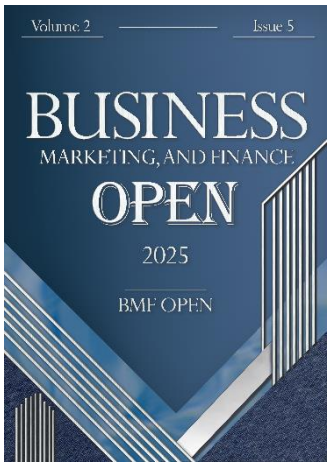
The Effect of Economic Growth on the Stock Returns of Iranian Listed Banks, with Emphasis on Endogenous Money Supply

Shahriar Montazeri [1,*], Seyyed Abbas Hosseini Ghaffar [2] and Negin Zarir Taji [3]



[1] Instructor, Department of Economics and Management Accounting, Payame Noor University, Iran;
[2] Assistant Professor, Department of Economics, Ashrafi Isfahani University, Isfahan, Iran;
[3] Assistant Professor, Department of Economics and Political Science, Shahid Beheshti University, Tehran, Iran;

* Correspondence: shmontazeri@pnu.ac.ir

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Abstract: The endogeneity of the money supply means that the money supply is determined by internal factors within the economy. This study tests the Post-Keynesian theory concerning the stock returns of Iranian listed banks. In the first model, endogenous money supply is used as the threshold variable, whereas in the second model, endogenous money supply and economic growth are employed as threshold variables. Using panel data from 14 Iranian listed banks during the 2013–2024 period, this study examines the effects of endogenous money supply and economic growth on stock returns through the Panel Smooth Transition Regression (PSTR) approach. The threshold variables of endogenous money supply and economic growth have nonlinear relationships with stock returns. The findings indicate that, in the endogenous money supply threshold model, neither the direction nor the intensity of the effect of endogenous money supply on stock returns changes in the upper regime. In other words, when a regime transition occurs, the effect of endogenous money supply remains positive in the upper regime. In the second model, which uses endogenous money supply and economic growth as threshold variables, economic growth has a positive effect on the stock returns of listed banks in the upper regime. The findings recommend the adoption of robust policies aimed at promoting economic growth and sustainable development for economic stakeholders.

Keywords: stock returns, endogenous money supply, economic growth, Panel Smooth Transition Regression (PSTR) approach.

1. Introduction

The banking system occupies a central position in the financial architecture of modern economies because banks simultaneously mobilize savings, create credit, facilitate payments, allocate financial resources, and transmit monetary policy impulses to firms and households. In bank-based economies, changes in banking conditions can therefore influence both the real sector and financial markets. Listed banks are particularly important in this respect because their stock prices reflect investors' assessments of profitability, asset quality, liquidity, macroeconomic conditions, monetary policy, and future economic activity. Bank stock returns are consequently shaped not only by firm-specific factors but also by broad macroeconomic variables, including money supply, inflation, interest rates, output growth, and the availability of credit. Understanding these relationships is essential for investors, bank managers, monetary authorities, and policymakers because instability in bank stock

returns may transmit uncertainty across the financial system. Previous research has accordingly emphasized that macroeconomic conditions constitute an important source of variation in stock-market performance and investor expectations [1].

Economic growth is one of the most important macroeconomic determinants of financial-market performance. An expansion in real economic activity can increase household income, aggregate demand, corporate sales, investment opportunities, and firms' expected cash flows. These developments may enhance corporate profitability and increase the fundamental value of equities. For banks, economic growth can expand demand for loans, improve borrowers' repayment capacity, reduce credit risk, increase fee-based activities, and strengthen interest income. However, the relationship between economic growth and stock returns is not necessarily direct, proportional, or stable over time. Stock prices are forward-looking, whereas official measures of output generally reflect realized economic activity. Investors may incorporate expected growth into prices before changes in gross domestic product become observable. Moreover, rapid growth may be accompanied by inflationary pressures, monetary tightening, higher funding costs, and changes in risk premiums, all of which can weaken stock returns. Consequently, the effect of economic growth on equity returns may vary across economic regimes and institutional settings.

The theoretical association between economic growth and stock returns has generated extensive debate. Conventional valuation principles suggest that stronger economic growth should improve expected corporate earnings and dividends, thereby supporting higher stock prices. Nevertheless, higher aggregate output growth does not always translate into proportionately greater returns for existing shareholders. Economic expansion may be driven by the creation of new firms, increased labor income, or capital accumulation that dilutes the share of aggregate growth captured by incumbent listed companies. Cornell argued that the relationship between aggregate economic growth and equity investment performance is more complex than the frequently assumed positive correspondence between gross domestic product growth and stock returns [2]. Similarly, cross-country evidence has shown that economic growth and stock returns may display weak, unstable, or even inverse relationships, depending on valuation levels, reinvestment patterns, market structure, and the extent to which growth expectations have already been reflected in asset prices [3].

Empirical findings also indicate that the growth–return relationship may differ considerably across countries and economic systems. Jiang demonstrated that the co-movement between economic growth and stock returns is dynamic and that its pattern differs between the United States and China, highlighting the importance of structural and institutional heterogeneity [4]. Evidence from emerging markets similarly suggests that macroeconomic variables can exert significant effects on stock-market returns, although the direction and magnitude of these effects depend on the characteristics of the economy, monetary regime, financial depth, and market efficiency. Research on Nigeria, for example, identified causal relationships between stock-market returns and selected macroeconomic variables, confirming that equity-market movements cannot be adequately explained without reference to broader economic conditions [5]. Evidence from Spain likewise illustrates that stock-market responses to macroeconomic shocks evolve over time and may involve complex impact-response mechanisms rather than fixed linear effects [6].

Within Iran, the relationship between economic growth and stock returns is especially important because the capital market operates in an environment characterized by persistent inflation, monetary expansion, banking-sector dominance, exchange-rate volatility, fiscal pressures, and periodic structural changes. These conditions may alter the way in which real-sector developments are transmitted to equity prices. A Markov-switching analysis of the relationship between stock returns and economic growth in Iran has emphasized the importance of regime-dependent dynamics and has suggested that the association may change across different states of the economy [7].

Research on the Tehran Stock Exchange has also shown that macroeconomic variables affect changes in the total stock price index and that trading volume may function as an intermediary mechanism through which macroeconomic information is incorporated into market prices [8]. These findings indicate that linear models with constant coefficients may be insufficient for explaining Iranian stock-market behavior.

In addition to economic growth, money supply is a fundamental determinant of financial activity and asset valuation. An increase in money supply may affect stock returns through several channels. Greater liquidity can reduce interest rates, increase the availability of credit, stimulate consumption and investment, and encourage investors to shift portfolios from money and fixed-income instruments toward equities. Monetary expansion may therefore increase demand for shares and raise stock prices. However, excessive monetary growth may also intensify inflation, depreciate the domestic currency, increase uncertainty, and reduce the real value of future corporate earnings. For banks, monetary expansion can influence deposit growth, lending capacity, funding costs, net interest margins, asset prices, and the quality of loan portfolios. The ultimate effect of money supply on bank stock returns therefore depends on how liquidity is created, distributed, and transmitted through the banking system.

A key theoretical issue concerns whether the money supply should be treated as exogenous or endogenous. In conventional monetary theory, the central bank is commonly assumed to control the monetary base and, through the money multiplier, the broader money supply. In contrast, the Post-Keynesian approach argues that money is primarily credit-driven and endogenously created. Under this framework, commercial banks extend loans in response to the demand of creditworthy borrowers and subsequently obtain the reserves required to settle payments and satisfy regulatory obligations. Deposits are therefore created through bank lending, and the central bank accommodates the demand for reserves to maintain financial stability and achieve its interest-rate objectives. Money supply is thus influenced by the behavior of banks, borrowers, financial institutions, and the real economy rather than being determined independently by the monetary authority.

The endogenous-money perspective is particularly relevant to banking studies because it places bank lending and deposit creation at the center of monetary dynamics. In this framework, the balance sheets of commercial banks are not passive recipients of externally determined monetary impulses; instead, they actively shape liquidity creation and credit expansion. Theoretical examinations of endogenous money in the context of Iran's Islamic banking system have emphasized that institutional arrangements, financing contracts, regulatory requirements, and the operational behavior of banks must be considered when evaluating monetary creation [9]. Because interest-based and Islamic banking frameworks may differ in their formal contractual structures while retaining comparable balance-sheet mechanisms for credit and deposit creation, the assessment of money endogeneity in Iran requires attention to the specific features of the national banking system.

A growing body of Iranian evidence supports the relevance of endogenous money supply. Falahati et al. examined money endogeneity in Iran and discussed its implications for monetary analysis and policy effectiveness [10]. A nonlinear investigation also provided evidence that the behavior of money supply in Iran cannot necessarily be represented adequately by a simple exogenous and linear process [11]. Saadat Mehr tested the Post-Keynesian endogenous-money hypothesis in the Iranian economy and further highlighted the role of credit creation and banking behavior in determining liquidity [12]. A comparative assessment of the exogenous and endogenous nature of liquidity similarly addressed the degree to which monetary aggregates in Iran respond to domestic banking and economic forces [13]. More recent evidence using a Post-Keynesian framework and a two-stage

control-function estimation approach has reinforced the argument that the endogeneity of money supply should be explicitly evaluated in Iran rather than assumed away [14].

The mechanism through which bank deposits are generated provides another important basis for evaluating money endogeneity. Deposits may respond to the volume of banking facilities, income, interest-rate conditions, inflation, and the public's portfolio decisions. An examination of economic factors affecting the volume of deposits in the Iranian banking system directly compared the money-endogeneity and money-exogeneity hypotheses and emphasized that deposit formation is closely associated with banking and macroeconomic mechanisms [15]. This relationship has direct implications for listed banks because deposits constitute a major source of bank funding, while credit facilities represent a principal income-generating asset. When bank lending creates deposits and expands liquidity, variations in endogenous money supply can affect bank earnings, net interest margins, balance-sheet size, risk exposure, and ultimately market valuation.

The transmission of monetary conditions to bank stock returns also depends on the interest-rate structure. Lending and deposit rates influence banks' financing costs, lending incentives, credit demand, and profitability. A widening spread between lending and deposit rates may initially increase bank income, but higher lending rates can reduce the demand for credit, increase default risk, and weaken the quality of banks' assets. Conversely, lower rates may stimulate borrowing while compressing interest margins. Research on the monetary-policy transmission mechanism in Iran within the term structure of interest rates has demonstrated that the effects of monetary policy should be analyzed through interconnected maturity structures and financial channels rather than through a single policy variable [16]. Therefore, the relationship between endogenous liquidity and bank stock returns may vary according to interest-rate conditions, inflation, and economic growth.

Recent international evidence directly links the endogeneity of money supply to bank stock returns. Liu et al. investigated whether endogenous money supply influences bank stock returns in South Asian economies and developed a framework in which bank loans, deposits, inflation, interest-rate margins, output, and bank earnings interact in determining monetary conditions and equity performance [17]. Their approach is particularly relevant because it moves beyond the general relationship between money supply and an aggregate stock index and focuses on listed banks, whose balance sheets are themselves involved in money creation. This distinction is crucial: whereas nonfinancial corporations mainly respond to monetary conditions, banks both respond to and contribute to changes in the money supply. Consequently, an increase in endogenous money may affect bank shares through market liquidity and aggregate demand while simultaneously altering the deposits, loans, revenues, and risks recorded on banks' balance sheets.

Despite these theoretical and empirical advances, several gaps remain. First, much of the existing literature examines either the effect of macroeconomic variables on broad stock-market indices or the endogenous nature of money supply without integrating these two research streams. Second, studies of stock returns often assume that the effects of monetary and real variables are linear and constant across observations. Such an assumption may be restrictive in an economy where inflation, liquidity growth, output, credit conditions, and investor expectations undergo substantial changes. Third, the relationship between economic growth and bank stock returns may depend on the prevailing level of endogenous liquidity. Economic expansion under moderate liquidity conditions may strengthen banking profitability, whereas expansion accompanied by excessive monetary growth and inflation may produce different valuation effects. Similarly, the effect of endogenous money supply may change once liquidity or output crosses a critical threshold.

Nonlinear econometric models provide an appropriate framework for addressing these issues. Traditional threshold models divide observations into distinct regimes and permit coefficients to change when a threshold variable crosses an estimated value. However, economic transitions are rarely instantaneous. Investors, banks, borrowers, and policymakers generally adjust gradually to changing conditions. The Panel Smooth Transition Regression approach allows regression coefficients to shift continuously between regimes according to an observable transition variable. The framework developed for panel smooth-transition analysis permits heterogeneity across cross-sectional units while capturing gradual nonlinear adjustment [18]. Subsequent applications have demonstrated the usefulness of this approach for evaluating threshold effects in international panel data, including changes in the productivity of public capital across different economic conditions [19].

The PSTR framework is also well suited to the analysis of financial development and economic growth because it can identify whether the effect of one variable strengthens, weakens, or changes direction at different levels of a transition variable. Jude applied a panel smooth-regression approach to the relationship between financial development and growth, illustrating that financial effects may vary across regimes rather than remain constant [20]. From an econometric perspective, selecting the number of transition functions, threshold locations, and appropriate model specification is essential for distinguishing genuine nonlinear behavior from misspecified linearity. Advanced econometric treatments emphasize the importance of model diagnostics, stationarity tests, linearity tests, information criteria, and residual evaluation in nonlinear panel estimation [21]. These procedures are particularly important when financial and macroeconomic variables display trends, structural changes, and heterogeneous responses.

Applying a PSTR model to Iranian listed banks offers several analytical advantages. It permits the effect of endogenous money supply on stock returns to be estimated separately in lower and upper monetary regimes while allowing the transition between them to occur smoothly. It also makes it possible to determine whether the influence of economic growth changes when growth exceeds an estimated threshold. By including inflation and bank earnings alongside money supply and output, the model can distinguish the direct effects of monetary expansion and economic growth from related changes in prices and banking profitability. This framework therefore provides a more realistic representation of the interactions among credit creation, deposits, liquidity, output, bank balance sheets, and equity valuation.

The issue has significant policy implications. When money supply is endogenous, attempts to control liquidity solely through restrictions on the monetary base may be ineffective if commercial banks continue to create credit in response to financing demand. Monetary authorities must therefore consider the behavior of bank lending, deposit creation, interest-rate margins, and credit allocation. At the same time, policies aimed at promoting economic growth may influence bank stock returns differently depending on the monetary regime. Identifying these threshold effects can assist the Central Bank of Iran in designing more effective monetary and prudential policies, help bank managers understand the market consequences of balance-sheet expansion, and enable investors to evaluate bank shares under changing macroeconomic conditions. It may also clarify why similar changes in output or liquidity generate different stock-market responses across periods.

Accordingly, the aim of this study is to examine the nonlinear effects of endogenous money supply and economic growth on the stock returns of Iranian listed banks during the 2013–2024 period using a Panel Smooth Transition Regression approach.

2. Methodology

The Panel Threshold Regression (PTR) model is the initial form of a class of regression models based on panel data and was introduced by Hansen (1999). The Panel Smooth Transition Regression (PSTR) model, introduced and developed by González et al. (2005) and Colletaz and Hurlin (2006), is an extension of the Panel Threshold Regression model that incorporates a transition function. The fundamental distinction of PSTR models concerns the manner in which regression coefficients change across different regimes. More specifically, the slope of the transition function represents the speed of adjustment and transition between regimes. The generalized form of the PSTR model with more than one transition function is expressed as follows:

$$y_{it} = \mu_i + \lambda_t + \boldsymbol{\beta}_0' \mathbf{x}_{it} + \sum_{j=1}^{r} \left[\boldsymbol{\beta}_j' \mathbf{x}_{it}\right] g_j\left(q_{it}^j; \gamma_j, c_j\right) + u_{it} \qquad (1)$$

Based on the theoretical framework developed by González et al. (2005) and Joud (2010), the PSTR estimation process begins with a linearity test. When the null hypothesis of a linear relationship is rejected, the number of transition functions must be determined to obtain an appropriate specification of nonlinear behavior. Accordingly, two transition functions are considered in the model related to endogenous money supply. In the model incorporating endogenous money supply and economic growth, the appropriate number of transition functions is selected to provide a complete explanation of the nonlinear relationships. The Lagrange Multiplier–Wald statistic, the Lagrange Multiplier–Fisher statistic, and the likelihood-ratio statistic are used to test this hypothesis.

Drawing on Liu et al. (2024), this study extends the conventional test to a three-equation model to examine the effect of endogenous money supply on the stock returns of listed banks. The effect of the money supply varies according to three factors: bank deposits, bank credit facilities, and the effects of cash flows and balance-sheet items on the return on equity reported in banks' balance sheets. Simultaneous and interrelated equations are considered to test the relationship between the money supply and banks' return on equity. According to Post-Keynesian theory, bank lending may initially be accompanied by an expansion of the money supply, indicating that the money supply is endogenous. Dividend valuation theory establishes a significant and positive relationship between banks' return on equity and their share prices. Bank earnings (BES) constitute an important component of a bank's balance sheet and are calculated as follows:

$$BES = [(BLR \times BL) - (BDR \times BD)] \qquad (2)$$

In Equation (2), BLRrepresents the bank deposit rate, whereas BDRrepresents the bank lending rate. BLdenotes bank deposits, and BDrepresents the amount of bank loans.

The following equation demonstrates how the net interest rate margin is calculated:

$$RLRD = RL - RD \qquad (3)$$

In this equation, RLrepresents the bank lending rate, and RDrepresents the bank deposit rate. In this study, $RLRD$, or the net interest rate margin, is assumed to have an inverse relationship with the amount of bank lending. This is because increases in bank lending and deposit rates also increase the net interest rate margin. When bank lending rates are higher, fewer loans are granted, thereby reducing the total volume of bank lending. The money supply equation is expressed as follows:

$$MS = f(BL, INF, RLRD) \qquad (4)$$

Alternatively, it can be written as Equation (5):

$$MS = \alpha_0 + \alpha_1 BL + \alpha_2 INF + \alpha_3 RLRD \qquad (5)$$

In this equation, MSdenotes the money supply, BLdenotes bank lending, INFrepresents the inflation rate, and $RLRD$represents the net interest rate margin. The stock return index equation is presented as Equation (6):

$$SPI = f(MS, INF, Y, BES) \qquad (6)$$

The logarithmic form of the model is written as Equation (7):

$$\ln SPI_{it} = \beta_0 + \beta_1 \ln MS_{it} + \beta_2 \ln INF_{it} + \beta_3 \ln Y_{it} + \beta_4 BES_{it} + \varepsilon_{it} \qquad (7)$$

In this equation, SPIdenotes bank stock returns, MSdenotes the money supply, BLdenotes bank lending, INFrepresents the inflation rate, Yrepresents output, and BESdenotes bank earnings.

The listed banks examined in this study are Eghtesad Novin Bank, Ansar Bank, Parsian Bank, Pasargad Bank, Post Bank of Iran, Tejarat Bank, Hekmat Iranian Bank, Middle East Bank, Day Bank, Saman Bank, Sina Bank, Saderat Bank, Karafarin Bank, and Mellat Bank.

Bank stock returns (SPI) are calculated by multiplying the number of bank shares by the bank's share price and considering the return on the bank's stock market. The average value of bank shares is measured relative to the base year. The money supply (MS), real income or real gross domestic product (Y) at constant 2016 prices, inflation (INF) expressed as a percentage, and bank earnings (BES) are included in the model. Bank earnings refer to the rapid and secure transfer of money from one account to another through banking and digital networks. The lending rate is represented by the five-year interest rate, while the bank deposit rate is represented by the one-year interest rate. Data on the market value of shares, credit facilities, and deposits of listed banks were collected from the Rahavard Novin software, the Tehran Stock Exchange database, and the CODAL website. Data on the money supply, lending rates, deposit rates, income, inflation, and the one-year interest rates of state-owned banks were extracted from the balance sheets and available databases of the Central Bank of Iran.

3. Findings and Results

In this study, the effects of endogenous money supply and economic growth as threshold variables on the stock index of listed banks during the 2013–2024 period are estimated using the Panel Smooth Transition Regression model.

The estimation results for the endogenous money supply equation are presented in Table 1.

Table 1. Estimation of the Endogenous Money Supply Equation

Variable	Coefficient	***t*-Statistic**	Probability
LBL	0.35^{**}	13.698	0.000
LINF	-1.64^{**}	-6.886	0.000
RLRD	-9.57	-1.542	0.125

Four panel unit-root tests are conducted for the variables at level and with lagged terms. The unit-root tests include the Levin–Lin–Chu (LLC), Im–Pesaran–Shin (IPS), Maddala–Wu and Choi, and Breitung tests, which are used to evaluate the stationarity of the Iranian data at first order. Table 2 presents the stationarity-test statistics for

the first-differenced variables. As shown, all variables contain a unit root according to the Levin–Lin–Chu test and become stationary after first differencing; therefore, they are integrated of order one.

Table 2. Unit-Root Tests for the First-Differenced Variables

Variable	Levin, Lin, and Chu t^*	Im, Pesaran, and Shin W-Statistic	ADF–Fisher Chi-Square	PP–Fisher Chi-Square
$D(LM2)$	$-3.044^{**}(0.001)$	–	28.207 (0.453)	16.3610 (0.9602)
$D(LGDP)$	$-3.1034^{**}(0.0014)$	-0.2604 (0.3974)	23.376 (0.7140)	13.015 (0.993)
$D(LBL)$	$-4.758^{**}(0.0000)$	$-3.911^{**}(0.0000)$	$66.362^{**}(0.000)$	$107.149^{**}(0.000)$
$D(RLRD)$	$-9.607^{**}(0.000)$	$-4.191^{**}(0.000)$	$72.821^{**}(0.0000)$	$74.816^{**}(0.000)$
$D(LINF)$	$-6.414^{**}(0.000)$	–	$61.535^{**}(0.000)$	$274.782^{**}(0.000)$
$D(BES)$	$-1.375^{***}(0.084)$	–	$88.765^{**}(0.0000)$	$147.56^{**}(0.000)$
$D(LMS)$	$-1.871^{**}(0.030)$	$-1.961^{**}(0.025)$	$58.9181^{**}(0.000)$	$122.323^{**}(0.000)$
$D(LSPI)$	$-3.695^{**}(0.000)$	$-1.315^{***}(0.094)$	37.143 (0.115)	$62.870^{**}(0.000)$

According to the PSTR methodology, after confirming the stationarity of the variables, the first step in specifying the model is to test linearity against the PSTR alternative. In this study, endogenous money supply and economic growth are selected as threshold variables. Before estimating the final model, the null hypothesis that the relationships are linear is tested. Subsequently, for a more comprehensive assessment, the hypothesis of one transition function is tested against the alternative hypothesis of at least two transition functions to examine any remaining nonlinear relationships. Table 3 reports the Lagrange Multiplier–Wald (LMW), Lagrange Multiplier–Fisher (LMF), and likelihood-ratio (LR) statistics for one and two threshold locations ($m = 1,2$) for Iranian listed banks.

Table 3. Results of the Linearity Test and Determination of the Number of Transition Functions

Endogenous Money Supply

Hypothesis	$m = 1$: LMW	$m = 1$: LMF	$m = 1$: LR	$m = 2$: LM	$m = 2$: LMF	$m = 2$: LR
$H_0: r = 0$ versus $H_1: r = 1$	-0.191 (0.01)	-0.040 (0.02)	-0.191 (0.02)	0.372 (0.03)	0.038 (0.01)	0.372 (0.02)
$H_0: r = 1$ versus $H_1: r = 2$	0.235 (0.055)	2.169 (0.076)	9.523 (0.049)	6.406 (0.221)	1.365 (0.254)	4.436 (0.218)

Economic Growth

Hypothesis	$m = 1$: LMW	$m = 1$: LMF	$m = 1$: LR	$m = 2$: LM	$m = 2$: LMF	$m = 2$: LR
$H_0: r = 0$ versus $H_1: r = 1$	17.959 (0.001)	4.488 (0.002)	19.095 (0.002)	22.629 (0.004)	2.842 (0.006)	24.474 (0.002)
$H_0: r = 1$ versus $H_1: r = 2$	0.352 (0.986)	0.073 (0.990)	0.352 (0.986)	6.070 (0.639)	0.636 (0.746)	6.193 (0.626)

In this specification, $m$represents the number of threshold locations, whereas $r$represents the number of limiting regimes or transition functions. The test results indicate that all Lagrange Multiplier–Wald, Lagrange Multiplier–Fisher, and likelihood-ratio statistics for the endogenous money supply variable follow a nonlinear pattern for threshold specifications $m = 1$and $m = 2$, with $r = 1$limiting regime. Based on the hypothesis-testing results, the null hypothesis of linear relationships involving endogenous money supply and economic growth is rejected, thereby confirming nonlinear relationships between these variables.

The model is estimated for each possible threshold specification. The optimal number of threshold locations is then selected by identifying the smallest values of the Schwarz and Akaike criteria and the PSTR residual sum of squares. Table 4 reports the corresponding values.

Table 4. Results of the Test for Determining the Number of Threshold Locations

Threshold Variable and Specification	Residual Sum of Squares	Schwarz Criterion	Akaike Criterion
Endogenous money supply			
$m = 1$	195.102	0.441	0.638
$m = 2$	192.483	0.477	0.664
Economic growth			
$m = 1$	173.933	0.523	0.326
$m = 2$	173.542	0.560	0.343

The results presented in the table indicate that, according to the Schwarz and Akaike criteria, $m = 1$has the smallest criterion values in both PSTR models and is therefore selected as the optimal specification for Iran.

Figures 1 and 2 illustrate the trends in endogenous money supply and economic growth used to identify the corresponding threshold levels.

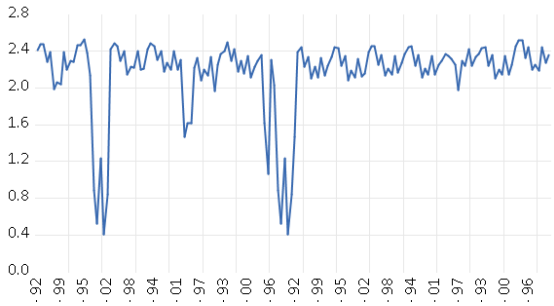

Figure 1. Trend Used to Determine the Threshold Levels of Endogenous Money Supply

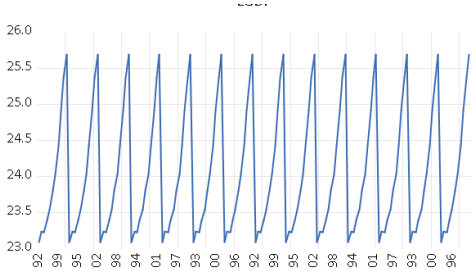

Figure 2. Trend Used to Determine the Threshold Levels of Economic Growth

Based on the estimated probabilities of the transition functions, endogenous money supply is used as the transition variable in Model 1, whose results are reported in Table 5. Economic growth is used as the transition variable in Model 2, whose results are reported in Table 6. The threshold value of endogenous money supply for each transition function and the slope parameter, which represents the speed of transition from one regime to another, are presented for the lower and upper regimes.

Table 5. Slope-Coefficient Results for Endogenous Money Supply as the Threshold Variable: PSTR Test

Variable	Lower-Regime Coefficient	Standard Error	t-Statistic	Upper-Regime Coefficient	Standard Error	t-Statistic
LMS	0.0003**	0.000	2.414	4.027**	1.593	2.527
LINF	-0.001	0.000	-1.674	0.100	0.060	1.675
LGDP	0.0007**	0.002	3.354	1.86**	0.725	2.560
BES	0.000	0.000	1.554	0.000	0.000	1.634

$$c = 0.856$$
$$\delta = 18.837$$

Model 1 contains two regimes: a lower regime and an upper regime. The speed of transition from the lower regime to the upper regime is 0.856, and the threshold value is 18.837. Only endogenous money supply and gross domestic product are statistically significant at the 5% level in both regimes. The coefficient of endogenous money supply is 0.0003, which is negligible in magnitude but statistically significant. The direction of the effect of endogenous money supply on the stock returns of listed banks does not change; however, the magnitude of the effect increases in the upper regime. In other words, a regime transition occurs. Endogenous money supply has a positive effect on stock returns, and economic growth also has a positive effect on stock returns. Thus, when the

regime transition occurs, the effect of economic growth increases. The slope coefficients of the variables are considered conditional on the value of endogenous money supply as the transition variable for Iran.

Based on the estimated probabilities of the transition functions, economic growth is used as the threshold variable in Model 2, whose results are reported in Table 6. The threshold value of economic growth for each transition function and the slope parameter, which indicates the speed of transition from one regime to another, are presented for the lower and upper regimes.

Table 6. Slope-Coefficient Results for Economic Growth as the Threshold Variable: PSTR Test

Variable	Lower-Regime Coefficient	Standard Error	t-Statistic	Upper-Regime Coefficient	Standard Error	t-Statistic
LGDP	-0.020	1.0146	-0.020	0.279**	0.139	2.007
LMS	-0.527	0.3521	-1.450	1.054	0.543	1.940
LINF	-0.033	0.0219	-1.512	0.110**	0.033	3.370
BES	-0.087	0.1704	-0.513	-0.003	0.284	-0.010
			$c = 5.264$			
			$\delta = 23.87$			

Model 2 contains two regimes: a lower regime and an upper regime. The speed of transition from the lower regime to the upper regime is 5.264, and the threshold value is 23.876. Only inflation and economic growth are statistically significant at the 5% level in the upper regime. The coefficient of economic growth is approximately 0.28, and the direction of its effect on the stock returns of listed banks changes across regimes, although it is statistically significant only in the upper regime. In other words, a regime transition occurs. Economic growth has a positive effect on stock returns. When the regime transition occurs, inflation also has a positive effect in the upper regime.

4. Discussion and Conclusion

The present study examined the nonlinear effects of endogenous money supply and economic growth on the stock returns of Iranian listed banks during the 2013–2024 period through the Panel Smooth Transition Regression approach. The findings first confirmed that the relationships among endogenous money supply, economic growth, and bank stock returns could not be adequately represented by a conventional linear model. The linearity tests rejected the null hypothesis of linearity, indicating that the effects of the explanatory variables differed according to the prevailing monetary and economic regimes. The model-selection results further showed that one threshold location provided the optimal specification for both endogenous money supply and economic growth. This finding demonstrates that the relationship between macroeconomic conditions and bank stock returns changes gradually after the transition variable crosses a specific threshold. Such a result supports the use of nonlinear econometric models in financial analysis because the responses of investors, banks, and monetary authorities to changes in liquidity and output are unlikely to occur instantaneously or remain constant over time [18-20].

In the first model, in which endogenous money supply was used as the threshold variable, endogenous money supply had a positive and statistically significant effect on the stock returns of listed banks in both the lower and upper regimes. Although the direction of the relationship remained positive after the regime transition, the magnitude of the coefficient increased considerably in the upper regime. Therefore, higher levels of endogenous liquidity strengthened the positive effect of money supply on bank stock returns. This result indicates that an expansion in liquidity generated through the interaction of bank lending, deposit creation, and credit demand can improve the market valuation of listed banks, particularly when the level of endogenous money supply exceeds

the estimated threshold. The finding is consistent with the Post-Keynesian view that commercial banks are active creators of money rather than passive intermediaries distributing a fixed quantity of central-bank money [10, 12, 14].

The positive relationship between endogenous money supply and bank stock returns can be explained through several interconnected mechanisms. When banks extend additional credit, new deposits are created, bank balance sheets expand, and the volume of interest-earning assets increases. If the expansion of lending is accompanied by adequate credit quality and stable funding costs, banks can generate higher interest income and improve their expected profitability. Investors may interpret growth in loans, deposits, and liquidity as evidence of stronger banking activity and improved future earnings, thereby increasing demand for bank shares. The effect may be especially strong in the upper regime because high levels of liquidity can increase trading activity in the capital market and direct a greater proportion of financial resources toward equities. The results therefore accord with evidence that the endogeneity of money supply is closely related to the behavior of bank credit, deposits, and domestic economic activity in Iran [13, 15].

The findings also align with the evidence reported by Liu et al., who showed that money supply endogeneity can affect bank stock returns through bank lending, deposits, inflation, interest-rate margins, economic output, and bank earnings [17]. The present results extend that framework to Iranian listed banks by demonstrating that this influence is nonlinear and regime-dependent. In the lower regime, the positive coefficient of endogenous money supply was statistically significant but economically small, suggesting that limited increases in liquidity do not necessarily generate large changes in bank equity values. However, after liquidity crossed the estimated threshold, its effect became substantially stronger. This may be because higher liquidity levels produce broader portfolio reallocation, stronger credit expansion, greater stock-market participation, and higher nominal values of bank assets and earnings. Thus, the market response to liquidity growth depends not only on the direction of monetary expansion but also on its scale.

The finding that money supply behaves endogenously is also consistent with previous Iranian research. Nonlinear evidence has indicated that Iran's monetary aggregates respond to banking-sector and real-sector conditions rather than being determined entirely outside the economy [11]. Studies testing the Post-Keynesian hypothesis have similarly concluded that credit creation and the demand for financing play important roles in determining liquidity [12]. More recent research using a two-stage control-function approach has provided additional support for the endogenous nature of money supply in Iran [14]. The current study adds a financial-market dimension to this literature by showing that endogenous money creation is not merely a monetary phenomenon but also has implications for the stock returns of the banks involved in the creation and distribution of credit.

Gross domestic product also had a positive and statistically significant effect on bank stock returns in both regimes of the first model, with a stronger effect in the upper regime. This finding suggests that economic expansion improves the performance and valuation of listed banks, particularly when accompanied by high endogenous liquidity. Economic growth increases household income, business activity, investment demand, and the volume of financial transactions. These developments can increase demand for bank loans and payment services, improve borrowers' repayment capacity, reduce nonperforming loans, and enhance banks' interest and fee income. Consequently, investors may revise their expectations of bank profitability upward and increase their demand for bank shares. The stronger upper-regime coefficient implies that the beneficial effects of economic growth are amplified when the banking system has sufficient liquidity to finance investment and commercial activity.

This positive growth effect is consistent with the conventional valuation argument that stronger economic activity supports corporate profitability and stock-market performance. Evidence from Iran has shown that stock returns and economic growth are connected through regime-dependent mechanisms, with the nature of the relationship changing according to economic conditions [7]. Studies in other economies have also demonstrated dynamic co-movement between output growth and stock returns, although the magnitude and direction may differ across countries and periods [4]. The current findings support the proposition that the relationship is positive for Iranian listed banks once nonlinear transitions are taken into account. They also indicate that the banking sector may benefit more directly from economic expansion than some nonfinancial sectors because growth simultaneously affects credit demand, asset quality, deposits, and payment activity.

Nevertheless, the positive association identified in this study should not be interpreted as evidence that economic growth always leads automatically to higher equity returns. Previous research has emphasized that aggregate economic growth and stock returns may diverge because stock prices are forward-looking, growth expectations may already be incorporated into valuations, and new economic activity does not always accrue to existing shareholders [2, 3]. The present results suggest that, for Iranian banks, the relationship becomes clearer when threshold behavior is modeled explicitly. In other words, a linear specification may conceal the positive effect because the response of bank stock returns differs across low- and high-growth or low- and high-liquidity environments.

In the first model, inflation did not have a statistically significant effect in either regime. This result suggests that, when endogenous money supply is used as the transition variable, the direct effect of inflation on bank stock returns is not sufficiently stable to be distinguished from the influences of liquidity, output, and bank earnings. Inflation can affect bank shares through competing channels. It may increase nominal asset values, loan amounts, and reported revenues, but it can also raise funding costs, reduce the real value of financial assets, increase economic uncertainty, and weaken borrowers' repayment capacity. These offsetting mechanisms may explain the absence of a statistically significant net effect. Research on macroeconomic determinants of stock-market performance has similarly indicated that the effects of inflation and other macroeconomic variables depend on the monetary environment, market structure, and the manner in which investors process economic information [1, 5, 6].

Bank earnings were also statistically insignificant in both regimes of the first model. One possible explanation is that the market valuation of Iranian banks is influenced more strongly by macroeconomic liquidity, expected economic conditions, asset revaluation, and regulatory developments than by the contemporaneous bank-earnings measure included in the model. Bank earnings may also be affected by accounting practices, delayed recognition of credit losses, regulated interest rates, and changes in the composition of bank assets and liabilities. Therefore, the reported earnings variable may not fully capture the underlying economic profitability anticipated by investors. Moreover, the effects of lending and deposit rates may operate indirectly through endogenous money supply and net interest margins rather than through the bank-earnings variable alone. The complexity of these transmission channels is compatible with research emphasizing the importance of the term structure of interest rates and multiple monetary-policy transmission mechanisms in Iran [16].

In the second model, in which economic growth was used as the threshold variable, the effect of economic growth was negative but statistically insignificant in the lower regime and positive and statistically significant in the upper regime. This regime change represents one of the central findings of the study. It implies that low levels of economic growth are insufficient to generate a meaningful improvement in bank stock returns. When the economy operates below the threshold, weak demand, underutilized capacity, limited investment, and elevated

credit risk may prevent banks from converting small increases in output into higher profitability. Once economic growth crosses the estimated threshold, however, the effect becomes positive and statistically significant. At that point, stronger business activity, loan demand, deposit growth, and improved debt-servicing capacity may jointly increase expected bank earnings and equity valuations.

This result supports the argument that financial-market responses to real economic activity are state-dependent. The PSTR evidence reported by Jude demonstrates that the effect of financial development on growth changes across different regimes, emphasizing that financial and real-sector relationships cannot always be represented by constant parameters [20]. Similarly, the dynamic relationship between economic growth and stock returns identified across the United States and China indicates that institutional and cyclical conditions influence the strength of co-movement [4]. The current findings show that a comparable form of nonlinearity exists among Iranian listed banks: economic growth becomes a significant driver of stock returns only after the economy moves into the upper-growth regime.

Inflation was negative and statistically insignificant in the lower-growth regime but became positive and statistically significant in the upper-growth regime. This change suggests that the effect of inflation depends on the strength of real economic activity. Under weak-growth conditions, inflation may mainly represent higher costs, lower purchasing power, financial instability, and greater credit risk. Under stronger-growth conditions, however, moderate or demand-driven inflation may coincide with expanding nominal income, higher asset prices, increased lending, and greater nominal bank revenues. In an inflationary economy, banks may also benefit from the nominal expansion of their balance sheets and the revaluation of certain assets, provided that growth is sufficiently strong to preserve borrowers' repayment capacity. Therefore, the positive upper-regime effect does not imply that inflation is universally beneficial; rather, it indicates that its association with bank stock returns changes after economic growth exceeds the estimated threshold.

The significance of inflation in the upper regime is broadly compatible with studies showing that the responses of stock markets to macroeconomic shocks depend on the prevailing economic environment [6]. It also corresponds with evidence from the Tehran Stock Exchange that macroeconomic variables affect stock-price movements through both direct mechanisms and changes in trading activity [8]. In periods of stronger growth, investors may interpret inflation as a reflection of rising aggregate demand and nominal profitability rather than solely as a source of instability. In contrast, during stagnation, the same inflationary pressure may be interpreted as a sign of macroeconomic imbalance. This difference illustrates why threshold models can provide more informative results than conventional linear regressions.

Endogenous money supply was not statistically significant in either regime of the second model, although its coefficient changed from negative in the lower regime to positive in the upper regime. This result indicates that when economic growth serves as the transition variable, the independent contribution of money supply is weaker than in the model in which liquidity itself defines the regimes. One interpretation is that the effect of endogenous liquidity on bank returns is conditional on the state of the real economy. Liquidity expansion during weak economic conditions may not translate into productive lending or improved bank profitability and may instead contribute to inflation, speculative activity, or the accumulation of low-quality assets. By contrast, liquidity expansion during stronger economic growth may support investment and banking activity, producing a positive but statistically marginal effect. This interpretation is consistent with Post-Keynesian analyses emphasizing that the consequences of endogenous money creation depend on the demand for credit, the allocation of financing, and the institutional structure of the banking system [9, 10].

Taken together, the two models demonstrate that endogenous money supply and economic growth are interdependent drivers of bank stock returns, but their effects depend on which variable determines the prevailing regime. When liquidity defines the transition, both endogenous money supply and economic growth have significant positive effects, and their influence strengthens in the upper regime. When economic growth defines the transition, economic growth and inflation become significant only in the upper regime, whereas money supply loses statistical significance. These findings imply that liquidity alone cannot guarantee improved bank-market performance unless it is accompanied by sufficient real economic activity. Likewise, economic growth generates stronger positive effects when the monetary and banking system can provide the liquidity required to finance production, investment, and trade.

The results have important implications for the interpretation of monetary policy in Iran. If money supply is largely endogenous, the central bank cannot manage liquidity solely by controlling reserve money or announcing aggregate monetary targets. It must also influence the incentives and constraints governing bank lending, deposit creation, interest-rate margins, credit allocation, and balance-sheet risk. The evidence that the effect of liquidity intensifies after a threshold further suggests that uncontrolled credit expansion may produce increasingly large changes in financial-asset prices. At the same time, the positive effect of growth in the upper regime indicates that policies that direct bank credit toward productive investment may strengthen both economic performance and the market value of banks. Advanced nonlinear econometric analysis is therefore essential for identifying the points at which monetary and economic effects change in magnitude or direction [21].

This study has several limitations. The analysis was restricted to 14 Iranian listed banks, and the results may not be generalizable to unlisted banks, credit institutions, or banks operating in financial systems with different regulatory and institutional structures. The available annual data also limited the number of observations and may not fully capture short-term changes in monetary conditions, investor expectations, or bank-specific shocks. Moreover, the model included a limited set of macroeconomic and banking variables, while exchange-rate fluctuations, political uncertainty, sanctions, asset quality, capital adequacy, nonperforming loans, corporate governance, and regulatory interventions may also affect bank stock returns. The measurement of bank earnings and interest-rate margins may not completely reflect economic profitability because accounting practices and regulated rates can obscure the underlying financial position of banks.

Future studies should examine the relationship using quarterly or monthly data to identify shorter-term transitions and improve the precision of the estimated threshold parameters. Researchers may compare listed and unlisted banks, distinguish between state-owned and privately owned institutions, or estimate separate models for large and small banks. Additional variables such as exchange rates, sanctions, oil revenues, fiscal deficits, capital adequacy, nonperforming loans, market liquidity, investor sentiment, and policy uncertainty should be incorporated into future models. Comparative research involving Iran and other emerging or bank-based economies could also determine whether the estimated nonlinear patterns are country-specific or reflect broader features of endogenous monetary systems. Alternative techniques, including dynamic PSTR models, Markov-switching models, nonlinear autoregressive distributed-lag models, and quantile regressions, may provide further evidence regarding asymmetric and regime-dependent effects.

Monetary authorities should monitor the interaction between bank lending, deposit creation, economic growth, and asset-market performance rather than focusing exclusively on aggregate liquidity targets. Credit expansion should be directed toward productive activities that strengthen output, employment, and borrowers' repayment capacity, because liquidity growth without sufficient real-sector expansion may not improve bank performance.

Bank managers should incorporate macroeconomic threshold indicators into lending, liquidity, and investment decisions and should avoid excessive balance-sheet expansion when economic growth remains below the level required to support credit quality. Investors should evaluate bank shares by considering the joint state of liquidity, inflation, and economic growth rather than interpreting changes in any single macroeconomic variable in isolation. Policymakers should also improve financial disclosure, strengthen credit-risk supervision, and promote stable economic growth so that banking-sector liquidity contributes to sustainable development rather than speculative asset-price inflation.

Authors' Contributions

Authors equally contributed to this article.

Ethical Considerations

All procedures performed in this study were under the ethical standards.

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Conflict of Interest

The authors report no conflict of interest.

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