Journal of Money and Economy
Vol. 21, No. 2, Spring 2026
pp. 307-333

Original Research Article

Oil Shocks, Asymmetric Inverse-Velocity Dynamics, and the Breakdown of the Constant-Velocity Quantity Relation in Iran

Fateme Kiani[*] **Teymur Rahmani**[†]
Ali Taiebnia[‡] **Mehdi Darabi**[§]

Received: 07 Dec 2025 Approved: 01 Feb 2026

This paper examines the breakdown of the constant-velocity, quantity-theory-consistent money-demand relation in Iran amid large swings in real oil-export value. Conventional specifications fail because real GDP excludes oil-rent-financed absorption and terms-of-trade gains, even though these expand the effective transaction base financed by oil revenues. We therefore model the inverse velocity of money as a function of both the real oil price and oil production, using linear ARDL and nonlinear NARDL frameworks over 1960–2024. The results establish a stable long-run cointegrating relationship: both real oil price and oil production exert positive and statistically significant effects on inverse velocity, with a significant negative error-correction term. Asymmetry is pronounced in the short run for oil prices—positive shocks raise inverse velocity more strongly than negative shocks reduce it—while for oil production, expansions significantly increase inverse velocity but contractions are muted, consistent with fiscal smoothing, monetization, and sanctions-related adjustments. Two policy-regime dummies (deposit-rate war 2014–2017 and bank balance-sheet controls since 2021) confirm that oil channels dominate velocity dynamics. These findings imply that monetary policy must be explicitly oil-contingent: targets should net out oil-driven shifts in money demand, quantity-based instruments should be used during oil booms, and fiscal/foreign-exchange sterilization is essential to prevent velocity instability and mis-calibrated inflation outcomes.

[*] PhD candidate, Faculty of Economics, University of Tehran, Tehran, Iran
fateme.kiani@ut.ac.ir
[†] Professor, Faculty of Economics, University of Tehran, Tehran, Iran; trahmani@ut.ac.ir (Corresponding Author)
[‡] Professor, Faculty of Economics, University of Tehran, Tehran, Iran; taiebnia@ut.ac.ir
[§] PhD, Faculty of Economics, University of Tehran, Tehran, Iran; m.daraby@ut.ac.ir
This paper is derived from the first author’s PhD dissertation submitted to the Faculty of Economics, University of Tehran

Keywords: Inverse velocity; Money demand; Oil price; Oil production; ARDL; NARDL; Fiscal dominance; Iran
JEL Classification*:* E41, E31, E52, Q43, O53

1 Introduction

The Quantity Theory of Money[1] (QTM) provides one of the most enduring frameworks linking money, prices, and output. However, empirical evidence for Iran over the past decades reveals that the classical relationship between monetary aggregates and inflation has persistently failed to hold (see, e.g., Farrokhi Balajadeh et al., 2019; Maleki et al., 2015). This paradox raises a fundamental question: why does the money-demand function implied by the constant-velocity version of the QTM not work in the Iranian context?

Figure 1 plots the inverse velocity of money and the real value of oil exports for 1960–1990 and 1991–2023. In both panels, major level shifts in inverse velocity align with sharp surges in real oil income—most notably during the oil booms of the 1970s and 2000s. In each episode, money expanded substantially more than real activity, creating a persistent wedge between real money and output and, in turn, undermining the constant-velocity proportionality implied by the Quantity Theory of Money. Taken together, these visual patterns suggest that fluctuations in oil income—through both price and quantity channels—are central to Iran's inverse-velocity dynamics and to the failure of a constant-velocity quantity relation.

While oil-related trading gains constitute the primary driver of velocity fluctuations in Iran—as clearly illustrated in Figure 1—several non-oil factors also influence money velocity. These include the opportunity cost of holding money (real interest rates and deposit-rate competition), financial innovation and liberalization that alter transactions demand, currency substitution induced by exchange-rate volatility and sanctions, inflationary expectations, and shifts in monetary-policy regimes. In the Iranian context, however, these non-oil factors have historically played a secondary role relative to terms-of-trade shocks, as evidenced by the striking co-movement between inverse velocity and real oil-export value.

[1] Throughout this paper, "money" is measured as broad money (M2) in domestic currency, as reported by the Central Bank of Iran.

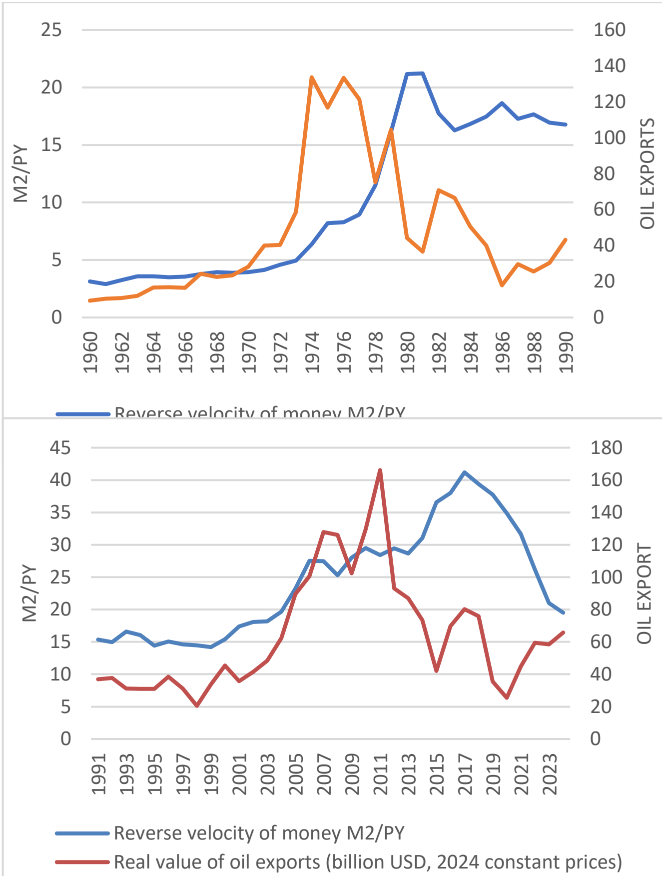

Figure 1. Inverse velocity and real oil-export value in Iran: two subperiods, 1960–1990 and 1991–2023.
Source: Research findings

In Iran's economy—where natural-resource rents from oil are large relative to GDP—real money balances in the long run depend not only on real output but also on the rent generated by oil exports (Arman & Aghajari, 2009). A sizable share of this rent is absorbed through imports of goods and services; accordingly, the demand for real money rises to be used in transactions of both domestically produced goods and services and imported goods and services financed by oil rents. For policy, it is essential to disentangle how much of any increase or decrease in real money balances is attributable to the production side, how much to oil-export revenues (the rent component), and how much to monetary policy itself (Rahmani, 2025). As shown in Figure 1, the post-2018 decline in inverse velocity—real money balances relative to real output—should not necessarily be interpreted as evidence of deliberate monetary tightening. The reimposition of U.S. sanctions substantially reduced Iran's oil exports and oil-sector activity and was followed by a sharp depreciation of the rial and increased inflationary pressures (World Bank, 2020; Laudati & Pesaran, 2023). These developments reduced the oil-rent-financed transaction base and affected the real value of monetary balances. Therefore, without systematically decomposing changes in inverse velocity into production, oil-sector, and monetary-policy components, assessments of inflationary conditions and the appropriate choice of policy instruments may be misleading.

Traditional studies on Iran primarily test the stability of the money demand function by estimating long-run relationships among real balances, income, and interest-rate proxies (see, e.g., Bahmani-Oskooee, 1996; Bahmani-Oskooee & Rehman, 2005; Kumar et al., 2013). While many economies exhibit reasonably stable money-demand relations consistent with monetary targeting (Bahmani-Oskooee & Gelan, 2009), the case of Iran is markedly different, owing to structural oil dependence and fiscal dominance. In oil-based countries, shocks to both the price and the quantity of oil revenues propagate through fiscal spending to bank balance sheets and money growth, generating asymmetric disturbances that destabilize money demand (Goswami & Celasun, 2002). Prior work on Iran's fiscal behavior documents pronounced oil dependence and procyclicality—often alongside deficits and endogenous money creation (see, e.g., Farzanegan, 2011).

Empirical studies, including Bastin et al. (2021), indicate that international sanctions and financial constraints have weakened the interest-rate channel and amplified exchange-rate volatility, thereby disrupting the transmission of monetary policy. In addition, low levels of banking soundness and stability constitute another key factor undermining the effectiveness of monetary transmission in Iran. Against this backdrop, the Central Bank of Iran gradually shifted over the period 2017–2024 from a primary reliance on price-based instruments toward more direct, quantity-based controls over bank balance sheets and other administrative interventions—a strategy that we refer to as the *bank balance-sheet control policy* in this paper.

Over the past decade, two distinct monetary regimes have emerged. The first, 2014–2017, was characterized by intense deposit-rate competition among banks (“interest-rate war”), with elevated nominal deposit rates and aggressive liability gathering that inflated bank balance sheets and undermined policy control via interest-rate. The second regime, from 2021 onward, reflects a transition to balance-sheet control, in which the central bank imposed bank-by-bank quantitative limits on asset growth to curb money growth. While these measures temporarily moderated money expansion, the velocity of money remained volatile, driven by oil revenues, sanctions, and fiscal pressures.

What is missing is a unified framework that centers on inverse velocity, brings in both oil price and oil production, and tests for short-run and long-run asymmetries while accounting for Iran’s policy-regime shifts. We provide such a framework by integrating these elements into ARDL/NARDL models and embedding two regime dummies (dr, 2014–2017; dd, 2021–2024), thereby explaining why the classical quantity-theory proportionality breaks down in Iran. The remainder of the paper is organized as follows: Section 2 reviews the literature; Section 3 presents the analytical framework and empirical strategy; Section 4 reports the results; Section 5 concludes with policy implications.

2 Literature

Classical and modern formulations of the Quantity Theory posit a stable long-run link among money, prices, and output, which presumes a predictable or approximately constant velocity (Fisher, 1911, 1912). The Cambridge cash-balance view recasts money demand as desired real balances relative to income (Marshall, 1890; Pigou, 1917), while in Friedman’s restatement of the Quantity Theory, money is treated as an asset and the demand for real balances is stable in the long run. Accordingly, the quantity relation can be written as $M^d/P = kY$(with $k = 1/V$), where $k$reflects desired real money holdings and varies with permanent income and the opportunity cost of holding money (Friedman, 1956, 1959). Empirically, cointegration and error-correction studies often find reasonably stable money-demand relations in advanced and emerging economies (e.g., Bahmani-Oskooee, 1996; Dreger & Wolters, 2014; Kumar et al., 2013). However, stability is not guaranteed in environments marked by structural shocks, fiscal dominance, and financial repression—conditions that characterize many resource-dependent economies.

In oil exporters, shocks to both the price and the quantity of oil revenues propagate through fiscal outlays to bank balance sheets and money growth, potentially creating asymmetric disturbances that destabilize money demand. Studies that augment money-demand functions with the exchange rate can improve short-run fit, but often fail to restore long-run stability because exchange-rate volatility largely reflects oil-revenue cycles and capital-flow swings rather than an exogenous price of money (Albulescu, 2022; Bahmani-Oskooee, 1996; Bahmani-Oskooee & Bahmani, 2015; Mehrara & Oskoui, 2007; Mehrara, 2008; Rashid et al., 2023). This suggests that explicitly modeling the oil channel—by price and production—is more structural than treating the exchange rate as a stand-alone driver.

A growing strand of evidence for oil exporters shows that linear specifications often yield mixed stability results, whereas non-linear approaches recover long-run relationships with asymmetric effects of oil shocks. For the GCC, panel evidence documents a long-run money-demand relation but highlights vulnerability to oil-revenue conditions under fiscal dominance (Alsamara et al., 2017; Chelghoum et al. 2023; Mahmood & Asif, 2016). For commodity-dependent Nigeria, stability is sensitive to specification and structural-break controls (Kumar et al., 2013). Crucially, for Saudi Arabia, a NARDL study over 1990Q1–2014Q4 finds no cointegration in a linear setting but detects a long-run relation once oil-price changes are decomposed into positive and negative partial sums; positive shocks have stronger and more persistent impacts on real money demand than negative shocks, with short-run asymmetry limited and dynamic multipliers converging only over many quarters (Alsamara et al., 2017). These findings align with the NARDL framework of Shin et al., (2014) and motivate modeling oil shocks with sign-specific dynamics when assessing money-demand stability in oil-based, fiscally dominated settings.

For Iran, prior research documents pronounced oil dependence and procyclical fiscal behavior; when oil revenues fall, deficits emerge and tend to be monetized (Farzanegan, 2011; Mehrara & Karsalari, 2011). Sanctions and financial constraints have weakened the interest-rate channel and amplified exchange-rate volatility, disrupting monetary transmission (Bastin et al., 2021; Heydarian et al., 2024; Kandil & Mirzaie, 2021). In response to these disruptions, the Central Bank of Iran has, especially since 2021, moved away from relying primarily on price-based instruments and shifted toward direct, quantity-based controls on the expansion of banks' balance sheets—an approach commonly referred to as the bank balance-sheet control policy. Two regimes stand out: an interest-rate war among banks in 2014–2017 that inflated balance sheets despite high nominal rates (Ebrahimi et al., 2021), and a post-2021 move to balance-sheet control via bank-by-bank growth caps (Ahmadyan, 2023). Despite temporary restraint on money expansion, the velocity of money remained volatile, consistent with oil-driven dynamics under fiscal dominance (Ahmadyan, 2023; Peykani et al., 2025).

The existing literature for Iran and other oil exporters rarely integrates, within a unified empirical framework, four key elements: (i) an inverse-velocity perspective (real money relative to real output), (ii) both oil price and oil production shocks, (iii) short- and long-run asymmetries, and (iv) policy-regime shifts specific to Iran. This leaves three weaknesses: the oil sector is typically omitted or captured only by a single oil-price or export-value indicator; terms-of-trade and RGDI considerations are not linked to money-demand or velocity models; and non-linear oil shocks are analysed without jointly accounting for production changes and Iranian monetary-regime shifts. Our paper addresses these gaps by centering the analysis on inverse velocity, embedding both oil price and oil production in linear and nonlinear ARDL models, explicitly testing for short- and long-run asymmetries, and including regime dummies for the interest-rate war (2014–2017) and the balance-sheet-control phase (2021–2024). This unified design shows precisely why the constant-velocity interpretation of the Quantity Theory breaks down in an oil-based, sanction-constrained, fiscally dominated economy like Iran and anticipates our empirical results: a positive long-run oil–money link with stronger responses to oil expansions than contractions, alongside state-dependent velocity dynamics.

3 Methodology

In the Quantity Theory of Money, the starting point is the identity $M.V = P.Y$, where M denotes money, V the velocity of circulation, P the price level, and Y real output. In the classical, constant-velocity interpretation, V is approximately stable in the long run and Y is determined by real factors, so that real money balances move in a systematic way with a small set of fundamentals and a stable money-demand relation exists. Empirically, this stability is often examined by modelling the inverse velocity $M/P.Y$ as the counterpart of money demand. In applied work, the “output” term in $M/P.Y$ is typically proxied by real GDP, implicitly assuming that the flow of goods and services transacted each period is produced by domestic factors. This is a poor approximation for Iran. A large and time-varying share of the goods and services that residents purchase is financed by natural-resource rents from crude-oil exports and enters as imports rather than domestic value added. Because real GDP records only domestic value added, the oil-rent–financed import component does not show up in Y even though it expands the transaction base that money must finance. Hence real money balances respond not only to domestic production but also to oil-rent–driven absorption. These considerations motivate our choice to work explicitly with inverse velocity and to extend the standard QTM-consistent money-demand relation by incorporating oil-sector variables.

In oil-exporting economies, conventional real GDP does not internalize trading gains arising from movements in the external terms of trade. Real gross domestic income (RGDI)—often reported as GDI in constant prices—augments real GDP by a terms-of-trade adjustment (ToTa) that captures the change in the purchasing power of domestic production. Intuitively, when export prices rise relative to import prices, a given volume of domestic output can command more foreign goods and services; RGDI therefore exceeds real GDP by the magnitude of the trading gain. In national accounting practice, this relationship is implemented by adding the ToTa term (constructed in constant prices and local currency) to real GDP to obtain RGDI.

For Iran, this conceptual wedge is economically notable. Episodes characterized by elevated real oil export values—most notably in the 1970s and the 2000s—coincide with sustained gaps between GDI and GDP. As illustrated in Figure 2, GDI persistently lies above GDP during such booms, consistent with sizable trading gains embedded in the ToTa term. Figure 3 further shows that fluctuations in the real value of oil exports are closely aligned with the dynamics of ToTa, underscoring the role of oil-price-driven terms-of-trade shocks in shaping the economy's effective income. In our empirical specification below, we therefore centre the analysis on inverse velocity, $lmpy = ln(M2/(P \cdot Y))$ and augment real GDP with explicit oil-sector fundamentals—namely the real oil price and oil production—to capture the oil-rent-financed component of the transaction base that GDP alone omits. Under the constant-velocity interpretation of the QTM, $lmpy$ should be stable once these fundamentals are controlled for; systematic and persistent oil effects on $lmpy$ then signal a breakdown of QTM-consistent stability of money demand in Iran.

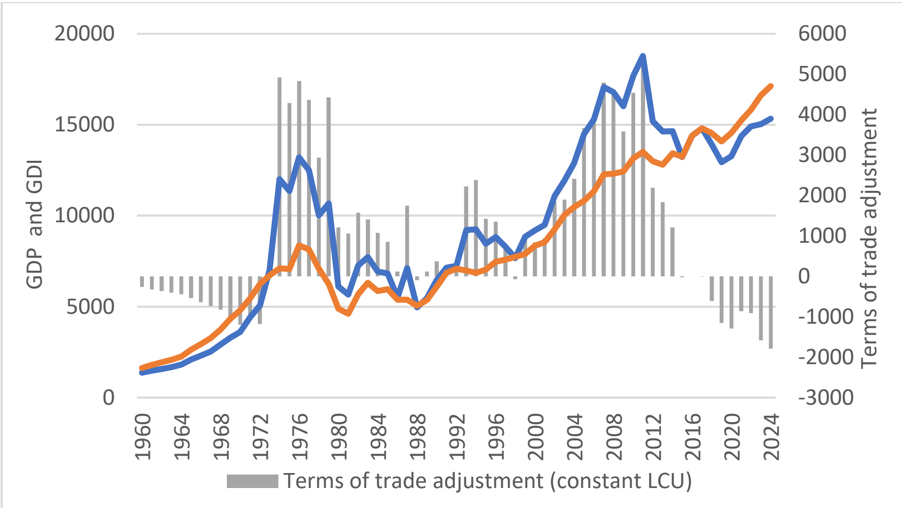

Figure 2. GDP, GDI, and the Terms-of-Trade Adjustment (ToTa) in Iran, 1960–2024.
Source: Research findings

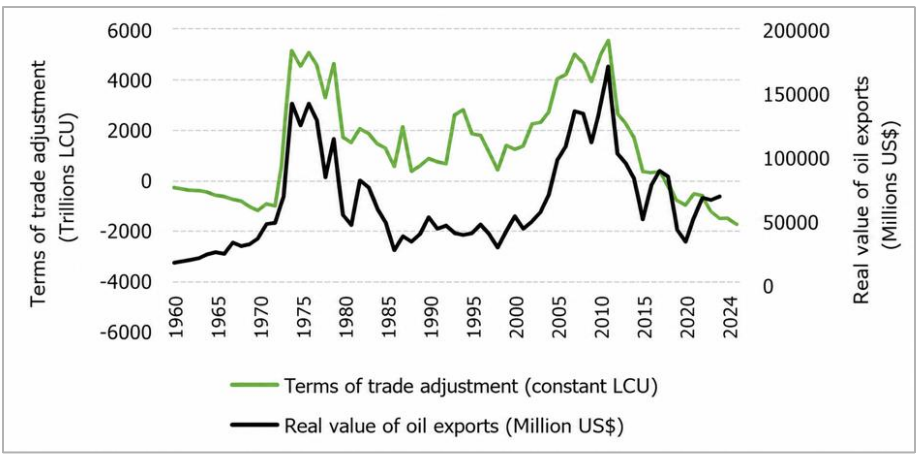

Figure 3. Terms-of-Trade Adjustment (ToTa) and the Real Value of Oil Exports in Iran, 1960–2024.
Source: Research findings

As Figure 3 shows, fluctuations in the real value of oil exports closely track the terms-of-trade adjustment (ToTa), indicating that oil-rent–financed imports are a prime driver of the transaction base that conventional real GDP omits. This helps explain why the quantity-theory proportionality breaks down in Iran: part of the goods and services transacted each period is funded by external oil rents rather than domestic value added. Guided by this evidence, we test two hypotheses: (H1) the real value of oil exports is a significant determinant of the inverse velocity of money (real money relative to real output); and (H2) this effect is asymmetric across oil booms and busts. Moreover, because in Iran not only oil prices move but export volumes vary materially due to sanctions and production limits, we explicitly include both the real oil price and oil-export volumes as separate drivers, allowing the data to distinguish price from quantity channels and to detect sign-specific asymmetries.

Building on the RGDI concept, we can restate the quantity-theory relation by recognizing that the relevant scale variable should capture the economy's effective transaction base rather than domestic value added alone. Let real GDP be denoted by $RGDP$, and let $ToTa$ be the terms-of-trade adjustment; then real gross domestic income is $RGDI = RGDP + ToTa$. The equation of exchange can therefore be written as: $M.V = P.RGDI = P\ (RGDP + ToTa)$

This reformulation makes explicit that, in an oil-exporting economy, monetary aggregates may co-move with a transactions scale that expands in oil booms through trading gains and oil-rent-financed absorption, even when $RGDP$ does not fully reflect that expansion. As documented in Figure 3, the most important driver of fluctuations in $ToTa$ is the real value of oil exports. Since the real value of oil exports has two distinct components—price and quantity—it is informative to model these channels separately. Accordingly, in the empirical money-demand relationship derived from the quantity-theory perspective (and in our inverse-velocity specification), we include the real oil price and oil quantity (proxied by oil production) as separate regressors rather than using a single composite oil-export-value measure. This separation allows us to distinguish price-driven from quantity-driven oil shocks and improves the interpretability (and, in the nonlinear case, the sign-specific asymmetries) of the estimated oil-rent channel.

On the money-supply side, oil-export receipts are typically transformed into domestic liquidity through the fiscal–monetary nexus: foreign-exchange inflows accrue to the public sector and are converted into domestic currency, affecting the central bank's balance sheet and, via banking intermediation, broad money. In this environment, observed monetary expansion may partly *accommodate* oil-rent-driven increases in the effective transactions base and liquidity demand, rather than reflecting purely autonomous policy shocks. To further reduce ambiguity about supply-side influences, we also control for two domestic, regime-like shifts in monetary/financial conditions using dummy variables: (i) an episode of deposit-rate increases associated with banking-sector imbalances, which can amplify deposit creation and liquidity growth through balance-sheet and funding-cost channels; and (ii) the introduction of balance-sheet (credit) controls that directly constrain banks' balance-sheet expansion and money creation. Including these dummies helps isolate the oil-rent channel in inverse velocity from discrete policy/financial regime shifts on the supply side.

Building on the theoretical framework, this section outlines the empirical specification and estimation strategy. Consistent with the empirical literature, we adopt a standard log-linear functional form to model the long-run relationship between inverse velocity of money ($lmpy_t$) and the real international oil price (lop_t) and oil production as follows:

$$lmpy_t = \rho_0 + \rho_1 lop_t + \rho_2 loil_t + \epsilon_t \quad (1)$$

We include the real international oil price (lop_t) and Iran's crude-oil production ($loil_t$) as separate drivers to capture, respectively, external price shocks and sanctions/production-limit–driven volume swings that expand the transaction base beyond domestic value added. All series are in natural logs and aligned to a common frequency over the sample period.

It is common in the empirical literature to use the error correction model (ECM) to analyse the relationship between variables which are integrated of order one (I(1)). (Pesaran et al., 2001) have developed a linear co-integration ARDL to evaluate simultaneously the long- and the short-run effects. The ARDL model has a number of key advantages. First, it can be used to test levels relationships between variables in the case that both I(0) and/or I(1) may be present. Second, the ARDL approach performs well in small samples compared to the other multivariate cointegration method. Third, the test is based on a single ARDL equation, rather than on a VAR, as in Johansen and Juselius method, thus reducing the number of parameters to be estimated. Fourth, it is applicable even when the explanatory variables are endogenous (Pesaran et al., 2001).

The equation of ARDL (p,q) bounds test for co-integration is as follows:

$$\Delta lmpy_t = \alpha_0 + \alpha_1 dd_t + \alpha_2 dr_t + \sum_{i=1}^{k} \beta_{1i} \Delta lmpy_{t-i} + \sum_{i=0}^{k} \beta_{2i} \Delta lop_{t-i} + \sum_{i=0}^{k} \beta_{3i} \Delta loil_{t-i} + \delta_1 lmpy_{t-1} + \delta_2 lop_{t-1} + \delta_3 loil_{t-1} + \varepsilon_t \quad (2)$$

where dd_t is a dummy variable equal to 1 in 2021-2024 (balance-sheet controls years) and 0 otherwise; dr_t is a dummy variable equal to 1 in 2014-2017 (deposit_rate_war_dummy years) and 0 otherwise. To capture institutional shifts in monetary instruments, we include dr_t and dd_t as exogenous regime indicators in selected specifications. These dummies absorb policy-regime dependence without altering identification of the oil channels, which remain our main focus. β_{1i}, β_{2i}, and β_{3i} represent short-run dynamics; and δ_1, δ_2, and δ_3 (from the long-run equation) denote the long-run coefficients. The null hypothesis for the bounds test is $H_0: \delta_1 = \delta_2 = \delta_3 = 0$.

Following Shin et al. (2014), the estimation of the non-linear ARDL is based on the following equation which includes simultaneously the long and the short run of the positive and negative partial sums:

$$\Delta lmpy_t = \theta_0 + \theta_1 dd_t + \theta_2 dr_t + \sum_{i=1}^{k} \rho_{1i} \Delta lmpy_{t-i} + \sum_{i=0}^{k} \rho_{2i}^{+} \Delta lop_{t-i}^{+} + \sum_{i=0}^{k} \rho_{2i}^{-} \Delta lop_{t-i}^{-} + \sum_{i=0}^{k} \rho_{3i}^{+} \Delta loil_{t-i}^{+} + \sum_{i=0}^{k} \rho_{3i}^{-} \Delta loil_{t-i}^{-} + \gamma_1 lmpy_{t-1} + \gamma_2^{+} lop_{t-1}^{+} + \gamma_2^{-} lop_{t-1}^{-} + \gamma_3^{+} loil_{t-1}^{+} + \gamma_3^{-} loil_{t-1}^{-} + u_t \quad (3)$$

These non-linear econometrics technique (NARDL), which presents the long- and short-run asymmetric effects of the explanatory variables, includes three steps:

Step 1: The estimation of Equation (3) by the standard OLS.

Step 2: Check the presence of co-integration relationship between the levels of the series $lmpy_t$, lop_t^{+}, lop_t^{-}, $loil_t^{+}$, and $loil_t^{-}$ by using the F_{pss} statistic proposed by Shin et al. (2014), which refers to the joint null hypothesis of no co-integration ($\gamma_1 = \gamma_2^{+} = \gamma_2^{-} = \gamma_3^{+} = \gamma_3^{-} = 0$).

Step 3: Testing the long- and the short-run symmetry by using the Wald test. For long-run symmetry, the null hypothesis to test is $\delta_2 = \gamma_2^{+} = \gamma_2^{-}$ and $\delta_3 = \gamma_3^{+} = \gamma_3^{-}$. For the short-run symmetry, the null hypothesis is $\sum_{i=0}^{k} \rho_{2i}^{+} = \sum_{i=0}^{k} \rho_{2i}^{-}$ and $\sum_{i=0}^{k} \rho_{3i}^{+} = \sum_{i=0}^{k} \rho_{3i}^{-}$ or $\gamma_{2i}^{+} = \gamma_{2i}^{-}$ and $\gamma_{3i}^{+} = \gamma_{3i}^{-}$ for all i.

In this study, all variables are constructed at an annual frequency over the period 1960–2024. Broad money (M2) is measured using the Broad Money series from the World Development Indicators (World Bank, 2025a). The price level (P) is proxied by the consumer price index (CPI), also obtained from the World Development Indicators (World Bank, 2025a). Real output (Y) is measured by real GDP, likewise sourced from the World Development

Indicators (World Bank, 2025a). The oil quantity variable (OIL) captures Iran's crude oil production, obtained from the Annual Statistical Bulletin 2025 (Organization of the Petroleum Exporting Countries [OPEC], 2025). Finally, OP denotes the real oil export price, proxied by the average global oil price reported in the World Bank Commodity Price Data (The Pink Sheet) (World Bank, 2025b). The real oil price is calculated by deflating the nominal oil price using the U.S. consumer price index from the World Development Indicators (World Bank, 2025a).

4 Estimation Results

We begin by defining the key variables and documenting their time-series properties. The dependent variable is $lmpy$=ln($M2/PY$), where $M2$ denotes broad money, P is the consumer price index (CPI), and Y is real GDP at constant prices. This ratio is the inverse of monetary velocity up to a constant, so persistent movements in $lmpy$ directly reflect departures from a stable quantity relation. The main oil-sector drivers are (i) lop, the natural logarithm of the real international oil price (USD per barrel), and (ii) $loil$, the natural logarithm of Iran’s crude oil production (in barrels). All variables are expressed in natural logarithms and are measured at a common annual frequency over the 1960–2024 sample period.

Before estimating the ARDL/NARDL specifications, we assess the order of integration of each series. Specifically, we apply Augmented Dickey–Fuller (ADF) tests under alternative deterministic components (intercept only; intercept and linear trend), choosing lag lengths by the Akaike Information Criterion. Establishing that no variable is integrated of order two ensures the validity of the bounds-testing framework and guards against spurious regression concerns. The test statistics and critical values are reported in Table 1, which provide the basis for the modeling strategy adopted in the next subsection.

Table 1
ADF unit root tests.

	Level		**First difference**	
	Intercept	Trend	Intercept	Trend
lmpy	-1.81	-0.96	-4.55^{***}	-4.85^{***}
lop	-2.54	-2.99	-7.44^{***}	-7.41^{***}
loil	-3.69^{***}	-3.63^{**}	-6.23^{***}	-6.32^{***}

Note. The optimal lag structure of the ADF test is chosen based on the Akaike Information Criterion.
*, **, *** Indicate the significance at 10%, 5% and 1%, respectively.
Source: Research findings

The ADF results reported in Table 1 indicate mixed orders of integration across the variables. The inverse-velocity measure, lmpy=ln(M2/PY), and the oil-sector variables, lopand loil, are integrated of order zero, I(0), or order one, I(1), and none of the series is integrated of order two, I(2). These results justify the use of the autoregressive distributed lag (ARDL) bounds-testing framework developed by Pesaran et al. (2001), which is applicable when the variables are a mixture of I(0) and I(1).

We estimate parsimonious ARDL specifications for lmpyas a function of lopand loil, including an intercept. Lag lengths are selected using the Akaike Information Criterion, subject to the limited number of annual observations and the need to preserve degrees of freedom. Table 2 reports the PSS F-statistic for the joint significance of the lagged level terms under the null hypothesis of no level relationship, together with the corresponding critical bounds.

To accommodate potential asymmetry in oil shocks, we further estimate a nonlinear ARDL (NARDL) model in which lop is decomposed into partial-sum processes for positive and negative changes (lop^{+}, lop^{-}) following Shin et al. (2014), while $loil$ is retained in levels. The corresponding bounds statistics for the asymmetric specification are also reported.

As shown in Table 2, the computed F-statistics for the linear ARDL (and, more strongly, for the NARDL) exceed the upper bound at conventional levels, leading us to reject the null of no long-run relationship between $lmpy$ and the oil-sector drivers. This supports the existence of a stable, albeit potentially nonlinear, equilibrium link connecting the inverse-velocity measure $lmpy$ to oil price and oil production. Accordingly, we proceed to estimate the long-run coefficients and the associated error-correction dynamics in Tables 3 and 4.

Table 2
Bounds test for co-integration in the linear and the non-linear specifications.

	AIC ARDL(3,0,1)	**SBC ARDL(3,0,1)**
ARDL	13.52^{***}	13.52^{***}
	AIC ARDL(3,1,1)	SBC ARDL(3,1,1)
NARDL	7.08^{***}	7.08^{***}

Note. *, *, and *** *denote significance at the 10%, 5%, and 1% levels, respectively.*
Source: Research findings

Having established a long-run level relationship, we estimate a parsimonious linear ARDL model for $lmpy$ with lop (real oil price) and $loil$ (oil production) as regressors. Lag orders are set to deliver a parsimonious specification for the annual sample while preserving degrees of freedom. All specifications include an intercept and, where appropriate, a linear trend. The model is presented both in levels—to recover long-run coefficients—and in error-correction form to characterize short-run dynamics.

The long-run parameters on lop and $loil$ can be read as elasticities of the inverse-velocity measure $lmpy = ln(M2/PY)$ with respect to oil-sector conditions. Under the oil-dominance hypothesis, both elasticities are expected to be positive—oil booms raise real money balances relative to real output—while the error-correction term should be negative and significant, indicating convergence back to the equilibrium path after temporary shocks.

For econometric reliability, Table 3 also reports standard residual diagnostics used with ARDL models, including tests for serial correlation (LM/Breusch–Godfrey), heteroskedasticity, and normality (Jarque–Bera). These complement the main estimates and help verify that the baseline specification is well behaved before turning to asymmetric oil adjustments in the next subsection.

Table 3
ARDL estimation.

	ARDL(3,0,1)
Panel A: Estimated long run coefficients	
lop	0.65***
loil	0.66**
constant	-14.84***
Panel B: Error correction representation	
ECM	-0.11***
$\Delta lmpy_{t-1}$	0.32***
$\Delta lmpy_{t-2}$	-0.29***
$\Delta loil_t$	-0.17***
dd	-0.08***
dr	0.12***
Panel C: Diagnostic tests	
χ^2_{CS}	2.44
χ^2_{NORM}	1.61
χ^2_{H}	0.34

Note. *, *, and *** denote significance at the 10%, 5%, and 1% levels, respectively.
χ^2_{CS}, χ^2_{NORM}, and χ^2_{H} denote the Breusch–Godfrey LM test for serial correlation, the Jarque–Bera test for normality, and the Breusch–Pagan–Godfrey test for heteroskedasticity, respectively.
Source: Research findings

The linear benchmark in Table 3 may conceal asymmetric responses of $lmpy = ln\left(\frac{M2}{PY}\right)$ not only to oil prices but also to oil production. We therefore adopt a NARDL specification that decomposes both the real oil price and oil production into partial-sum processes of positive and negative changes: $lop+$, $lop-$ and $loil+$, $loil-$, respectively. This setup allows oil-price increases and decreases—and likewise production expansions and contractions—to exert potentially different effects on the inverse-velocity measure.

In the short run, coefficients on $\Delta lop+$ vs. $\Delta lop-$ and on $\Delta loil+$ vs. $\Delta loil-$ capture immediate asymmetric adjustments. In the long run, the level terms associated with $lop+$ and $lop-$ (and with $loil+$ and $loil-$) measure the persistent effect of cumulative oil shocks of each sign. The error-correction term indicates the speed at which deviations from the long-run relation—documented by the bounds tests—are eliminated.

Table 4 reports the NARDL estimates alongside Wald tests of symmetry for each regressor: (i) short-run symmetry (equality of the coefficients on the positive and negative first-differences), (ii) long-run symmetry (equality of the level coefficients on the positive and negative partial sums), and (iii) a joint symmetry test combining short- and long-run restrictions. Evidence against symmetry would indicate that oil booms and busts—and, separately, production expansions and contractions—have economically distinct effects on $lmpy$. We next discuss the implied long-run elasticities, the speed of adjustment, and the pattern of asymmetry revealed by these tests.

Table 4
NARDL estimation.

	NARDL(3,1,1)
Panel A: Estimated long run coefficients	
lop^{+}	0.46^{***}
lop^{-}	0.44^{***}
$loil^{+}$	0.44^{**}
$loil^{-}$	0.18
constant	-12.57^{***}
Panel B: Error correction representation	
ECM	-0.18^{***}
$\Delta lmpy_{t-1}$	0.35^{***}
$\Delta lmpy_{t-2}$	-0.24^{***}
Δlop_t^{+}	0.15^{***}
Δlop_t^{-}	-0.06
$\Delta loil_t^{+}$	-0.07
$\Delta loil_t^{-}$	-0.22^{***}
dd	-0.12^{***}
dr	0.11^{***}
Panel C: Diagnostic tests	
χ^2_{CS}	3.09
χ^2_{NORM}	1.10
χ^2_{H}	0.71
Wald Tests of Long-Run Symmetry	
$lop\ (\chi^2)$	0.87
$loil\ (\chi^2)$	0.34
Wald Tests of Short-Run Symmetry	
$lop\ (\chi^2)$	7.37^{***}
$loil\ (\chi^2)$	1.14
Joint Wald Tests for long-run and short-run symmetry	
$lop\ (\chi^2)$	7.53^{**}
$loil\ (\chi^2)$	1.55

Note. *, **, *and* ***denote significance at the 10%, 5%, and 1% levels, respectively.

χ^2_{CS}, χ^2_{NORM}, and χ^2_{H} denote the Breusch–Godfrey LM test for serial correlation, the Jarque–Bera test for normality, and the Breusch–Pagan–Godfrey test for heteroskedasticity, respectively.

Source: Research findings

The stability of the estimated parameters is assessed using the CUSUM and CUSUMSQ tests based on recursive residuals. As shown in Figures 4 and 5, the CUSUM and CUSUMSQ statistics remain within the 5% critical bounds over the sample period, indicating no evidence of systematic parameter instability and supporting the structural stability of both the ARDL and NARDL specifications. This strengthens the credibility of the estimated long-run relationship and the associated short-run dynamics.

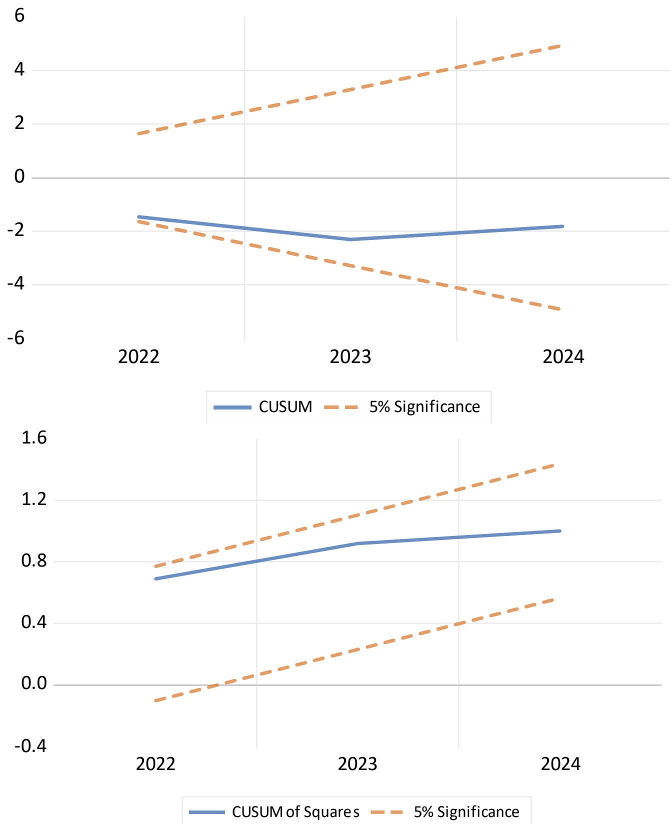

Figure 4. CUSUM and CUSUMSQ Stability Tests for the ARDL Model.
Note: The solid line denotes the test statistic and the dashed lines indicate the 5% critical bounds. Source: Research Finding

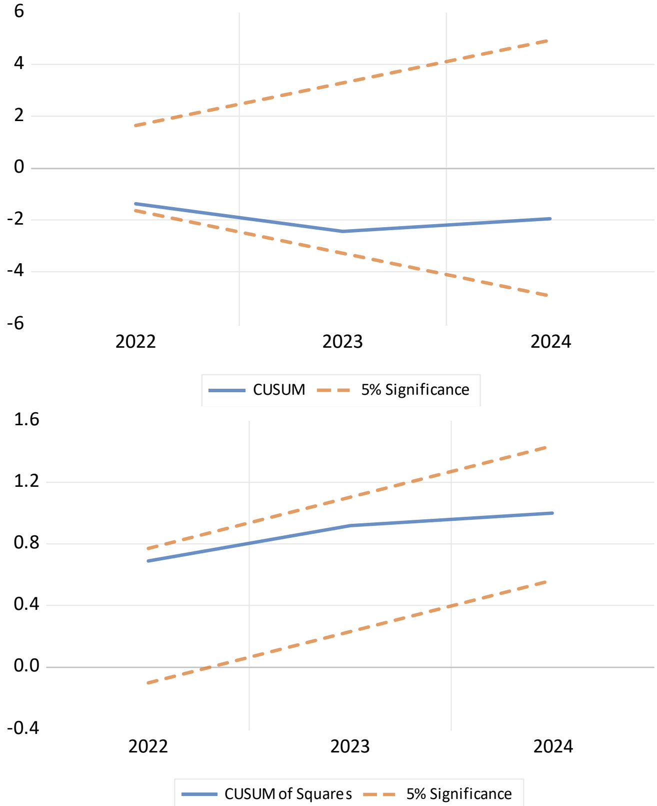

Figure 5. CUSUM and CUSUMSQ Stability Tests for the NARDL Model.
Note: The solid line denotes the test statistic and the dashed lines indicate the 5% critical bounds. Source: Research Finding

We formally tested for structural breaks using the Bai–Perron multiple-breakpoint procedure (Bai & Perron, 1998, 2003), applying sequential tests with a trimming proportion of 0.15 and allowing for a maximum of five breaks. The sequential test comparing the null hypothesis of no structural break against the alternative of one break was not statistically significant at the 5% level, as the calculated F-statistic was below the corresponding critical value ($F=3.09<21.87$). Accordingly, we find no evidence of a statistically significant structural break in the estimated relationship over the 1960–2024 sample period.

In response to potential endogeneity concerns, we emphasize that Iran is effectively a price taker in the global oil market; therefore, the real oil price

(LOP) can reasonably be treated as exogenous with respect to domestic monetary conditions. By contrast, oil production (LOIL) may be more exposed to domestic and sanctions-related constraints, yet from a theoretical standpoint there is no clear mechanism through which the inverse velocity of money (LMPY) would causally determine physical oil output. To further mitigate simultaneity concerns in the short run, we re-estimated the model using a "lag-only" ARDL specification in which oil variables enter only with lags, removing contemporaneous oil movements from the dynamics. The bounds test strongly rejects the null of no levels relationship ($F = 11.24$, exceeding the 1% upper bound), confirming cointegration. The error-correction term remains negative and highly significant (COINTEQ = −0.115, $p < 0.01$), indicating a stable adjustment toward the long-run equilibrium. Importantly, the long-run coefficients remain positive and statistically significant for both oil price and oil production (LOP: 0.686; LOIL: 1.133), showing that our main conclusions are robust to this endogeneity-focused re-specification.

To allow for sign dependence, Table 4 reports the NARDL estimates based on positive and negative partial sums for both oil price and oil production. Two patterns emerge.

1) Long-run effects: the cumulative (level) terms for positive and negative oil shocks are both positive, and long-run symmetry cannot be rejected at usual thresholds—indicating that, over the long horizon, oil expansions and contractions shift inverse velocity in the same direction (with similar magnitudes).
2) Short-run effects: Wald tests reject short-run symmetry for oil prices (but not for production), showing that price increases trigger a stronger near-term rise in inverse velocity than price decreases induce in reverse. The NARDL error-correction coefficient (about –0.18*** in Table 4) indicates faster convergence under the asymmetric specification, consistent with state-dependent adjustment.

Overall, the asymmetry is concentrated in the short run for oil prices, while production shocks—although long-run relevant—exhibit weaker short-run asymmetry.

In our estimates, increases in oil production have a strong and statistically significant effect on inverse velocity, whereas the effect of decreases is statistically weak. Three mechanisms may explain this pattern in Iran. First, fiscal smoothing and expenditure rigidity imply that when oil production falls, government spending—particularly wages, transfers, and subsidies—does not decline proportionately. The resulting financing gap is often monetized or financed through the banking system, offsetting the contractionary effect of lower oil volumes on real money balances and thereby muting the net response of $M2/(PY)$. Second, oil-production downturns typically coincide with exchange-rate depreciation and weaker real activity. A higher CPI increases the denominator PY, reducing inverse velocity, whereas lower real output reduces the denominator and monetization increases the numerator M2, both of which raise inverse velocity. The interaction of these opposing forces may therefore produce a small net effect for loil^-. By contrast, increases in oil production relax fiscal and external constraints, finance import-led absorption, and facilitate bank-balance-sheet expansion with less offsetting pressure, resulting in a statistically significant positive effect on inverse velocity. Third, measurement and timing issues under sanctions may weaken the estimated effect of production declines. Inventory drawdowns, unrecorded or indirectly routed shipments, swaps, and refinery reallocation may partially cushion reported production losses, attenuate the measured effect of loil^-, and spread the adjustment across successive annual observations. Taken together, institutional responses to oil downturns dampen the inverse-velocity response, whereas production expansions are transmitted more rapidly and visibly, giving rise to the observed asymmetry.

We include regime dummies to capture institutional shifts in instruments: dr (=1 in 2014–2017: the "interest-rate war") and dd (=1 from 2021 onward: balance-sheet controls). Across specifications, adding dr and dd leaves the sign and significance of the oil elasticities broadly unchanged, indicating that the oil channels, rather than regime proxies, underpin the long-run inverse-velocity dynamics. The coefficients on dr and dd are consistent with priors — dr coincides with a period of rapid broad-money growth driven by banking distress and a weakening of money destruction, rather than deliberate expansionary policy, whereas dd reflects subsequent restraint under the balance-sheet control framework— but the oil variables remain the principal drivers of lmpy.

The results are robust to (i) alternative lag specifications selected under the principle of parsimony, (ii) replacing the separate measures of the real oil price and oil production with aggregate real oil-export value (price × volume), which yields qualitatively similar conclusions, and (iii) using small-sample critical values for the bounds tests. In economic terms, the baseline ARDL estimates reported in Table 3 indicate that a 1% increase in the real oil price or oil production is associated with an approximately 0.65–0.66% increase in inverse velocity in the long run. The estimated error-correction coefficients imply that approximately 11% of the deviation from the long-run equilibrium is corrected each year in the linear ARDL model and approximately 18% is corrected each year in the NARDL specification.

Taken together, Table 4 deliver a coherent message. First, cointegration confirms that inverse velocity co-moves with oil prices and oil production over the long run. Second, short-run asymmetry for oil prices implies that booms raise inverse velocity more sharply than busts compress it, even though the long-run effects are broadly symmetric. Third, regime shifts (dr, dd) matter for the policy environment but do not overturn the oil-centric inverse-velocity mechanism. The evidence therefore rejects a constant-velocity quantity relation for Iran and supports an interpretation in which velocity is oil-sensitive and state-dependent.

5 Concluding Remarks

This paper re-examined the constant-velocity interpretation of the Quantity Theory of Money (QTM) for an oil-dependent economy by focusing on Iran and modeling the inverse velocity of money as the empirical counterpart of money demand. Consistent with Sections 2–4, we find a long-run level relationship between inverse velocity and oil-sector fundamentals—real oil price and oil production—using ARDL/NARDL methods. Long-run elasticities are positive and economically meaningful, while the error-correction term is negative and significant, confirming convergence toward an oil-linked equilibrium. Asymmetry emerges mainly in the short run for oil prices: positive price shocks raise inverse velocity more sharply than negative shocks compress it, even though long-run effects are broadly symmetric. Including regime dummies—dr (interest-rate war, 2014–2017) and dd (balance-sheet controls, 2021–2024)—does not overturn the oil-centric mechanism: oil variables remain the principal drivers of inverse-velocity dynamics, with dr coinciding with a period of rapid broad-money growth driven by banking distress and a weakening of money destruction rather than deliberate expansionary policy, and dd capturing subsequent temporary restraint under the balance-sheet-control framework. These results jointly reject a constant-velocity quantity relation for Iran and, equivalently, the notion of a stable QTM-consistent inverse-velocity relation, and support a view in which velocity is oil-sensitive and state-dependent.

Beyond oil prices, our NARDL results also reveal an asymmetry for oil production: increases in production ($loil^+$) are associated with a significant rise in inverse velocity, whereas decreases ($loil^-$) are statistically weak. We read this asymmetry through three mechanisms. First, fiscal smoothing and rigidity: when volumes fall, government outlays are downward-sticky and the shortfall is often monetized or bank-financed, offsetting the contractionary impact on real money balances. Second, offsetting macro adjustments: production downturns typically co-move with exchange-rate depreciation and weaker activity, so higher CPI (and lower Y) partly cancel the mechanical effect on M2/(PY), yielding a small net response. Third, sanctions-era measurement and timing: inventory drawdowns, re-routing, and reporting frictions attenuate measured declines. Taken together, production booms relax fiscal/external constraints and transmit strongly into higher inverse velocity, whereas busts trigger financing and accounting responses that mute the net effect—hence the insignificance of $loil^{-}$.

Implications for monetary programming:

1) Make money targets oil-contingent. Because inverse velocity moves with oil conditions, aggregate M2 targets calibrated under a constant-velocity premise will mispredict inflation. Program targets and inflation guidance should be conditioned on oil scenarios, explicitly netting out the oil-induced component of inverse-velocity changes inferred from the model's long-run elasticities and short-run multipliers.
2) Distinguish oil-driven shifts in money demand from policy-driven balance-sheet expansion. Our results indicate that a non-trivial share of movements in real money balances reflects supply-side developments in the oil sector—through oil-rent-financed absorption via imports and fiscal outlays—rather than autonomous monetary expansion. For monetary policy, it is therefore crucial to identify whether increases in desired real money balances are driven by oil-related expansions in the transaction base or by non-oil policy actions that enlarge bank balance sheets. The former may be partly benign during oil booms, whereas the latter calls for greater restraint and tighter control over monetary and credit aggregates.
3) Consider using quantity tools as an important stabiliser in oil booms. The evidence that the interest-rate channel is weakened under sanctions and fiscal dominance, together with the short-run asymmetry of inverse velocity to positive oil-price shocks, is consistent with a greater role for dd-type balance-sheet instruments (such as bank-by-bank asset-growth caps and tighter limits on off-balance-sheet exposures) during oil upswings. In such episodes, quantity tools can help contain excess balance-sheet expansion when oil-driven increases in real money demand are large and the signalling power of interest rates is impaired, although a full welfare or optimal-policy evaluation of these regimes lies beyond the scope of this paper.

4) Coordinate with fiscal policy and sterilize oil surges. Since the mechanism operates via the treasury–banking nexus, monetary stability hinges on fiscal-monetary coordination. Rules that save/sterilize a share of oil windfalls (e.g., stabilization funds with clear draw-down rules) help delink money creation from volatile oil revenues and damp the inverse-velocity surge in booms.

The baseline estimates imply that a 1% increase in the real oil price or in oil production is associated with a long-run increase of approximately 0.6–0.7% in inverse velocity. Depending on the specification, the estimated error-correction coefficients indicate that roughly 10–20% of any deviation from the long-run equilibrium is corrected each year. In practical terms, a large and persistent oil-sector expansion may raise real money balances relative to real output over successive years, even in the absence of changes in the policy stance. This finding underscores the importance of incorporating oil-market conditions into monetary and fiscal programming.

The dr period (2014–2017) illustrates how deposit-rate competition can inflate bank balance sheets without restoring monetary control; the dd period (2021-2024) shows that quantitative limits can temporarily restrain money growth yet cannot by themselves offset oil-driven velocity swings. Taken together, these patterns are consistent with a policy mix in which dd-type quantity tools are maintained as a standing instrument and tightened in oil booms, ideally combined with fiscal/FX sterilisation; a full evaluation of the design and welfare implications of such regimes is left for future research.

In Iran, the QTM's proportionality breaks down because velocity is not constant—it is oil-sensitive. Monetary policy that ignores this state dependence will systematically mis-calibrate. A coherent framework links oil, fiscal behavior, and bank balance sheets to inverse velocity; the policy response should be oil-contingent, rely on dd-type quantity tools during booms, and coordinate with fiscal/FX operations to delink money creation from the oil cycle.

References

Ahmadyan, A. (2023). The effect of inflation targeting and money growth rate on banks' balance sheets during Covid-19. *Iranian Journal of Economic Studies, 12(1), 123–15*4. https://doi.org/10.22099/ijes.2024.49424.1949. [In Persian]

Albulescu, C. T. (2022). Bank financial stability and international oil prices: Evidence from listed Russian public banks. *Eastern European Economics, 60(3), 217–246*. https://doi.org/10.1080/00128775.2022.2064876

Alsamara, M., Mrabet, Z., Dombrecht, M., & Barkat, K. (2017). Asymmetric responses of money demand to oil price shocks in Saudi Arabia: A non-linear ARDL approach. *Applied Economics, 49(37), 3758-3769*.

Chelghoum, A., Boumimez, F., & Alsamara, M. (2023). Asymmetric effects of oil price shocks on the demand for money in Algeria. *The Quarterly Review of Economics and Finance, 89, 1-11*.

Arman, A., & Aghajari, S. (2009). Oil revenue effects on inflation and growth oil revenue, inflation and growth in Iran: A pre-exchange rate reform examination of Dutch disease. *Quarterly Journal of Quantitative Economics, 6(2), 55–78*. https://doi.org/10.22055/jqe.2009.10706. [In Persian]

Mahmood, H., & Asif, M. (2016). An empirical investigation of stability of money demand for GCC countries. *International Journal of Economics and Business Research, 11(3), 274-286*.

Bahmani-Oskooee, M. (1996). The black market exchange rate and demand for money in Iran. *Journal of Macroeconomics, 18(1), 171–176*. https://doi.org/10.1016/S0164-0704(96)80010-3

Bahmani-Oskooee, M., & Bahmani, S. (2015). Nonlinear ARDL approach and the demand for money in Iran. *Economics Bulletin, 35(1), 381–391*. http://www.accessecon.com/Pubs/EB/2015/Volume35/EB-15-V35-I1-P42.pdf

Bahmani-Oskooee, M., & Rehman, H. (2005). Stability of the money demand function in Asian developing countries. *Applied Economics, 37(7), 773–792*. https://doi.org/10.1080/0003684042000337424

Bahmani-Oskooee, M., & Gelan, A. (2009). How stable is the demand for money in African countries? *Journal of Economic Studies, 36(3), 216-235*.

Bai, J., & Perron, P. (1998). Estimating and testing linear models with multiple structural changes. *Econometrica, 66(1), 47–78*. doi:10.2307/2998540

Bai, J., & Perron, P. (2003). Computation and analysis of multiple structural change models. *Journal of Applied Econometrics, 18(1), 1–22*. doi:10.1002/jae.659

Bastin, H., Sabet, S. A. H., Razouh, M. S., & Hosseinpour, A. (2021). Investigating the non-linear effects of the economic sanctions index on the relationship between monetary policy transmission channels and economic growth in Iran. *International Journal of Nonlinear Analysis and Applications, 12(Special Issue), 1719-1730.*

Goswami, M., & Celasun, O. (2002). *An analysis of money demand and inflation in the Islamic Republic of Iran*. IMF Working Papers, 2002(205). https://doi.org/10.5089/9781451874563.001

Dreger, C., & Wolters, J. (2014). Money demand and the role of monetary indicators in forecasting euro area inflation. *International Journal of Forecasting, 30(2), 303–312*. https://doi.org/10.1016/j.ijforecast.2013.09.008

Ebrahimi, P., Fekete-Farkas, M., Bouzari, P., & Magda, R. (2021). Financial performance of Iranian banks from 2013 to 2019: A panel data approach. *Journal of Risk and Financial Management, 14 (6), 257*. https://doi.org/10.3390/jrfm14060257

Farrokhi Balajadeh, H., Khochiani, R., & Asayesh, H. (2019). Investigating the dynamic relationship between the money growth and inflation in Iran: An econophysics analysis of quantity theory of money. *Quarterly Journal of Quantitative Economics, 6(2), 215–238.* [In Persian]

Farzanegan, M. R. (2011). Oil revenue shocks and government spending behavior in Iran. *Energy Economics, 33(6), 1055–1069*.

Fisher, I. (1911). *The purchasing power of money: Its determination and relation to credit, interest, and crises*. Macmillan.

Fisher, I. (1912). The "equation of exchange" for 1912, and forecast. *The American Economic Review, 3(2), 341–345*.

Friedman, M. (1956). *The quantity theory of money—A restatement*. In M. Friedman (Ed.), Studies in the quantity theory of money (pp. 3–21). University of Chicago Press.

Friedman, M. (1959). The demand for money: some theoretical and empirical results. *Journal of Political Economy, 67(4), 327–351*.

Heydarian, S., Pahlavani, M., & Mirjalili, S. H. (2024). Financial Sanctions, Oil Revenues and Monetary and Fiscal policies in Iran: DSGE Model. *International Journal of Business and Development Studies, 16(2), 145–183*.

Kumar, S., Webber, D. J., & Fargher, S. (2013). Money demand stability: A case study of Nigeria. *Journal of Policy Modeling, 35(6), 978–991*. https://doi.org/10.1016/j.jpolmod.2013.03.012

Laudati, D., & Pesaran, M. H. (2023). Identifying the effects of sanctions on the Iranian economy using newspaper coverage. *Journal of Applied Econometrics, 38(3), 271–294*. DOI: 10.1002/jae.2947

Maleki, T., Isfahani, R. D., & Barzaani, M. V. (2015). Quantity theory of money (Allais' viewpoint) The case study of Iran economy. *Journal of Business & Economic Policy, 2(4), 152–168*. https://jbep.thebrpi.org/journals/Vol_2_No_4_December_2015/16.pdf

Marshall, A. (1890). *Principles of Economics*. Macmillan.

Mehrara, M., & Oskoui, K. N. (2007). The sources of macroeconomic fluctuations in oil exporting countries: A comparative study. *Economic Modelling, 24(3), 365–379*.

Mehrara, M. (2008). The asymmetric relationship between oil revenues and economic activities: The case of oil-exporting countries. *Energy Policy, 36(3), 1164–1168*. https://doi.org/10.1016/j.enpol.2007.11.004

Mehrara, M., & Karsalari, A. R. (2011). Oil revenues, economic growth and resource curse in Iran economy. *Journal of Social and Development Sciences, 2(2), 73-80*.

Kandil, M., & Mirzaie, I. A. (2021). Macroeconomic policies and the Iranian economy in the era of sanctions. *Middle East Development Journal, 13(1), 78-98*.

Organization of the Petroleum Exporting Countries (OPEC). (2025). Annual statistical bulletin 2025 (60th ed.). https://www.opec.org/opec_web/en/publications/202.htm

Pesaran, M. H., Shin, Y., & Smith, R. J. (2001). Bounds testing approaches to the analysis of level relationships. *Applied Econometrics, 16(3), 289–326*. https://doi.org/10.1002/jae.616 BOUNDS

Peykani, P., Sargolzaei, M., Oprean-Stan, C., Kamyabfar, H., & Reghabi, A. (2025). The effect of macroeconomic shocks on non-performing loans and credit risk in the Iranian banking system using time-varying parameter vector autoregressions. *Plos one, 20(8), e0329587*. https://doi.org/10.1371/journal.pone.0329587

Pigou, A. C. (1917). The value of money. *The Quarterly Journal of Economics, 32(1), 38-65*.

Rahmani, T. (2025). *Monetary policy, interest rates, and financing in the economic situation of Iran 2025* [Policy report, in Persian]. Monetary and Banking Research Institute. https://mbri.ac.ir/Home/News_Page_En?News_ID=416902

Rashid, A., Jehan, Z., & Kanval, N. (2023). External shocks, stock market volatility, and macroeconomic performance: An empirical evidence from Pakistan. *Journal of Economic Cooperation & Development*, *44*(2), 1-26.

Shin, Y., Yu, B., & Greenwood-Nimmo, M. (2014). Modelling asymmetric cointegration and dynamic multipliers in a nonlinear ARDL framework. In R. C. Sickles & W. C. Horrace (Eds.), *Festschrift in honor of Peter Schmidt: Econometric methods and applications* (pp. 281–314). Springer.

World Bank. (2025a). World Development Indicators [Data set]. World Bank.

World Bank. (2025b). World Bank commodity price data (The Pink Sheet) [Data set]. World Bank, Development Prospects Group.

World Bank. (2020, April 16). *Iran's economic update—April 2020*. https://www.worldbank.org/en/country/iran/publication/economic-update-april-2020