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An Analysis of the Relationship between Public Sector Borrowing Requirement (PSBR), Money Supply and Inflation Rate in Türkiye

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Abstract

The objective of this study is to examine the correlation between the public sector borrowing requirement, inflation rate, and money supply in Türkiye, utilizing yearly data spanning the period from 1975 to 2020. In this study, the authors employ the unit root tests with multiple structural breaks proposed by Zivot and Andrews, Lumsdaine and Papell, as well as the Maki cointegration tests with multiple structural breaks, to analyze the data. Subsequently, the application of the fully modified ordinary least squares (FMOLS) approach was utilized to ascertain the presence of a long-term association between the variables. The results indicate a positive correlation between inflation rates in Türkiye and both the public sector borrowing need and money supply over an extended period of time. Furthermore, a bootstrap causality analysis was undertaken by Hacker and Hatemi in order to investigate the causative relationship between the variables. Based on the findings pertaining to causation, it has been observed that there exists a unidirectional causal relationship from the money supply to inflation, as well as from the public sector borrowing demand to the money supply.

Keywords: public sector borrowing requirement, money supply, inflation
Jel Codes: B22, C22, E31

Türkiye'de Kamu Borçlanma Gereksinimi (KKGB), Para Arzı ile Enflasyon İlişkisinin İncelenmesi

Özet

Kamu kesiminin mali yıl sonunda ortaya çıkan bütçe açıklarının finansmanı için borçlanma yoluna gitmesi zamanla kaçınılmaz bir tercih olmakta, özellikle Türkiye gibi gelişmekte olan ülkelerde böylesi zorunlu bir tercihin makroekonomik koşullar üzerinde bir dizi etkiler oluşturabileceği varsayılmaktadır. Bu bakımdan kamu borçlanmalarının enflasyon oranı ve parasal genişleme ile ilişkisi literatürde tartışılmaya devam eden önemli konular arasındadır. Yapılan bu çalışmanın amacı, Türkiye'de 1975-2020 yılları arası kamu kesimi borçlanma gereksinimi, enflasyon ve para arzı ilişkisini incelemektir. Öncelikle bu tarih aralığında yapısal kırılmaları dikkate alan Zivot ve Andrews, Lumsdaine ve Papell, çoklu yapısal kırılmalı Carrion-i Silvestre vd. birim kök testleri ve Maki çoklu yapısal kırılmalı eşbütünleşme testleri uygulanmıştır. Daha sonra değişkenler arasında uzun dönemli ilişkinin varlığını belirlemek için düzeltilmiş en küçük kareler (FMOLS) yöntemi uygulanmış ve elde edilen bulgulara göre Türkiye'de enflasyon oranlarının kamu kesimi borçlanma gereksinimi ve para arzı ile uzun dönemli pozitif ilişkili olduğu tespit edilmiştir. Ayrıca değişkenler arasındaki nedensellik bağını incelemek için Hacker ve Hatemi bootstrap nedensellik analizi yapılmıştır. Elde edilen nedensellik sonuçlarına göre para arzından enflasyona ve kamu kesimi borçlanma gereksiniminden para arzına doğru tek yönlü nedenselliğin varlığı saptanmıştır.

Anahtar Kelimeler: kamu borçlanma gereksinimi, enflasyon, para arzı
Jel Codes: B22, C22, E31

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1. Introduction

The budget deficit is commonly understood as the fiscal imbalance that arises when a nation's expenditures surpass its receipts over a given fiscal year. Additionally, it can be defined as the situation where budgetary revenues fall short of covering the corresponding expenditures. The budget deficit serves as an indicator of the government's financial requirements during a specific timeframe, as well as the corresponding percentage increase in public debt. Additionally, it furnishes insights on the management of government spending and the effectiveness of resource mobilization. The primary factor contributing to the budget deficit is the government's excessive and ineffective spending (Karazijiene, 2009). Various strategies are employed to address this fiscal shortfall, including the implementation of tax rate hikes, the practice of monetary expansion through the printing of currency (known as monetization), and the acquisition of funds from both local and international markets through borrowing. The preferred approach among these options is contingent upon the comparative advantages and disadvantages associated with each method. Different macroeconomic repercussions may be observed with each favored financing option. The process of monetization has the potential to result in inflation, while domestic borrowing can lead to a burden of interest rates. External borrowing carries the risk of causing external debt crises, and the utilization of foreign exchange reserves can be influenced by exchange rate fluctuations and may potentially contribute to balance of payments crises. According to Kibritçioğlu (2002), the magnitude of a nation's budget deficit and the means by which it is financed have significant implications for the country's debt dynamics and fiscal limitations in the medium and long run. While determining the most suitable approach among these methods is a complex task, it is customary for governments to rely on borrowing as a means of financing.

Within this particular setting, Kellerman (2007) highlights the concept known as the "golden rule of public sector borrowing." Based on this principle, it is recommended that immediate expenses be funded from present income, while borrowing should be permissible solely for the purpose of financing investment-related costs. If the funding of present expenditures is achieved by taxation and the financing of investments is done through borrowing, it will result in an equitable allocation of resources across different generations. Simultaneously, it may be argued that public borrowing, functioning as a form of finance to address the budget deficit, constitutes a significant means of government income generation. Public borrowing is a fundamental and intricate undertaking that has significant implications for the economy of a nation, political dynamics, international standing, and various other elements. The utilization of resources should be optimized in order to maximize the benefits and opportunities they offer. Alternatively, the imposition of interest payments places a certain level of pressure on the economy. Interest payments, which are included in the government's current expenditures, can result in either an escalation of the tax burden or an elevation of the public sector borrowing demand. According to Karazijiene (2009), the national debt gets ever more onerous. An increasing number of nations are turning to borrowing as a means to fulfill their financial requirements that cannot be satisfied by conventional taxation approaches. According to Aimola (2020), during a period of increasing interest rates, the act of public borrowing has the potential to negatively impact the process of macroeconomic stability.

The augmentation of the public borrowing requirement results in a rise in the net demand for credit, so exerting upward pressure on interest rates and displacing private investment. As a consequence, there is a deceleration in actual production and an escalation in prices. Moreover, the imposition of elevated interest rates drives the financial industry to cultivate financial instruments that possess characteristics akin to cash. The study conducted by Akcay, Alper, and Ozmucur (1996) highlights the inflationary tendencies that are reinforced by the adoption of low-risk investments. According to Wray (1997), an additional point of contention is that these deficiencies have the potential to displace private investment due to increased interest rates, ultimately resulting in elevated levels of inflation or inflationary expectations. According to Özker (2020), there are two significant implications associated with the rise in the proportion of the public sector borrowing demand in relation to the gross domestic product (GDP). There are two primary factors to consider. Firstly, elevated interest rates have the effect of discouraging medium and long-term investments. Secondly, the reduction in public savings resulting from declining investments contributes to a rise in short-term speculative gains. Additionally, the increasing need for public borrowing and the

concurrent rise in market interest rates contribute to the exacerbation of public finance deficits, so placing the public sector in an unfavorable financing position. The aforementioned phenomenon elicits apprehension among policymakers due to its adverse impact on macroeconomic stability, particularly in emerging nations characterized by relatively feeble and reliant monetary frameworks. Hence, it can be argued that the utilization of debt-financed deficits has a detrimental impact on macroeconomic stability, necessitating the implementation of efficient coordination with the monetary authority in order to mitigate the risk of experiencing elevated and volatile inflation rates (Aimola, 2020).

The proportion of public debt relative to gross domestic product (GDP) has attained an unprecedented level across global economies, surpassing the historical mean. The implementation of fiscal measures aimed at alleviating the adverse health and economic impacts of the COVID-19 pandemic, which commenced in 2019, has had a substantial impact on budgetary equilibrium. According to Diler (2023), the occurrence of economic and fiscal shocks has resulted in substantial budget deficits, thereby necessitating increased levels of public borrowing. The escalation of worldwide public debt in recent years can be attributed to the profound influence of the global economic crisis that transpired from 2008 to 2012. According to Nastansky, Mehnert, and Strohe (2014), the implementation of multibillion-dollar bailouts by governments in collaboration with central banks, aimed at restoring stability in the financial and banking sector, served as a significant catalyst for increased borrowing in numerous nations. According to Goodhart et al. (2021), there has been a substantial rise in global public debt since 2007, impacting countries such as the United States, Canada, and the Euro area. The ongoing pandemic problem has further exacerbated this debt trajectory, and it is anticipated that inflation expectations will have a more pronounced impact in the future. The adverse effects of these conditions on developing nations are unavoidable. Developing nations are shown a growing inclination towards allocating government funds to education, healthcare, and infrastructure, with the aim of fostering economic expansion, generating additional job opportunities, and upholding socio-economic equilibrium. Due to insufficient tax revenues to meet government expenditures, budget deficits are incurred, leading to the necessity of domestic and external borrowing as a means to mitigate the risks of elevated inflation and socio-economic instability (Bon, 2015). They lack the capacity to exhibit resilience in the face of unforeseen economic setbacks. According to the United Nations (UN), the worldwide public debt is projected to reach 92 trillion dollars by 2022 as a consequence of the epidemic, with a notable concentration of this indebtedness observed in emerging nations.

Türkiye is among the nations that have been significantly impacted by these global events. The significant influence of the state on the economy has resulted in an amplification of the repercussions stemming from the disparity between public revenues and expenditures. Insufficient or volatile tax collections have historically necessitated the funding of public deficits through the practice of borrowing. Consequently, there was a further rise in the proportion of public expenditures allocated towards principle and interest payments, resulting in a cycle of accumulating debt and contributing to the inflationary trajectory (Yavuz, 2003). Inflation, which emerged subsequent to the global oil crisis in the 1970s and persisted with sustained double-digit rates for an extended period, has evolved into a significant structural challenge. The primary contributors to inefficiency within the public sector have been the substantial costs associated with security issues and the financial burden imposed by political instability. Numerous crises have arisen as a result of public deficits and current account deficits (Diler, 2023). During periods characterized by increasing inflation and budget deficits, predominantly monetary measures were implemented in attempts to address the issue. However, these strategies failed to yield substantial gains. During the 2000s, a number of programs were implemented that aimed to integrate monetary and fiscal policies. The implementation of initiatives such as transitioning to a robust economy and adopting inflation targeting measures has been undertaken to achieve this objective. According to Altunöz (2021), the implementation of rigorous fiscal measures led to notable outcomes, including a reduction in public deficits and a decrease in inflation to single-digit levels. Nevertheless, the post-2010s period witnessed a surge in exchange rate volatility, which subsequently refocused attention on the country's underlying structural issues and the adverse macroeconomic consequences they entail (Diler, 2023).

It is evident that the global economies, as well as emerging nations such as Türkiye, have experienced

repercussions as a result of these adverse occurrences. The actions implemented by governments in response to these adverse events have expedited budget deficits and the subsequent pursuit of funding requirements. These circumstances indicate a correlation between the subsequent occurrence of high inflation and the escalation of money supply, which may be attributed to the act of public borrowing. Türkiye has consistently pursued short-term remedies for public deficits by resorting to borrowing and/or monetary expansion over an extended period of time. Nevertheless, this financial obligation was further exacerbated, resulting in the persistence of inflation. The aforementioned experiences have given rise to a body of scholarship that examines the correlation between budget deficits or public borrowing, inflation, and money supply. This study seeks to examine the correlation between the public sector borrowing need, inflation, and money supply in Türkiye from 1975 to 2020, in accordance with the aforementioned causes. The primary characteristic that sets this study apart is the utilization of the public sector borrowing demand variable as a representation of public borrowing. According to Özker (2020), the public sector borrowing demand holds significant importance as a financial indicator, particularly for developing nations characterized by elevated financial fragility, such as Türkiye. When analyzing budget deficits and comprehending potential cash deficits, it is essential to consider cyclical macro variables that encompass the entire time, as they offer valuable insights. The unit root tests with multiple structural breaks conducted by Zivot and Andrews, Lumsdaine and Papell, and Carrion-i Silvestre et al. are employed, along with the Maki cointegration test with multiple structural breaks. The fully modified ordinary least squares (FMOLS) method is utilized to ascertain the cointegration relationship between the series. Furthermore, the researchers employed the Hacker and Hatemi bootstrap causality test in order to ascertain the causal relationship between the variables. The introduction to the study provides a comprehensive overview of the significance of the research, outlining the objectives and methodology. Subsequently, a synthesis of prior research pertaining to the topic was undertaken, followed by the initiation of the analytical part. Ultimately, the examination of the data pertaining to the presence of a correlation is scrutinized, and the investigation is ultimately ended with suggestions for policy implementation.

2. Literature Review

The existing body of research examining the association between public debt and inflation typically asserts a positive correlation. Moreover, this correlation is found to be particularly prominent in nations burdened with high levels of public debt and possessing weak financial markets (Aimola, 2020). One of the research conducted by Bon (2015) examined the correlation between public debt and inflation rate in a sample of 60 developing nations in Asia, Latin America, and Africa from 1990 to 2014. Based on the results derived from the implementation of the Arellano-Bond difference generalized method of moments (GMM), it can be concluded that there exists a statistically significant positive relationship between public debt and the inflation rate. While it is true that public debt can contribute to inflation in developing nations, governments are unable to cease borrowing in order to fund fiscal deficits. Public debt serves as an indirect instrument of fiscal policy, enabling governments to foster economic growth and maintain stability in social security. The study conducted by Aimola and Odhiambo (2021) investigated the influence of public debt on the inflation rate in Ghana during the period spanning from 1983 to 2018. Based on the results obtained from the autoregressive distributed lags (ARDL) analysis, there exists a positive correlation between public debt and the inflation rate over an extended period of time. The results validate the presence of inflationary consequences associated with governmental debt in Ghana. Hence, it is imperative for the government to consider the implications of rising public debt while devising strategies aimed at mitigating inflationary pressures. A study conducted by Akitoby, Komatsuzaki, and Binder (2014) presented a contrasting perspective by positing that an increase in inflation would lead to a fall in the actual value of indebtedness. The researchers evaluated the impact of inflation rates on public debt within the G-7 countries throughout the period spanning from 2012 to 2017. Based on the findings of the simulation, it can be observed that a reduction in inflation rates leads to an increase in public debt, whereas an escalation in inflation rates results in a drop in public debt. Hence, it is plausible that elevated levels of inflation could potentially contribute to the alleviation of public debt burdens in developed economies. Nevertheless, it is improbable that this measure will singularly resolve the issue of debt. To begin with, the experience of Japan in recent decades

has demonstrated the considerable challenges associated in augmenting inflation rates.

Kwon, McFarlane, and Robinson (2009) conducted a study that investigated the correlation between public debt, inflation, and money supply in a sample of 71 developed and developing nations from 1963 to 2004. Based on the empirical results derived from static and dynamic panel data analysis, it can be observed that in developing nations, the presence of public debt leads to an augmentation of monetary expansion and inflation. This association is more prominent in countries characterized by elevated levels of public debt, while it gradually diminishes as the magnitude of public debt declines. In contrast, the aforementioned association is typically absent in wealthy nations. Nevertheless, if the process of monetary expansion is effectively managed, the influence of public debt on inflation diminishes. The findings of this study indicate that in nations characterized by substantial debt obligations, the efficacy of monetary stabilization measures alone is contingent upon the concurrent implementation of fiscal consolidation efforts. The study conducted by Nastansky, Mehnert, and Strohe (2014) investigated the correlation among public debt, money supply, and inflation within the context of Germany from 1991 to 2010. Based on the empirical results derived from the vector error correction model (VECM), it can be concluded that there exists a positive long-term relationship between public spending and inflation rates, whereby changes in one variable have a mutually reinforcing effect on the other. The impact of the money supply on the inflation rate is equally significant. The correlation between public expenditures and inflation rates can be attributed to several factors, including the expenses incurred due to the process of German reunification during the 1970s, fiscal assistance provided for the establishment of a comprehensive social security system, implementation of various economic stimulus packages, and financial support extended to banks during times of crisis. Furthermore, the impact of public expenditure on inflation becomes increasingly significant in the context of an expansion in the money supply. In other words, when the level of monetary expansion increases, the influence of public debt on the inflation rate becomes more pronounced.

In their study, Romero and Marin (2017) examine the correlation among public debt, money supply, and inflation rate over a sample of 52 nations spanning the years 1965 to 2014. Based on the results derived from both static and dynamic panel data analysis, it can be concluded that there exists a positive correlation between increases in public debt and both money supply and inflation rate. Furthermore, it has been shown that in nations characterized by elevated levels of public debt, augmentations in said debt have a greater propensity to have an impact on inflation. The observed association lacks statistical significance within wealthy nations. The findings of this study indicate that the proper implementation of fiscal policy plays a crucial role in maintaining macroeconomic stability over both the short and long term. In their study, Ezeanyeji, Priscilla, and Frank (2019) conducted an examination of the correlation between governmental debt, money supply, and inflation rate in Nigeria during the period spanning from 1981 to 2017. The results derived from the error correction model (ECM) indicate a positive relationship between public debt, money supply, and the inflation rate. In this scenario, the efficacy of the government's stringent fiscal and monetary measures in addressing the inflationary phenomenon is evident.

Nguyen (2015) conducted an analysis on the correlation between budget deficit, money supply, and inflation in several Asian nations, namely Bangladesh, Cambodia, Indonesia, Malaysia, Pakistan, and Bangladesh. The study period spanned from 1985 to 2012. Based on the results derived from the application of panel data analysis using the Arellano-Bond dynamic panel estimating method of generalized method of moments (GMM) and Mean Group estimator, it can be concluded that the pooled means group (PMG), budget deficit, and money supply exhibit a positive relationship with the inflation rate. The findings of this study indicate that it is crucial to consider the implementation of monetary and fiscal policies as a means to effectively manage inflation. The study conducted by Abdelkafi (2016) examined the effects of fiscal shocks, specifically those related to public debt, on monetary policy and macroeconomic dynamics in Tunisia during the period from 2002 to 2013. Based on the empirical results derived from the application of the structural vector error correction model (SVECM), it can be concluded that augmentations in public debt have a positive impact on both the money supply and inflation levels. Based on the findings of Granger causality research, it can be concluded that there exists a reciprocal causal relationship between the variables under investigation. The findings of this study demonstrate the interconnectedness between

governmental debt, monetary policy, and economic activity. The study conducted by Oyeleke and Orisadare (2018) investigated the influence of fiscal and monetary variables on the inflation rate in Nigeria during the period from 1980 to 2015. Based on the empirical results derived from the vector autoregression model (VAR), it can be observed that the impact of public debt on inflation is more pronounced compared to the impact of money supply expansion. The findings of this study indicate that fiscal factors hold greater significance in relation to price stability as compared to monetary issues.

Akcay, Alper, and Ozmucur (1996) conducted an analysis on a sample of Turkish data, examining the interplay between state debt, money supply, and inflation rate in Türkiye from 1948 to 1994. Based on the empirical results derived from the vector autoregression model (VAR) and autoregressive integrated moving average (ARIMA), it can be concluded that a persistent and consistent association exists between budget deficits, monetary growth, and inflation, indicating a stable long-term link. The study conducted by Altunöz (2021) examined the correlation between budget deficits, public debt, money supply, and inflation in the Turkish context during the period spanning from 2005 to 2020. Based on the results derived from the autoregressive bounds test with distributed lags (ARDL), it can be concluded that inflation is positively influenced by the escalation of budget deficits, public debt, and money supply. The Toda-Yamamoto causality test reveals the presence of a unidirectional causal relationship, wherein budget deficits and public debt exert an influence on inflation, and inflation, in turn, affects the budget deficit. The findings of this study indicate that there is a significant correlation between budget deficits, public borrowing, and the inflationary process. In their study, Diler (2023) conducted an analysis on the correlation between the public sector borrowing need and the inflation rate in Türkiye for the period spanning from 1975 to 2021. Based on the results derived from the Toda-Yamamoto causality test, it is observed that there exists no causal relationship between the public sector borrowing demand and the inflation rate. However, a unidirectional causality is detected, indicating that changes in the inflation rate have an impact on the public sector borrowing requirement. This discovery suggests that episodes characterized by elevated levels of inflation have adverse consequences for macroeconomic indicators, particularly in relation to public finance.

3. Data and Methodology

This study examines the correlation between the public sector borrowing requirement, inflation, and money supply in Türkiye, utilizing data spanning from 1975 to 2020. The variables in the model have been transformed using logarithms. The attributes of the data, mathematical model, and equation are delineated as follows.

Table 1. Variables Utilized in the Analysis and Explanations

Country/Period	Definition	Abbreviation of Variables	Source
Türkiye 1975-2020	Inflation, Consumer Prices (annual %)	CPI	World Bank
	Public Sector Borrowing Requirement (PSBR/GDP)	PSBR	Department of Strategy and Budget
	Broad Money Growth (annual %)	MS	World Bank

$$CPI = f(PPBR, MS)$$

$$lnCPI_t = \beta_0 + \beta_1 PSBR_t + \beta_2 MS_t + \varepsilon_t$$

In the model, t refers to time, β to slope parameter, and ε to error term.

3.1. Unit Root Tests

The initial stage in determining the suitable econometric model (regression, cointegration, and causation) involves verifying the stationarity of the series. A time series that has a unit root is considered non-

stationary. The elucidation of the significance of stationarity in time series is vital. When a time series is non-stationary, it is possible to assess the behavior of the time series during the specific period being examined. Hence, it may be concluded that each every time series represents a unique scenario and cannot be extrapolated to other time periods. According to Gujarati (2016:320), the use of stationary series guarantees predictability and mitigates the issue of potential false regression. To assess the stationarity of the series, both conventional unit root tests and tests incorporating considerations of structural breaks were employed. The following equations depict the generic forms of the Augmented Dickey and Fuller (1981) and Phillips and Perron (1988) tests, which are conventional methods of testing:

$$\Delta y_t = \alpha_1 + \alpha_1 \Delta y_{t-1} + \sum_{i=1}^{n} \alpha \, \Delta y_t + e_t$$

$$y_t = \beta_0 + \delta_1 y_{t-1} + \delta_2 (t - \frac{T}{2}) + e_t$$

The hypotheses raised for the tests are as follows:

H_0: Contains unit root which means the series is not stationary

H_1: Does not contain unit root which means the series is stationary

The unit root test results obtained to determine the order of stationarity of the series are presented in Table 2:

Table 2. Unit Root Tests Results

ADF Unit root test				
Variable	**Stationary**		**Stationary and trendy**	
	Test statistics	**probability**	**Test statistics**	**Probability**
CPI	-1.687956	0.4304	-2.487889	0.3324
MS	-1.574441	0.487	-2.257936	0.4471
PSBR	-2.284288	0.1813	-2.340247	0.4046
ΔCPI	-7.088127	0.000*	-7.130421	0.000*
ΔMS	-10.93399	0.000*	-10.90204	0.000*
ΔPSBR	-6.374336	0.000*	-6.295156	0.000*
PP Unit Root test				
Variable	**Stationary**		**Stationary and trendy**	
	Test Statistics	**Probability**	**Test Statistics**	**Probability**
CPI	-1.673709	0.4374	-2.420546	0.3645
MS	-2.480958	0.1267	-2.979537	0.1491
PSBR	-2.40525	0.146	-2.482843	0.3347
ΔCPI	-7.137923	0.000*	-7.197868	0.000*
ΔMS	-11.11049	0.000*	-11.0475	0.000*
ΔPSBR	-6.374336	0.000*	-6.295156	0.000*

Note: * and ** correspond to %1 and %5 of significance levels respectively.

Based on the findings presented in Table 2, the ADF and PP unit root tests indicate that the series exhibit unit root characteristics, both with a constant and with a constant and trend. Consequently, it can be concluded that the series are non-stationary at the level of significance (Prob>1%, 5%, 10%). To put it

otherwise, the null hypothesis (H_0) is deemed to be accepted. Based on the results obtained from doing the Augmented Dickey-Fuller (ADF) and Phillips-Perron (PP) unit root tests on the differenced series, it can be concluded that all three series exhibit stationarity at a significance level of 1% (Prob<1%), as well as at significance levels of 5% and 10%.

Within the contemporary econometrics literature, various methodologies have been developed to incorporate the consideration of structural breaks when conducting unit root tests. Perron (1997) proposed a novel unit root test that incorporates a single unknown break point (Gövdeli, 2018:576). Zivot and Andrews (1992) proposed a unit root test that allows for endogenous determination of break dates and accommodates a single break. Building upon this work, Lumsdaine and Papell (1997) further enhanced the Zivot and Andrews (1992) model by developing a two-break unit root test.

Table 3. Zivot and Andrews Unit Root Test

Variable	Model	Date of break	Test statistics	Critical values		
				1%	5%	10%
CPI	A	2002	-3.954015	-5.34	-4.93	-4.58
	C	1999	-3.675451	-5.57	-5.08	-4.82
MS	A	2002	-4.418755	-5.34	-4.93	-4.58
	C	2002	-3.887811	-5.57	-5.08	-4.82
PSBR	A	2004	-4.683704	-5.34	-4.93	-4.58
	C	2004	-4.118216	-5.57	-5.08	-4.82

Note: Critical values are obtained from Zivot and Andrews (1992).

Table 3 presents the Zivot and Andrews unit root test results. According to the unit root test results, the test statistics obtained for CPI and MS series in both Model A and Model C are smaller than the critical values in absolute value. Therefore, it is concluded that both series are unit rooted at the level. The PSBR series, on the other hand, is stationary at level when structural breaks are taken into account according to Model A and unit rooted at level according to Model C.

Table 4. Lumsdaine and Papell Unit Root Test

Variable	Model	Dates of break	Test statistics	Critical values		
				1%	5%	10%
CPI	AA	1986, 2001	-4.6423	-6.74	-6.16	-5.89
	CC	1993, 2008	-7.8928	-7.19	-6.75	-6.48
MS	AA	1993, 2001	-6.0229	-6.74	-6.16	-5.89
	CC	1993, 2008	-6.0057	-7.19	-6.75	-6.48
PSBR	AA	1980, 2003	-5.2999	-6.74	-6.16	-5.89
	CC	1980, 2003	-4.9151	-7.19	-6.75	-6.48

The results of the Lumsdaine and Papell unit root test allowing for two structural breaks are presented in Table 4. The CPI series is considered to be unit rooted at the level since the Model AA test statistic, which takes into account the break in the constant, is smaller than the critical values in absolute value. The MS series is considered to contain a unit root at the level since the Model CC test statistics, which takes into account both the constant and trend breaks, are smaller than the critical value in absolute value. The PSBR series is concluded to contain a unit root at the level since both Model AA and Model CC test statistics are smaller than the critical value in absolute terms.

In contrast to these two approaches, Carrion-i-Silvestre et al. (2009) developed a unit root test in which the break date is determined endogenously and allows up to five structural breaks. In Carrion-i-Silvestre et al. (2009), the null hypothesis suggests that 'there is a unit root' under multiple structural breaks. In this test, five different test statistics were created (Katırcioğlu, 2014:385-386):

$$P_t(\lambda^0) = \frac{[S(\bar{\alpha}, \lambda^0) - \bar{\alpha} S(1, \lambda^0)]}{S^2(\lambda^0)}$$

In this equation, P_t refers to Gaussian point optimal statistic and S to spectral density function.

$$MP_t(\lambda^0) = \frac{[c^2 T^{-2} \sum_{t=1}^{T} \tilde{y}_{t-1}^2 + (1-\bar{c}) T^{-1} \tilde{y}_T^2]}{S(\lambda^0)^2}$$

In this equation, MP_t represents where the point optimal statistic was modified under Ng and Perron (2001).

$$Z_\alpha(\lambda^0) = (T^{-1}\tilde{y}_T^2 - s(\lambda^0)^2)\left(2T^{-2}\sum_{t=1}^{T}\tilde{y}_{t-1}^2\right)^{-1}$$

$$MSB(\lambda^0) = \left(s(\lambda^0)^{-2}T^{-2}\sum_{t=1}^{T}\tilde{y}_{t-1}^2\right)^{1/2}$$

$$MZ_t(\lambda^0) = (T^{-1}\tilde{y}_T^2 - s(\lambda^0)^2)\left(4s(\lambda^0)^2 T^{-2}\sum_{t=1}^{T}\tilde{y}_{t-1}^2\right)^{1/2}$$

Here, MZ_α is the M class statistics of MSB and MZ_t obtained by utilization of a GLM approach.

Table 5. Multiple Structural Break Carrion-i Silvestre et al. (2009) Unit Root Test Test

Variable	Test Statistics					Dates of Breaks
	PT	**MPT**	**MZA**	**MSB**	**MZT**	
CPI	15.63 (5.54)	13.95 (5.54)	-6.5 (-17.33)	0.27 (0.17)	-1.80 (-2.90)	1979, 1984, 1989, 1994, 2002
MS	8.87 (5.54)	8.23 (5.54)	-11.08 (-17.33)	0.21 (0.17)	-2.35 (-2.90)	1981, 1986, 1993, 1999, 2004
PSBR	9.92 (5.54)	10.11 (5.54)	-9.16 (-17.33)	0.23 (0.17)	-2.10 (-2.90)	1984, 1993, 1999, 2004, 2009
ΔCPI	3.97 (5.54)	4.10 (5.54)	-22.26 (-17.33)	0.15 (0.17)	-3.34 (-2.90)	
ΔMS	5.08 (5.54)	5.27 (5.54)	-17.27 (-17.33)	0.16 (0.17)	-2.89 (-2.90)	
ΔPSBR	4.15 (5.54)	4.32 (5.54)	-22.28 (-17.33)	0.15 (0.17)	-3.30 (-2.90)	

Note: Critical values are shown in parentheses and are generated using bootstrap with 1000 iterations.

Table 5 presents the results of the Carrion-i-Silvestre et al. unit root test. If the test statistic values are greater than the critical values, it is decided that there is a unit root. The results suggest that the tests for the H_0 hypothesis cannot be rejected for the entire set of P_t, MP_t, MZ_α, MSB ve MZ_t test statistics at the

level. For this reason, the series are not stationary at the level value.

3.2. Co-Integration Analysis

Cointegration test is conducted to determine the long-run equilibrium relationship between non-stationary series. The results obtained from traditional unit root tests and unit root tests that take into account structural breaks show that the series contain unit roots at the level and become stationary after the first differences are taken. For this reason, cointegration tests should be applied to test whether the series move together in the long run.

3.2.1. Maki (2012) Multiple Structural Break Cointegration Analysis

The cointegration test created by Maki (2012) was developed in a way that allows for multiple breaks. The most important feature of this test is that the break dates are determined endogenously by the model. The Maki (2012) cointegration test with structural breaks, which has four different models, is shown below:

Model 0: Trendless model allowing for a break in the fixed term:

$$y_t = \mu + \sum_{i=1}^{k} \mu_i K_{i,t} + \beta x_t + \upsilon_t$$

Model 1: Trendless model allowing breaks in the fixed term and slope:

$$y_t = \mu + \sum_{i=1}^{k} \mu_i K_{i,t} + \beta x_t + \sum_{i=1}^{k} \beta_i x_i K_{i,t} + \upsilon_t$$

Model 2: Model with trend allowing breaks in the fixed term and slope:

$$y_t = \mu + \sum_{i=1}^{k} \mu_i K_{i,t} + \gamma x + \beta x_t + \sum_{i=1}^{k} \beta_i x_i K_{i,t} + \upsilon_t$$

Model 3: Model allowing breaks in the fixed term, slope and trend:

$$y_t = \mu + \sum_{i=1}^{k} \mu_i K_{i,t} + \gamma x + \sum_{i=1}^{k} \gamma_i t K_{i,t} + \beta x_t + \sum_{i=1}^{k} \beta_i x_i K_{i,t} + \upsilon_t$$

Here, i K_i refers to dummy variables. The hypotheses of the Maki cointegration tests are as follows:

H_0: There is no cointegration relationship between variables under structural breaks.

H_1: There is cointegration relationship between variables under structural breaks.

Table 6 shows the results of the Maki cointegration test that allows up to five breaks. If the test statistic values are smaller than the critical values in absolute terms, it is accepted that there is no cointegration relationship. According to Model 3, which allows breaks in the constant term, slope and trend, the H_0 hypothesis is rejected, and it is concluded that there is a cointegration relationship between the series.

Table 6. Maki (2012) Multiple Structural Break Cointegration Test Results

Model	Test statistics	Critical values			Dates of structural breaks
		1%	5%	10%	
MODEL 0	-5.18	-6.075	-5.5	-5.297	1978, 1988, 1993, 2003, 2016
MODEL 1	-4.56	-6.53	-5.993	-5.722	1978, 1986, 1998, 2002, 2013
MODEL 2	-5.92	-7.839	-7.288	-6.976	1982, 1986, 1991, 1998, 2004
MODEL 3	-9.57*	-8.713	-8.129	-7.811	1980, 1987, 1991, 1998, 2001

Not: Critical values are obtained from Maki (2012) * refers to significance at the level of %1.

3.2.2. Maki (2012) Multiple Structural Break Cointegration Analysis

After determining the cointegration relationship between the series, the FMOLS method developed by Phillips and Hansen (1990) was used to estimate the long-run cointegration coefficients. FMOLS long-run coefficient estimator has the feature of adjusting autocorrelation and endogeneity with a nonparametric approach.

Table 7. FMOLS Estimator Results

Variables	Coefficient	t-statistics
Constant Term	11.77118**	2.490696 (0.0174)
MS	0.492064*	7.603131 (0.0000)
PSBR	1.340342*	2.855939 (0.0070)
D1980	-1.942185	-0.438824 (0.6633)
D1987	0.1247510*	2.983313 (0.0050)
D1991	0.1911633	0.388610 (0.6998)
D1998	-0.1227369**	-2.650575 (0.0118)
D2001	-0.1378016**	-2.151838 (0.0380)

Not: *,** and *** represent %1, %5 and %10 levels of significance respectively. The parentheses show the probability rate.

Table 7 presents the results of the FMOLS long-run coefficient estimator. The findings indicate that increases in money supply and public sector deficits increase inflation. The dummy variables representing 1998 and 2001 are negative, while the dummy variable representing 1987 is positive.

3.3. Causality Analysis: Hacker and Hatemi (2006) Causality Test

While long-run coefficient estimates indicate the severity of the interaction between variables, causality analysis should be performed to determine the direction of the interaction. One of these tests, the Hacker and Hatemi (2006) causality test, is based on the Toda and Yamamoto (1995) test. The Hacker and Hatemi (2006) Booststrap causality test does not require the series to be stationary. As in the Toda and Yamamoto test, the Var (p+d) model is applied as follows:

$$yt = v + A_1 y_{t-1} + \cdots + A_p y_{t-p} + \ldots A_{p+d} y_{t-p-t} + \varepsilon_t$$

Here, p refers to number of VAR lags, A to parameter matrix and d to maximum order of stationarity.

The causality test developed by Hacker and Hatemi (2006) was used to determine the causality relationship between the variables. The appropriate lag length was determined by the HJC (Hatemi-J Criterion) criterion and 1 lag was added to the VAR model. The HJC criterion is set as 2 in all methods. In order to reach the

appropriate critical values, 1000 bootstrap simulations were performed.

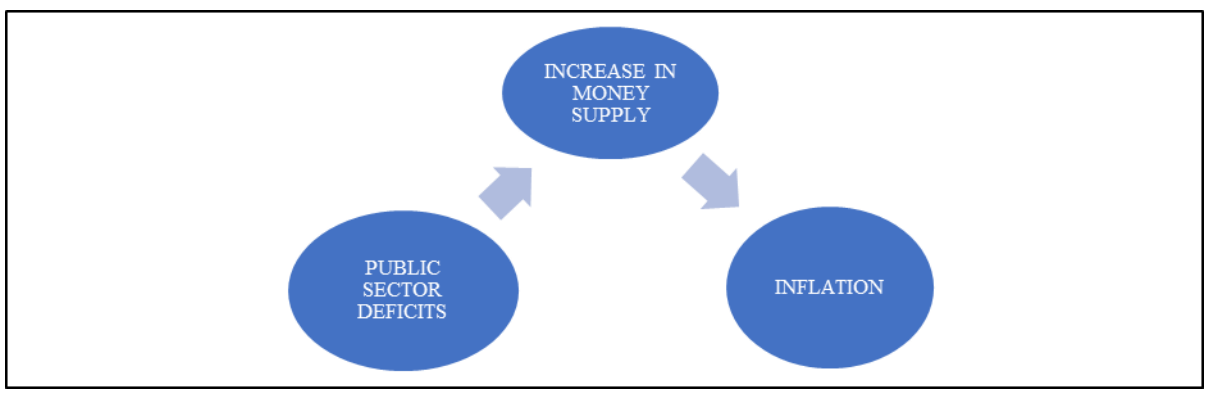
Table 8. Hacker and Hatemi Bootstrap Causality Test Results

Causality	MWALD Statistics	Bootstrap Critical Values			
		k	1%	5%	10%
CPI≠> MS	0.127	2	7.662	4.301	2.848
CPI ≠> KKBG	1.219	2	7.361	4.157	2.855
MS ≠>CPI	18.591*	2	7.479	4.085	2.848
MS ≠>PSBR	0.790	2	10.006	6.254	4.823
PSBR ≠>CPI	0.593	2	7.537	4.153	2.916
PSBR ≠>MS	5.687***	2	11.020	6.804	5.226

Not: *,** and **** represent %1, %5 and %10 levels of significance respectively.

Table 8 shows the results of the Hacker and Hatemi bootstrap causality test. Since the MWALD Statistic is greater than the bootstrap critical values at the 1% level of significance, causality is found from money supply to inflation. Since the MWALD Statistic is greater than the bootstrap critical values at the 10% level of significance, a causality relationship is detected from public sector borrowing requirement to money supply. The causality relationship between the series can be schematized in Figure 1

Figure 1. The Causality Relationship



4. Conclusion

The public sector seeks various forms of financing in order to find solutions to the deficits that arise between the revenues from taxes, which are the main source of revenue, and expenditures. In this case, the public sector is expected to borrow from domestic or foreign markets, and this is accepted as a major method. In fact, budget deficits at the end of the fiscal year are also an indicator of how much the government needs to borrow. Therefore, the public sector borrowing requirement, according to Özker (2020), has an important place in terms of ensuring fiscal balances in public expenditures and formulating fiscal policies regarding the process. Especially in developing countries that are still in the process of completing their technological and infrastructure levels, budget deficits and public borrowing are expected to be high. However, some countries also resort to borrowing to finance short-term current expenditures. This is directly reflected in the increase in interest rates and thus leads to deterioration in a number of macroeconomic indicators. The crowding out effect of interest rate hikes on private investment may ultimately result in rising inflation and inefficient monetary policies conducted by the central bank. In line with this assumption, the fact that public borrowing may be related to inflation and money supply has aroused curiosity in the economic literature and necessitated an examination of the relationship between these variables. In particular, the recent global

economic crises, pandemic-like adverse conditions affecting the economies of the whole world and the search for solutions to them have made it even more important to determine public borrowing and its impact on the macroeconomy.

In the context of these explanations, the relationship between public sector borrowing requirement, which represents public borrowing in Turkey between 1975 and 2020, and inflation and money supply is analyzed. First of all, various tests that take into account whether there are structural breaks between these dates have been applied. Zivot and Andrews, Lumsdaine and Papell, Carrion-i Silvestre et al. unit root tests with multiple structural breaks and Maki cointegration tests with multiple structural breaks have shown that breaks have occurred in some periods. The common findings from these tests point to various periods of 1980s, 1990s and 2000s. When the breaks in the Turkish economy are analyzed, the effects of the January 24, 1980 decisions on the economy have been decisive. Moreover, the military coup in 1980 and the subsequent governance crisis damaged Turkey's economy. In 1986, due to the extraordinary increase in public expenditures, the budget deficit amounted to 2.5 billion dollars and increased by 150% compared to the previous year, leading to a brief contractionary crisis (1986). This was followed by a devaluation. This necessitated a series of measures in 1987. In 1991, the Gulf War launched by the US against Iraq and the embargo imposed by the US shook many countries, including Turkey, negatively (Çoban, 2014:111-117). The 1998-1999 Russian Crisis, which emerged in 1998 when Russia announced that it could not fulfill its government bond obligations, negatively affected many countries, including Turkey (Özatay, 2016:135-138). In 2001, the economic crisis in Turkey deeply shook the macroeconomic dynamics of the country.

After determining the structural breaks, the existence of a long-run relationship between the variables was tested. According to the findings obtained with the FMOLS method, increasing inflation in Turkey is positively associated with public sector borrowing requirement and money supply in the long run. This result is consistent in explaining the determinants of inflation, which has become chronic in Turkey for many years, and is consistent with the theoretical assumptions. It is in line with the studies of Akcay, Alper and Ozmucur (1996), Nastansky, Mehnert and Strohe (2014), Bon (2015), Nguyen (2015), Romero and Marin (2017), Oyeleke and Orisadare (2018), Ezeanyeji, Priscilla and Frank (2019), Aimola and Odhiambo (2021), Altunöz (2021) and Diler (2023). In addition, Hacker and Hatemi bootstrap causality analysis was conducted to determine the direction of causality between variables. According to the causality results, there is unidirectional causality from money supply to inflation and from public sector borrowing requirement to money supply. These findings indicate that monetary expansion is the main driver of inflation and public sector borrowing requirement is the main driver of monetary expansion. It is an accepted reality that Turkey has not yet achieved sufficient positive results in these macroeconomic areas, which it has been trying to combat effectively. Budget deficits, the level of public sector borrowing, the persistent inflation problem and the ideal monetary base set by the central bank are some of the areas where solutions are being sought. Achieving an ideal coordination between these areas certainly depends on the harmony of monetary and fiscal policies. However, these can only be achieved with the realization and support of deeper structural improvements.

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