,\mathrm{K},T-1 \tag{13}$$

where $\lambda_{j,T}$ are harmonic ordinates of the z_t, I($\lambda_{j,T}$) denotes the periodogram of these ordinates, and $b = -d$. Thus, this is a nonparametric estimator of *d* based on z_t's spectral representation.

Table 4: Estimates of ARFIMA(0,*d*,0) Models

ICPISA[1]			
	EML	NLS	GPH
D	0.258 (0.000)***[2]	0.269 (0.000)***	0.271 (0.000)***
Constant	0.070 (0.000)***	0.070 (0.000)***	0.070 (0.000)***
D(92.01)	0.036 (0.000)***	0.036 (0.000)***	0.036 (0.000)***
D(94.04)	0.162 (0.000)***	0.162 (0.000)***	0.163 (0.000)***
D(94.05)	0.063 (0.000)***	0.063 (0.000)***	0.062 (0.000)***
Normality [chi(2)][3]	2.429 (0.297)	2.541 (0.281)	2.492 (0.288)
ARCH(1,1) [F(1,126)][3]	0.063 (0.802)	0.068 (0.794)	0.052 (0.821)
LB(36) [chi(20)][3]	35.356 (0.018)**	35.296 (0.019)**	34.850 (0.021)**
IWPISA[1]			
D	0.356 (0.000)***	0.381 (0.000)***	0.422 (0.000)***
Constant	0.045 (0.000)***	0.042 (0.000)***	0.045 (0.000)***
D(87.06)	-0.060 (0.000)***	-0.060 (0.000)***	-0.063 (0.000)***
D(87.12)	0.068 (0.000)***	0.068 (0.000)***	0.071 (0.000)***
D(94.04)	0.227 (0.000)***	0.226 (0.000)***	0.240 (0.000)***
D(94.05)	0.049 (0.000)***	0.048 (0.000)***	0.055 (0.000)***
Normality [chi(2)]	14.408 (0.001)***	13.428 (0.001)***	13.776 (0.001)***
ARCH(1,1) [F(1,137)]	0.001 (0.978)	0.004 (0.951)	0.001 (0.981)
LB(36) [chi(19)]	72.152 (0.000)***	70.099 (0.000)***	68.547 (0.000)***
IWPIPRIVSA[1]			
d	0.366 (0.000)***	0.396 (0.000)***	0.419 (0.000)***
Constant	0.042 (0.000)***	0.044 (0.000)***	0.042 (0.000)***
D(87.06)	-0.082 (0.000)***	-0.082 (0.000)***	-0.078 (0.000)***
D(94.04)	0.153 (0.000)***	0.152 (0.000)***	0.174 (0.000)***
D(94.05)	0.060 (0.000)***	0.059 (0.000)***	0.059 (0.000)***
Normality [chi(2)]	18.552 (0.000)***	17.793 (0.000)***	18.228 (0.001)***
ARCH(1,1) [F(1,138)]	0.641 (0.424)	0.448 (0.504)	1.017 (0.315)
LB(36) [chi(20)]	87.188 (0.000)***	86.640 (0.000)***	83.005 (0.000)***
IWPIPUB			
d	0.250 (0.001)***	0.262 (0.001)***	0.249 (0.001)***
Constant	0.041 (0.000)***	0.040 (0.000)***	0.041 (0.000)***
D(87.12)	0.164 (0.000)***	0.164 (0.000)***	0.160 (0.000)***
D(92.01)	0.110 (0.000)***	0.110 (0.000)***	0.100 (0.000)***
D(94.04)	0.399 (0.000)***	0.399 (0.000)***	0.398 (0.000)***
Normality [chi(2)]	42.512 (0.000)***	40.347 (0.000)***	40.755 (0.001)***
ARCH(1,1) [F(1,149)]	0.235 (0.628)	0.245 (0.622)	0.229 (0.633)
LB(36) [chi(31)]	41.402 (0.100)***	41.223 (0.104)***	40.676 (0.115)***

Notes:

1. Instead of using the deseasonalised series, as we did when testing for unit roots, we added eleven centered seasonal dummies to the model, but the actual coefficient estimates are not provided to conserve on space. However, their coefficients are found to be highly significant in every case. The test results are available upon request.
2. The figures in parentheses are p-values.
3. "Normality" is the test for normality in the residuals due to Doornik and Hansen (1994), ARCH(1,1) is the F-version of the Lagrange Multiplier test for first-order Autoregressive Conditional Heteroscedasticity, and LB(36) is the Ljung-Box test for autocorrelation based on 36 sample autocorrelations.

*: significant at the 10% level. **: significant at the 5% level. ***: significant at the 1% level.

In presenting our empirical results, we first give those on the ARFIMA(0, *d*, 0) case, which will include estimates from EML, NLS and GPH. These may be regarded as benchmark values with which to compare the results for the ARFIMA(*p*, *d*, *q*) models. They are given in Table 4.

We note the following points from this table:

1. All estimates lie between 0 and 0.50, indicating that all inflation rates are stationary and exhibit long memory.
2. The estimates of *d* for ICPISA and IWPIPUB are smaller than those for IWPISA and IWPRIVSA. This result is not surprising for IWPIPUB, in view of the unit root results, where stationarity evidence is quite strong. But the results for the remaining series, ICPISA and IWPIPRIVSA in particular, appear to be in conflict. An explanation of this outcome may be provided, for the ADF case, by the findings of Diebold and Rudebusch (1991) who indicate that the ADF test may lead to the incorrect conclusion that a series has a unit root when the alternative is a fractionally integrated process.

In all cases except IWPIPUB, EML gives the lowest and GPH the highest results, but the differences are not very large. Given the fact that GPH is the least efficient estimator of the three (see, e.g., Agiaklioglu, Newbold and Wohar, 1993) we may concentrate on the EML and NLS results. EML may be preferable since it is an exact ML procedure whereas NLS is approximate (see Baillie (1996) for a survey of the Monte Carlo evidence regarding EML and NLS).[8]

We now turn to Table 5 which contains the results of a full ARFIMA(*p,d,q*) modeling effort. We note that the estimates for ICPISA and IWPIPUB are quite comparable to those obtained for ARFIMA(0,*d*,0), with the latter results being slightly larger in magnitude, particularly for NLS. The diagnostics for ICPISA appear to be acceptable except for LB which indicates the presence of some autocorrelation in the residuals; this is less significant in the EML case than the NLS case. For IWPIPUB, on the other hand, the diagnostic test, which is significant, is normality. This may be due to the possible existence of additional outliers, which we may not have captured; the plot of IWPIPUB in Figure 1 appears to imply that this may be the case.

Turning to the IWPISA and IWPIPRIVSA results, we first note that the NLS estimates for IWPISA are not available because of the presence of a negative unit root at MA(12) which makes the polynomial $\Theta(L)$ of equation (9) noninvertible.

Table 5: Estimates of ARFIMA(*p*,*d*,*q*) Models

ICPISA[1]		
	EML	NLS
D	0.252 (0.000)***[2]	0.251 (0.000)***
AR(9)[3]	0.192 (0.032)**	0.198 (0.027)**
Constant	0.044 (0.000)***	0.046 (0.000)***
D(92.01)	0.034 (0.000)***	0.034 (0.000)***
D(94.04)	0.156 (0.000)***	0.156 (0.000)***
D(94.05)	0.063 (0.000)***	0.063 (0.000)***
Normality [chi(2)][4]	3.092 (0.213)	4.052 (0.132)
ARCH(1,1)[F(1,125)][4]	0.014 (0.908)	0.020 (0.889)
LB(36) [chi(19)][4]	29.440 (0.059)*	31.475 (0.036)**
IWPISA[1]		
D	0.444 (0.000)***	-
AR(7)	0.197 (0.017)**	-
AR(12)	0.482 (0.000)***	-
MA(12)[3]	-1.000 (0.000)***	-
Constant	0.042 (0.000)***	-
D(87.06)	-0.065 (0.000)***	-
D(87.12)	0.059 (0.000)***	-
D(94.04)	0.219 (0.000)***	-
D(94.05)	0.039 (0.000)***	-
Normality [chi(2)]	4.947 (0.084)*	-
ARCH(1,1) [F(1,134)]	0.932 (0.336)	-
LB(36) [chi(16)]	51.970(0.000)***	-
IWPIPRIVSA[1]		
D	0.435 (0.000)***	0.526 (0.000)***
AR(2)	-0.208 (0.016)**	-0.140 (0.110)
AR(7)	0.238 (0.005)***	0.236 (0.001)***
Constant	0.041 (0.009)***	0.038 (0.022)**
D(87.06)	-0.082 (0.000)***	-0.096 (0.025)**
D(94.04)	0.165 (0.000)***	0.160 (0.000)***
D(94.05)	0.066 (0.000)***	0.067 (0.000)***
Normality [chi(2)]	10.987 (0.004)***	10.574 (0.005)***
ARCH(1,1) [F(1,136)]	0.485 (0.488)	0.195 (0.660)
LB(36) [chi(18)]	76.025(0.000)***	68.858 (0.000)***
IWPIPUB		
D	0.250 (0.001)***	0.224 (0.003)***
AR(7)	-0.153 (0.065)*	-0.159 (0.054)*
AR(12)	-0.142 (0.093)*	-0.144 (0.083)*
Constant	0.041 (0.00)***	0.043 (0.000)**
D(87.12)	0.159 (0.000)***	0.134 (0.184)
D(92.01)	0.112 (0.000)***	0.111 (0.000)***
D(94.04)	0.394 (0.000)***	0.394 (0.000)***
Normality [chi(2)]	39.835 (0.000)***	36.696 (0.000)***
ARCH(1,1) [F(1,147)]	0.017 (0.896)	0.148 (0.701)
LB(36) [chi(29)]	33.768 (0.247)	31.901 (0.324)

Notes:
1. Instead of using the deseasonalised series, as we did when testing for unit roots, we added eleven centered seasonal dummies to the model, but the actual coefficient estimates are not provided to conserve on space. However, their coefficients are found to be highly significant in every case. The test results are available upon request.
2. The figures in parentheses are p-values.
3. AR(p) stands for the pth autoregressive lag of the dependent variable and MA(q) stands for the qth moving average lag.
4. "Normality" is the test for normality in the residuals due to Doornik and Hansen (1994), ARCH(1,1) is the F-version of the Lagrange Multiplier test for first-order Autoregressive Conditional Heteroscedasticity, and LB(36) is the Ljung-Box test for autocorrelation based on 36 sample autocorrelations.

*: significant at the 10% level. **: significant at the 5% level. ***: significant at the 1% level.

Secondly, we find that the estimates of d are somewhat larger than those obtained for the ARFIMA(0,d,0) model. In fact, the NLS estimate of d for IWPIPRIVSA implies that this series may not be stationary even though it may not have a unit root. The fact that EML yields a value in the (0, 0.5) interval may be misleading in this case since the estimation procedure constrains the estimate of d to lie within this interval (Doornik and Ooms, 1999) while NLS does not. Thus, these models indicate that IWPISA and IWPIPRIVSA have stronger long memory components than ICPISA and IWPIPUB.

Of course, one needs to be careful in making strong claims based on these results since only outcomes of the ARCH(1,1) test are acceptable. Both normality and lack of autocorrelation are strongly rejected. Once again, as in the case of IWPIPUB, one may investigate further if there are other additive outliers, which may have led to nonnormal residuals, or whether tests for higher order ARCH should be performed. Thus, these results should be regarded as tentative.

Nevertheless, one last point worth pursuing may be to assess the forecasting performance of the ARFIMA(p,d,q) models vis-à-vis those of ARIMA(p,0,q) models. Since the estimates of d indicate that the inflation series in question are stationary, they may be modeled without any filtering which takes account of persistence and checked to see if filtering improves upon their predictive performance.

We, thus, modeled the four series without any filtering and found the best fitting models to be ARIMA((1)[9],(9),0,0) for ICPISA, ARIMA(12,0,(12)) for IWPISA, ARIMA((1),(2),7-12,0,0) for IWPIPRIVSA and ARIMA(1,0,0) for IWPIPUBSA.[10] Using the EML estimates of these eight models, we forecast monthly inflation rates for the period February 2000 – September 2000. The results are presented graphically in Figures 2 and 3. There is a pair of graphs for each series. The one on the left gives the actual and forecasted values for the series. For

example, the first graph on the left in Figure 2 has the plot of ICPI and the forecasts from the ARFIMA((9),*d*,0) and ARIMA((1),(9),0,0) models, denoted by FICPI1 and FICPI2, respectively. The graph on the right provides us with information about forecast performance. We calculated the ratio of the forecast error to the standard error of the forecast and, noting that this statistic has an asymptotic standard normal null distribution under the hypothesis that the mean of the forecast error is zero, we scaled its absolute value by 1.96, the critical value at the 5% significance level. The plot of these scaled statistics (denoted for, e.g., ICPI as TEICPI1 and TEICPI2) and the horizontal line of unity as the critical value (CV) enables us to state that a prediction is poor whenever the plot of the statistic lies above the CV line.

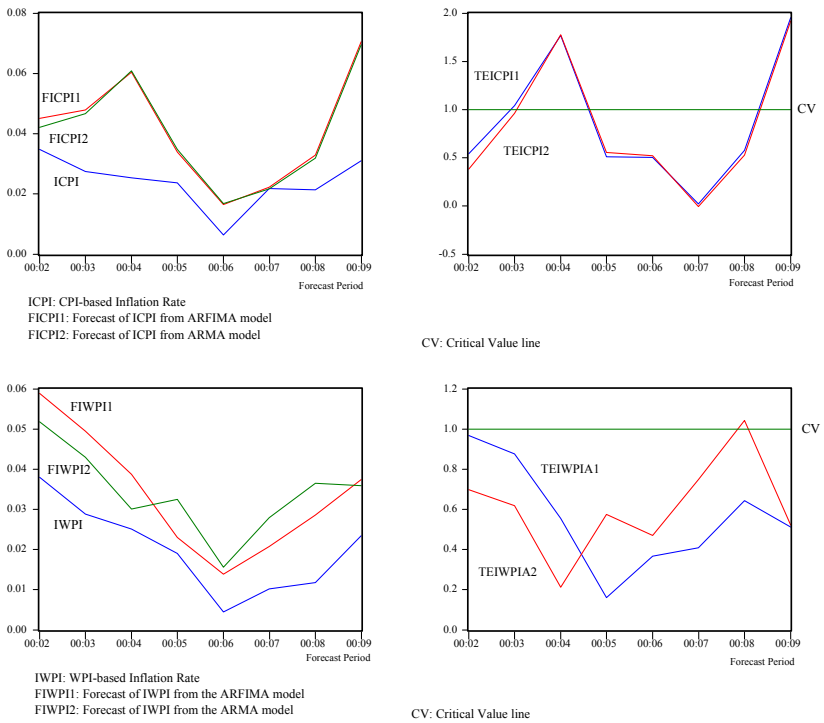

Figure 2: Forecast Performance of ARFIMA(*p*,*d*,*q*) and ARMA(*p*,*q*) Models for CPI and WPI-based Inflation Rates

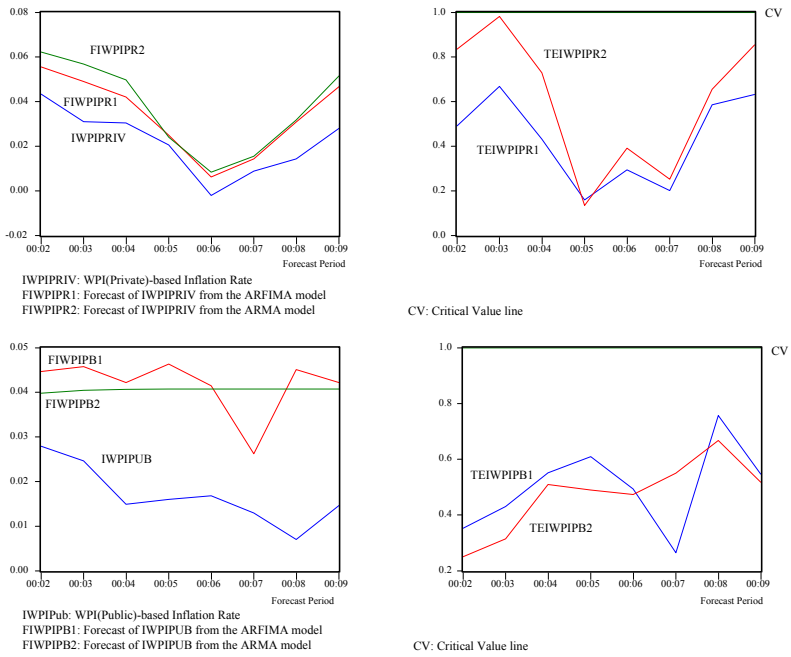

Figure 3: Forecast Performance of ARFIMA(*p,d,q*) and ARMA(*p,q*) Models for WPI(Private) and WPI(Public)-based Inflation Rates

The first thing we note from these graphs is that all models overpredict the inflation rates. This is not surprising as the prediction period is one when strong anti-inflationary measures had started to bear fruit so that monthly inflation rates show a distinct decline until June 2000 (this decline continues on to August 2000 for IWPIPUB) after which they start increasing again but they do remain below their pre-February 2000 values.

Turning to each individual series, we find that there does not appear to be much to choose between the models for the filtered and nonfiltered ICPI. Their forecasts are quite close to each other in value and they show the same rather poor performance for March, April and September 2000. As for IWPI, the model with long-memory appears to track the series better and TEIWPI1 lies totally below the CV line, implying a better performance than the model for the unfiltered series. The picture, in the case for IWPIPRIV, is a bit different since both forecasts track the series quite well, with FIWPIPR1 slightly closer than FIWPIPR2. The test statistics for both forecasts lie below CV but the distance of TEIWPIPR1 from CV is, almost always, larger than that of TEIWPIPR2. Thus, the long-memory model

again has a better forecast performance but not as much as in the case of IWPI. Finally, for IWPIPUB, we note that both models do a rather poor job of tracking the series with FIWPIPB1 doing slightly better. Both test statistics lie below CV at all points but, given their tracking performance, this does not mean much.

To sum up, this forecasting exercise implies that one should prefer models which incorporate the long-memory component, particularly if the estimate of *d* is close to 0.5, as in the case for IWPI and IWPIPRIV.

4. Conclusions

In this study we investigated the nature of persistence in Turkish monthly inflation rates. We first carried out unit root tests in order to see if the persistence was due to the presence of a unit root. We did this by using tests, which took additive outliers into account. We found that the evidence favored the absence of a unit root in IWPIPUB and the presence of one in ICPISA. For IWPISA one, probably, could argue for the absence of a unit root, but for IWPIPRIVSA, the evidence is mixed. Hence, we may conclude that unit root tests do not provide us with clear-cut evidence, one way or the other, but they do lean towards implying that the WPI-based series may be stationary.

Given this state of affairs, we undertook the task of modeling each series as ARFIMA(p,d,q). The results clearly show that the estimated value of d, which is highly significant in every case, lies in the interval (0, 0.5), implying that the series are stationary but exhibit long-memory. This long-memory component is smaller in the case of ICPISA and IWPIPUB, which is in contrast with the unit root test results for ICPISA but is in accordance with the same test results for IWPIPUB. On the other hand, the estimate of *d* is closer to 0.5 in the case of IWPISA and IWPIPRIVSA, which contrasts with, at least, the ADF results for these two inflation rates.

When we assessed the forecast performance of these ARFIMA models against those of ARIMA(p,0,q) models, we found that the ARFIMA models appeared to give better results when *d* was closer to 0.5 than otherwise, but it was difficult to talk about a clear-cut superiority.

These results indicate that the two recent, IMF-backed attempts by the government to reduce inflation have to deal with a process which, essentially, is stationary but has a strong long-memory component and will exhibit a great deal of resistance initially, but if the anti-inflationary policy is successful, would yield long-lived results.

Appendix 1: Persistence

In this section, we would like to be formally more specific about the term "persistence" and its link to nonstationarity and stationarity with long memory. Hence, let the series y_t be I(1) so that Δy_t may be modeled as ARMA(p,q). Then, its infinite moving average version may be expressed as,

$$\Delta y_t = \mu + \sum_{i=0}^{\infty} a_i \varepsilon_{t-i} = \mu + A(L)\varepsilon_t$$

where A(L) represents an infinite polynomial in L, and the $\varepsilon_t \sim iid(0, \sigma_\varepsilon^2)$. The level of the time series may then be obtained as,

$$y_t = t\mu + a_0 \sum_{i=-\infty}^{t} \varepsilon_i + a_1 \sum_{i=-\infty}^{t-1} \varepsilon_i + a_2 \sum_{i=-\infty}^{t-2} \varepsilon_i + \mathrm{K} \quad . \tag{14}$$

To characterize persistence, we shall be interested in how the impact of a marginal change in the ε_t on the time series at $t+k$, changes for different values of k. In other words, we are interested in updating equation (14) k periods,

$$y_{t+k} = (t+k)\mu + a_0 \sum_{i=-\infty}^{t+k} \varepsilon_i + a_1 \sum_{i=-\infty}^{t+k-1} \varepsilon_i + a_2 \sum_{i=-\infty}^{t+k-2} \varepsilon_i + \mathrm{K}$$

and differentiating it with respect to ε_t to yield the impulse responses,

$$\frac{\partial y_{t+k}}{\partial \varepsilon_t} = a_0 + a_1 + \mathrm{K} + a_k \quad . \tag{15}$$

We shall, thus, characterize persistence as the behavior of the impulse responses as $k \to \infty$. Hence, from equation (15), we obtain,

$$\lim_{k \to \infty} \frac{\partial y_{t+k}}{\partial \varepsilon_t} = \sum_{i=0}^{\infty} a_i = A(1) \quad .$$

Thus, persistence is measured by the long-run impulse response, A(1) (see Campbell and Mankiw, 1987, or Mayadunne *et al.*, 1995). The case of y_t being a random walk may now be characterized as A(1) = 1. The other extreme, A(1) = 0, will imply a stationary series where the impact of a shock to the series will eventually die out. The question we are interested in is how long it will take for this impact to die out. For this we need to talk about degrees of stationarity. In other words, $(1\text{-}L)^0 y_t$ represents a series which needs no differencing to be made stationary while $(1\text{-}L)y_t$ is a series which may be made stationary by differencing. Let us denote the differencing parameter by d and allow it to take any value on the real line. Then, we may be able to consider processes which are stationary but for which the impact of a unit shock dies out slowly; i.e., the process has long memory.

We may now consider filtering y_t as $(1\text{-}L)^d y_t$ and modeling the filtered series as an ARMA model. Such processes are called ARFIMA(p,d,q) processes and may be expressed as

$$\Phi(L)(1-L)^d(y_t - \mu_t) = \Theta(L)\varepsilon_t$$

where $\Phi(L)$ and $\Theta(L)$ are polynomials in L of degrees p and q, respectively, and μ_t is the mean of y_t. The values of d may be linked to A(1) as follows:

$$\begin{aligned} A(1) &= 1 \quad \text{for } d = 1 \\ &= 0 \quad \text{for } d < 1 \\ &\to \infty \quad \text{for } d > 1 \end{aligned}$$

Thus, we would be interested in values of d less than or equal to unity. For d greater than unity we have the explosive case which does not concern us in the present context.

Appendix 2: The MZ_tGLS Statistic

In this section, we link the MZ_tGLS statistic to the original Phillips-Perron statistic (Z_t). In the present context, Z_t would be obtained from the OLS estimation of

$$\Delta y_t = \beta_0 + \beta_1 y_{t-1} + u_t \tag{16}$$

using the residuals to adjust the t-ratio for β_1, $t_{\hat{\beta}_1}$, as

$$Z_t = \left(\frac{\hat{\sigma}_u}{\hat{\sigma}_w}\right) t_{\hat{\beta}_1} - \frac{1}{2}\frac{\hat{\sigma}_w^2 - \hat{\sigma}_u^2}{\left[\hat{\sigma}_w^2 (T-1)^{-2} \sum_{t=2}^{T} y_{t-1}^2\right]^{1/2}}$$

where $\sigma_u^2 = \lim_{T\to\infty} T^{-1} E(\sum_{t=1}^{T} u_t^2)$, $\sigma^2 = \lim_{T\to\infty} T^{-1} E[(\sum_{t=1}^{T} u_t)^2]$ (Perron and Ng, 1996), and are estimated as

$$\hat{\sigma}_u^2 = \frac{\sum_{t=2}^{T} \hat{u}_t^2}{T-1} \qquad \textit{and} \qquad \hat{\sigma}_w^2 = \hat{\sigma}_u^2 + \frac{2}{T-1}\sum_{\lambda=1}^{m} w(\lambda/m) \sum_{t=\lambda+1}^{T} \hat{u}_t \hat{u}_{t-\lambda}$$

where $w(\lambda/m)$ is a spectral window which ensures that $\hat{\sigma}_w^2$ is always positive.

The modified Phillips-Perron statistic (MZ_t), as developed by Perron and Ng (1996), is obtained by (a) estimating, in addition to equation (16),

$$\Delta y_t = \beta_0 + \beta_1 y_{t-1} + \sum_{i=1}^{p} \gamma_i \Delta y_{t-i} + \varepsilon_i$$

to yield the $\hat{\varepsilon}_t$ and $\hat{\gamma}_i$ so that, (b) σ^2, is now estimated as[11]

$$\hat{\sigma}_R^2 = \frac{\sum_{t=p+2}^{T} \hat{\varepsilon}_t^2}{(T-p-1)(1-\sum_{i=1}^{p} \hat{\gamma}_i)^2}$$

and used to calculate Z_t instead of $\hat{\sigma}_w^2$, and (c) this Z_t, based on $\hat{\sigma}_R^2$, is further modified as,

$$MZ_t = Z_t + \frac{1}{2}\left[\sum_{t=2}^{T} \frac{\tilde{y}_{t-1}^2}{\hat{\sigma}_R^2}\right]^{1/2} (\hat{\beta}_1 - 1)^2 .$$

The MZ_tGLS statistic is, then, simply obtained by calculating MZ_t based on the estimation output from equations (6a) and (6b), as described in the main text.

Notes

1 For theoretical discussions on price inertia see, e.g., Nadiri (1987) and Taylor (1998). I am grateful to the editors for these references.

2 Even though such jumps may be taken into account by using impulse dummies, it still does not change the fact that one is using two series based on weights obtained from two, quite different, household surveys. We wished to avoid the problems that this may entail by using the 1987-based series for which sufficient observations do exist.

3 The simplest way to do this is to add the impulse dummy $D(\hat{T}_{ao})_t$ to equation (1) and carry out the search for t = 1, ... , $\hat{T}_{ao} - 1$ and t = $\hat{T}_{ao} + 1$, ... ,*T*.

4 Ng and Perron's (1995) findings indicate that the sequential testing procedure may be preferable but this result is challenged by Taylor (2000), who points out that their result is based on models with no deterministic terms and may no longer hold if such terms, a linear trend term in particular, exist. Hence, in the light of these results, our practice of using all three criteria and looking for an agreement between them appears even more justified.

5 Ng and Perron (2001b) compare various ways of setting the sample size, as found in the textbook literature, and conclude that our practice is the correct one.

6 The use of this statistic when outliers were present was suggested by Vogelsang (1999) but he refers to an earlier version of the Ng and Perron (2001a) paper.

7 The AO dummies included in the models are based on the use of the Vogelsang (1999) critical values in the previous version of this paper. Using the correct critical values, as we have done above, rendered some of these AO dummies insignificant but we kept them in the ARFIMA models because they were statistically significant in these models and they improved the outcomes of the diagnostic tests.

8 We have not taken any account of the diagnostics given in Table 4 since the results involve no modeling. The outcomes of the diagnostics are not so good but this is to be expected. They do improve when AR and MA components are included.

9 Lags in parenthesis indicate that only these have been included in model. In ARIMA((1),(9),0,0), for example, only autoregressive lags 1 and 9 have been included in the model, all lags between 1 and 9 have been left out.

10 All models contain the same AO dummies as in the ARFIMA models of Table 5 and seasonality is again taken into account by using centered dummies. The estimation results are available upon request.

11 $\hat{\sigma}_R^2$ is called the autoregressive spectral density estimator of σ^2 and its properties have been extensively analyzed by Perron and Ng (1998).

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PART III

PERSPECTIVES ON DISINFLATION IN TURKEY

Chapter 6

Inflationary Expectations and the Costs of Disinflation: A Case for Costless Disinflation in Turkey?

Selahattin Dibooğlu

Abstract: This chapter explores the output costs of a credible disinflationary program in Turkey. It is shown that a necessary condition for a costless disinflationary path is that the weight attached to future inflation in the formation of inflationary expectations exceeds 50%. Using quarterly data from 1980–2000, the estimate of the weight attached to future inflation is found to be consistent with a costless disinflation path. The chapter also uses structural Vector Autoregressions (VAR) to explore the implications of stabilizing aggregate demand. The results of the structural VAR corroborate minimum output losses associated with disinflation.

1. Introduction

Inflationary expectations and aggregate demand pressure are two important variables that influence inflation. It is recognized that reducing inflation through contractionary demand policies can involve significant reductions in output and employment relative to potential output. The empirical macroeconomics literature is replete with estimates of the so-called "sacrifice ratio", the percentage cumulative loss of output due to a 1% reduction in inflation.

It is well known that inflationary expectations play a significant role in any disinflation program. If inflationary expectations are adaptive (backward-looking), wage contracts would be set accordingly. If inflation drops unexpectedly, real wages rise increasing employment costs for employers. Employers would then cut back employment and production disrupting economic activity. If expectations are formed rationally (forward-looking), any momentum in inflation must be due to the underlying macroeconomic policies. Sargent (1982) contends that the inflation-output trade-off disappears when one adopts the rational

expectations framework. The staggered wage-setting literature provides evidence that even if expectations are formed rationally, wage and price determination will have backward-looking and forward-looking elements. The backward-looking element reflects last year's contracts on this years prices whereas the forward-looking element reflects next year's contracts on this year's prices. Taylor (1998) presents a detailed account of the staggered wage and price setting literature, and the exercise will not be pursued here. Calvo (1983) shows that in a world of stochastic contract length, the costless disinflation result extends to a world of staggered wage contracts with forward-looking expectations. Stopping inflation is then a matter of a resolute commitment on part of the government to a credible disinflation program.

It is likely that in an economy there are both forward- and backward-looking elements in inflationary expectations. Chadha, Masson, and Meredith (1992) (henceforth CMM), provide a unified framework to test for expectations formation in a single specification. CMM use a Phillips curve framework to consider two benchmark cases: a Phelps-Friedman adaptive expectations model which places a weight of unity on past inflation (complete inflation stickiness) and a rational staggered contracts model based on Calvo (1983) that places a weight of unity on expected inflation (inflation is independent of past inflation). These two extremes are nested in one specification where current inflation is a weighted average of past and expected future inflation.

The primary objective of this chapter is to explore the output costs of a credible disinflationary program in Turkey. To that end, I follow the CMM framework closely to illustrate the necessary condition for a costless disinflation path. I then estimate the reduced form inflation equation to estimate the weights attached to past and future inflation. Using quarterly data from 1980–2000, the estimate of the weight attached to future inflation is found to be consistent with a costless disinflation path. Moreover, Vector Autoregressions (VAR) methods will be used to explore the implications of an aggregate demand contraction. The results of the structural VAR corroborate minimum output losses associated with disinflation. Section 2 of the chapter sets forth the CMM framework and methodology. Section 3 presents results from the estimates of the inflation equation and structural VARs while section 4 concludes.

2. Inflationary Expectations and Price Dynamics

CMM derive restrictions for the form of the Phillips curve assuming that the economy has alternative wage setting schemes, and both forward- and backward-looking agents. In one extreme, the Phelps-Friedman expectations augmented Phillips curve implies complete inflation stickiness with no role for future expected inflation in determining current inflation. In the other extreme, the Calvo (1983) model implies 100% weight on expected future inflation in determining current inflation with no inflation stickiness. If the economy has both forward and backward-looking agents, the current inflation is a weighted average of past and expected future inflations.

Consider the expectations augmented Phillips curve,

$$\Delta p_t = \pi_t^e + \beta y_t \tag{1}$$

where Δp is the actual inflation rate, π^e is the expected inflation rate, t is the time index, and y is a measure of aggregate demand pressure, e.g., output gap. If expectations are formed adaptively, the expected inflation rate is assumed to be formed as a weighted average of past expected inflation and actual inflation:

$$\pi_t^e = \alpha\pi_{t-1}^e + (1-\alpha)\Delta p_{t-1} \tag{2}$$

which can be solved recursively to yield:

$$\pi_t^e = (1-\alpha)\sum_{i=0}^{\infty}\alpha^i \Delta p_{t-i-1} \ . \tag{3}$$

Combining equations (1) and (2), current actual inflation can be expressed as

$$\Delta p_t = \Delta p_{t-1} + \beta(1-\alpha)y_t + \alpha\beta(y_t - y_{t-1}) \ . \tag{4}$$

It is evident from equation (4) that inflation responds to past inflation one-for-one (complete inflation stickiness) and is a function of current excess demand as well as the acceleration in excess demand. Moreover, a successful reduction in inflation must involve reductions in excess demand and an increase in unemployment.

The Calvo staggered contracts model implies that the representative log wage quotation initiated at time t is a weighted average of all expected future price levels and future excess demand:

$$v_t = (1-b)\sum_{s=t}^{\infty} E_t(p_s + \beta y_s)b^{s-t} \tag{5}$$

or alternatively,

$$v_t = bE_t v_{t+1} + (1-b)p_t + \beta y_t \tag{6}$$

where v_t is the contract wage that is assumed to be fixed during the contract period where the quotation expiration date is assumed to follow a geometric distribution, and E_t is the expectations operator conditional on available and relevant information at time t. Here b is the probability that a wage quotation will survive one more period. The log price level is equal to the average log wage level, which is a weighted average of all existing contract wages:

$$p_t = (1-b)\sum_{s=-\infty}^{t} b^{t-s} v_s \tag{7}$$

where $(1\text{-}b)^{t\text{-}s}$ is the proportion of wages that were negotiated s periods ago. Equation (7) is equivalent to

$$p_t = bp_{t-1} + (1-b)v_t \ . \tag{8}$$

Iterating equation (8) forward and taking expectations of its first difference,

$$E_t \Delta p_{t+1} = b\Delta p_t + (1-b)(E_t v_{t+1} - v_t) \ . \tag{9}$$

Combining equations (8), (6), and (9), the current inflation rate can be expressed as:

$$\Delta p_t = E_t \Delta p_{t+1} + \frac{(1-b)^2}{b}\beta y_t \ . \tag{10}$$

Equation (10) has strong implications for the behavior of inflation: regardless of past inflation, the inflation rate responds to expected future shocks that influence future inflation, irrespective of the wage/price stickiness parameter *b*. Thus the Calvo rational staggered price model predicts that inflation is a completely forward-looking variable, the elimination of which requires no painful output losses.

If the economy is inhabited by both forward-looking and backward-looking agents, CMM show that the two approaches can be nested in one inflation equation, where inflation is a weighted average of past and expected future inflation:

$$\Delta p_t = \gamma E_t p_{t+1} + (1-\gamma)\Delta p_{t-1} + \alpha y_t + \beta \Delta y_t \ . \tag{11}$$

In order to explore inflationary dynamics, consider equation (11) under perfect foresight rewritten in terms of the acceleration of inflation:

$$\psi_{t+1} = [(1-\gamma)/\gamma]\psi_t - (\alpha/\gamma)y_t - (\beta/\gamma)\Delta y_t \tag{12}$$

where $\psi_t \equiv \Delta p_t - \Delta p_{t-1}$. The characteristic root of this difference equation is $\mu \equiv (1-\gamma)/\gamma$. The equation is convergent if and only if $\gamma > 0.5$ so that $\mu < 1$. Suppose the authorities have an instrument (say, money supply) that would enable them to set the inflation rate subject to equation (12). What is the dynamic path of inflation that would avoid output losses completely? Setting $y_t = 0$ in equation (12) for all $t \geq 0$ yields

$$\psi_{t+1} = \mu\psi_t \ . \tag{13}$$

Iterating from period 0 onward gives the costless disinflation path:

$$\Delta p_t = \Delta p_0 + \psi_1 \sum_{i=0}^{t-1} \mu^i = \Delta p_0 + \psi_1 \left[\frac{1-\mu^t}{1-\mu} \right] . \tag{14}$$

It is evident that the path of inflation depends on the initial deceleration of inflation $\psi_1 < 0$, and the weight attached to future inflation in wage/price determination. Thus, convergence to zero inflation without output losses requires $\mu < 1$ which holds if and only if the weight attached to future inflation in inflation expectations formation is greater than 0.5 and the announced policy is credible. The logic behind this result is as follows: if agents attach a greater weight to expected future inflation than past

inflation, an expectation of a fall in inflation pulls down inflation in the current period. The appropriate policy is then to decelerate money growth such that the fall in current inflation relative to last period is just offset by a further expected decrease in the following period.

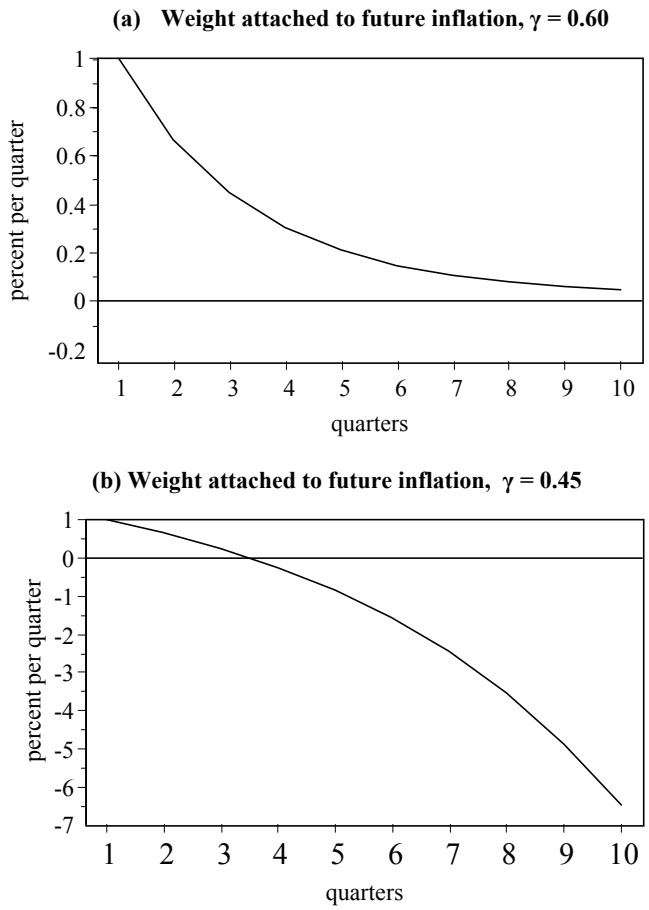

Figure 1: Time Path of Inflation under Alternative Expectations Schemes

Figure 1a simulates the inflation path for an initial deceleration of 33% (ψ_1 = -0.33) and a weight attached to future inflation of 60% (γ = 0.6). These values are chosen such that they approximate a realistic path for a country like Turkey. From an initial inflation of 100%, inflation falls to 30% in four quarters and reaches around 8% in eight quarters. It is evident that in this case inflation asymptotically converges to near zero. However if $\gamma < 0.5$,

then the speed of deceleration has to increase and inflation becomes unbounded in the downward direction, which can be stopped at severe output costs. This is evident in Figure 1b where the inflation path is simulated for $\gamma = 0.45$. The important point is that a costless disinflationary program can be carried out if the weight attached to future inflation in expectations formation is greater than 50% and provided that the announced policy is credible.

2.1 Empirical Implementation

In the empirical estimation equation, CMM include led and lagged inflation terms, a measure of excess demand pressure, and an absorption price term which is intended to capture the wage earners' desire to be compensated for changes in the real consumption wage:

$$\Delta p_t = \gamma E_t \Delta p_{t+1} + (1-\gamma)\Delta p_{t-1} + \alpha(\Delta pa_t - \Delta p_t) + \phi(pa_t - p_t) + \beta ed_t \qquad (15)$$

where p_t is the log GDP deflator, pa_t is the log absorption deflator, ed_t is a measure of excess demand pressure[1] defined as $ed_t \equiv (CU_t/100 - 1)$ and CU_t is the capacity utilization rate defined to equal 100 when the economy is at the potential level of output. Since both p_t and Δp_t are present on the right hand side of equation (15), a simultaneity problem is likely. To avert this problem, CMM reparameterize equation (15) by adding $(\alpha+\phi)\,\Delta p_t$ to each side and dividing by $(1+\alpha+\phi)$:

$$\begin{aligned}\Delta p_t &= (1-\bar{\alpha}-\bar{\phi})\left[\gamma E_t \Delta p_{t+1} + (1-\gamma)\Delta p_{t-1}\right] \\ &\quad + \bar{\alpha}\Delta pa_t + \bar{\phi}(pa_t - p_{t-1}) + \beta ed_t\end{aligned} \qquad (16)$$

where a bar over a parameter indicates that it is normalized by $(1+\alpha+\phi)$. In order to account for the endogeneity of right hand side variables dated t and t+1, I follow CMM by using the following instrumental variables: lagged values of capacity utilization, lagged growth of the GDP deflator, lagged growth in the real money balances (M1 deflated by the Consumer Price Index denoted $\Delta(m\text{-}p_c)$), and lagged values of the ratio of government spending to capacity output (g_y). Capacity utilization is derived relative to capacity output, which is obtained using the Hodrick-Prescott filter. Moreover, in the estimation, expected inflation is replaced by ex-post led inflation. It is also possible to augment equation (16) with the first difference of capacity utilization in case aggregate demand exhibits

momentum in a particular direction. The case where $\gamma \rightarrow 0$ (i.e., zero weight on future inflation) is consistent with the Phelps-Friedman hypothesis while $\gamma \rightarrow 1$ corroborates the Calvo model with complete forward-looking behavior. The advantage of the specification in (16) is that it nests the two extremes in one specification and allows for statistical inference regarding the underlying behavior.

3. Empirical Results

In order to assess the role of inflationary expectations, equation (16) is estimated using quarterly data from 1980.Q1 through 2000.Q2. Quarterly national accounts data for 1980–86 are from the State Institute of Statistics and from the Central Bank of the Republic of Turkey thereafter. Money supply (M1) and consumer prices used to deflate it are from the CD ROM edition of IMF's *International Financial Statistics*. All data are seasonally adjusted using the Census X-11 method. In order to properly estimate the equation, variables are tested for stationarity using a KPSS test, due to Kwiatkowski *et al.* (1992). The results are presented in Table 1.

Table 1: KPSS η_τ Statistics

	k	statistics
p_t	4	0.107
pa_t	4	0.097
$pa_t - p_{t-1}$	4	0.081
ed_t	4	0.033
g_t	4	0.141
$m-p_c$	4	0.031

Notes*:* Critical values for the KPSS η_τ statistics are, 0.119 (10%), 0.146 (5%), 0.176 (2.5%), 0.216 (1%).

Table 1 indicates that all variables are trend stationary at the 5% significance level indicating that conventional statistical inference methods are appropriate. Equation (16) is then estimated with two-stage nonlinear least squares using the following instrumental variables: lagged values of capacity utilization, lagged growth of the GDP deflator, lagged growth in the real money balances and lagged values of the ratio of government spending to capacity output. The results are given in Table 2.

Table 2: Estimated Inflation Equation

$p_t = (1-a_2 -a_3)[a_1 \Delta p_{t+1}+(1-a_1)\Delta p_{t-1}] + a_2\Delta pa_t + a_3(pa_t-p_{t-1}) + a_4\, ed_t + a_5\, \Delta CU_t$

	a_1	a_2	a_3	a_4	a_5
Model I	0.599	-0.990	0.488	-1.944	-0.116
	(0.021)	(0.640)	(0.043)	(0.530)	(0.007)
Model II	0.561	–	0.433	–	-0.109
	(0.017)	–	(0.011)	–	(0.007)

Notes: p-values based on asymptotic t-ratios are given in parenthesis.

Estimates of equation (16) augmented with the growth rate of capacity utilization are given as Model I at the upper portion of Table 2. The estimated weight on future inflation is about 60% and is statistically significant at conventional significance levels. The term on the growth in the absorption deflator (a_2) and the term on excess demand (a_4) are not statistically significant. The relative price term (pa_t-p_{t-1}) is statistically significant, indicating that wage earners increase wage pressures when the relative price of absorption increases. Notice that excess demand terms have negative signs. This is in contrast to a conventional case where increases in aggregate demand above capacity output can be expected to increase inflationary pressures. One can conjecture that this is due to the nature of the business cycle in Turkey. Downturns in output in Turkey tend to correspond to financial or balance of payments crises which disrupt production, leading to higher levels of inflation.

Since growth in the absorption deflator and the level of excess demand are not significant, a more parsimonious model, denoted Model II in Table 2, is estimated. Results from this model indicate that the weight attached to future inflation is 56%, still higher than 0.5, the benchmark necessary for a costless disinflation path. The estimate is statistically significant indicating that the traditional Phelps-Friedman hypothesis is rejected by the data. A Wald test that $a_1 = 1$ is rejected by the data with a p-value of 0.059. This indicates that inflationary expectations in Turkey in the sample period can be characterized neither as completely backward-looking nor completely forward-looking, although the point estimate of 56% attached to future inflation indicates a higher weight on future inflation. The important point is that the data reject both extreme schemes on inflationary expectations and the point estimate is consistent with a costless disinflation path.

3.1 Evidence from Structural VARs

It is recognized in contemporary macroeconomics that the efficacy of aggregate demand policies in altering output hinges on wage/price rigidity and/or imperfect information. Ever since the Lucas' misperceptions model (Lucas, 1972) economists recognize that changes in the money supply and inflation can induce real changes in the economy provided that policy is unanticipated. It is common in empirical macroeconomics to assume that aggregate demand impulses have positive, albeit temporary, effects on output. Using this restriction, Blanchard and Quah (1989) impose this long run aggregate demand neutrality to explore the dynamic effects of aggregate demand impulses on output.

In this section, I use long run neutrality of aggregate demand to identify aggregate demand shocks and assess their effects on output. If output is primarily driven by supply shocks, then the role of aggregate demand is limited and a disinflation policy will have limited effects in terms of output losses. Suppose output growth and inflation are driven by aggregate supply ($\in^{s}$) and aggregate demand ($\in^{d}$) shocks[2] so that

$$\begin{aligned} \Delta y_t &= a_{11}(L)\in_t^s + a_{12}(L)\in_t^d \\ \Delta p_t &= a_{21}(L)\in_t^s + a_{22}(L)\in_t^d \end{aligned} \tag{17}$$

where y is log GDP, p is log GDP deflator as before, and $a_{ij}(L)$ are polynomials in the lag operator, L. After estimating the model, it is straightforward to obtain trend output as output due to supply shocks. By purging output of aggregate demand shocks, one can gauge the extent of output losses that would result from a disinflationary program which would restrict aggregate demand.[3]

Table 3: Variance Decomposition of Output

k	Supply	Demand
1	94.1	5.9
4	93.0	7.0
8	95.0	5.0
16	97.2	2.8
24	98.1	1.9
36	98.7	1.3

In order to estimate the system in equation (17), a VAR in [Δy Δp] is estimated with four lags for the 1980.Q1–2000.Q2 period. The VAR is then inverted, and aggregate demand neutrality is imposed [the sum of the coefficients in the $a_{12}(L)$ polynomial are restricted to equal zero] to obtain estimates of the $a_{ij}(L)$ polynomials and the historical realizations of the structural shocks [$\in^{s} \in^{d}$]. Since observed movements in the data are due to shocks [$\in^{s} \in^{d}$] and responses to these shocks represented by the coefficients of $a_{ij}(L)$, one can assess the effects of particular shocks on output by innovation accounting (e.g. variance decompositions), and simulations based on historical realizations of the shocks. Variance decompositions of output at various forecasting horizons are given in Table 3.

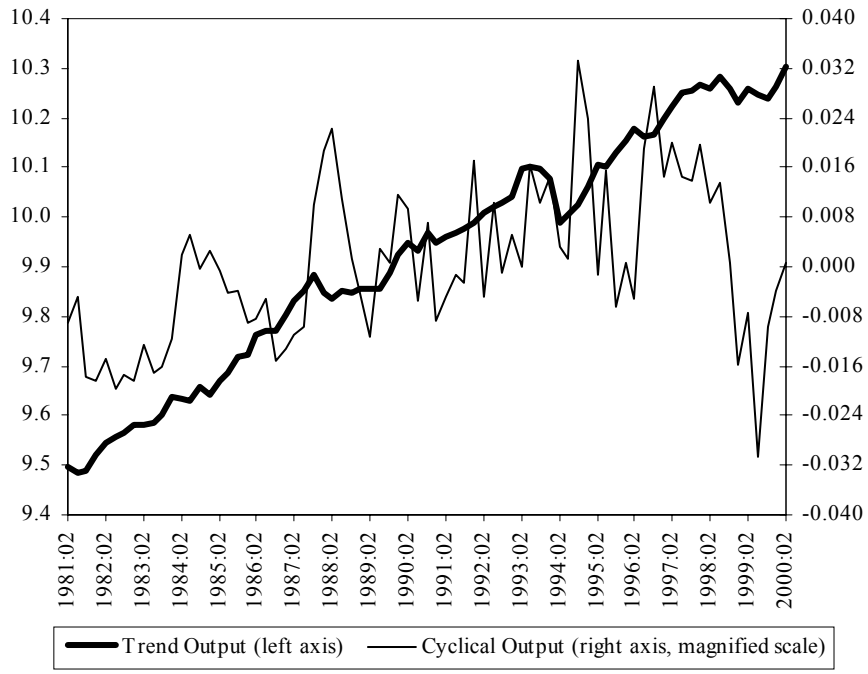

Figure 2: Trend and Cyclical Output (in billions of 1987 Turkish liras, logarithmic scale, 1981.II – 2000.II)
Source: Author's calculations, based on the VAR model.

It is evident from the table that aggregate demand shocks have a negligible effect on output. At a one-quarter forecasting horizon, aggregate demand shocks explain about 6% of the forecast error variance of output. At four

quarters, the effect of an aggregate demand shock reaches its peak explaining 7% of output. Since aggregate demand shocks are constrained to have no long run effect on output, their effects necessarily die down in the long run. Overall variance decompositions show that output is primarily driven by supply shocks at all forecasting horizons and demand shocks have modest effects.

In order to gain further insight on the effect of aggregate demand shocks, Figure 2 presents the decomposition of output into trend output (output due to aggregate supply shocks), and transitory/cyclical output (due to aggregate demand shocks). The estimates of trend and cyclical output point to a very limited role played by aggregate demand shocks. In that regard, if aggregate demand is stabilized through a disinflationary program, output losses would be very limited. This corroborates evidence presented above regarding inflationary expectations where forward-looking expectations are dominant; as such output costs of disinflation would be limited, if nonexistent.

4. Conclusions

This chapter attempted to explore output costs of disinflation by investigating the nature of inflationary expectations and using structural VARs. Following Chadha *et al.* (1992), an inflation equation nesting the traditional Phelps-Friedman hypothesis with backward-looking expectations and a staggered wage contract model of Calvo (1983) with completely forward-looking expectations is derived. It is shown that a necessary condition for a costless disinflationary path is that the weight attached to future inflation exceeds 50%. The inflation equation is estimated for Turkey for the 1980–2000 period using quarterly data. Empirical results indicate that in terms of the weight attached to future inflation in Turkey, the data reject both the Phelps-Friedman and the Calvo hypotheses. However the point estimate of the weight attached to future inflation is consistent with a costless disinflation path. The main problem in Turkey has been the chronic lack of resolve on the part of governments to undertake structural reforms and the lack of commitment to credible disinflation programs.

The chapter also presents evidence from structural VARs. A bivariate model of output growth and inflation with long run aggregate demand neutrality is estimated to decompose output movements into those attributable to aggregate supply and aggregate demand shocks. Empirical

results indicate that aggregate demand shocks contribute very modestly to output. Hence the Lucas critique notwithstanding, a disinflationary program that would stabilize aggregate demand is not likely to cause severe output losses in Turkey.

Notes

1 CMM also consider non-linear excess demand effects.

2 Some question the issue of whether "aggregate supply shocks" and "aggregate demand shocks" are appropriate descriptions of the shocks identified by the Blanchard-Quah procedure. Robertson and Wickens (1997) argue that "real shocks" and "nominal shocks" may be a better description.

3 That is, if the underlying structure is stable enough to give an idea about the effect of particular shocks in the future. Here, I am alluding to the Lucas critique.

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Chapter 7

Turkish Inflation and Real Output Growth: 1963–2000*

Tevfik F. Nas and Mark J. Perry

Abstract: This chapter investigates the links among inflation, inflation uncertainty and real output growth in Turkey from 1963–2000. Inflation uncertainty is generally assumed to be positively associated with the level of inflation and negatively related to real output growth. Although both relationships (inflation-inflation uncertainty and inflation uncertainty-output) are closely related theoretically, they have previously been empirically investigated separately, mostly in the low inflation G-7 countries. The contribution of this chapter is to investigate these two relationships for the first time in the high inflation country of Turkey using a single statistical, bivariate GARCH-M system of equations. We find strong statistical support that a) monthly inflation significantly raises inflation uncertainty (measured by the conditional variance of inflation) and b) inflation uncertainty significantly lowers real output growth over the sample period.

1. Introduction

Starting with Friedman (1977), many macroeconomists have suggested that there should be a positive relationship between inflation and inflation uncertainty, since monetary policy becomes more erratic and unpredictable during periods of high inflation.[1] Friedman and others also suggest that greater inflation uncertainty will adversely affect real economic activity, because inflation uncertainty reduces the information content of prices, distorts relative prices and therefore lowers economic efficiency.[2] In this chapter, we develop a GARCH-M system of equations to construct a time-series measure of inflation uncertainty, and then test the potential relationships between inflation and inflation uncertainty, and inflation uncertainty and real output growth. Using monthly data from 1963 to 2000, our empirical results indicate strong statistical support that inflation significantly raises inflation uncertainty and that inflation uncertainty significantly lowers real output growth.

The chapter proceeds as follows. The historical record of inflation and output growth in Turkey from 1963–2000 is presented in Section 2. Section 3 introduces bivariate GARCH-M models, empirical results are discussed in Section 4, and Section 5 contains a summary of our main findings.

2. Background on Turkish Inflation and Output Growth, 1963–2000

Turkish inflation, measured by the consumer price index, grew from single digit levels in the 1960s and reached its first peak in 1980 at more than 80% (see Figure 1a). After reaching a second peak of 125% in 1994, inflation started a downward trend in response to a series of stabilization measures that were introduced in the same year. Throughout the second half of the 1990s, inflation continued to fluctuate within a 70 to 100% range. However, after the introduction of the 1999 Disinflation and Fiscal Adjustment Program and the three-year stand-by agreement signed with the International Monetary Fund (IMF), inflation dropped significantly. Under the three-year stand-by arrangement, the year-end inflation was targeted at 25% in 2000 and 10–12% by the end of 2001. Turkey today is still considered as a high inflation country with an annual inflation rate just around 80%.

A combination of internal and external factors starting in the late 1970s was responsible for Turkey's record of high inflation. Throughout the 1960s and the 1970s, Turkey followed an inward-looking growth strategy driven by import substitution policies. During the earlier stages of this strategy inflation was relatively low and the expansionary effects of macro policies were moderate. The public sector, which was the driving force behind the growth strategy, relied heavily on domestic savings and foreign exchange receipts to meet borrowing requirements. However, as public sector borrowing requirements reached unmanageable levels due to excessive spending during the 1973–74 oil crisis, Turkey resorted to external borrowing and intensified its aggressive short-term borrowing practices. A severe balance-of-payments crisis followed and led to the debt crisis of 1978. Rising monetary aggregates exacerbated the inflation situation; that, and supply limitations resulting from widespread shortages of imported inputs, caused inflation to accelerate significantly toward the end of the 1970s.[3]

In 1980, Turkey introduced drastic measures to stabilize the economy, encourage export promotion, and gradually remove trade barriers and foreign exchange restrictions. The main goals of these measures were to

lower inflation from the peak of more than 80%, improve the balance of payments, and through further restructuring transform Turkey into an outward-looking, export driven economy.[4] Inflation initially fell to 30% in 1981, but then gradually began to rise and fluctuate within a 40 to 70% range during the rest of the 1980s.[5]

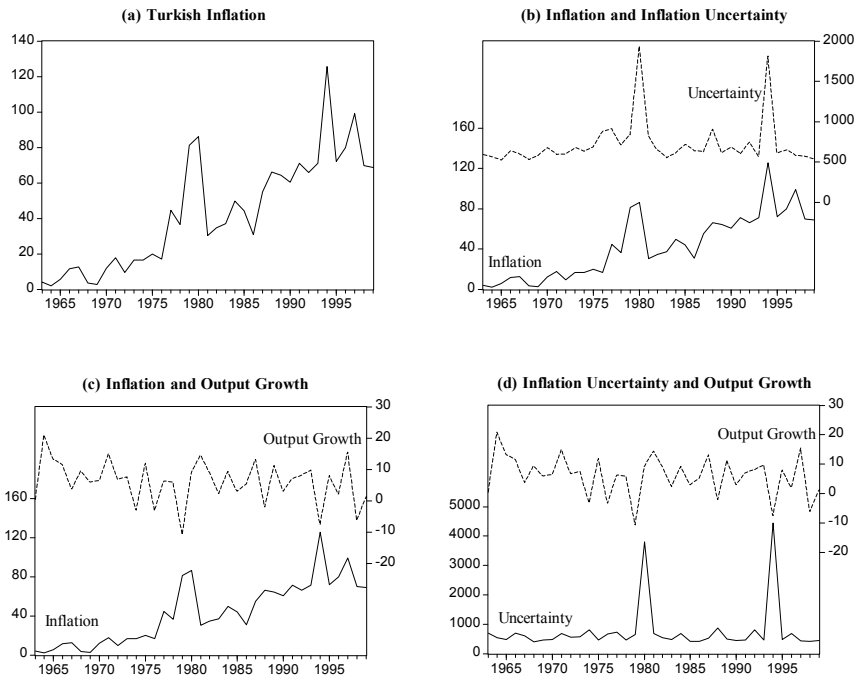

Figure 1: Inflation and Output Growth in Turkey
(a) Turkish Inflation (percent).
(b) Inflation and Inflation Uncertainty (percent).
(c) Inflation and Output Growth (percent).
(d) Inflation Uncertainty and Output Growth (percent).
Note: For all figures, inflation is calculated as the annual difference in the log of the consumer price index from 1963-2000. Output growth is likewise the annual difference in the log of the total industrial production index from 1963-2000. Inflation uncertainty is the conditional variance generated from a GARCH(1,1) specification of annual consumer inflation.
Source: State Institute of Statistics.

Starting in 1988, Turkey began to follow populist measures that caused inflation to accelerate in the following years.[6] As a result of excessive spending, rapid expansion of public sector credits, and expansionary

monetary policies motivated by local and general elections, inflation rose significantly in the 1990s. Inflation reached its all time high of 125% in 1994, and Turkey experienced a severe financial crisis.

In response to the rising inflation and the widening budget deficits, the government tried to keep interest rates low and switched from domestic borrowing to foreign debt and monetization. This policy, which was intended to reduce inflation without giving up economic growth, led instead to higher interest rates, higher deficits, and continued high inflation. The austerity plan introduced in 1994 did eventually succeed in bringing inflation down temporarily, but did not eliminate the macroeconomic imbalances. The year-end inflation, after surging to 125%, declined to 72% in 1995 but rose to almost 100% again by 1997. Efforts to reduce the interest burden on the budget continued, but that did not prevent the non-interest expenditures from rising. Thus, one primary source of inflation, excessive spending and the resulting budget deficits, remained in effect, and inflation continued to dominate Turkey's macroeconomic environment in the later 1990s.

One of the real, potential costs that high levels of inflation imposes on the economy, is the accompanying increase in uncertainty about future inflation. An empirical analysis of Turkish inflation by Nas and Perry (2000) confirms that the course of future inflation became much harder to predict during the episodes of high inflation, leading to the close link between the level of inflation and uncertainty about future inflation shown in Figure 1b. The figure reveals that annual inflation uncertainty, measured by the conditional variance of inflation using GARCH techniques, rose significantly during the periods of high inflation.

The effects of inflation on real output growth (measured by the growth rate in industrial production) are also considerable (see Figure 1c). Generally, the periods of high inflation are associated with declining growth rates of industrial output. From the mid-1960s to 1980, the growth rate of industrial output fluctuated in a downward trend as inflation rose. Especially after the 1973–74 oil crisis when inflation began its steep rise, output growth moved in the opposite direction, declining almost 11% in 1979, about the same time when inflation peaked. A subsequent decline in inflation was followed by a decline in output, but thereafter, as inflation began an upward trend during the 1980s and 1990s, output growth fluctuated for the most part in the opposite direction. During the 1994 financial crisis, in particular, industrial production growth hit another yearly low of -7.5%, as inflation rose sharply. Thus, over the 1963–2000

period, output growth rates were negative and lowest when inflation reached its highest levels during the 1979 and 1994 crises.

As depicted in Figure 1d, at the highest levels of inflation uncertainty, output growth rates were also negative and at their lowest levels.[7] Although during the 1979 debt crisis the decline in real output slightly preceded the increase in inflation uncertainty, for the most part, rising inflation uncertainty was accompanied by declining output growth rates on an annual basis (e.g., during the 1994 crisis).

Clearly, an analysis of the historical record and graphical evidence of annual data indicates that inflation, inflation uncertainty, and real output growth are closely related in Turkey. To further investigate these relationships more formally, we next develop a bivariate GARCH-M system of equations to simultaneously investigate in a single model the relationships between a) monthly inflation and inflation uncertainty and b) monthly inflation uncertainty and real output growth. Most research on inflation uncertainty has been done on low inflation countries like the U.S., and each relationship has been treated separately.[8] In the next section, we will investigate both relationships simultaneously in the high inflation country of Turkey.

3. Bivariate GARCH-M Model of Inflation, Inflation Uncertainty and Output Growth

A multi-equation GARCH-M model allows equations for the conditional means, conditional variances and covariances of both inflation and output growth to be jointly estimated.[9] The level of inflation is included as an exogenous variable in the equation for the conditional variance of inflation to determine whether average inflation affects the level of inflation uncertainty. The conditional variance of inflation generated from a GARCH(1,1) specification of inflation is used as a time-series measure of inflation uncertainty and appears as a regressor in the output equation to test for the effects of inflation uncertainty on real output in Turkey.[10]

A bivariate GARCH(1,1)-M model consists of the following equations:

$$\Pi_t = \beta_0 + \sum_{i=1}^{n} \beta_i \, \Pi_{t-i} + \sum_{i=n+m}^{m} \beta_i \varepsilon_{t-i} + \varepsilon_t \ . \tag{1}$$

$$\sigma^2_{\varepsilon_t} = \alpha_0 + \alpha_1 \varepsilon^2_{t-1} + \alpha_2 \sigma^2_{\varepsilon_{t-1}} + \alpha_3 \Pi_{t-1} \ . \tag{2}$$

$$Y_t = \Theta_0 + \sum_{i=1}^{n} \Theta_i Y_{t-i} + \sum_{i=n+m}^{m} \Theta_i v_{t-i} + \Theta_{m+1} \sigma^2_{\varepsilon_t} + v_t \ . \tag{3}$$

$$\sigma^2_{v_t} = \alpha_3 + \alpha_4 v^2_{t-1} + \alpha_5 \sigma^2_{v_{t-1}} \ . \tag{4}$$

$$COV_t = \rho_{\varepsilon v} \sigma_{\varepsilon_t} \sigma_{v_t} \ . \tag{5}$$

Inflation (Π_t) and output growth (Y_t) in equations (1) and (3) follow an autoregressive-moving average (ARMA) process, and are a function of autoregressive lags and moving average terms. Equations (2) and (4) are GARCH(1,1) specifications for the conditional variances of inflation ($\sigma^2_{\varepsilon_t}$) and output growth ($\sigma^2_{v_t}$) respectively, implying that the conditional variance at time t depends on the squared residuals at time t-1 (ε^2_{t-1}) from the conditional mean equations (1) and (3) and the lagged conditional variances. The constant conditional correlation model of the covariance between ε_t and v_t is represented in equation (5).[11]

The estimated conditional variance of inflation ($\sigma^2_{\varepsilon_t}$) from equation (2) is the time series measure of inflation uncertainty. If inflation uncertainty adversely affects real output growth, then the coefficient Θ_{m+1} will be negative and significant in equation (3). Lagged inflation enters the conditional variance of inflation equation (2) as an exogenous variable to assess the link between the level of inflation and the degree of inflation uncertainty. The coefficient α_3 will be significantly positive if higher average inflation is associated with greater inflation uncertainty. Therefore, the bivariate GARCH-M model outlined above in equations (1) – (5) simultaneously estimates inflation, real output growth and inflation uncertainty, and also provides tests the statistical interaction between a) inflation and inflation uncertainty, and b) inflation uncertainty and output in a single statistical model.

4. Empirical Results

In applying the GARCH-M model to the Turkish case, inflation is calculated as the log of the monthly difference in the wholesale price index (*WPI*), on an annualized basis [$\Pi_t = \log (WPI_t / WPI_{t-1}) * 1200$]. Real output growth is likewise the log of the monthly difference in industrial production (IP): [$Y_t = \log (IP_t / IP_{t-1}) * 1200$] on an annualized basis. The sample period is monthly from January 1963 to December 2000 using data from the State Institute of Statistics.

Assuming that Turkish inflation and output growth follow standard ARMA processes, we specify single equation OLS models for each variable.[12] With standard Box-Jenkins techniques, we determine the best fitting time-series models for inflation and output growth, and then perform diagnostic tests on the residuals and squared residuals to determine whether serial correlation or conditional heteroskedasticity is present.

Panel A of Table 1 reports the best fitting ARMA time series model for Turkish inflation, which includes eight autoregressive lags and a twelfth-order moving average term. The residuals show no evidence of serial correlation (Ljung-Box Q-statistic = 8.24 at 12 lags compared to a critical value of 15.5 for the 5% level of significance), but the squared residuals are significantly time-varying. Using a standard ARCH Lagrange Multiplier (LM) test for autoregressive, conditional heteroskedasticity, the null hypothesis of a constant error variance is rejected for 1, 4 and 8 lags at the 5% level of significance, indicating the presence of a significant time-varying error variance in the inflation equation.

The real output equation in Panel B of Table 1 also contains eight autoregressive lags and a twelfth-order moving average term. The Ljung-Box Q(12)-test for serial correlation indicates no pattern in the residuals, but the squared residuals in the output equation are significantly correlated at 1, 4 and 8 lags as the ARCH LM tests indicate. In both the inflation and output equations, the AR(8)-MA(12) specifications account for any error pattern in the conditional means, but do not capture the strong heteroskedastic pattern in the conditional error variances. Since the squared residuals are significantly time-varying in both equations, the conditional variances of both inflation and output growth follow a GARCH(1,1) specification in the subsequent estimations.[13]

Table 1: OLS Regressions for Turkish Inflation and Output Growth

A. Inflation

$$\Pi_t = \underset{(3.37)}{8.252} + \underset{(8.20)}{.383}\,\Pi_{t-1} + \underset{(1.25)}{.062}\,\Pi_{t-2} + \underset{(3.73)}{.186}\,\Pi_{t-3} - \underset{(1.44)}{.073}\,\Pi_{t-4} - \underset{(0.42)}{.021}\,\Pi_{t-5}$$
$$- \underset{(0.20)}{.009}\,\Pi_{t-6} + \underset{(0.65)}{.032}\,\Pi_{t-7} + \underset{(4.01)}{.185}\,\Pi_{t-8} + \underset{(3.04)}{.146}\,\varepsilon_{t-12} + \varepsilon_t$$

Log-Likelihood = -2141

R^2 = .375

Ljung-Box Q(12) = 8.24

LM ARCH Tests 1 lag: 4.82 4 lags: 23.7* 8 lags: 24.5**

B. Output Growth

$$Y_t = \underset{(4.85)}{17.21} - \underset{(12.33)}{.580}\,Y_{t-1} - \underset{(5.43)}{.294}\,Y_{t-2} - \underset{(2.97)}{.165}\,Y_{t-3} - \underset{(3.35)}{.186}\,Y_{t-4} - \underset{(3.18)}{.177}\,Y_{t-5}$$
$$- \underset{(1.70)}{.094}\,Y_{t-6} - \underset{(2.48)}{.132}\,Y_{t-7} - \underset{(3.44)}{.160}\,Y_{t-8} + \underset{(4.78)}{.229}\,v_{t-12} + v_t$$

Log-Likelihood = -2474

R^2 = .335

Ljung-Box Q(12) = 16.47

LM ARCH Tests 1 lag: 13.89 4 lags: 14.51* 8 lags: 20.05**

Notes: Sample period is from 1963.01 to 2000.12. Π_t is the inflation rate calculated from the wholesale price index. Y_t is the growth rate of industrial production (seasonally adjusted). T-statistics are in parentheses. Q(12) is the Ljung-Box statistic for twelfth-order serial correlation in the residuals. The critical value at the 0.05 level is 21.0. The ARCH tests are distributed χ^2 with degrees of freedom equal to the number of lags. Critical values at the .05 significance level are 3.84, 9.49 and 15.5 for 1, 4 and 8 degrees of freedom respectively. A * indicates statistical significance at the .05 level for LM ARCH tests. Data obtained from the State Institute of Statistics.

The GARCH specification, by modeling the significant conditional heteroskedasticity in the inflation and output equations, is useful for two important purposes. First, it significantly increases the efficiency of the estimation process by accounting for the strong pattern in the error variance. Secondly, the GARCH-M process generates the monthly inflation variance from the inflation equation, which can then be used as a time series measure of inflation uncertainty.

Table 2: Inflation and Output Growth in Turkey

GARCH(1,1)-M System

(1)
$$\Pi_t = \underset{(3.63)}{7.64} + \underset{(7.55)}{.58}\,\Pi_{t-1} - \underset{(1.32)}{.09}\,\Pi_{t-2} + \underset{(2.45)}{.16}\,\Pi_{t-3} - \underset{(0.27)}{.02}\,\Pi_{t-4} - \underset{(0.19)}{.01}\,\Pi_{t-5} + \underset{(0.08)}{.005}\,\Pi_{t-6} + \underset{(0.06)}{.003}\,\Pi_{t-7} + \underset{(2.61)}{.15}\,\Pi_{t-8} + \underset{(3.23)}{.12}\,\varepsilon_{t-12} + \varepsilon_t$$

(2)
$$\sigma^2_{\varepsilon_t} = \underset{(3.80)}{152.1} + \underset{(6.53)}{.373}\,\varepsilon^2_{t-1} + \underset{(5.15)}{.369}\,\sigma^2_{\varepsilon_{t-1}} + \underset{(2.87)}{2.46}\,\Pi_{t-1}$$

(3)
$$Y_t = \underset{(5.09)}{36.5} - \underset{(11.16)}{.57}\,Y_{t-1} - \underset{(4.75)}{.29}\,Y_{t-2} - \underset{(3.42)}{.19}\,Y_{t-3} - \underset{(3.81)}{.22}\,Y_{t-4} + \underset{(3.68)}{.20}\,Y_{t-5} - \underset{(2.22)}{.11}\,Y_{t-6} - \underset{(2.79)}{.16}\,Y_{t-7} - \underset{(3.66)}{.16}\,Y_{t-8} + \underset{(4.70)}{.23}\,v_{t-12} - \underset{(3.50)}{.755}\,\sigma^2_{\varepsilon_t} + v_t$$

(4)
$$\sigma^2_{v_t} = \underset{(2.30)}{1816} + \underset{(2.48)}{.187}\,v^2_{t-1} + \underset{(0.72)}{.200}\,\sigma^2_{v_{t-1}}$$

(5)
$$COV_t = -\underset{(0.45)}{.027}\,\sigma_{\varepsilon_t}\sigma_{v_t}$$

	Inflation Eqn.	Output Eqn.	Cross-Eqn.
Q(12)	15.96	18.89	18.72
$Q^2(12)$	6.09	6.74	–

Log Likelihood Function = -4537

Notes: Sample period is January 1963 – December 2000. Π_t is the inflation rate calculated from the wholesale price index and Y_t is the growth rate of industrial production (seasonally adjusted). T-statistics are in parentheses. Q(12) is the Ljung-Box statistic for twelfth-order serial correlation in the residuals. $Q^2(12)$ is the Ljung-Box statistic for twelfth-order serial correlation in the squared residuals. The critical value for both Q-statistics is 21.0 at the 5% level. Data obtained from the State Institute of Statistics.

4.1 Bivariate GARCH-M Results

The bivariate GARCH-M system of equations (1–5) is estimated using a nonlinear maximum likelihood technique and the results are reported in Table 2.[14] Estimates for the conditional mean and conditional variance of inflation are reported in equations (1) and (2). The sum of the eight autoregressive coefficients in the inflation equation is .778 in Table 2, which is very close to .745, the sum of the OLS coefficients reported in

Table 1. The GARCH(1,1) coefficients in equation (2) are both significant at the 1% level, and sum to less than one, which is a requirement for stationarity of the variance process. The estimated coefficient for lagged inflation in the conditional variance of inflation equation is positive and significant at the 1% level (t-statistic = 2.87), indicating that inflation significantly raises inflation uncertainty in Turkey over this period.[15]

Equations (3) and (4) report the estimates for the conditional mean and conditional variance of real output growth. The estimated coefficients for the AR(8)-MA(12) in the GARCH-M model are similar to the OLS coefficients reported in Table 1. The GARCH(1,1) parameters in the conditional variance equation (4) are stable (they sum to less than one), and the coefficient for the lagged, squared residuals (v_{t-1}^2) is significant at the 5% level (t=2.48). The coefficient on the lagged error variance ($\sigma_{v_{t-1}}^2$) in the output equation is insignificant, indicating that output growth shocks have no persistent effect on output growth uncertainty. The estimated coefficient for inflation uncertainty ($\sigma_{\varepsilon_t}^2$) in the output equation is negative (-.755) and significant at the 1% level (t-stat = -3.50), indicating that inflation uncertainty significantly lowers average output growth in Turkey.[16] The conditional correlation coefficient in equation (5) is not significantly different from zero, suggesting that the residual covariance between equations is not significant.

A series of diagnostic tests on the residuals and squared residuals are reported at the bottom of Table 2. Ljung-Box Q-tests for 12 lags show that the errors and squared errors are serially uncorrelated (at the 5% level) for the inflation and output equations, indicating that our GARCH(1,1)-M system adequately captures both the conditional variance and the joint distribution of the residuals.

The main implication of our empirical study is that we find strong statistical support for Friedman's (1977) hypotheses in Turkey during the 1963–2000 period. Using bivariate GARCH-M methods to simultaneously estimate inflation, inflation uncertainty and output growth in a single system of equations, we find that the level of inflation significantly *raises* inflation uncertainty in Turkey (at the 1% level), and that inflation uncertainty significantly *lowers* real output growth (at the 1% level).

Table 3: Inflation and Output Growth in Turkey

GARCH(1,1)-M System with Standardized Regression Coefficients

(1)
$$\Pi_t = \underset{(0.14)}{.005} + \underset{(7.84)}{.57}\,\Pi_{t-1} - \underset{(1.05)}{.07}\,\Pi_{t-2} + \underset{(2.45)}{.15}\,\Pi_{t-3} - \underset{(0.36)}{.02}\,\Pi_{t-4} - \underset{(0.16)}{.01}\,\Pi_{t-5} + \underset{(0.03)}{.005}\,\Pi_{t-6} + \underset{(0.05)}{.003}\,\Pi_{t-7} + \underset{(2.74)}{.15}\,\Pi_{t-8} + \underset{(3.63)}{.12}\,\varepsilon_{t-12} + \varepsilon_t$$

(2)
$$\sigma^2_{\varepsilon_t} = \underset{(6.45)}{.188} + \underset{(7.00)}{.335}\,\varepsilon^2_{t-1} + \underset{(5.70)}{.370}\,\sigma^2_{\varepsilon_{t-1}} + \underset{(2.69)}{.059}\,\Pi_{t-1}$$

(3)
$$Y_t = \underset{(2.94)}{.282} - \underset{(11.07)}{.57}\,Y_{t-1} - \underset{(4.70)}{.29}\,Y_{t-2} - \underset{(3.36)}{.19}\,Y_{t-3} - \underset{(3.66)}{.21}\,Y_{t-4} + \underset{(3.48)}{.19}\,Y_{t-5} - \underset{(2.09)}{.11}\,Y_{t-6} - \underset{(2.56)}{.15}\,Y_{t-7} - \underset{(3.45)}{.15}\,Y_{t-8} + \underset{(4.85)}{.24}\,v_{t-12} - \underset{(3.99)}{.443}\,\sigma^2_{\varepsilon_t} + v_t$$

(4)
$$\sigma^2_{v_t} = \underset{(2.32)}{.397} + \underset{(2.54)}{.194}\,v^2_{t-1} + \underset{(0.72)}{.196}\,\sigma^2_{v_{t-1}}$$

(5)
$$COV_t = -\underset{(0.33)}{.195}\,\sigma_{\varepsilon_t}\sigma_{v_t}$$

	Inflation Eqn.	Output Eqn.	Cross-Eqn.
Q(12)	13.84	18.33	18.05
$Q^2(12)$	6.44	6.43	–

Log Likelihood Function = -1017

Notes: Sample period is January 1963 – December 2000. All variables have been standardized by subtracting their means from them and dividing them by their own standard deviations. The inflation rate is calculated from the wholesale price index and Y_t is the growth rate of industrial production (seasonally adjusted). T-statistics are in parentheses. Q(12) is the Ljung-Box statistic for twelfth-order serial correlation in the residuals. $Q^2(12)$ is the Ljung-Box statistic for twelfth-order serial correlation in the squared residuals. The critical value for both Q-statistics is 21.0 at the 5% level. Data obtained from the State Institute of Statistics.

4.2 GARCH-M Results Using Standardized Variables

To assess the impact that a change in Turkish inflation will have on output growth, we re-estimate the GARCH-M system of equations (1) – (5) using standardized variables (X_s).[17] The advantage of using standardized variables is that we can then measure the change produced in one of the dependent variables by a unit change in an independent variable, when both are measured in terms of standard deviation units. Given the drastic scale

differences between the conditional variance of inflation (mean = 752, σ = 1534) compared to either Turkish inflation (mean = 32.25%, σ_{Π} = 33.57%) or output growth (mean = 6.14%, σ_{Y} = 67.58%), standardized coefficients provide a more realistic and meaningful interpretation of average or typical changes than the unstandardized coefficients. The results of the standardized estimation are reported in Table 3.

Using the standardized coefficients of .059 for lagged inflation in equation (2) and -.443 for inflation uncertainty in equation (3), we can trace the effect on real output of a one standard deviation reduction in inflation in Turkey. A permanent one standard deviation *reduction* in inflation at time t-1 (Π_{t-1}) would decrease inflation uncertainty ($\sigma^2_{\varepsilon_t}$) by -.059 standard deviations at time *t*, which would then permanently increase real output growth by +.026 standard deviations (+.026 = -.059 x -.443). A permanent one standard deviation reduction in Turkish inflation would approximate a 33.57% reduction in average inflation (σ_{Π} = 33.57%), and the effect on real output of a +.026 standard deviation increase would be to permanently raise output growth by +1.75% per year (.026 x σ_{Y} =1.75%).

To further illustrate, consider that the standard deviation of monthly inflation in Turkey from 1963–97 was 34.5%, and then decreased to 18.1% from 1998–2000, a decrease of about ½ of a standard deviation unit. The expected positive effect on output of this reduction in inflation and uncertainty would be about half of the effect of the one standard deviation change outlined above; that is, industrial output growth would be expected to permanently increase by almost one percentage point per year (.875% per year = .5 x 1.75%) as a direct result of the reduction in inflation during the last few years. Further reductions in Turkish inflation and inflation uncertainty, bringing it closer to the average level of other European countries, would result in additional favorable and significant improvements in economic performance.

5. Summary and Conclusions

Macroeconomists generally predict that inflation, inflation uncertainty and real output growth are related theoretically and empirically. In this chapter, we present a GARCH-M system of equations to simultaneously examine the inflation-inflation uncertainty and inflation uncertainty-real output growth relationships empirically in Turkey using monthly data. The evidence shows that Turkish inflation *significantly raised* inflation uncertainty and *significantly lowered* real output growth during the 1963–

2000 period. Further investigation indicates that the adverse effects of inflation and inflation uncertainty on real output growth in Turkey are nontrivially large and persistent.

Based on the empirical evidence that we uncovered, real output growth will improve significantly if inflation continues its downward trend. Recent macroeconomic data indicate that inflation has declined considerably and industrial production rose sharply during the first half of 2000. Based on these encouraging outcomes and the predictions of our model, the strict implementation of disinflation programs should increase real output growth by lowering inflation and inflation uncertainty.

Notes

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1 Ball (1992) formalizes Friedman's hypothesis with a theoretical model that predicts a positive association between inflation and inflation uncertainty. Empirical studies showing that inflation raises inflation uncertainty include Ball and Cecchetti (1990), Brunner and Hess (1993), Evans and Wachtel (1993), Holland (1995), Grier and Perry (1998), and Nas and Perry (2000).

2 For empirical studies showing that inflation uncertainty adversely affects economic performance, see Mullineaux (1980), Makin (1982), Hafer (1986), Katsimbris (1985), Coulson and Robbins (1985) Holland (1988), and Grier and Perry (2000).

3 For details, see Kopits (1987) and Celasun (1990).

4 For a review of the objectives and the performance of the 1980 program and Turkey's liberalization experiment see Şenses (1988), Baysan and Blitzer (1990), Rodrik (1991), Nas (1992) and Uygur (1993).

5 The initial decline in inflation was largely due to contractionary monetary and fiscal policies. A sharp increase in foreign currency inflows as a result of restructuring the external debt also reduced the need for inflationary finance (Rodrik, 1991). Also, for a review of monetary and fiscal policies during the first half of the 1980s, see Kopits (1987).

6 See Sayarı (1992) and Waterbury (1992).

7 Inflation uncertainty is measured here, as in Figure 2, as the annualized conditional variance of inflation, using a single equation GARCH(1,1) model for Turkish inflation.

8 See Golob (1993) for a comprehensive review of the existing literature.

9 We follow the procedure developed in Grier and Perry (2000).

10 Before the introduction of ARCH and GARCH models, ad-hoc measures of inflation uncertainty were used previously including the moving standard deviation of the inflation rate and the cross-sectional dispersion of individual forecasts from survey data. GARCH methods are statistically superior to ad-hoc methods, because by estimating the conditional variance of inflation, an actual parametric, time series measure of inflation uncertainty is constructed.

[11] Several parameterizations of the general multivariate GARCH model are possible, including the constant conditional correlation model outlined in Bollerslev (1990). In the constant conditional correlation model, the conditional covariance matrix is allowed to be time-varying but the conditional correlation across equations is assumed to be constant. The assumption of a constant correlation matrix represents a major reduction in terms of computational complexity and is commonly used in multivariate GARCH estimation.

[12] Using Dickey-Fuller and Phillips-Peron tests, we first investigate whether inflation and real output growth in Turkey are stationary variables. The null hypothesis of a unit root is rejected at the 1% level for both variables at various lag lengths using both tests, indicating that both inflation and output growth are clearly stationary.

[13] Other specifications besides a GARCH(1,1) model of the conditional variance are possible and were considered, but the GARCH(1,1) model provided the best-fitting model.

[14] The software used to estimate the GARCH system of equations is a FORTRAN program called MGARCH, which is available from the University of California-San Diego.

[15] Recent papers showing a positive relationship between inflation and inflation uncertainty using Granger-causality methods include Holland (1995) for the United States, Grier and Perry (1998) for all G-7 countries, and Nas and Perry (2000) for Turkey.

[16] These key GARCH-M empirical results for the effect of inflation uncertainty on output growth in Turkey (coefficient = -.766, t-statistic = 3.05) are very similar to the results found by Grier and Perry (2000) using the same GARCH-M methodology in the United States over a monthly 1948-1996 sample period (coefficient = -1.03 and t-statistic = 3.28).

[17] The variables have been standardized according to the formula: $X_s = (X - X_i) / \sigma_x$ where X is the mean of variable X, and σ_x is the standard deviation of X.

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Chapter 8

Seigniorage, Currency Substitution and Inflation in Turkey*

Faruk Selçuk

Abstract: In this short chapter, it is shown that the link between seigniorage and inflation is nonlinear in Turkey and that the seigniorage-maximizing rate of inflation cannot deviate from the world inflation. Therefore, a seigniorage loss should not be concern for authorities after a successful stabilization program.

1. Introduction

It is commonly argued that a high and persistent inflation is caused by a large fiscal deficit and the need of the government to collect extra seigniorage to finance this deficit. However, a solid link among seigniorage, the government budget deficit, and inflation has hardly been established in applied studies on the post-world war high-inflation economies, such as Latin American countries or Israel. The evidence from these economies shows that there is no significant upward trend in seigniorage revenue measured as a percent of gross national product (GNP) although the rate of inflation rises in a stepwise fashion (Eckstein and Leiderman 1992, Bruno 1993).

The Turkish economy is not an exception to this general stylized fact. Figure 2 plots the real money balances and the money stock (M1)-nominal GNP ratio in Turkey between the years 1987–2000. Clearly, there was a downward trend in both variables although there was a stepwise increase in inflation during the same period (see Figure 1).[1] There are several hypotheses to explain this observed phenomenon. A well-known approach considers the possibility of dual equilibria in the economy. As Sargent and Wallace (1987) and Bruno and Fischer (1990) showed, a given amount of seigniorage revenue may be collected at either a low or a high level of inflation. Hence, there is one "critical level" of inflation at which the government can maximize the seigniorage revenue. Any attempt to raise

the seigniorage revenue higher than this critical level by printing money may put the economy into a hyperinflationary path. Therefore, it is important to obtain some information on the "critical level" of inflation or the shape of the seigniorage Laffer curve.

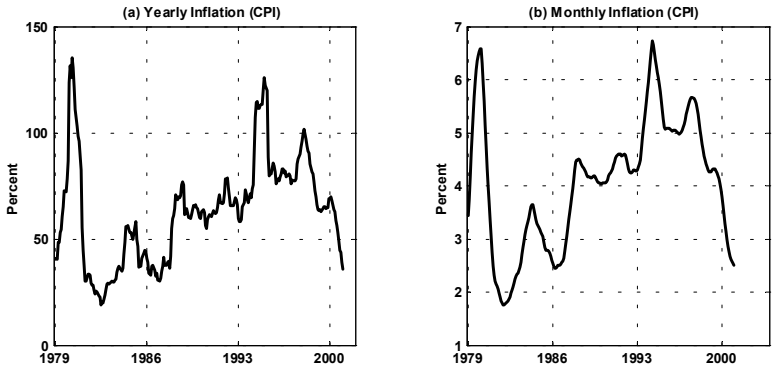

Figure 1: Inflation in Turkey
(a) Annual inflation, CPI (in percent).
(b) Monthly inflation, CPI (seasonally adjusted, in percent). Monthly inflation series are filtered to eliminate strong seasonality.
Source: State Institute of Statistics.

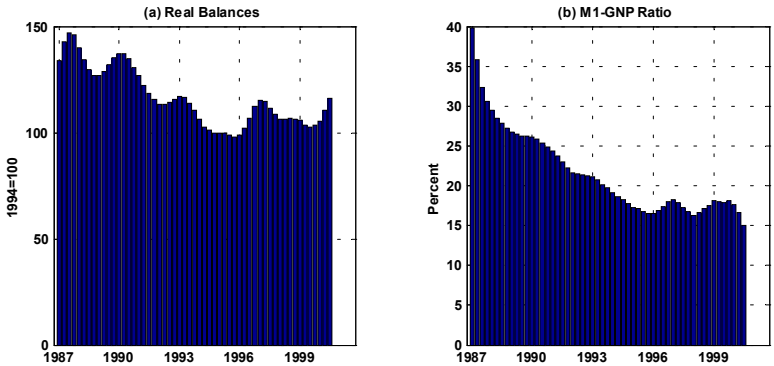

Figure 2: Money Supply in Turkey
(a) Real money balances, 1994=100. Nominal money stock (M1) divided by the consumer price index.
(b) M1 Money stock-Nominal GNP ratio (in percent). Sample: 1987:I–2000:III (Quarterly). Both variables are filtered to eliminate strong seasonality.
Sources: Central Bank of the Republic of Turkey and State Institute of Statistics.

Conventional studies employ a Cagan-type money demand function to estimate the critical level of inflation. If the observed inflation rate is less than the estimated seigniorage-maximizing inflation, the economy is said to be on the "correct side" of the seigniorage Laffer curve; i.e., there is still room for higher seigniorage at higher inflation rates, and there is an implicit loss of seigniorage revenue if the economy moves to a lower level of inflation. This second implication might be a serious consideration for a policy maker (and an obstacle to implementing a stabilization program) if the current inflation rate is perceived to be less than the estimated seigniorage-maximizing rate of inflation in the economy.

Another approach to the seigniorage maximization issue considers the fact that domestic residents may substitute a foreign currency for the domestic one when they anticipate a relative increase in the cost of holding domestic real balances. Hence, a high level of currency substitution reduces the government's ability to collect seigniorage revenue; i.e., a given budget deficit may be financed with relatively higher inflation. What is more, if domestic residents are very quick in adjusting real balances, the economy may find itself on a hyperinflationary path. Therefore, it is natural to expect a weak relation between seigniorage and inflation especially in chronic-high inflation economies like Turkey.[2]

In this chapter, the effect of currency substitution on the seigniorage-maximizing inflation rate in Turkey is examined. Estimates of a money-in-the-utility function model show that the seigniorage-maximizing rate of inflation in Turkey can not deviate from the world inflation rate, since there is a high elasticity of substitution between domestic and foreign currencies and the share of foreign real balances in producing domestic liquidity services is significant. This result is compared with that obtained from a conventional money demand estimation. The conventional estimate of the seigniorage-maximizing rate of inflation in Turkey is several times higher than the world inflation rate, and it is grossly misleading since it ignores the possibility of currency substitution.

Simple Cagan-type classical money demand function estimates are presented in Section 2. A money-in-the-utility function model is introduced in Section 3. The numerical exercises of Euler equations based on estimated parameters for the Turkish economy are also presented in the same section. The last section contains a brief conclusion.

2. The Cagan Model

The Cagan-type money demand function plays a central role in estimating the seigniorage maximizing inflation rate. It is given by:

$$\frac{m_t}{p_t} = \alpha_0 e^{\lambda\left(\frac{\pi_t}{1+\pi_t}\right)^{\gamma}} y^{\phi} \tag{1}$$

$$\ln\left(\frac{m_t}{p_t}\right) = \ln \alpha_0 + \lambda\left(\frac{\pi_t}{1+\pi_t}\right)^{\gamma} + \phi \ln y_t \tag{2}$$

where m is nominal money supply, p is price level, y is real income, and π is inflation. Following Calvo and Leiderman (1992), the inflation cost of holding money is $\pi_t/(1+\pi_t)$, not just π_t as it is assumed in almost all conventional studies of money demand in high inflation economies. The semi-elasticity of money demand with respect to inflation is given by

$$\gamma\lambda\left(\frac{\pi_t}{1+\pi_t}\right)^{\gamma-1} .$$

It follows that the necessary condition for the existence of a seigniorage Laffer curve is $\lambda < 0$ and $\gamma > 0$.

Easterly, Mauro and Schmidt-Hebbel (1995) shows that the elasticity of substitution in transactions between money and alternative assets determines how inflation semi-elasticity of money demand changes as inflation rises; i.e., γ in money demand function above is usually not equal to one. Based on panel data estimates from eleven high inflation countries, Easterly *et al.* (1995) report that the semi-elasticity of money demand increases with increasing inflation; i.e., higher inflation causes a flight from money towards alternative assets and strong currencies. They conclude that money demand estimations based on a constant semi-elasticity assumption might be misleading.

Preliminary estimates of the nonlinear form of the Cagan-type money demand function for the Turkish economy revealed that γ does not differ significantly from one. Therefore, it was decided to work with a log-linear form of the money demand function. It is commonly assumed in money

demand estimations that there might be some adjustment lags of actual real balances to the desired level of real balances so that

$$\ln\left(\frac{m_t}{p_t}\right)-\ln\left(\frac{m_{t-1}}{p_{t-1}}\right)=k\left[\ln\left(\frac{m_t}{p_t}\right)^d-\ln\left(\frac{m_{t-1}}{p_{t-1}}\right)\right] \tag{3}$$

where k is the adjustment parameter and $(m_t/p_t)^d$ is the desired level of real balances. Substituting equation 3 into the money demand function (Equation 2) and imposing the restriction γ=1 yields the following estimation equation

$$\ln\left(\frac{m_t}{p_t}\right)=b_0+b_1\left(\frac{\pi_t}{1+\pi_t}\right)+b_2\ln y_t+b_3\ln\left(\frac{m_{t-1}}{p_{t-1}}\right)+\varepsilon_t \tag{4}$$

where ε_t is a serially uncorrelated white noise disturbance term and seigniorage maximizing steady-state inflation rate $\bar{\pi}$ is given by:[3]

$$\frac{\bar{\pi}}{1+\bar{\pi}}=-\left(\frac{1}{\lambda}+\phi g\right).$$

Equation 4 is estimated in difference form for the sample period of 1988:I–1999:IV. The sample period is restricted because of data availability. Our data set consists of quarterly CPI (p), quarterly real GNP (y), end of quarter M1 (m), and quarterly inflation ($\pi_t=(p_t-p_{t-1})/p_{t-1}$). All variables are in natural logs except for the inflation rate.[4] The results are:

$$\Delta\ln\left(\frac{m_t}{p_t}\right)=-0.798\Delta\left(\frac{\pi_t}{1+\pi_t}\right)+0.213\Delta\ln y_t+0.508\Delta\ln\left(\frac{m_{t-1}}{p_{t-1}}\right)$$

$$R_A^2=0.36 \qquad DW=1.72 \tag{5}$$

where Δ is the difference operator ($\Delta x_t = x_t-x_{t-1}$), R_A^2 is adjusted R^2 and DW is the Durbin-Watson Statistic. All the coefficients are statistically significant at less than 5% significance level except for the coefficient of $\Delta\ln y_t$ which has a 10% significance level. Estimation results indicate that the seigniorage-maximizing quarterly rate of inflation is approximately

60% (over 500% yearly!) for the Turkish economy. Given the fact that quarterly inflation in Turkey never exceeded 25% (except 1994:II), one may (mistakenly) conclude that the policy makers were on the correct side of Laffer curve and the government could have collected more seigniorage revenue as a percentage of GNP if they had stimulated inflation by printing money.

3. A Money-in-the-Utility Function Model

This section utilizes a simple model of money demand, developed by Imrohoroğlu (1996). Similar models were empirically estimated and tested for low inflation or chronic-high inflation economies, see for example, Imrohoroğlu (1994), Easterly, Mauro, and Schmidt-Hebbel (1995), Selçuk (1997) among others.

Suppose that an economy consists of infinitely lived identical individuals. At the beginning of each period, a representative agent decides how much to consume c_t, how much to save in the form of internationally traded real bonds b_t^*, and how much to hold in the form of domestic real balances m_t/p_t, and foreign real balances m_t^*/p_t^*. This decision is made by maximizing the expected discounted sum of the period-utility function U,

$$E\sum_{t=0}^{\infty}\beta^t U\left(c_t, \frac{m_t}{p_t}, \frac{m_t^*}{p_t^*}\right) \tag{6}$$

subject to the budget constraint

$$c_t + \frac{m_t}{p_t} + \frac{m_t^*}{p_t^*} + b_t^* \leq y_t - \tau_t + \frac{m_{t-1}}{p_t} + \frac{m_{t-1}^*}{p_t^*} + (1 + r_{t-1})b_{t-1}^* \tag{7}$$

where β is the discount factor and c_t per capita consumption. Internationally traded real bonds that are bought in period t yield a net real interest rate of r_t. Each individual receives an exogenous endowment y_t, and is subject to a lump-sum tax of τ_t. Money services are produced by domestic and foreign real balances in a Constant Elasticity of Substitution (CES) production function:

$$x_t = \gamma\left[\alpha\left(\frac{m_t}{p_t}\right)^{-\rho} + (1-\alpha)\left(\frac{m_t^*}{p_t^*}\right)^{-\rho}\right]^{-1/\rho} . \tag{8}$$

Finally, the government finances some part of the real deficit g_t by imposing an inflation tax. The government budget constraint is given by

$$g_t = \tau + \frac{M_t - M_{t-1}}{P_t} . \tag{9}$$

The government determines the nominal amount of seigniorage by selecting a value for the nominal growth rate of money. However, real seigniorage is basically determined by the optimizing behavior of the representative agent. Suppose that the utility function of the representative agent is given by

$$U(t) = \frac{\left(c_t^{\ \alpha} x_t^{\ 1-\alpha}\right)^{\theta} - 1}{\theta} . \tag{10}$$

Let

$$z = \alpha\left(\frac{m_t}{p_t}\right)^{-\rho} + (1-\alpha)\left(\frac{m_t^*}{p_t^*}\right)^{-\rho} .$$

Imrohoroğlu (1996) shows that the following equations may numerically be solved to obtain the deterministic steady-state values of c, m/p, and m^*/p^* as a function of the parameters of preferences, technology and government policies,

$$\alpha(1-\rho)z^{-1}\left(\frac{m_t}{p_t}\right)^{-1-\rho} + \beta\sigma c^{-1}(1+\pi)^{-1} - \sigma c^{-1} = 0 \tag{11}$$

$$(1-\alpha)(1-\rho)z^{-1}\left(\frac{m_t^*}{p_t^*}\right)^{-1-\rho} + \beta\sigma c^{-1}\left(1+\pi^*\right)^{-1} - \sigma c^{-1} = 0 \tag{12}$$

$$y - g - c - \frac{\pi_t^*}{1+\pi_t^*}\frac{m_t^*}{p_t^*} = 0 \tag{13}$$

where $\pi = (p_{t+1} - p_t)/p_t$, and $\pi^* = (p_{t+1}^* - p_t^*)/p_t^*$. The first two equations are derived from standard Euler equations. The last equation represents the constraint faced by the economy.[5]

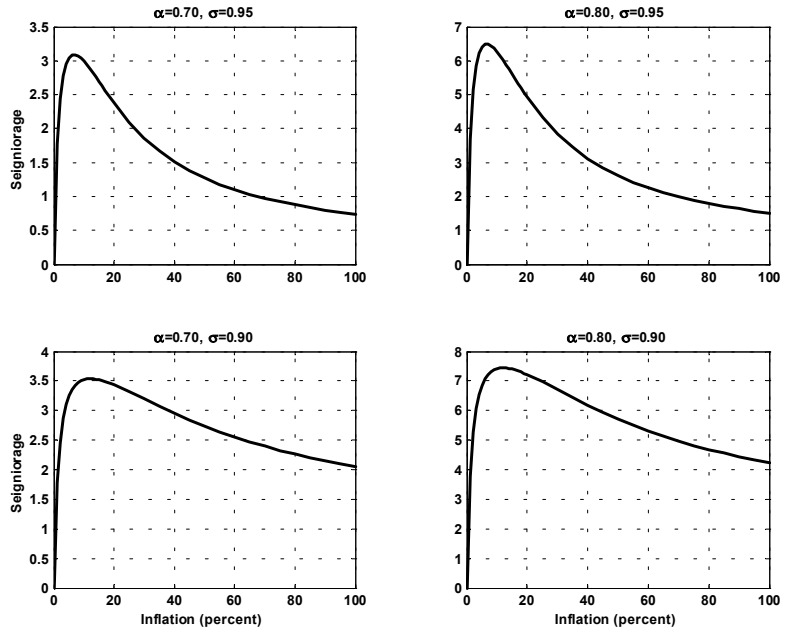

Figure 3: Annual Inflation and Seigniorage Estimations
Annual inflation and seigniorage estimates from the numerical evaluations of Euler equations in Equations 11–13. The share of money services in the utility function is (1-σ) while α is the share of domestic real balances in producing domestic liquidity services.

In order to estimate the steady-state values of c, m/p, and m^*/p^* by evaluating Equations 11, 12 and 13, the numerical values of the underlying parameters of preferences, technology and government policy are required. Based on the stylized facts, it is assumed that y = 100, g = 20 and $\pi^* = 0.05$. For the other parameters, Selçuk (1997) estimated a money-in-utility function model, similar to the one outlined in the previous section for the Turkish economy and showed that the elasticity of substitution between domestic and foreign balances is high and significant and that the share of

foreign real balances in producing domestic liquidity services is relatively high and statistically significant. The values of estimated parameters in that study are $\beta = 0.9865$, $\alpha = 0.703$, and $\rho = -0.65$. The last parameter implies an elasticity of currency substitution of 2.86 while the second parameter sets the share of foreign balances in producing liquidity services to 30%. The share of money services in the utility function ($1-\sigma$) is assumed to be at 0.05. Given those parameters, real seigniorage revenue is calculated for each inflation rate π between 0.01 and 1.0 with increments of 0.01. The results are reported in Figure 3 for different parameter settings. In general, the seigniorage Laffer curve reaches the maximum right after the exogenously given world inflation rate of 5%. After this rate, the seigniorage falls and approaches a lower limit while inflation goes to infinity. Given a high elasticity of currency substitution and a reasonable share of foreign real balances in producing domestic liquidity services, the results show that the Turkish government cannot collect more seigniorage revenue by simply increasing monetary base growth and consequently inflation. Therefore, it is not surprising that there is no observed linear relation between seigniorage and inflation in Turkey.

The significance of money services in the utility function plays an important role in seigniorage collection. If the share of money services in the utility function is higher (smaller value of σ), the government is able collect more seigniorage revenue at a given inflation rate. Holding everything else constant and setting $\sigma = 0.90$ results in a higher seigniorage Laffer curve in Figure 3. The implication is that a less developed financial sector (in terms of limited usage of checking accounts, credit cards, etc.) gives an opportunity to collect more seigniorage revenue through money creation and inflation.

The share of foreign real balances in producing domestic liquidity services is another important factor in the determination of the maximum seigniorage. Holding everything else constant, the share of foreign balances is reduced to 20% ($\alpha = 0.80$) from the previous (estimated) 30%. The resulting Laffer curves are given in the right panels of Figure 3. The results show that the seigniorage revenue for every level of inflation increases after a decrease in the share of foreign real balances. Also the seigniorage maximizing level of inflation becomes higher although the shape of the seigniorage Laffer curve does not change much.

4. Conclusion

The central message of the numerical exercises of Euler equations based on the estimated parameters from the Turkish economy is a clear one: as long as there is some degree of currency substitution in the economy, the Turkish government cannot collect more seigniorage revenue by simply setting the growth rate of monetary base at a higher level. Contrary to the findings of conventional studies on the subject, if foreign real balances produce some liquidity services in the economy, the seigniorage-maximizing level of inflation in Turkey cannot deviate from the world inflation. The result also implies that the Turkish economy is always on the wrong side of the seigniorage Laffer curve as long as the domestic inflation is higher than the world inflation and there is some degree of currency substitution. This result has important policy implications in conducting a stabilization program. If a stabilization program is implemented vigorously so that the steady-state level of inflation is closer to the world inflation, it is very likely that the real seigniorage revenue will increase significantly.

Notes

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1 See Ertuğrul (1982) for a macroeconometric analysis of fiscal deficit, money stock and inflation in Turkey during the 1970s. Öniş and Özmucur (1990) investigates the inflation dynamics in Turkey under the vicious cycle hypothesis. For the relationship between inflation and the budget deficit in Turkish economy including more recent data, see Lim and Papi (1997), Metin (1995, 1998) and the references therein.

2 Sometimes, it is argued that currency substitution may provide inflation discipline (Fisher 1982, Canzoneri and Diba 1992). However, it can not be a substitute for a sound fiscal and monetary policy, lacking in chronic-high inflation economies. See Giovannini and Turtelboom (1994) for a detailed survey on currency substitution. Végh (1989) examines the effect of currency substitution on inflationary finance and seigniorage. Melvin and Peiers (1996) analyzes the cost of large seigniorage losses due to dollarization. Akçay *et al.* (1997) and Selçuk (1994, 1997) investigate the dynamics of currency substitution in Turkey.

3 Derived from the standard seigniorage maximization condition $\varepsilon(\pi+\phi g)+ 1 = 0$ where ε is the semi-log elasticity of real money demand with respect to inflation cost of holding money, g is the growth rate of real income, and ϕ is elasticity of real money demand with respect to real output. Note that the estimate of λ is calculated as $\lambda = b_1 / (1 - b_3)$ and estimate of ϕ is given by $\phi = b_2 / (1-b_3)$.

4 Preliminary investigation revealed that the data series were not stationary. Differencing the series as x_t-x_{t-4} eliminated the high seasonality and nonstationarity.

[5] Given the development stage of the financial markets in the economy, it is assumed that $b^* = 0$ so that the relevant Euler equation drops out.

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Chapter 9

The Impact of a Disinflation Program on the Structure of the Turkish Banking Sector: Evidence from 1988–99*

C. Emre Alper, M. Hakan Berument and N. Kamuran Malatyalı

Abstract: This chapter uses an unbalanced panel of observations on Turkish commercial banks over the period from 1988–99, attempts to define the structure of the banking sector through descriptive statistics and panel regressions and forecasts the changes that will take place in the banking system based on these. We follow the methodology of Demirgüç and Huizinga (1999) closely, but instead of a cross-country analysis, we focus on issues pertaining to Turkey undergoing the ambitious three-year stabilization program. The descriptive analysis of the commercial banks operating in Turkey during 1988–99 points to the following facts: the chronic inflation of the past 15 years and the resulting high real interest rate have displaced income from core banking activities by arbitrage income through open positions. The prevailing high net interest margins allowed for the existence of large number of small banks and persistent net losses from non-interest related activities. The foreign banks in such an environment did not need to increase their size since scale economies did not matter as evidenced by the highest before tax profits accruing to smaller size banks.

1. Introduction

On February 21, 2001, Turkish authorities announced the forced abandonment of the pegged exchange rate regime, which was in effect since the launching of the International Monetary Fund-backed three-year stabilization program at the end of 1999. This announcement came following the acute liquidity crises of November 2000 and February 2001, which threatened the viability of the Turkish banking system as a whole. The financial turmoil following the abandonment of the pegged exchange rate regime necessitated a revised disinflation program, which is likely to put an end to poor banking practices and deficiencies in supervision by

prompting rapid consolidation and taking actions to boost profitability of the banking sector.

Prior to the disinflation program of 2000, the Turkish banking sector operated in a difficult environment. Bank management was very complicated due to the existence of macroeconomic instability as characterized by high volatility in the growth and real interest rates, chronic inflation, persistent fiscal imbalances and balance-of-payments crises, which resulted in high credit, sovereign and foreign exchange risks as well as very short planning horizons. The chronic inflation rate affected banks' asset and liability management decisions unfavorably and caused income from core banking operations to be displaced by float income and arbitrage gains. The unstable macroeconomic environment coupled with tax and regulatory distortions led to the explosive growth of the repo market and increased the maturity mismatch risk of the Turkish banking sector since 99% of the volume of transactions had taken place on repos of a single day maturity whereas the underlying government securities had 15 months average maturity. The existence of state banks introduced additional distortions to the banking sector due to their duty losses, i.e., directed lending at subsidized rates to favored sectors. Following the speculative attack and the financial crisis of 1994, the Turkish authorities guaranteed all deposits in banks. This tolerated the development of an unhealthy banking sector since problems of information asymmetry prevailed.

The three-year disinflation program, as outlined in *The Letter of Intent*[1] of December 9, 1999, was essentially an exchange-rate-based stabilization program supplemented by fiscal adjustment and structural reform measures involving agricultural reform, pension reform, fiscal measurement and transparency, and tax policy and administration. There were also measures to strengthen and regulate the banking sector.[2] In September 2000, an autonomous banking regulatory body was established, which took quick decisions in terms of taking over the troubled banks. However, there was not enough time to restructure other troubled private banks, and reorganize public banks, which remained as an important source of vulnerability. The November 2000 liquidity crisis broke out because of the existing vulnerability due to the "other troubled private banks"[3] and the following February 2001 liquidity crisis erupted due to the excess liquidity needs of the public banks. A revised program in which structural reform and fiscal adjustment measures will be taken at a faster pace, will be replacing the failed one.

The rapid restructuring of the banking system is the central issue in the revised program, which is being drawn up by the authorities. With

successful completion of this program, past problems associated with the highly unstable macroeconomic environment should disappear. Presumably, the previous strategies and practices will no longer be successful in this relatively stable environment. Bank managers will have to develop real banking relationships, generate sustainable sources of income and start worrying about such "new" concepts as asset and liability management as well as credit risk.

Keeping in mind the changes the Brazilian financial system[4] had to go through following the *Plano Real* that was launched in July 1994, the aim of this paper is to find out whether the structure of the financial system is compatible with an environment characterized by lower inflation and higher stability. Mendonca and Almeida (1997) argue that the restructuring of the financial system in Brazil, following the stabilization program, can be broadly divided into three overlapping phases. Phase 1 can be roughly described as the period in which mergers and acquisition as well as liquidation took place. Phase 2 was distinguished by the entry of foreign firms to the banking sector. Phase 3 is the replacement of the float income and arbitrage gains by income from growing financial intermediation and commission fees. Previous empirical research on the effects of stabilization on the Turkish banking system includes van Rijckeghem (1997) through maturity gap and duration analyses argued that the temporary effects of stabilization on the profitability of the banking sector would be positive since the windfall gains outweigh the loss from float income.

This chapter uses an unbalanced panel of observations[5] on Turkish commercial banks during 1988–99, attempts to define the structure of the banking sector in the high-inflation environment of the 1990s through descriptive statistics and panel regressions and also investigates whether the initial structure was compatible with the disinflation program. There has been an increase in the amount of empirical research on the banking sector using panel regressions on cross-country data sets recently. (See for example, Demirgüç and Huizinga, 1999; Claessens *et al.*, 1998; and Eichengreen and Rose, 1998, among others.)

Demirgüç and Huizinga (1999) analyzed the determinants of interest margins and profitability of banking systems using bank level data for 80 countries for the 1988–95 period. They conclude that higher inflation and real interest rates are associated with higher realized interest margins and profitability. They also found that banking sectors with higher ratios of concentration have higher margins and earn more profits. Claessens *et al.* (1998), utilizing the same database, analyzed the impact of foreign presence on the banking sector and found that an increase in the share of

foreign banks implies lower profitability for the domestic banks. Eichengreen and Rose analyzed banking crises with macroeconomic and financial data for the 1975–92 period and concluded that a 1% increase in the developed countries' interest rate is associated with an increase in the probability of a banking crisis in the emerging market economies of around 3%. Ertuğrul and Zaim (1996) investigated economic efficiency of the Turkish commercial banks for the post-1980 period and showed that the public banks were more efficient than the private banks up until 1993, and that this situation was reversed in the post-1993 period. One other finding was that the financial liberalization benefited both type of banks and resulted in efficiency increases.

We follow the methodology of Demirgüç and Huizinga (1999) closely, but instead of a cross-country analysis, we focus on issues pertaining to the implications of the stabilization program on the current structure of the Turkish banking sector. Section 2 provides the data source and the descriptive statistics. Section 3 discusses the panel regression results. Section 4 concludes.

2. Data

The banking sector is different from other sectors in that its main function is to provide liquidity-transformation services. Because of the inherent existence of economies of scale, banks have an advantage in making illiquid investments compared to a typical household or a firm. In addition, banks can exploit economies of scale and scope for monitoring borrowers and assessing repayment capacity and hence are better equipped to cope with information asymmetry problems. The efficiency of the banking system is thus an important factor for a country's growth prospects.

The efficiency and the profitability of the banking sector in Turkey prior to the launching of the 2000 stabilization program will next be analyzed. The data set will be organized according to ownership and size and the behavior of certain ratios will be evaluated.

This study uses annual balance sheet, income statement and off-balance sheet data of commercial banks in Turkey for the period 1988–99. The database is gathered from the annual "Banks in Turkey" periodicals provided by the Banks Association of Turkey. From the entire data set, commercial banks, which were transferred to the Deposit Insurance Fund before the launching of the disinflation program in January 2000, were excluded.[6] Development and investment banks as well as banks that have

less than four years of observations were also excluded. This yielded an unbalanced panel of a maximum of 494 observations from 52 banks. Macroeconomic and financial data from the database of the Central Bank of the Republic of Turkey was also utilized.

Before giving a descriptive analysis of the data, a caveat is in order in terms of the problems associated with the reporting, accounting standards, lack of transparency and thus the quality of the available data. As outlined in IMF Staff Country Reports (1998), the quality of the database is hindered since:

- Commercial banks' securities portfolios are not marked to market.
- There exist divergent approaches to loan-loss provisioning and tax liabilities. Because of this, the level of non-performing loans may be biased and the direction of the bias cannot be determined.
- The "Other Assets" item is the largest asset item of the state banks' balance sheets, which suggests the importance of the magnitude of receivables from the Treasury.
- The reported level of profitability of the state banks reflects more of administrative decisions than performance of those banks conducting the market activities.
- There exist foreign subsidiaries and incomplete consolidation practices which hamper the determination of the level of the foreign exchange risk and the off-balance sheet exposure with a certain level of reliability.
- Lack of inflation accounting for a majority of banks (those that are not quoted in the Istanbul Stock Exchange) conceals the true level of the banking sector profitability.

As a measure of efficiency of and profitability due to bank intermediation, net interest margin over total assets, NI/TA, which reflects the difference between the interest revenues and expenditures over the total assets, is analyzed.[7] In contrast to the previous usage,[8] the net interest margin is defined as the net interest revenue plus net income from foreign exchange transactions. The latter item is generally incurred due to interest related activities as a result of net open positions and hence is included. Also, the net interest revenues item excludes interest income from securities portfolio.[9] Interest income from securities portfolio is subtracted from net interest margin in order to reveal the group(s) of banks that will encounter difficulties in the post-stabilization program period, when the public sector borrowing requirement as well as the real return on the government securities portfolio will go down.

Table 1: Descriptive Statistics of the Turkish Banks: 1988–99 (Data Organized by Ownership)

		#	TA/GDP	NI/TA	TR/TE	NNI/TA	BTP/TA	OHC/TA
	1988	16	20.48	-0.30	116.30	0.35	3.17	4.13
Private	**1999**	31	46.09	-2.53	117.28	-0.01	6.37	4.78
	Average	24	24.21	0.62	116.59	-1.23	4.61	5.10
	1988	5	20.77	0.78	120.01	-0.57	2.56	4.46
Public	**1999**	4	32.53	-0.07	105.79	0.66	2.10	3.38
	Average	5	21.76	-0.25	107.94	-2.40	1.49	5.19
	1988	10	1.36	-0.97	125.32	1.35	4.68	4.23
Foreign	**1999**	17	4.90	-3.78	109.52	2.79	8.48	4.89
	Average	17	2.05	2.24	122.65	-1.56	6.77	5.58

		#	NPL/TA	CTC/TA	OFF/TA
	1988	16	0.32	14.17	43.49
Private	**1999**	31	0.26	13.29	123.15
	Average	24	0.11	19.11	73.89
	1988	5	0.31	13.85	21.65
Public	**1999**	4	0.94	8.01	32.38
	Average	5	0.33	17.09	27.70
	1988	10	0.52	12.55	66.78
Foreign	**1999**	17	0.07	5.88	222.80
	Average	17	0.15	12.12	136.99

Notes: TA/GDP is the sum total assets of banks within each group over GDP. NI/TA is the sum total of net interest margin over the sum of total assets across banks within each group. In contrast to the previous literature, the net interest margin is defined as the net interest revenue plus net income from foreign exchange transactions and the net interest revenue does not include interest revenues obtained from securities portfolio. Net gains from exchange rate are added since this item is generally incurred due to interest related activities while the latter item is subtracted to reveal the interest obtained through credit extension. TR/TE stands for the ratio of sum total gross revenues of banks divided by sum total gross expenditures. NNI/TA is the total net non-interest related income over total assets. Net non-interest income excludes net income from foreign exchange transactions. BTP/TA is the before tax profit over total assets. OHC/TA is the overhead costs over the total assets. Overhead costs are defined as the sum of personnel related expenditures plus other non-interest related expenditures. CTC/TA is the annual change in total credits over total assets. OFF/TA is the ratio of the off-balance sheet total to the total assets.

As a measure of efficiency, TR/TE, the ratio of gross total revenues to the gross total expenditures, is used. The NNI/TA variable is the net non-interest related income over total assets excluding net income from foreign exchange transactions and is used to reflect the importance of brokerage services and commission fees, generally reflecting income from more sustainable sources. BTP/TA is the before tax profit over total assets and reflects bank's profitability. OHC/TA is overhead costs over total assets, reflecting the importance of the banks' entire overhead costs associated with all its activities. Overhead costs are defined as the sum of personnel

related expenditures plus other non-interest related expenditures. NPL/TA is the annual change in the net non-performing loan stock over the total assets and measures the importance of bad debts. CTC/TA is the annual change in total credits over total assets. OFF/TA is the ratio of the off-balance sheet total to the total assets. The latter two variables reflect the importance of traditional versus emerging activities in the banks' total activities.

Table 2: Descriptive Statistics of the Turkish Banks: 1988–99
(Data Organized by Size)

		#	TA/GDP	NI/TA	TR/TE	NNI/TA	BTP/TA	OHC/TA
	1988	9	37.31	0.09	115.47	-0.63	2.42	4.22
Size 1	**1999**	9	60.70	-0.63	113.24	-0.65	4.33	3.95
	Average	9	38.44	0.28	112.66	-1.87	3.06	5.05
	1988	8	3.70	0.65	144.63	5.56	7.54	4.83
Size 2	**1999**	10	13.97	-5.11	110.40	1.19	5.82	4.82
	Average	10	6.11	-0.45	114.73	-1.17	4.00	5.88
	1988	7	7.63	1.75	122.17	0.14	2.97	5.05
Size 3	**1999**	18	1.34	-4.36	112.70	2.02	6.45	4.89
	Average	14	2.92	1.94	116.64	-1.77	4.65	5.73
	1988	7	0.27	3.23	154.25	0.24	9.17	4.88
Size 4	**1999**	15	1.22	4.31	104.27	-0.91	8.08	7.34
	Average	13	0.58	5.16	130.54	-2.15	8.07	6.26

		#	NPL/TA	CTC/TA	OFF/TA
	1988	9	0.30	13.15	29.13
Size 1	**1999**	9	0.59	10.93	52.68
	Average	9	0.21	18.46	39.61
	1988	8	0.41	20.16	54.31
Size 2	**1999**	10	0.20	10.45	201.92
	Average	10	0.23	16.90	113.46
	1988	7	0.66	15.34	93.55
Size 3	**1999**	18	0.56	10.51	199.74
	Average	14	0.17	14.86	127.19
	1988	7	0.53	29.20	69.48
Size 4	**1999**	15	0.36	10.28	228.75
	Average	13	0.48	12.79	114.35

Notes: Size 1 denotes banks with TA/GDP average over 1%; Size 2 over 0.5% less than 1%; Size 3 over 0.1% less than 0.5% during 1988–99.

Table 1 summarizes the data set by organizing the data according to ownership and giving within-group averages as well as the initial and the final observations. Similarly, Table 2 presents the same data set by

breaking it down with respect to the size of the banks. Banks in the size-1 group have individual total assets over GDP greater than 1% when averaged over the 12 years. Size-2 banks have total assets over GDP less than or equal to 1% but greater than 0.5% when averaged over the years. Size-3 banks have total assets over GDP greater than 0.1% and less than 0.5%.

Some striking observations from Tables 1 and 2 are as follows:

- In terms of the share of net interest margins (adjusted for interest revenue from government securities) in total assets, public banks' performance is dismal. The high share of average non-performing loans in total assets for public banks is not a surprising statistic given the fact that public banks were regarded as extra-budgetary, subsidy-disbursing devices by the fiscal authorities in the high inflation period.
- Even though foreign banks constitute the group smallest in size, the shares of before tax profits as well as the net interest margins are the largest. In terms of the ratio of total revenues to expenditures, again the foreign banks and the smallest size banks seem to be the most efficient. In the pre-stabilization, high inflation environment, arbitrage related activities did not seem to be subject to economies of scale. This observation also explains the phenomenon of the survivability of a large number of relatively small sized banks in the sector.
- Even though the share of net interest margin item was not subject to economies of scale, the share of net non-interest income in total assets was. It is evident that banks on average incurred losses from these activities, and more importantly smaller sized banks suffered more. However, in an environment where the average before tax profits over total assets stood at 8.07, a value of –2.15 for net non-interest income did not receive enough emphasis for the smallest size banks.
- Similarly, the average share of the overhead costs are highest at the foreign and the smallest size banks. One can also observe the same pattern for the average share of change in the stock of total credits extended in total assets variable.
- The smallest size banks have the highest average share of change in the non-performing loans in total assets variable.
- Combining these points, one can come up with certain predictions about the future structure of the Turkish banking sector. Under the assumptions of:
    - a successful finale to the current stabilization effort and a significant reduction in the outstanding government debt and real interest rates;

- the privatization or "autonomization" of the public banks; and
- the continuation of the current trend in international banking activities in which the traditional banking related activities are being displaced by off-balance sheet and non-interest related service provision that require scale economies;

one can conjecture that

- bank consolidation is expected, as smaller banks will not be able to survive in the stable environment;
- foreign banks will grow in size to be able to compete with larger size banks and not incur losses. The growth in size can be in the form of direct investment and opening up new branches or through mergers and acquisitions.

- One should also note that when the outstanding government debt stock falls, sovereign risks carried by the commercial banks will be replaced by credit risk. Also, since Turkish conglomerates will prefer direct financing through issues of private securities, banks will be financing medium- to small-sized firms. In the very near future, just like the case of Brazil following the launching of the *Plano Real*, non-performing loans will increase. Maturity mismatch risk will also grow. There is yet no secondary market for illiquid assets; securitization will be an important issue in the very near future.
- The explosive growth of the share of the off-balance sheet activities in total assets of the private and foreign banks is mostly due to the volume of the forward foreign exchange market. The importance of guarantees and warranties will also contribute to this growth with the emergence of private bonds and bills markets in Turkey.

The descriptive analysis was based on data broken down with respect to ownership and size. The analysis based on ownership did not control for size, and similarly the analysis based on size did not control for ownership. Also, changes in the macroeconomic environment were not controlled for. These problems are dealt with in the next section where we investigate results from the regression analysis using individual bank data.

3. Analyses Based on Panel Regressions

This section presents results gathered from dynamic panel regressions. The estimation method is generalized least squares with cross sectional weights. The unbalanced panel data set has a maximum of 494 observations for 52 banks over the period from 1988–99. The existence of the lagged

dependent variables as an exogenous variable in the regressions imply that the observed coefficients will be the impact multipliers and that medium- to long-run effects of each variable will be much larger if the lagged dependent variable is statistically significant. The ensuing analysis will interpret the regression results as being descriptive in nature: rather than focusing specifically on the magnitude of the coefficients the signs of the coefficients will be receiving emphasis. Table 3 presents estimation results from four individual panel regressions.

The dependent variables are the share of net interest margin (which includes foreign exchange related income and excludes interest revenues from securities portfolio) in total assets (NI/TA), the ratio of total revenues to total expenditures (TR/TE), and the shares of net non-interest related income (excluding income from foreign exchange related transactions) in total assets (NNI/TA), and overhead costs in total assets (OHC/TA). The effects of size and ownership are accounted for through the use of intercept and slope dummy variables. A dummy variable that takes the value of unity in 1994, zero otherwise, is also included in regressions to account for effects brought about by the 1994 crisis.[10] Other changes in the macroeconomic environment are incorporated in the model via the inclusion of variables such as the annual growth of GDP, the annual CPI-based inflation rate, and the *ex-post* annual real interest rate.[11] The intercept dummy variables are set up such that the coefficients of ownership dummy variables should be interpreted relative to private-owned banks and the coefficients of the size dummy variables are to be interpreted relative to the smallest size banks. Rather than interpreting each regression equation separately, the ensuing analyses will be based on the interpretation of the estimated coefficients of explanatory variables across regressions.

Controlling for ownership and macroeconomic environment changes, it can be seen that relative to smallest size banks, average net interest margins are significantly lower for larger size banks. We should note that since interest income from holding government securities is excluded, this figure represents interest income from "core" banking operations only. On the other hand, the average share of the net non-interest related income is significantly higher for larger size banks. These results also conform to those obtained from the descriptive analysis. It is important to note that once the smallest size banks are excluded, the relation between bank size and the average interest and non-interest income related activities breaks down since the magnitude of the coefficients of size 1, 2, and 3 banks are quite similar.

Table 3: Panel Regressions

Variable	NI/TA	TR/TE	NNI/TA	OHC/TA
Constant	-0.24	**63.30**	-0.75	**3.19**
	[0.27]	[17.00]	[1.72]	[7.51]
Size Dummies				
Size 1 (largest)	**-2.78**	2.49	**0.96**	**-1.42**
	[3.48]	[1.20]	[2.79]	[4.73]
Size 2	**-2.86**	-1.04	**1.24**	**-1.56**
	[3.79]	[0.52]	[3.59]	[5.12]
Size 3	**-2.84**	**-4.57**	**0.88**	**-0.99**
	[4.04]	[2.34]	[2.72]	[3.42]
Ownership Dummies				
Public	-0.97	**-3.92**	-0.29	**0.69**
	[0.48]	[2.19]	[0.29]	[2.11]
Foreign	-1.38	0.16	**1.71**	**-2.94**
	[0.79]	[0.04]	[2.42]	[3.75]
Macro Variables				
Dummy for 1994 Crisis	**-2.40**	**-3.80**	**0.60**	-0.30
	[7.05]	[4.90]	[3.18]	[2.74]
Real Interest	**0.03**	**0.08**	**0.02**	-0.00
	[2.08]	[3.00]	[2.63]	[0.50]
Interactive Dummies				
GDP Growth *Private	**0.27**	0.12	**-0.07**	-0.01
	[9.65]	[1.69]	[4.24]	[1.76]
GDP Growth *Public	**0.26**	**0.16**	-0.04	0.03
	[2.15]	[2.99]	[0.71]	[1.43]
GDP Growth *Foreign	-0.03	**-0.54**	-0.05	-0.07
	[0.31]	[2.60]	[1.12]	[1.62]
Inflation*Private	**0.06**	-0.01	**-0.02**	**0.00**
	[6.32]	[0.44]	[5.65]	[2.25]
Inflation*Public	**0.06**	**-0.07**	-0.02	-0.00
	[2.15]	[4.55]	[1.74]	[0.91]
Inflation*Foreign	**0.08**	0.06	**-0.04**	**0.04**
	[3.12]	[1.08]	[4.45]	[3.79]
Lagged dependent variable	**0.58**	**0.47**	**0.54**	**0.60**
	[10.60]	[16.41]	[10.42]	[12.09]
Adjusted R^2	0.45	0.98	0.36	0.72
Durbin's h test	0.13	0.30	-0.02	-0.32
Number of Observations	492	489	494	494

Notes: The regression is estimated using Generalized Least Squares with cross section weights, pooling an unbalanced bank level data set of 52 banks during the 12 years 1988–99. Absolute value of the t-ratios using standard deviations from the White's heteroskedasticity-consistent variance-covariance matrix are provided inside brackets below each coefficient. Coefficients given in bold imply significance at 5% level.

When we consider the share of overhead costs in total assets, we again encounter the evidence of returns to scale gains: average share of overhead costs are smaller for larger size banks. Measuring efficiency in terms of TR/TE, size 3 banks seem to be the least efficient among size 1, size 2, and size 4 banks. Thus, in the high-inflation environment of the 1990s, bank efficiency was not subject to scale economies. Based on the results for the size dummies, one may conjecture that in a low inflation environment characterized by lower net interest margins, smallest size banks will have difficulty in surviving since they have the lowest average non-interest income and the highest overhead costs. In the high-inflationary macroeconomic environment of the 1990s, persistent negative net non-interest margins and high overhead costs did not receive enough emphasis due to the high profitability of holding government securities. However, with the reduction in the real interest rates and the public sector borrowing requirement, these items, which are subject to economies of scale, will receive more emphasis and will constitute reasons for Turkish banking sector consolidation.

Controlling for size, the foreign and public banks on average do not differ significantly from private banks and foreign ownership seems to lower net interest margins. This is an important result. We can conclude that the reason the public banks fared worse in terms of net interest margins according to Table 1 is due to their size attributes rather than ownership. However, in terms of efficiency, as evidenced by the ratio of total revenues to total expenditures, public banks are significantly worse off than private banks. Foreign banks are as efficient as the private banks. When we analyze the net non-interest income, as argued previously, economies of scale seem to matter and larger size banks seem to do better than the smallest size banks. Controlling for size, foreign banks seem to do better than private banks in the non-interest income related activities. This is also not very surprising because other than Treasury-related operations, foreign banks have specialized in foreign sector-related transactions and are earning commission fees. In terms of overhead costs, conforming to the results concerning efficiency, public banks have a higher share in total assets and the foreign banks have lower shares. With speedy privatization or "autonomization" measures, we expect an increase in efficiency and a reduction in the share of overhead costs in the banking sector.

The real interest rate seems to increase the share of net interest margin, total revenue over total expenditures and the share of net non-interest related revenues. Following a successful conclusion of the revised stabilization program, permanent level reductions in the real interest rates

are to be expected. The reduction in net interest revenues in such an environment is not surprising. However, we expect certain structural changes in the banking system such that the currently free banking services will be fee-based in the very near future. The importance of the non-interest related income should be emphasized. Thus even though a reduction in the interest rates implied a reduction in the share of net non-interest income, due to the expected structural change, we expect the share to go up.

The coefficients of the interactive dummy variables explain the relevance of macroeconomic changes on the shares of net interest margin, net non-interest income and overhead costs in total assets as well as the ratio of total revenues to total expenditures according to ownership. Regardless of the ownership, a reduction in the inflation rate reduces the share of the net interest margins. This is consistent with observations on countries going through similar disinflation programs. It is also noteworthy to observe that a reduction in the inflation rate increases the net non-interest revenues and decreases the overhead costs of the private and the foreign owned banks but not public banks. However, with measures taken to privatize or "autonomize" the public banks, we expect the share of non-interest revenues to go up and the overhead costs to go down for the whole banking sector.

4. Conclusion

The descriptive analysis of the commercial banks operating in Turkey during the 1988–99 period points to the following: the chronic inflation of the past 15 years and the resulting high real interest rate displaced income from core banking activities by arbitrage income through open positions. The prevailing high net interest margins allowed for the existence of a large number of small banks and persistent net losses from non-interest related activities. The foreign banks in such an environment did not need to increase their size since scale economies did not matter as evidenced by the highest before tax profits accruing to smaller size banks.

With the successful completion of the currently revised stabilization program, investment horizons will be lengthened; arbitrage gains and high net interest margins will be eliminated. Banks will have to switch to non-interest income related activities and will have to generate sustainable sources of fee-based income. Compared to the environment when the public sector borrowing requirement was high and the existing banks did not have to compete with each other for asset management, economies of

scale will be an important issue. Consolidation within the sector will be taking place and small size banks will not be able to survive. Foreign banks will also need to grow in size, most probably through mergers and acquisitions, to be able to compete with large size banks in retail banking.

Since the market risk of the banks will mostly be due to credit risk (rather than the sovereign risk of holding Turkish government securities) in this future stable environment, securitization will be an important issue. In such an environment, bank financing will be mostly channeled to medium- and small-sized firms since Turkish conglomerates will prefer direct financing through issuing commercial papers. In the very near future, just like the case of Brazil following the launching of the *Plano Real*, banks profitability will be closely linked to the business cycles: during recession non-performing loans will increase. Maturity mismatch risk will also grow. The development of a mortgage-based securities market and establishment of a secondary market for other illiquid assets by the authorities as early as possible is a prerequisite to avoid future liquidity crises and to increase the strength of the banking system, which currently has a very fragile structure.

Notes

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1 The disinflation program is outlined in the Letter of Intent, which can be accessed at http://www.imf.org/external/np/loi/1999/120999.htm in its entirety.

2 See *The Letter of Intent*, articles 52-61.

3 See Alper (2001) for details on the November 2000 crisis.

4 For a detailed survey of financial restructuring following the disinflation experiences in Argentina and Brazil, see İnan (1999).

5 The term "an unbalanced panel of observations" implies that the data set is not a full matrix, that is, some banks in the sample have missing data during the 1988-1999 period.

6 These banks were excluded because data quality problems such as false reporting, inconsistent accounting standards and lack of transparency are more apparent for this group of banks and, if included, would have introduced additional noise to the data set.

7 It is important to note that a reduction in NI/TA does not necessarily imply an improvement in efficiency. An increase in interest expenditures, *ceteris paribus*, reduces the net interest margin.

8 See for example, Demirgüç and Huizinga (1998).

9 However, the results are not qualitatively sensitive to the exclusion of the interest income from securities portfolio. See Alper *et al.* (2001) for results using the definition of net interest margin including interest revenue from government securities portfolio.

10 See Özatay (1996) for a detailed analysis of the 1994 crisis.

[11] The regression results are robust to inclusion of variables such as market capitalization of the Istanbul Stock Exchange, and the concentration variable, which is the share of the largest three banks' assets in total banking assets.

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