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EXCHANGE RATES AND THE MONEY DEMAND PROCESS…

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Exchange Rates and the Money Demand Process during the Persistently High Inflation Period in the Turkish Economy: Causes and Dynamics[1]

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Abstract

The money demand process in Turkey during the period 1987:1-2002:3 can be explained better in the sense of Cagan (1956) rather than in the sense of Sargent *et al*. (1973). Cagan assumes the exogeneity of money. Sargent *et al*. suggest the endogeneity of money. Implicitly, the money supply process with regard to Turkish inflation is unpredictable with respect to the past history of prices, i.e. either inflation or currency depreciation. Therefore, the Turkish monetary regime may be described as a random walk monetary standard with short-term (myopic) discretionary policies used by the authorities. Moreover, the unpredictable money growth implies that the Central Bank's passive monetary policy implementations help maintain the persistently high inflationary process in Turkey.

Key Words: *Demand for Money, High Inflation, Granger Causality, Exogeneity of Money, Endogeneity of Money, Exchange Rate-Based Pricing.*

JEL: E31, E41, E65

Özet

1987:1-2002:3 döneminde Türkiye'nin para talebi sürecini, Cagan'ın (1956) dışşsal para talebi önerisi; Sargent vd.'nin (1973 para talebinin içselliği varsayımından daha iyi açıklamaktadır. Dolaylı bir biçimde, Türkiye'deki enflasyonun para arzı süreci, geçmişteki fiyatlar (yani enflasyon ve paranın değer yitirmesi) gözönüne alındığında kestirilemez bir süreçtir. Bu nedenle, Türk para rejimi, otoritelerin kısa dönemli (miyop) rastgele rassal adımlı para politikaları uyguladıkları bir rejim olarak tanımlanabilir. Yanısıra, Merkez Bankasının pasif para politikaları uygulamaları anlamına gelen kestirilemez parasal büyüme, Türkiye'de kalıcı yüksek enflasyonist sürecin devam ettirilmesine yardım etmiştir.

Anahtar Sözcükler: *Para Talebi, Yüksek Enflasyon, Granger Nedensellik, Paranın Dışsallığı, Paranın İçselliği, Döviz Kuruna Dayanan Fiyatlama.*

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1. Introduction

In this work we include the expected rate of the exchange rate in the Cagan demand for money function to assess whether the expected depreciation rate of the exchange rate appears to be an appropriate explanatory variable in the demand for money equation along with the expected rate of inflation. As Cagan (1956) argues that depreciating foreign currencies will not be completely abandoned due to increases in the cost of holding domestic currency. He implicitly assumes that the relevant substitution in the demand for real money balances is between real domestic currency and foreign currency that moves to equate the difference between foreign and domestic inflation rates. It is the aim of this work to investigate whether the monetary-fiscal or the balance of payments view better explains the dynamics of the inflationary process in Turkey over the sample period January 1987-March 2002. The monetary-fiscal approach, which stresses the predominant role of a fiscal shock or rapid money growth in prompting an excessive expansion in the money stock to finance the budget deficit, seems at first glance to best explain the inflationary process of the Turkish economy. On the other hand, ongoing currency depreciation due to persistent erosion in the real value of domestic balances under high inflationary circumstances has a significant role in explaining inflation in Turkey. Balance of payments approach stresses the role of the external sector, i.e. foreign exchange rate or external shocks in prompting high inflation. One may assume that a competing balance of payments approach may be a useful tool to understand Turkish chronic high inflation.

Economists generally accept the view that persistent inflation, irrespective of its roots, is ultimately a monetary phenomenon (Friedman, 1963). In fact, inflation is the observable outcome of a complex process of political and economic interaction in society. Hence, in such a context, a simple rhetoric of the cause-and-effect perhaps would not be so persuasive. For each cause brings into view one or more prior causes of which it may be the effect and effects at one stage becoming causes of another. It is then necessary to determine thoroughly the links between variables chosen from a large set. Furthermore, "in the absence of a comprehensive inflation theory, alternative models coexist. Each of them has its strengths and its weaknesses" (Heymann *et al*., 1995, p.11).

In the economic literature, there are three distinct families of simple high inflation theories, namely, structuralists, the monetary-fiscal approach and the balance of payments view of inflation. The monetary approach to high or hyperinflation assumes that prices continuously clear markets along an inflationary path. That is, prices are set in the money market by the interaction of the supply and demand for money although "such modeling devices do not provide a description of how prices are formed in actual market settings" (Heymann *et al*., 1995, p.12). Generally, the monetary approach to inflation concentrates either on the money supply or on money demand in explaining the inflationary process. Cagan's (1956) illustrious money demand analysis of hyperinflation attempted to search for a stable money demand function in the hyperinflationary episodes whilst the Sargent *et al*. (1973) paper drew attention to the

money supply process in hyperinflation. Monetary-fiscal view of high and hyperinflation suggests that money supply and money demand determine the price level, and purchasing power parity subsequently sets the exchange rate. The balance of payments view of inflation stresses the role of the external sector, e.g. exchange rates or terms of trade shocks, in prompting high inflation (Dornbush, 1985, and Dornbush, Sturzenegger and Wolf, 1990).

High inflation in Turkey has been an *intrinsic* characteristic of the economy since 1977 (Fry, 1986). Having stood in the throes of a balance of payments crisis in late 1979 with inflation into triple digits, Turkey achieved a remarkable transformation from an inward-oriented outlook to an outward-oriented one. It had also undergone significant liberalization in the areas of trade and finance starting from the outset of the 1980s. However, there remain some disturbing similarities with the late 1970s. Despite the favorable terms of trade, inflation is around 70 percent and the public sector budget is out of control. In other words, on the one hand, the economy enjoyed a successful external adjustment; on the other hand it went through severe internal imbalances. The scope of government activity was considerably enlarged via extra-budgetary funds, which in fact could be used and abused for discretionary purposes. External finance was replaced by domestic borrowing, at terms highly disadvantageous to the public sector. The Central Bank was obliged to finance the public sector deficits and hence fiscal imbalance induced rapid growth in the monetary aggregates, propagating inflationary pressure. Consequently, the economy underwent financial crises in early 1994 and 2001, which first hit the financial markets and gradually affected the real sector. The 1994 collapse costs the economy a 6.1 percent decrease in GNP and the latter cost the economy a 9.4 contraction in GNP. Although the authorities have shifted from monetizing the budget deficit to bond financing since the early 1990s, the short average maturity of domestic government debt prevented the effective management of the alternative means of deficit financing. In fact, the large debt stock leads to an expansion in the money stock in the economy, which prevents the Bank from asserting an active monetary policy. Accordingly, the bond-financed deficits appear to be inflationary as much as the monetized deficits, i.e. seigniorage.

Consequently, in this chapter we attempt to find answers to the following questions:
1. Was the driving force of the inflationary process in Turkey due to excessive growth of money stock or currency depreciation? We try to find out whether agents base their decisions on the exchange rate or inflation, i.e. price indices such as wholesale prices, in a chronic-high inflation economy like Turkey. It is safe to assume that the exchange rate is a daily observable variable set in the market, hence measured often without cost and error, which is not the case with price indices for they may be predicted with error. Moreover, contrary to price indices, the foreign exchange rates may be presumably widely followed and well understood. Consequently, most of the prices and incomes in a chronic high inflation economy like Turkey may be expressed in a hard foreign currency, which becomes the universal unit of account, and partially the medium of exchange. A natural extension of this hypothetical consideration is to assume that economic agents may use foreign exchange rates, while determining domestic real money holdings. In short, we test the hypothesis, whether the exchange rate is

determined in the money market, and hence as a consequence of currency substitution, agents denominate their real domestic currency holdings in foreign currency, and adjust them to the expected rate of exchange rate depreciation.
2. Was the money demand process specified endogenously, in the sense of Sargent *et al*. (1973) or exogenously, in the sense of Cagan (1956)?
3. According to the monetary approach, prices continuously clear markets along the inflationary path. Under chronic high inflation, what is the role of prices and exchange rates, in particular, with respect to adjustments to the money markets? Does money Granger-cause inflation and/or exchange rates? Or is there reverse causation from inflation to money and/or exchange rate; and from exchange rate to money and/or inflation?

We attempt to determine what are the key macroeconomic variables that underlie the inflationary process in Turkey. The main object of this study is to investigate whether the monetary or the balances of payments approach better explains the Turkish chronic high inflation. Was the excessive money expansion or currency depreciation the driving force of chronic high inflation in Turkey? Further, we will find out whether the money demand process in Turkey is an endogenous process or one, as suggested by Cagan that grows in an unpredictable and exogenous fashion. Finally, we will explore whether there exists an exchange rate-based pricing in the economy, or whether prices are set in the money market.

The remainder of the study is set out as follows. Following the introduction, in section 2, we briefly discuss the underlying theories explaining inflationary dynamics in the economy. In section 3, we discuss the structure of the data series used in the work. Section 4 investigates the causal nexus between the variables of interest applying Granger causality tests in an attempt to determine whether the money demand process is endogenous, i.e. predictable, as suggested by Sargent *et al*. (1973) or exogenous which means the money demand may change unpredictably, and hence agents form their expectations adaptively (Cagan, 1956, 1990). In section 5, we analyze the order of integration of the variables and test for cointegration so as to determine the number of long run relationships between the variables. First, we apply an unrestricted VAR in order to specify whether the variables are cointegrated. Then a restricted VAR is applied to test for the overidentfying restrictions imposed. The over identifying restrictions are imposed in order to specify the role of money demand and the existence of an exchange rate-based pricing procedure. Finally, we investigate price adjustments in the economy, using error correction models for prices and currency depreciation. In section 6, we offer some conclusions.

2. Theoretical Background

In the literature on high inflation, explanations of inflation may be combined into three distinct families, if sometimes interrelated. The non-monetary models of structuralist ancestry dwell on the political economy of a country, its ownership structure, the efficiency of investment and industry, and competition between different economic groups, i.e. price and wage setting practices. The balance of payments view of inflation

tends to center on the exchange rate dynamics in explaining inflationary process. The models of the quantity theory lineage, i.e. monetary-fiscal models, concentrate on the interaction between prices and money balances. "Monetarist have been called 'structuralists in a hurry', because their explanation of monetary accommodation of inflation seldom goes beyond the proximate or mechanical determinants of money supply to elaborate the fundamental structural forces driving the process" (*ibid*.). As Heymann *et al*. (1995, p.13) state the modern approach to inflation reflects the regime dependence of behavior. Hence each model incorporates features, which are specific to high inflation regimes, clearly distinguishes them from inflation models of an earlier generation (cf. Laidler *et al*., 1975).

The monetarist approach to inflation highlights the interactive dynamics of money demand and the money supply (in the money market) determining the behaviour of prices. There exist two main lines of research in the study of hyperinflation. The pioneering study of Cagan (1956) investigated the relationship between real money balances and prices and searched for a stable money demand function in the hyperinflation episodes. In fact, Cagan's (1956) study is the origin of two branches of hyperinflation studies. Although he also studied the money supply process, Sargent *et al*. (1973) mainly advanced the second line of the literature. Cagan (1956) assumed that the supply of money is exogenous, i.e. policy determined, and there is no feedback in the sense that the causal relationship between the money stock and prices is unidirectional. Also, expectations about future developments can differ from concurrent conditions and determine the agents' response to inflation. In essence, Cagan (1956) assumed that expectations are formed adaptively such that expected values are adjusted in proportion to their discrepancy from actual values. Hence, expectations of future inflation can be estimated as an exponentially declining weighted average of past inflation rates. Cagan (1956) was particularly interested in estimating the slope of the log of real balances with respect to expected inflation. For such adaptive expectations lag behind the changes in actual values, this may account for why hyperinflation characteristically tends to escalate. Cagan (1956) assumed that governments extract revenue from creating money as the principal means for deficit financing. Also, Cagan (1956, 1990) suggests that during hyperinflations the amount of money issued may change unpredictably or otherwise not be knowable with much precision. Thus, the hypothesis of rational expectations, which allows agents to estimate the rate of money creation, will not be useful for predicting the path for prices. The supply of money is governed by short-term discretion, reflecting the current hyperinflationary conditions and socio-political pressures. Heymann *et al*. (1995) name such fiscal and monetary policy regimes as *random walk monetary standards*. Cagan (1956, 1990) argues that the hyperinflationary episodes can only be unstable if they became a self-generating process, which means that the hyperinflation is driven by the escalations in the expected rate of inflation rather than increases in the money growth, i.e. when the supply of money is considered as endogenous to inflation. Nevertheless, Cagan's stability analysis only takes account of the case in which the money process is strictly exogenous.

Sargent *et al*. (1973) augmented Cagan's model by adding certain assumptions, and hence converted it into a rational expectations model: (i) adaptive expectations of

inflation are rational, (ii) the money demand disturbance is econometrically exogenous with respect to money growth and inflation, and (iii) the money demand disturbance follows a random walk (Christiano, 1986, p.33). The theory of rational expectations suggests that agents use all available information in predicting the inflation rate, which in particular, implies that agents predict the future level of inflation in an attempt to forecast the money creating policies of the government. In addition, if money is consistently issued to accrue revenue in real terms, monetary growth will hinge upon the inflation rate. Hence, the money stock is statistically endogenous to the inflationary process. The question of the relationship between the money stock and prices has been extensively discussed in the literature [see, Sargent *et al*., (1973); Frenkel (1977); Evans (1978); Salemi and Sargent (1979); and Protopapatakis (1983) *inter alia*]. Sargent *et al*. (1973) suggest that the negative effect of inflation on real money holdings, together with a failure to raise government tax receipts, leads to increasingly rapid accelerations in the nominal supply of money to finance real government expenditures. They argue that the expansion in the money supply is itself a result of ongoing inflation, and being a major factor in affecting the rate of inflation. Thus, there is evidence of uni-directional causation between the supply of money and inflation.

Sargent *et al*. (1973) explain that under the circumstances of the assumptions holding, the existence of a regime that attempts to maintain a constant proportion of resources in an economy through seigniorage. This suggests a specific causality running from prices to money growth. Because printing money to finance the deficit generates inflation, subsequent notes issued by the authorities have to be increased, in response to the effects of inflation on the nominal cost of resources in later periods. Consequently, the growth of money turns out to be dependent on the increase in prices; that is inflation causes money growth. Also, since expectations are rational, the public will adjust expectations of future inflation according to the rate of money growth. For the rate of money creation hinges upon past inflation, then agents will foresee the rate of money creation from past prices. Therefore, inflation will come to rest on past inflation and money creation drops out of the chain of causation, which in short, suggests a unidirectional causal direction from prices to money. Inflation once triggered can result in an increase in the fiscal deficit if the government attempted to maintain real expenditures through money creation while revenues lagged behind the movement in prices. Under the fiscal dominance theory, the supply of money is dependent on past inflation, and hence it is endogenous to the inflationary process.

Accordingly, the causal relationship will imply that the lagged values of prices and money explain current values of money better than past values of money alone, while at the same time lagged values of money and prices fail to explain current prices any better than past prices by themselves. In fact, if money growth does not cause inflation, Cagan's forecasting scheme in which only past inflation is used to predict future inflation may be rational rather than adaptive. Certain successful reform attempts might break this causal nexus from prices to money. Thus, a regime change designed to end the inflationary vicious circle entails the monetary authorities regaining control over money creation. Many countries, however, have pursued the policy of financing government expenditure by seigniorage in particular many developing countries in their pursuit of

growth through capital accumulation. They might have no choice but to run fiscal deficits so as to finance the budget deficit. First of all, their tax bases are inadequate to allow a high tax burden. Secondly their tax administrations are highly inefficient, and finally the political vacuum and pressures significantly hinder the enactment of an adequate tax policy. Moreover, the developing capital markets and limited external borrowing force the budget deficit to be financed wholly or partly through money creation. At the margin, the central bank tends to be the only ready taker of government bonds in large amounts, so that the deficits are routinely monetized. The main reason for this self-perpetuating effect between government deficits and prices is that the nominal revenues of the government are fixed in the short run, whereas their real value decreases in response to rapid inflation. Thus, this form of deficit financing causes inflationary pressures by increasing the supply of money.

The monetarist view of the hyperinflation models suggests that inflation is stable and will settle at the point where a maximum inflation tax is obtained. As Kiguel (1989) argues that hyperinflation may turn out to be an unstable process triggered by the government's attempt to create money in excess of the revenue maximizing inflation tax. This may result in financial collapse rather than continuing inflation. Nevertheless, an unsustainable budget deficit may be financed by seigniorage where real money holdings are increasingly trending and the rate of growth of prices is decreasing, i.e. deflation. However, Bruno *et al*. (1990) and Bruno (1993) show that there are two possible high and low equilibria when the government prints money in order to finance the deficit. Under rational expectations stable high inflation equilibrium is possible; a second unstable inflation low equilibrium is also possible. Under adaptive expectations, the low inflation equilibrium is likely to be stable. Therefore, Bruno *et al*. (1990) argue that when monetary policy appears to accommodate fiscal pressures, the inflation rate will be determined by the fiscal authority. Thus the economy may find itself in a high inflation trap due to the likelihood of multiple equilibria. In short, the monetary anchor cannot be replaced by a fiscal anchor even though fiscal adjustment is a prerequisite to stopping hyperinflation.

There is another explanation of the causality from prices to money, which is known as the balance of payments theory or 'the theory of the German hyperinflation'. According to this view, inflation is strictly linked to the changes in the exchange rate prompted by balance of payments crisis (Bruno *et al.*, 1990). The German hyperinflation was mainly caused by rigid wages, the inelastic supply of German exports, and the low elasticity of demand for her exports. The balance of payment approach to the seigniorage maximization issue considers the fact that domestic residents may substitute a foreign currency for the domestic currency 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, in particular, in chronic-high inflation economies. The underlying logic of the monetary approach to the balance of payments theory is that under the circumstances of certain

rigidities in the economy, such as rigid wages etc, the central bank comes to lose control of the supply of money when the price level escalates, for example, due to a significant decline in the exchange rate. Ultimately, the central bank will attempt to finance passively the accelerated nominal demand for money and credit balances. Unless the central bank intervenes with the money market, then there will be a currency collapse. As Dornbush (1985, p.15) states "the balance of payments approach…claims that adverse balance of payments developments force exchange rate depreciation which then deteriorates inflation and with that, budgetary performance. In a setting of passive money, exchange rate disturbances then cause inflation". Accordingly, when monetary authorities do not attempt to target a nominal anchor, i.e. passive monetary policy, either because of an explicit policy of monetary accommodation or because of the monetary financing of the deficit, the nominal exchange rate shocks may have some inflationary effects. Persistently large budget deficit will lead to inflation through reducing the central bank's foreign exchange assets, which will ultimately cause balance of payments crises. In fact, the analytical distinctions between the monetary and the balance of payments approaches to inflation seem difficult to pinpoint. For instance, for a small open economy the steady-state inflation rate may be identified by the exchange rate or budget policy. If the authorities introduce a budget deficit target, then the steady-state equilibria for the inflation can be pinpointed by the rate of growth of the money supply. In a small economy with a fixed exchange rate, however, the nominal money supply is beyond the control of the monetary authorities. Thus, the constancy of the steady-state real exchange determines the domestic rate of inflation. Hence the authorities will extract revenues from the inflation tax to finance the deficit. In the absence of a nominal anchor for the policies, the inflation rate will be a random walk.

3. Data

Monthly data on the wholesale price index (WPI), the broad money demand (M3), and the trade-weighted real effective exchange rate index for the period January 1987 through March 2002, which are obtained from the database of the Central Bank of Turkey. The reason for the restriction of the present work to the period 1987:1-2002:3 is the availability of data on the monthly money demand series and real exchange rate index. The M3 definition of money stock includes M2 plus official deposits plus foreign exchange deposits plus other deposits with the Central Bank. The demand of broad money series, M3 is transformed into logarithmic form, and then the first difference in the logarithm of the demand for money series is created to represent the monthly growth rate of the broad money demand (Δm). The monthly inflation rate is created by using the WPI, and hence the first difference of the logarithm of wholesale prices is used as the monthly inflation rate (Δp). The real effective exchange rate index is transformed into logarithmic form, and then the first difference in the log of real exchange rate index is created to obtain the monthly growth rate of the real effective exchange rate index (Δex). Thus, the corresponding monthly growth rates of the real exchange rate index represent the currency depreciation.

It is generally accepted that central banks can keep increases in monetary aggregates of the economy under control by monitoring the movements of reserve money. The control

of monetary aggregates is expected to have an inflation-reducing effect, based on the assumption that it will limit nominal aggregate demand through the interest rate and loan policy of the central bank. It is a fact that controlling reserve money growth is not an easy task in Turkey due to the rapidly increasing domestic debt stock that is restraining the Bank's ability to control reserve money. To the extent that increases in reserve money mainly stem from loans provided to the public sector. This has a stronger effect on accelerating in inflation than an increase in reserve money resulting from an increase in the foreign exchange operations of the Bank. Therefore, Treasury access to the Bank advances is capped at 3 percent of the increase in total budget appropriations. The Bank's main priorities are to ensure stability in money and foreign exchange markets. Since 1996, the Bank's goals were to follow a real exchange rate policy and to control reserve money over the liquidity demand. Accordingly, the authorities attempt to finance the increasing budget deficit through domestic borrowing by paying high interest rates on the debt rather than using the Bank's advances to the Treasury. As a result, the domestic debt tends to increase exponentially, which in turn results in expansions in monetary aggregates that is in fact necessary to manage the large stock of debt. It was excessive money growth that prompted the high inflation in Turkey. For instance, the public sector cash financing requirements increased 67.9 percent in 1997. The choice of M3 definition of the money demand is consistent with the aim of this work since it consists of both the foreign exchange and official deposits, which in particular fuel inflation. Also, it may provide us with the opportunity to analyze the effects of the Bank's operations on the financial markets through intervention in the foreign exchange markets in order to maintain stability of the exchange rates.

4. Monetarist vs. Balance of Payments Approach to Inflation: Granger Causality Tests

In order to investigate the relative importance of growth of the demand for M3 and currency depreciation in prompting the inflationary process in Turkey, we make use of the Granger causality tests in the sense of Dornbush *et al*. (1990). These are specified in a tri-VAR relationship between inflation and the growth rates of the money demand series and currency depreciation represented by the real effective exchange rate. Also, we carry out the Granger causality tests identified in a bi-VAR relationship between the money demand and inflation as suggested by Sargent *et al*. (1973). Both the bi-VAR and the tri-VAR systems are specified in first differences of the variables of interest given *a priori* non-stationarity of the variables; that is, we assume that they cointegrate. As we show in the following section that inflation, money growth and currency depreciation are non-stationary variables integrated of order one I (1), and are also cointegrated. An unrestricted VAR is well suited to identify data interdependencies for it should capture the dynamics in an unconstrained fashion. The results from the Granger causality tests will help identify whether the inflationary process is best explained by the monetary or balance of payments approach.

The Granger causality tests are performed by using the Johansen maximum likelihood (JML) cointegration methodology (Johansen, 1988; and Johansen *et al*., 1990). In fact, the unrestricted tri-VAR specified to test for the causal relationships among the variables

will be used to advance certain conjectures and to test them in the following section by imposing necessary restrictions. That is, while we employ the same unrestricted VAR cointegration technique to test for the causal relationship among the variables of interest, the obtained results from the tri-VAR cointegration tests should also be evidence of the existing cointegrating relationships among money growth, inflation and currency depreciation. Since the Johansen cointegration test technique is sensitive to the lag order, we first attempt to determine the lag length. A VAR order of 4 is chosen on the basis of the SBC for both tri-VAR (Δp, Δex, and Δm) and bi-VAR (Δp and Δm) systems. In fact, the lag length is determined on the basis of the underlying assumptions of the VAR model, which in particular, should be satisfied with respect to misspecification tests. Thus, having checked the diagnostics of the VAR models both for the single equation and vector systems, we conclude that the residuals in the VAR are free from serial correlation, heteroscedasticity, and non-normality. The Johansen VAR models are well specified.

Table 1. Granger Causality Tests

	Variables: Δp, Δex and Δm		
	Equation for:		
	Δp	***Δex***	***Δm***
Δp	8.288 (0.000)***	1.340 (0.510)	0.001 (0.967)
Δex	16.064 (0.000)***	0.017 (0.895)	0.101 (0.751)
Δm	1.003 (0.318)	32.260 (0.000)***	2.206 (0.113)
	Variables: Δp and Δm		
	Equation for:		
	Δp		***Δm***
Δp	1.506 (0.471)		0.285 (0.594)
Δm	6.646 (0.000)***		1.961 (0.122)

Notes: "***" denotes significance at 1%. The test statistics are given in the F-statistic form, whose degrees of freedom appears to be F(4,166) for tri-VAR system, and F(4,170) for bi-VAR system. p-values are in parentheses.

Table 1 displays the causal relationships among inflation, the broad money demand, and currency depreciation represented by the growth rates of the real effective exchange rate index. The results clearly show that the hypothesis of the money demand endogeneity (Sargent *et al*., 1973) does not hold for Turkish inflation over the period considered in this work. For the broad money equation shows that money growth is exogenous. As Sargent *et al*. (1973) suggest, under hyperinflation the government will resort to money creation to finance the budget deficit. This implies a specific causal relationship between money growth and inflation. As the creation of money to pay for budget deficit promotes inflation, the note issue will become dependent upon price increases. This suggests that inflation causes money growth. Assuming rational expectations, agents will predict the growth rate of money creation in an attempt to forecast the future inflation rate. Thus,

the empirical implication of fiscal dominance and rational expectations for hyperinflation tends to view the money supply as endogenous to the inflation process. However, as Cagan (1990, p.181) argues "usually…the amount of money issued may change unpredictably or otherwise not be knowable with much precision". Despite the fiscal dominance, the money supply process in the Turkish inflation grew mainly unpredictably, as suggested by Cagan (1990), rather than in a predictable, and hence endogenous way as advanced by Sargent *et al*. (1973). That is, the implication of a uni-directional causal ordering from prices to money growth is refuted. The Granger causality tests specified in a bi-VAR relationship between inflation and money growth are also considered, and the results obtained are reported in the second part of Table 1. As can be clearly seen from the table, money is exogenous and prices are endogenous, which verifies the results obtained from the tri-VAR system. The results from the Granger causality tests do not verify the balance of payments view that implies that the exchange rate is exogenous (Dornbusch *et al*., 1990). As can be seen from Table 1, inflation is Granger-caused by the rate of change in the foreign exchange rates. Also, the currency depreciation is Granger-caused by broad money growth. The results show that currency depreciation significantly Granger-causes inflation, which accounts for the importance of the exchange rate-based pricing. Upon being exogenous, the money supply process might be deemed as unpredictable, and cannot be Granger-caused by either inflation or currency depreciation. Accordingly, the money supply process follows a random walk with a drift, and grows unpredictably. In short, the money supply process in Turkey is exogenous and significantly affects currency depreciation. This supports the monetary explanation of inflation in Turkey over the sample period covered in this study.

There is a bulk of studies on the monetary explanation of hyperinflation. Salemi (1980) suggests that the money stock was not sensitive to changes in the exchange rates in the German hyperinflation era. He did not find a causal relationship running from the rate of exchange depreciation to the inflation rate. Aghevli and Khan (1978) found a two-way causal relationship between inflation and money growth. Petrovic (1995) suggest that the monetary approach to inflation tends to be more appropriate in explaining the Yugoslav hyperinflation than the balance of payments view. Because the Yugoslav money supply process is found to be exogenous supporting Cagan (1956), whereas the rate of exchange rate depreciation appears to be endogenous in contrast to the balance of payments view.

5. The Role of the Money Supply and the Exchange Rate Based Pricing

In this section, we will first determine the order of integration of the variables of interest by using the Augmented Dickey-Fuller (ADF) testing procedure. The monetary model of the exchange rate determination is generally considered as a theory of long-run equilibrium most appropriate for economies experiencing major monetary shocks. In testing a theory of long-run equilibrium, since the application requires a multivariate relationship, it is best to use the maximum likelihood cointegration tests, i.e. the Johansen maximum likelihood procedure. As we have already performed some unrestricted tri-VAR system of cointegration tests for inflation, the broad money supply series and the rates of foreign exchange depreciation, we will test explicitly certain

conjectures concerning exchange rate-based pricing and money driven inflation by imposing the corresponding restrictions. Then we attempt to identify the long run structure of the variables and to extract the common stochastic trend.

The results obtained from the unrestricted tri-VAR systems suggested that the variables entered into the cointegration space appear to be non-stationary, i.e. I (1). We have found some cointegrating vectors among the variables of interest, prior to testing for cointegration the ADF tests are applied to investigate the orders of integration for the variables of interest. Investigation of the orders of integration for the variables of interest is the first step in our analysis which, in fact, may be deemed to be part of the testing procedure of the stochastic structure of the time series involved. Thus, we carry out ADF tests (1981) in order to determine whether the variables are integrated of the order one or zero, i.e. stationary or non-stationary in levels. For our purposes, the variables ought to be I (0) in levels. Based on the evidence of the Schwarz Bayesian Criterion (SBC) lags up to the order of the twelve are applied in the ADF tests. A constant term, seasonal dummies, and a trend are included in the corresponding regressions. Unit root tests are presented for the levels and first differences of the variables that allows us to test whether a given series is integrated of order I (0) or I (1) and may be seen as testing for adjacent orders of integration (Ericsson *et al*., 1996, p.18). In all cases, the first differences do not tend to exhibit a unit root. According to the ADF test results, both the real money stock series and the inflation rate are integrated of order one, i.e. I (1), at the 1% significance level. Critical values for the ADF tests are taken from MacKinnon (1991). The ADF test is performed on both the level and the first differences of the variables.

Table 2 lists the ADF statistics for the variables. Empirically, looking at the levels of the variables, there is strong evidence in favour of the null hypothesis of non-stationary. All the test statistics (absolute values) are lesser than the critical values at 5% and 10% significant levels as their roots are large and close to unity, indicating that they might be stationary. As for the first differences of the variables, the null hypothesis suggests that the variables be integrated of order two whereas the alternative hypothesis refers to the integration of the variables at order one. The ADF test results tend to reject the null hypothesis of a second unit root and accept that the alternative hypothesis referring to the presence of a single unit root in the variables. We conclude that the first and second differences of the variables appear to be stationary; i.e. I (0), while the levels are non-stationary, namely I (1). Tests results indicate that none of the variables seems to show evidence of two unit roots. None of the variables are able to reject the null hypothesis of single unit root. That is, all of the variables are non-stationary in levels, but stationary in first, i.e. integrated of order one.

The Phillips-Perron (PP) test uses the same critical values of the ADF test. The PP test is performed on both the level and the first differences of the variables of interest where the n chosen large enough so as to ensure that the residuals are white noise. For this purpose, Newey and West (1987) lag window of order one is used. Rejection of the null hypothesis is rejection of a unit root (non-stationarity) in favour of stationarity. For the levels of the variables, the null hypothesis is that the variables are integrated of order

one, whilst the alternative hypothesis is that the variables are to be integrated of order zero. Looking at the levels of the variables, there is strong evidence in favour of the null hypothesis of non-stationary. All the test statistics (absolute values) are lesser than the critical values at 5% and 10% significant levels. As for the first differences of the variables, the null hypothesis suggests that the variables be integrated of order two whereas the alternative hypothesis refers to the integration of the variables at order one. As can be seen from Table 3, the PP test results tend to reject the null hypothesis of a second unit root and accept that the alternative hypothesis referring to the presence of a single unit root in the variables. Thus, we conclude that the first differences of the variables appear to be stationary; i.e. I (0), while the levels are non-stationary, namely I (1). The results are very similar to those of obtained from the ADF tests.

Table 2. ADF (12) Statistics for Testing for a Unit Root

	Levels		*First Differences*	
Variable	***Lags***	***ADF t-stats***	***Lags***	***ADF t-stats***
Δp	12	-1.733	11	-8.078***
Δex	1	-2.077	2	-10.467***
Δm	1	-1.083	12	-10.191***

Notes: "***" denote rejection at 1% critical values. The critical values for ADF (12) tests are from MacKinnon (1991). A constant, a time trend, and monthly seasonal dummies are allowed to enter in the estimated equations. The maximum available sample is used, and varies across null order. The estimated coefficients are given in parentheses. Performing the ADF tests, the optimum lag length was chosen based on the evidence provided by Schwarz Bayesian Criterion (SBC) - up to twelve lags.

Table 3. Phillips-Perron (12) Statistics for Testing for a Unit Root

	Levels		*First Differences*	
Variable	***t-statistics***	***p-value***	***t-statistics***	***p-value***
Δp	-1.220	0.227	-9.653***	0.000
Δex	-2.227	0.027	-8.030***	0.000
Δm	-1.164	0.247	-7.445***	0.000

Notes: "**" significant at 1%. The critical values for Phillips-Perron (1988) tests are taken from MacKinnon (1991). The Phillips-Perron (1988) test statistics are calculated for lag length 12. A constant and a time trend are included in the estimated equations.

Having determined that the variables of interest appeared to have one unit root each, we proceed to test for cointegration between the variables. Before testing for cointegration, it is useful to identify the long run structure of the variables. The findings suggest that

money growth is exogenous and plays a significant role in explaining the exchange rate depreciation that in essence determines inflation. All these empirical implications suggest the following transmission mechanism:

$$\Delta p_t = \alpha \Delta ex_t + \varepsilon_t \quad (1)$$

$$\Delta ex_t = \sigma \Delta m_t + \varphi_t \quad (2)$$

The transmission mechanism implies that inflation (Δp_t) is indexed to exchange rate depreciation (Δex_t), and the rate of exchange rate depreciation depends upon money growth (Δm_t), while ε_t and φ_t are random errors. Money growth ultimately drives inflation, but the causal relationship running from money to inflation is tightly linked to currency depreciation. One can analyze the transmission mechanism represented in a two-equation system employing the JML cointegration procedure (Johansen, 1995) with respect to identification, and weak exogeneity (Johansen, 1988). If the transmission mechanism is correctly specified, there must exist at least two cointegrating vectors representing two reduced form equations, i.e. Eq (1) and Eq. (2). Then, by putting some restrictions on the cointegrating vectors obtained from the unrestricted VARs, we attempt to analyze whether money growth is weakly exogenous in Eq. (2), as is the currency depreciation in Eq. (1).

Table 4. Cointegration Analysis of Inflation, Currency Depreciation and Growth of Broad Money Demand

H_0: rank=p	λ_{max}	95%	λ_{trace}	95%
r=0	64.218**	17.680	97.387**	24.050
r≤1	30.931**	11.030	33.169**	12.360
r≤2	2.237	4.160	2.237	4.160
Restricted VAR (4) Model				
Standardized Eigenvectors β′			***Long-run Adjustment Coefficients α′***	
Δp	**Δex**	**Δm**	**Δp**	**Δex**	**Δm**
1.0000	-1.2113	0.0233	-1.1642***	-0.3642	0.2753
0.8940	1.0000	-3.3079	-0.6936	-1.1010***	0.6262
Test of Identifying Restrictions on the Cointegrating Vectors					
Standardized Eigenvectors β′			***Long-run Adjustment Coefficients α′***	
Δp	**Δex**	**Δm**	**Δp**	**Δex**	**Δm**
1.0000	-1.1973	0.0000	-1.9482***	-0.0726	0.0000
0.0000	1.0000	-0.4075	-0.2115	-2.8007***	0.0000
Cointegrating Vectors Obtained from ARDL and FM-OLS Methods					

	ARDL (1,1,0)			*FM-OLS (2)*	
Δp	***Δex***	***Δm***	***Δp***	***Δex***	***Δm***
1.0000	-1.6200	-0.6051	1.0000	-0.9406	-0.4748
-	(-5.062)***	(-1.866)*	-	(-4.498)***	(-1.885)*

Notes: "*", '**' and "***" denote significance at 10%, 5% and 1%, respectively. For comparison, we estimated the cointegrating relationship using the ARDL and FM-OLS methods. The lag order of two for both methods is chosen using the lag selection process applied in the previous chapters.

Table 4 reports the cointegration test results. The maximal eigenvalue and trace eigenvalue statistics accept the alternative hypothesis of the presence of at least one but possibly two cointegrating vectors at the statistical significance level of 5%. Thus, we conclude that there are two cointegrating relationships between the variables of interest. Table 4 also reports the standardized eigenvectors (β') obtained from the unrestricted VAR. The standardized eigenvectors and adjustment coefficients appear to be correctly signed and plausible magnitudes. Nevertheless, the standardized eigenvectors are not determined uniquely with respect to stationarity since any linear combination of them is also stationary. Therefore, other criteria are needed to choose from the set of cointegrating vectors to identify the model, i.e. the proposed transmission mechanism. The proposed model suggests that money growth should be excluded from the first vector and inflation from the second. Moreover, if money growth appears to be weakly exogenous, adjustment coefficients (α') of money growth, i.e. α_{13} and α_{23} should be zero. This implies disequilibrium in the cointegrating relationship does not feedback directly onto money growth. The restricted long run structure of Eq. (1) and Eq. (2) will be equivalent to imposing and testing the restrictions as explained above. The overidentfying restrictions give us the opportunity to determine if the proposed model is correctly specified. The estimated model under the imposed restrictions is reported in Table 4. As can be seen from the table, these restrictions could not be rejected even at the 10 % level. The value of the corresponding LR-test, which is distributed as chi-square $\chi^2(2) = 1.3037$ (0.274), with the p-value in brackets. Thus, the null hypothesis that the restrictions imposed are valid cannot be refuted.

Hence, the overidentified long-run structure of the model, suggesting the long run relationships between inflation and currency depreciation as well as between currency depreciation and money growth is undoubtedly affirmed along with the weak exogeneity of money. The signs and size of the freely estimated parameters are a further indication of how suitable these identifying restrictions are. The resulting over-identified cointegrating vectors for inflation and currency depreciation are given as follows:

$$\Delta p_t = 1.1973 \Delta ex_t \quad (3)$$

$$\Delta ex_t = 0.4075 \Delta m_t \quad (4)$$

Both the inflation and currency depreciation relationships seem sensible. The exogeneity test justifies the normalization of cointegrating vectors (3) and (4), i.e. inflation is dependent on currency depreciation (3), and hence currency depreciation hinges on money growth. Therefore, the chain relationship implies that inflation is prompted ultimately by the money demand through currency depreciation. That provides evidence of the presence of exchange rate-based pricing in Turkey over the sample period. The long run adjustment coefficients measure the feedback effects of lagged disequilibrium in the cointegrating relationship onto the variables in the vector. Only α_{11} and α_{22} are significant, i.e. the coefficients of inflation and currency depreciation. The significant long run adjustment coefficient of inflation in the first cointegrating vector implies that the long run relationship between inflation and currency depreciation effects only short run changes in inflation, but not those in currency depreciation. As a result, currency depreciation (i.e. the rate of changes in the real effective exchange rate) appears to be weakly exogenous for inflation. The significant long-run adjustment coefficient on currency depreciation suggests that currency depreciation adapts to variations in money growth, but money growth is weakly exogenous to currency depreciation. This implies that disequilibrium in the long-run cointegrating relationship between currency depreciation and money growth does not feedback directly to the currency depreciation. It is worth noting that as inflation escalates, currency depreciation becomes significant with respect to price adjustments (Cagan, 1990).

As for the short-run dynamic adjustments, it is important to question how the short-run price adjustments made in high inflation. At moderate rates of inflation, prices adjust to past inflation and currency depreciation does not tend to play a dominant role. However, as inflation increases, the role of currency depreciation tends to play substantially a pronounced role in determining price adjustments. Empirical evidence suggests that in the regressions of current prices on currency depreciation and lagged prices, lagged prices tend to be an important predictor at low rates of inflation (Fischer *et al*., 2001). As inflation accelerates, however, currency depreciation takes over the role of inflation, being a good predictor. For we have already determined that in the long run, inflation depends on currency depreciation, the same relationship can be further analyzed to investigate the short-run price adjustments in a chronic high inflation country such as Turkey. To do so, we estimate the ECM model, underlying the long-run relationship between inflation and currency depreciation, and lagged values of second differences in prices and currency depreciation. Estimating the ECM models of inflation-currency depreciation regressions, we are particularly interested whether the lagged values of prices or exchange rate depreciation are jointly significant in the regressions. Jointly significant inflation (exchange rate depreciation) in the regressions suggests the importance of inflation (currency depreciation) in adjusting prices in the short run. Fischer *et al*. (2001) argue that Turkey had two high inflation episodes of short-duration. First episode of high inflation lasted 23 months and was between May 1993 and March 1995 with the cumulative inflation rate of 136.6. Second episode of high inflation in Turkey lasted 12 months and started in February 1997 and ended in January 1998. To test for the hypothesis stated above, we estimate the ECM models of inflation for the whole sample period and for two high inflation episodes. There was also one more high inflation episode in Turkey between March 1979 and September 1980. Our data series

does not cover this period, so we are unable to carry out the short-run analysis for this period. Table 5 shows the calculated Wald-tests [$\chi^2(4)$], with the p-values in parentheses, indicating the joint significance of the lagged values of inflation and currency depreciation in the ECM models for inflation.

Table 5. Significance of Lagged Inflation and Exchange Rate Depreciation in ECM for Inflation

	1987:1-2002:3	**1993:5-1995:3**	**1997:2-1998:1**
$\Delta^2 p$	17.0578 (0.002)	48.3675 (0.000)	45.0360 (0.000)
$\Delta^2 ex$	32.4704 (0.000)	43.3398 (0.000)	44.9630 (0.000)

As can be seen from Table 5, when the ECM is calculated for the whole sample period, the lagged prices appear to be jointly significant at 2% level. When estimating the ECM for the sub-periods of high inflation, lagged prices tend to be more significant. This indicates that at high rates of inflation lagged prices appear to be good predictors of current inflation. Currency depreciation remains substantially significant even for the whole sample period. This presumably suggests that as inflation accelerates, currency depreciation ultimately turns out to be the basis for prices.

To summarize, the monetary approach explains Turkish inflation better than the balance of payments approach. Deficit financing leads to increases in the money supply, and hence generates further inflation. Assuming agents are rational and set their expectations with respect to the rate of money creation, the growth of the money supply will both cause inflation and will be the result thereof. However, if the rate of money creation depends upon past inflation, the public should be able to foresee the rate of money creation from the past history of prices. Inflation depends on past inflation; that is, money creation drops out of the chain of causality. This suggests a unidirectional casual ordering from prices to money growth, i.e. no feedback (Sargent *et al*., 1973). However, the results obtained from the Granger causality tests and the cointegration tests clearly show that the growth of the money supply is exogenous in Turkey. In spite of the fiscal dominance, the money supply process grew mainly unpredictably, i.e. money is not endogenous. Thus, agents' future expectations of inflation are formed adaptively rather than rationally (Cagan, 1956 and 1990). Another important aspect of our results is that there is evidence of exchange rate-based pricing in Turkey over the sample period in this work, meaning that money fueled inflation through currency depreciation. This implies that prices may not be set in the money market, but they may be indexed to alternative foreign currencies instead. As Cagan (1990, p.180) stated that "although depreciating currencies are not abandoned completely, testifying to the great benefits of a common medium of exchange, the public undertakes costly efforts to reduce holdings of a rapidly depreciating money, including barter arrangements and the use of more stable substitutes such as foreign currencies".

6. Conclusion

In this work, we showed that the monetary approach to Turkish high inflation produces better results than the balance of payments view. First of all, it is excessive monetary expansion that prompts inflation in Turkey over the sample period considered in the work. Nevertheless, it is worth noting that the assumption of the monetary view that prices are set in the money market by the interaction between the supply and demand for money along an inflationary path may not be so compelling. There exists evidence of the presence of exchange rate-based pricing, suggesting that money prompts inflation through currency depreciation. That is, prices may be indexed to the foreign currencies. On the other hand, currency depreciation is found to be endogenous in contrast to the balance of payments view that assumes the exchange rates to be exogenous. Since currency depreciation has a significant effect on inflation, there may be evidence of the exchange rate-based pricing process in Turkey over the period covered in this work.

In short, the money demand process in Turkey during the period 1987:1-2002:3 can be explained better in the sense of Cagan (1956) rather than in the sense of Sargent *et al*. (1973). Cagan assumes the exogeneity of money changing unpredictably. Sargent *et al*. (1973) suggest the endogeneity of money that allows agents to form their future expectations of inflation rationally and to set prices based on money growth. Implicitly, the money supply process with regard to Turkish inflation is unpredictable with respect to the past history of prices, i.e. either inflation or currency depreciation. Therefore, the Turkish monetary regime may be described as a random walk monetary standard with short-term (myopic) discretionary policies used by the authorities. Moreover, the unpredictable money growth implies that the Central Bank's passive monetary policy implementations help maintain the persistently high inflationary process in Turkey.

References

Aghevli, B. B., and Khan, M. S., 1978, "Government Deficits and the Inflationary Process in Developing Countries", *IMF Staff Papers*, 25, pp. 383-416

Bruno, M., 1993, "Monetary Policy Rules for a Small, Open Economy", in R. Dornbusch (ed.), *Policymaking in the Open Economy: Concepts and Case Studies in Economic Performance*, EDI Series in Economic Development, Oxford University Press (for the World Bank)

Bruno, M., and Fischer, S., 1990, "Seigniorage, Operating Rules, and the High Inflation Trap", *The Quarterly Journal of Economics*, May, pp. 353-374

Cagan, P., 1956, "The Monetary Dynamics of Hyperinflation", in M. Friedman (ed.), *Studies in the Quantity Theory of Money*, University of Chicago Press, Chicago

_____, 1990, "Hyperinflation", in J. Eatwell, M. Milgate, and P. Newman (eds.), *The New Palgrave Money*, MacMillan Reference Books, pp. 179-184

Christiano, L. J., 1986, "Cagan's Model of Hyperinflation under Rational Expectations", *International Economic Review*, 28, 1, pp. 33-49

Dickey, D., and Fuller, W., 1981, "Likelihood Ratio Statistics for Autoregressive Time Series with a Unit Root", *Econometrica*, 49, pp. 1057-1072

Dornbusch, R., 1985, *Inflation, Exchange Rates, and Stabilization*, Working Paper, No. 1739, October, National Bureau of Economic Research (NBER)

Dornbusch, R., and Fischer, S., 1986, "Stopping Hyperinflations: Past and Present", *Weltwirtschafliches Archiv*, 122, pp. 1-46

Dornbusch, R., Sturzenegger, F., and Wolf, H., 1990, "Extreme Inflation: Dynamics and Stabilization", *Brookings Papers on Economic Activity*, 2, pp. 1-84

Ericsson, N. R., and Sharma, S., 1996, *Broad Money and Financial Liberalization in Greece*, International Finance Discussion Papers, No. 559, July, Board of Governors of the Federal Reserve System

Evans, L., 1978, "Time Series and Structural Analysis of the German Hyperinflation", *International Economic Review*, 19, pp. 195-209

Fischer, S., Sahay, R., and Vegh, C.A., 2001, "Modern Hyper- and High-Inflations", (forthcoming) *Journal of Economic Literature*, July

Frenkel, J. A., 1977, "The Forward Exchange Rate, Expectations, and the Demand for Money: The German Hyperinflation", *The American Economic Review*, 67, 4, pp. 653-670

Friedman, M., 1968, "The Role of Monetary Policy", *American Economic Review*, 58, 1, pp. 1-17

Fry, M. J., 1986, "Turkey's Great Inflation", *Middle East Technical University* (*METU*) *Studies in Development*, Ankara, 13, 1-2, pp. 95-116

Heymann, D., and Leijonhufvud, A., 1995, *High Inflation: The Arne Ryde Memorial Lectures*, Oxford: Clarendon Press

Johansen, S., 1988, "Statistical Analysis of Cointegration Vectors", *Journal of Economic Dynamics and Control*, 12, 2-3, pp. 231-254

_____, 1995, *Likelihood-based Inference in Cointegrated Vector Autoregressive Models*, Oxford University Press, Oxford

Johansen, S., and Juselius, K., 1990, "Maximum Likelihood Estimation and Inference on Cointegration-With Applications to the Demand for Money", *Oxford Bulletin of Economics and Statistics*, 52, 2, pp. 162-210

Kiguel, M. A., 1989, "Budget Deficits, Stability, and the Monetary Dynamics of Hyperinflation", *Journal of Money, Credit, and Banking*, 21, 2, pp. 148-157

Laidler, D. E. W., and Parkin, J. M., 1975, "Inflation – A Survey", *The Economic Journal*, 85, 340, pp. 741-809

Lütkepohl, H., 1991, *Introduction to Multiple Time Series Analysis*, Springer Verlag, Heidelberg

MacKinnon, J. G., 1991, "Critical Values for Cointegration Tests", Chapter 13 in R. F. Engle and C. W. J. Granger (eds.), *Long-run Economic Relationships: Readings in Cointegration*, Oxford University Press, Oxford

Petrovic, P., 1995, "Quasi-Fiscal Deficit and Money Demand in Yugoslavia's High Inflation: Some Econometric Evidence", *Journal of Comparative Economics*, 20, pp. 32-48

Phillips, P.C.B., and Perron, P., 1988, "Testing for a Unit Root in Time Series Regression", *Biometrika*, 75, pp. 335-46.

Protopapadakis, A., 1983, "The Endogeneity of Money During the German Hyperinflation: A Reappraisal", *Economic Inquiry*, 21, 1, pp. 72-92

Salemi, M. K., 1980, "Expected Exchange Depreciation and the Demand for Money in Hyperinflation Germany", *Journal of Money, Credit, and Banking*, 12, 4, pp. 592-602

Salemi, M. K., and Sargent, T. J., 1979, "The Demand for Money During Hyperinflation Under Rational Expectations: II", *International Economic Review*, 20, 3, pp. 741-758

Sargent, T. J., and Wallace, N., 1973, "Rational Expectations and the Dynamics of Hyperinflation", *International Economic Review*, 14, 2, pp. 328-350

Sims, C. A., Stock, J. H., and Watson, M. W., "Inference in Linear Time Series Models with some Unit Roots", *Econometrica*, 58, 1, pp. 113-144