Structural Adjustment of Monetary Policy Rules in a Post-Hyper-Globalization Era

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Abstract

This paper evaluates the performance of three monetary policy rules—Domestic Inflation Targeting (DIT), Consumer Price Inflation Targeting (CPIT), and forward-looking Nominal GDP Growth Targeting (NGDP-GT) rules—within a small open economy (SOE) DSGE framework subjected to structural supply-side distortions. As the global economy transitions away from hyper-globalization toward protectionist tariffs and fragmented trade patterns, traditional inflation-targeting rules face severe stagflationary trade-offs. We demonstrate that under persistent tariff and cost-push disturbances, an NGDP-GT rule superiorly stabilizes the real economy. By exploiting the inherent nominal income hedge, NGDP-GT mechanically balances supply-side shocks—absorbing price pressures through temporary inflation to prevent policy overreaction and minimize macroeconomic volatility. Conversely, we show that while DIT and CPIT provide stronger nominal anchors under demand-driven fluctuations, they exacerbate macroeconomic volatility when structural supply shocks dominate.

Key words: Nominal GDP Targeting, Inflation Targeting, Supply Shock, Tariff, Demand Shock

JEL Classification: F41, E52, E61, E58, F15, E12

1 Introduction

1.1 Macroeconomic Environment

For over three decades, the global macroeconomic landscape was characterized by hyper-globalization, expanding supply chains, and structurally declining trade barriers. This environment suppressed global supply-side volatility, allowing SOEs to adopt strict inflation targeting regimes—either targeting domestic producer prices or aggregate consumer prices—as highly effective nominal anchors.

However, the contemporary structural shift toward protectionist tariffs, geopolitical decoupling, and the shortening of global supply chains fundamentally alters the nature of macroeconomic disturbances. In this post-hyper-globalization era, SOEs are increasingly vulnerable to frequent, persistent, and highly disruptive supply-side shocks. Under traditional inflation targeting, a negative supply or tariff disturbance forces the monetary authority to raise nominal interest rates aggressively to combat cost-push inflation. This contractionary response severely deepens the concurrent decline in real output, triggering policy-induced stagflation. Consequently, modern geopolitical realities favor the adoption of monetary rules capable of absorbing supply-side friction.

This paper evaluates alternative monetary policy designs optimized for a high-supply-volatility regime. Specifically, we analyze the structural viability of a forward-looking Nominal GDP Growth Targeting (NGDP-GT) framework within an extended Galí-Monacelli (2005) New Keynesian open-economy model. By endogenously balancing inflation and real production growth, an NGDP-GT rule distributes the burden of supply-side friction across both prices and output, cushioning the real economy from policy overreactions—the literature review evaluates the historical and structural viability of nominal income targeting.

1.2 Literature Review

For Small Open Economies, the literature splits the performance based on whether shocks originate from supply or demand chains. Bhandari and Frankel (2017) employs a simple static analytical framework to study NGDP-GT for mid-sized developing countries and notes that inflation targeting forces the entire burden of a negative supply shock onto real output adjustment. NGDP targeting divides the burden automatically between price and output adjustments. Garín, Lester, and Sims (2016) prove that NGDP level targeting (NGDP-LT) significantly outperforms traditional Taylor rules and inflation targeting under supply shocks, replicating the welfare-maximizing output path. This is corroborated by Benchimol and Fourçans (2019) whose DSGE simulations conclude that nominal GDP targeting systematically minimizes central bank loss functions more effectively than traditional regimes under supply-driven volatility. Sheedy (2014) provides a financial-markets justification for NGDP-GT. The paper demonstrates that in an economy with incomplete financial markets and nominal debt contracts, an NGDP target acts as an optimal "automatic insurance device," aligning borrowers' ability to pay with their nominal income obligations. This transmission channel matches Chang et al. (2016), who shows that stabilizing nominal expenditures directly shields real economic variables from nominal financial frictions. Woodford (2012) defends NGDP-LT at the Zero Lower Bound (ZLB), showing that a commitment to catch-up inflation aggressively manages long-term expectations and lowers real interest rates. Chen (2020) and Chen (2021) note that while NGDP-LT excels at long-horizon expectation management, NGDP-GT avoids the highly volatile policy corrections required to correct historical misses. Finally, addressing data lag constraints, Sumner (2013) and Sumner (2015)proposes "NGDP Futures Targeting," where central banks conduct open market operations automatically based on active futures market forecasts to achieve real-time stabilization.

1.3 Distinction and Contribution

This paper makes four distinct contributions to the existing monetary policy literature:

Contribution 1: Geopolitical Integration (The "Supply Shock" Environment)

By embedding protectionist tariffs and deglobalization into an extended Galí-Monacelli (New Keynesian open-economy) framework, the paper shifts the paradigm. Instead of evaluating monetary policy under standard demand or productivity shocks, it tests rules against structurally driven, persistent supply-side (such as tariffs) volatility.

Contribution 2: OECD Calibration for Small Open Economies (SOEs)

It fills a gap in the literature by providing the first dedicated evaluation of Nominal GDP Growth Targeting (NGDP-GT) parameterized specifically to highly integrated, small open OECD economies.

Contribution 3: Forward-Looking Expectation Dynamics

By incorporating an explicit forward-looking component into the NGDP-GT rule, the model aligns perfectly with modern micro-founded New Keynesian price-setting (the forward-looking Phillips Cureve), capturing how anticipation of future nominal income shapes current inflation and output gap dynamics.

Contribution 4: The Core Mechanism: NGDP-GT vs. Inflation Targeting

The study finds that NGDP-GT rule superioly stabilizing small open economies under TFP shock and the markup shocks compared to traditional inflation targeting (DIT and CPIT). Instead of triggering contractionary rate hikes to fight supply-driven inflation, NGDP-GT exploits the natural hedge within nominal income (PY), where the price spike offsets the output drop. By mechanically absorbing price pressures, the rule permits countercyclical rate cuts that shield real output and consumption. This prevents policy overreaction and accelerates the return to steady state, making NGDP-GT highly optimal for economies exposed to protectionist tariffs and a fragmenting global trade landscape.

2 The Model

The model is mainly based on Gali and Monacelli (2005) dynamic stochastic general equalibrium (DSGE) model of a small open economy. The world economy is as a continuum of small open economies represented by the unit interval. It is assumed that a small economy's domestic policies do not have any impact on the rest of the world. While different economies are subject to imperfectly correlate productivity shocks, it is assumed that they share identical preferences, technology and market structure. Next we will describe households and firms' problems in detail.

2.1 Households

A small open economy is populated by identical, infinitely lived households. A representative household holds bonds denominated in domestic currency and owns the shares of home-based monopolistic competitive firms. The household derives income from working, collecting profits of the domestic firms and selling bonds. The consumption baskets consume basket is composed of differentiated domestic and foreign goods which are indexed by j. $P_{H,t} \equiv (\int_0^1 P_{H,t}^{1-\nu}(j)dj)^{\frac{1}{1-\nu}}$and $P_{F,t} \equiv (\int_0^1 P_{F,t}^{1-\nu}(j)dj)^{\frac{1}{1-\nu}}$ are defined as, respectively, the utility-based price indices associated to the baskets of domestic and foreign varieties of goods, both expressed in units of the domestic currency. The subscript H, is the index for home and F for foreign. $P_{H,t}(j)$ and $P_{F,t}(j)$ are the prices of the individual domestic and foreign good i, where ν denotes the elasticity of substitution between varieties within each category (home goods or foreign goods). Households' utility maximization at any given expenditure on differentiated goods within each category yields the demand function for any good variety j:

$$C_{H,t}(j) = (\frac{P_{H,t}(j)}{P_{H,t}})^{-\nu} C_{H,t}; C_{F,t}(j) = \frac{P_{F,t}(j)}{P_{F,t}} C_{F,t} \tag{1}$$

for all $j \in [0,1]$. $C_{H,t} \equiv (\int_0^1 C_{H,t}(j)^{\frac{\nu-1}{\nu}}dj)^{\frac{\nu}{\nu-1}}$and $C_{F,t} \equiv (\int_0^1 C_{F,t}(j)^{\frac{\nu-1}{\nu}}dj)^{\frac{\nu}{\nu-1}}$ are represent composite indexes of domestic and foreign (imported) goods,

respectively. The household consumes a CES aggregate of C_H and C_F:

$$C_t = [(1-\alpha)^{\frac{1}{\rho}}(C_{H,t})^{\frac{\rho-1}{\rho}} + \alpha(C_{F,t})^{\frac{\rho-1}{\rho}}]^{\frac{\rho}{\rho-1}} \tag{2}$$

where $\alpha \in [0,1]$ represents the share of domestic consumption allocated to imported goods. Therefore, $1-\alpha$ is the natural index of openness. ρ denotes the elasticity of substitution between home goods and foreign goods. The utility based consumer price index is given by

$$P_t = [(1-\alpha)(P_{H,t})^{1-\rho} + \alpha(P_{F,t})^{1-\rho}]^{\frac{1}{1-\rho}} \tag{3}$$

The household's problem of allocating any given expenditure between domestic and foreign goods yields the demand function for home goods and foreign goods:

$$C_{H,t} = (1-\alpha)(\frac{P_{H,t}}{P_t})^{-\rho}C_t; C_{F,t} = \alpha\frac{P_{F,t}}{P_t})^{-\rho}C_t \tag{4}$$

The representative household seeks to maximize the utility function:

$$E_t \sum_{t=0}^{\infty} \beta^t \xi_t [\frac{C_t^{1-\sigma}}{1-\sigma} - \frac{N_t^{1+\phi}}{1+\phi}] \tag{5}$$

where E_t is the expectation operator, β is the discount factor and $\beta \in (0,1)$, $\sigma > 0$, and $\phi > 0$. $1/\sigma$ implies the intertemporal elasticity of substitution, and ϕ denotes the elasticity of labor substitution. ξ_t is a preference variable, which affects the marginal utility of consumption. N_t is the labor supply of the household at time period of t. In each period, the representative household allocate his resource in consumption and purchasing new bond asset, where the resources is derived from supplying labor and holding bonds. Then the budget constraint of the household can be written as:

$$P_t C_t + E_t(B_{t+1}) = W_t N_t + (1+i_t)B_t + \tau_t \tag{6}$$

where B_t represents the quantity of one-period nominally riskless bond that is purchases in period t and matures in period $t+1$. Each bond pays one unit of domestic currency at maturity. i_t is the nominal interest rate, W_t is

the nominal wage and τ_t acts as the lump-sum transfer payment.

Household's choices of C_t,N_t, and B_{t+1} in maximizing the utility function subject to the budget constraint yield the following option conditions:

$$\frac{C_t^{-\sigma}}{N_t^{\phi}} = \frac{P_t}{W_t} \tag{7}$$

$$\beta E_t(\frac{C_{t+1}}{C_t})^{-\sigma} = E_t(\frac{1}{1+i_{t+1}}\frac{P_{t+1}}{P_t}\frac{\zeta_t}{\zeta_{t+1}}) \tag{8}$$

Equation (7) specifies the households consumption-leisure choice. Equation (8), the Euler equation, states the optimal dynamic evolution of the household's consumption. $\frac{1}{E_t(1+i_{t+1})}$ is the gross return on a riskless one-period discount bond paying off one unit of domestic currency in $t+1$.This paper assumes an efficient labor market. As to the rest of the world, foreign households are assumed to have similar preference as in the home country. The foreign demand for good j is given by

$$C^*_{H,t}(j) = (\frac{P^*_{H,t}(j)}{P^*_{H,t}})^{-\nu} C^*_{H,t} = (\frac{P_{H,t}(j)}{P_{H,t}})^{-\nu} C^*_{H,t} \tag{9}$$

where $C^\star_{H,t} = (1-\gamma^\star)(\frac{P^\star_{H,t}}{P^\star_t})^{-\rho} C^\star_t$. Equation (9) implies a domestic producer faces a download sloping demand for its product on the international markets. Therefore, the small open economy maintains the ability to affect its own terms of trade.

2.2 Domestic Firms

There is a continuum of monopolistically competitive firms indexed by $j \in [0,1]$ with a linear technology represented by the production function:

$$Y_t(j) = A_t N_t(j) \tag{10}$$

where $a_t \equiv logA_t$ follow the AR(1) process $a_t = \rho_a a_{t-1} + \epsilon_a$.

This paper follows Monacelli (2004), domestic firms can be thought as divided into two units, a production and a pricing unit. The production

unit chooses factor demands in a perfectly competitive fashion, taking the level of output as given. Cost minimization generates the static efficiency conditions for the choice of labor, which implies that real marginal benefit equals to the real marginal cost of labor.

$$RMC\frac{\partial Y_t(j)}{\partial N_t(j)} = \frac{W_t}{P_{H,t}} \tag{11}$$

where RMC is the real marginal cost. The above efficiency condition also hold for aggregate indexes, because the production function is homogeneous of degree one. Typically, each firm faces the same real marginal cost at period t.

Following Calvo (1983) , we assume that firms set prices in a staggered fashion. Hence, a measure of $1-\theta$ of firms that are randomly selected set new prices each period, while the remaining θ cannot adjust their prices. The parameter θ represents the degree of price rigidity. A large θ implies that fewer firms adjust their prices and the expected time between price changes will be longer. As a pricing unit, domestic firm j faces domestic and foreign demand. The probability of a firm not adjusting its price from t to $t+k$ is θ^k. The optimal price-setting strategy for the typical firm resetting its price in period t can be approximated by the (log-linear) rule

$$\bar{p}_{H,t} = \mu_p + (1-\beta\theta)\sum_{k=0}^{\infty}(\beta\theta)^k E_t\{rmc_{t+k} + p_{H,t}\} \tag{12}$$

where $\bar{p}_{H,t}$ denotes the (log) of newly set domestic prices, and $\mu_p \equiv log\frac{\epsilon}{\epsilon-1}$, which corresponds to the log of the (gross) mark-up in the steady state.

2.3 Price level, terms of trade and real exchange rate

The nominal exchange rate ϵ_t is the price of one unit of foreign currency in terms of domestic currency. with the law of one price, $P_{H,t} \equiv \epsilon_t P^{\star}_{H,t}$ and $P_{F,t} \equiv \epsilon_t P^{\star}_{F,t}$. The terms of trade, Q_t, is defined as the price of the imported good relative to the price of the domestic good ($Q_t \equiv \frac{P_{F,t}}{P_{H,t}} = \frac{\epsilon_t P^{\star}_{F,t}}{P_{H,t}}$). The real exchange rate is then defined as $S_t = \frac{\epsilon_t P^{\star}_t}{P_t}$.

In a small open economy, domestic policy decisions do not have any impact on the rest of the world. Therefore, we assume that $P^{\star}_{F,t} = P^{\star}_{t}$. The total CPI inflation is defined as $\pi_t \equiv log(P_{H,t}/P_{H,t-1})$. The no arbitrage condition can be written as $1 + i^{\star}_t/1 + i_t = \epsilon_t/\epsilon_{t+1}$.

2.4 The log-linearization of the model

The model is solved by taking log-linear approximation around the steady state. The model is described by a system of linear equations.

Output gap We define the output gap as

$$x_t = y_t - y^{nat}_t \tag{13}$$

where y^{nat}_t denotes natural rate of output.

CPI Composition We specify CPI inflation rate as

$$\pi_t = (1 - \alpha) * \pi_{H,t} + \alpha * \pi_{F,t} \tag{14}$$

Euler equation with preference shock The Euler equation, augmented with a preference shock, is given by

$$c_t = c_{t+1} - \frac{1}{\sigma}(i_t - \pi_{H,t+1} - r^{nat}_t) + \xi_t \tag{15}$$

Labor Supply The Labor supply function takes the form

$$w_t = \sigma c_t + \phi n_t + \theta_q q_t \tag{16}$$

Production Function The log-linearized production function is

$$y_t = a_t + n_t \tag{17}$$

New Keynesian Phillips Curve The New Keynesian Phillips curve is expressed as

$$\pi_{H,t} = \beta \pi_{H,t+1} + \kappa(y_t - y_t^{nat}) + \mu_t; \tag{18}$$

Protectionist tariffs enter the structural system directly through the cost-push variable, μ_t. Through the direct marginal cost channel, tariffs immediately inflate the nominal and real cost of imported intermediate goods. Because domestic firms utilize these inputs to produce final domestic goods, the aggregate nominal production cost shifts upward. This spike in marginal production costs is mechanically captured by a positive innovation to the cost-push shock ($\mu_t > 0$).

Natural output under flexible prices The log-linearized natural level of output in the flexible-price equilibrium is

$$y_t^{nat} = a_t - \frac{\phi}{\sigma + \phi} * \xi_t \tag{19}$$

Natural real interest rate The log-linearized real interest rate is

$$r_t^{nat} = \sigma * (c_{t+1} - c_t) + (1 - \beta) * \xi_t \tag{20}$$

Terms of trade The terms of trade are defined as

$$q_t = open * (y_t - y_{f,t}); \tag{21}$$

where $y_{f,t}$ is the foreign output.

Real exchange rate The log-linearized real exchange rate satisfies

$$s_t = q_t \tag{22}$$

Resource constraint The resource constraint is

$$y_t = (1 - open) * c_t + open * y_{f,t} \tag{23}$$

3 Monetary policy regimes

To close the model, we specify the behavior of the monetary authority through a set of interest-rate rules that capture alternative policy regimes commonly considered in the open-economy New Keynesian literature. In all cases, the central bank sets the nominal interest rate i_t subject to partial adjustment, with $\rho_i \in [0, 1]$ governing the degree of interest rate smoothing. The policy stance responds to inflation and real activity, but the precise inflation measure and the structure of the rule vary across regimes. We consider three specifications: a rule targeting domestic inflation, a rule targeting CPI inflation, and a forward-looking nominal GDP growth rule. These formulations allow us to compare the implications of different stabilization objectives for macroeconomic dynamics and determinacy.

3.1 Domestic inflation targeting rule (DIT)

The interest rate follows a partially inertial Taylor-type rule responding to domestic inflation:

$$i_t = \rho_i i_{t-1} + (1 - \rho_i)[\phi_\pi \pi_{H,t} + \phi_y (y_t - y_t^{nat})] \tag{24}$$

3.2 CPI inflation targeting rule (CPIT)

Alternatively, the central bank may respond to CPI inflation:

$$i_t = \rho_i i_{t-1} + (1-\rho_i)[\phi_\pi \pi_t + \phi_y (y_t - y_t^{nat})] \tag{25}$$

3.3 Forward-looking NGDP-growth targeting rule (NGDP-GT)

Under nominal GDP growth targeting, the policy rate responds to expected nominal GDP growth and the output gap:

$$i_t = \rho_i i_{t-1} + (1-\rho_i)\{\phi_{ngdp}[E_t \pi_{t+1} + (y_t - y_{t-1})] + \phi_y (y_t - y_t^{nat})\} \tag{26}$$

The NGDP-growth targeting rule responds to expected inflation, consistent with the forward-looking nature of price setting in New Keynesian models, while real output growth enters contemporaneously. This asymmetry reflects the fact that inflation expectations are central to monetary policy transmission, whereas current real activity is observable in real time and avoids introducing additional forward looking variables that would compromise determinacy.

Moreover, we implement this flexible NGDP growth targeting rule, in which the central bank adjusts the policy rate in response to expected nominal GDP growth and the domestic output gap, with gradual interest rate adjustment. This specification follows the standard practice of augmenting the primary target with real stabilization and smoothing terms, analogous to flexible inflation targeting rules

4 Calibration

4.1 Parameterization

Table 1 lists the baseline parameter values. These parameters are set to widely accepted values based on OECD countries' data.

5 Quantitative results

Upon a negative TFP shock, natural output (potential output) contracts instantaneously. As shown in Figure 1, RGDP also declines, yet nominal rigidities modeled via the Calvo price setting mechanism—prevent actually output from adjusting as rapidly as the natural rate. RGDP stays sticky above the crashing potential output level. Consequently, a positive output gap ($x_t = y_t - y^{nat}$) emerges in the short run; despite the absolute decline in production (total output is lower than it was before the shock), the economy temporarily operates above its diminished potential. This productivity slum drives up real marginal cost, as firms require increased labor input $y_t = a_t + n_t$ to maintain output levels, thereby fueling domestic inflation $\pi_{H,t}$ and by extensions, CPI inflation π_t. According to the definition of terms of trade, as domestic output falls relative to foreign output, q_t actually decreases—the terms of trade improve. Given that domestic goods become scarcer and more expensive relative to foreign goods. The domestic currency experiences a real appreciation—s_t drops. Aggregate consumption subsequently retreats, driven by two channels: One is a negative wealth effect, stemming from permanent lower income due to lower productivity, and an intertemporal substitution effect, as rising real interest rates incentivize saving over current consumption.

The trajectory of nominal interest rate in Figure 1 reveals a sharp divergence across policy regimes: while the instrument remains positive under the alternative rules, it turns out negative under the NGDP-GT rule. This downward pressure is driven by three primary factors. First, instantaneous contraction of output from its previous steady state ($y_{t-1} = 0$) results in a profoundly negative growth term ($y_t - y_{t-1}$). The NGDP-GT rule me-

chanically interprets this collapse as a massive contraction in the "normal size" of the economy. To keep NGDP growth on target, the rule mandates the central bank to cut rates to provide counter-cyclical liquidity and support, despite the shock's origin as a structural productivity loss rather than shortfall in aggregate demand. Second, our NGDP-GT rule's forward looking specification—utilizing expected future inflation ($E_t(\pi_{t+1})$) rather than the current inflation spike (π_t)—weakens the typical hawkish response to a supply shock. Given the $AR(1)$ persistence of TFP process, agents anticipate a mean-reverting inflationary path; if the magnitude of the output contraction ($y_t - y_{t-1}$) exceeds these expectations, the net policy stance turns expansionary, leading to an interest rate cut. Third, NGDP-GT rule lacks the "memory" inherent in NGDP-level targeting—the lack of a "price level" anchor. NGDP Growth targeting rule does not try to make up for past failures, but focusing exclusively on period-over-period changes. In the first period of a TFP shock, the change in output is at its most negative. The rule essentially "panics" at the sight of crashing output growth and lower i to prevent a nominal collapse. In a word, the collapse in y_t relative to y_{t-1}dominates the rule's internal logic, overriding the inflationary signals typically associated with negative TFP shock.

As illustrated in Figure 1, the NGDP-GT regime demonstrates a superior capacity for stabilizing real variables, including output, consumption, the terms of trade, and the real exchange rate. While DIT and CPIT regimes prioritize price stability, they do so at the expense of heightened output volatility and significant interest rate fluctuations. In contrast, the NGDP-GT rule exhibits an intertemporal efficiency advantage: although DIT and CPIT may achieve lower instantaneous inflation during the initial periods of the shock, the NGDP-GT paths for both domestic and CPI inflation converge more rapidly toward the steady state from the fifth quarter onward. This suggests that by accommodating the initial productivity-driven price surge, the NGDP-GT rule avoids the protracted 'correction' phase required by stricter inflation-targeting regimes, ultimately leading to a more stable long-run macroeconomic environment.

The numerical results presented in Table 2 are consistent with the im-

pulse response functions depicted in Figure 1. Following a negative TFP shock, the NGDP-GT rule demonstrates a superior capacity for stabilizing real variables, yielding lower volatility in output, the nominal interest rate, terms of trade, consumption, and the real exchange rate compared to alternative regimes. While DIT rule maintains a comparative advantage in smoothing domestic and CPI inflation—consistent with its primary policy mandate—the NGDP-GT rule remains highly effective in inflation stabilization. Critically, NGDP-GT achieves this price stability without incurring the significant output fluctuations associated with strict inflation-targeting regimes, suggesting a more favorable trade-off between price and real-sector stability.

Quantitatively, the NGDP-GT rule demonstrates a significant stabilizing advantage over the alternative regimes. Compared to the DIT rule, NGDP-GT reduces volatility in output, consumption, terms of trade and real exchange rate by 15% or more, and the nominal interest rate by 37%. Furthermore, it yields a 7% reduction in the volatility of the natural real interest rate. Relative to the CPIT regime, the gains remain substantial: NGDP-GT generates 5% less volatility in output and consumption, while simultaneously reducing fluctuations in domestic and CPI inflation by 29% and 30%, respectively. It also marginally improves the stability of the external sector, lowering the variance of the terms of trade and the real exchange rate by 4% relative to the CPIT regime. Most notably, the NGDP-GT rule significantly smooths the policy instrument, resulting in a 48% reduction in interest rate volatility compared to the CPIT framework.

The qualitative divergence between these regimes underscores the distinct stabilization properties of each rule. While DIT and CPIT policies prioritize price stability, they function as strict 'inflation-centric' regimes. In the presence of a negative supply shock, these rules mandate aggressive nominal interest rate hikes to counteract the initial inflationary spike. However, this response introduces a pro-cyclical contractionary bias, which inadvertently exacerbates the decline in real activity and deepens the recessionary trough.

In contrast, the NGDP-GT framework exhibits an inherent 'leaning'

property against supply-side disturbances. Because the policy target is the sum of inflation and real output growth, the upward pressure on prices is mathematically offset by the contemporaneous contraction in output. This mechanical balancing prevents a policy overreaction, allowing for a degree of temporary inflation in exchange for a significantly shallower output contraction. Consequently, by prioritizing the stabilization of nominal income growth, the NGDP-GT regime achieves a superior trade-off, minimizing the aggregate volatility of the macro economy.

The macroeconomic dynamics under a cost-push (markup) shock as in Figure 2 mirror those observed under the negative TFP shock, further validating the robustness of the NGDP-GT framework. A notable distinction, however, is the rule's enhanced capacity to stabilize the output gap (x_t) relative to both the DIT and CPIT regimes. While the inflation-targeting rules experience significant volatility in the gap as they attempt to offset the markup-driven price surge, the NGDP-GT rule facilitates a smoother adjustment of actual output toward its natural level. Regarding price stability, the NGDP-GT rule exhibits a performance parity with the CPIT framework; while it remains secondary to the DIT rule in minimizing domestic inflation—consistent with the latter's specific domestic price mandate—it successfully avoids the excessive real-sector volatility typically associated with strict inflation targeting.

The quantitative results in Table 3 further highlight the stabilization properties of the NGDP-GT rule under a markup shock. Most notably, the NGDP-GT framework achieves a 75% reduction in the volatility of both output and the output gap relative to the DIT regime. This superior performance extends across the macroeconomic spectrum: compared to DIT, the nominal interest rate is 54% less volatile, while consumption and the real exchange rate see fluctuations reduced by 75% and 74%, respectively. Furthermore, the volatility of the terms of trade, real exchange rate and the natural real interest rate decrease by 7% , 7% and 48%, respectively.

When contrasted with the CPIT regime, the NGDP-GT rule maintains a dominant position, yielding at least a 40% reduction in the variance of output, the output gap, the nominal interest rate, and all external sector

variables. While the CPIT rule maintains a marginal advantage in the stabilization of domestic and CPI inflation, this slight gain in price stability comes at a disproportionately high cost to real-sector stability. In contrast, the NGDP-GT rule provides a significantly more balanced policy response, effectively shielding the real economy from the adverse effects of markup-driven disturbances.

Upon the impact of a negative preference shock (ξ_t), the economy experiences a sharp contraction in current consumption as households shift their internal discount factor toward future utility. Households prefer to save for the future rather than spend now. This collapse in domestic demand propagates through the resource constraint, pulling down total production: $y = (1-open)*c+open*y_f$. Regarding employment, since $y_t = a_t+n_t$ (and a_t is constant here), firms cut hiring to match the lower production levels. Paradoxically, the natural level of output (y_t) shifts upward. As seen in the natural output relation–$y^{nat} = a - (\phi/(\sigma+\phi)) * \xi$ shows that a decrease in ξ_t actually increases y_{nat} as a lower ξ means a lower "wealth effect" on labor supply. People are less "lazy" and being more willing to work because they are not as focused on immediate leisure or consumption (lower ξ), raising the flexible-price equilibrium output (potential output). The simultaneous fall in actual output and rise in potential output generates a profoundly negative output gap ($x = y - y_{nat}$), characterizing a massive recessionary gap.

The negative output gap exerts downward pressure on prices through the NKPC, $\pi_H = \beta * \pi_H(+1) + \kappa * (y - y_{nat}) + \mu$, as firms lower prices to stimulate flagging demand. Consequently, domestic inflation and CPI inflation both retreat. Finally, the external sector reflects this domestic slump. Since $q_t = open(y_t - y_f)$, the fall in domestic output y_t relative to foreign output $y_{f,t}$ causes both terms of trade and real exchange rate to decrease or appreciate.

The Taylor-type interest rate instrument under the NGDP-GT rule responds aggressively to the dual pressures of negative inflation and contracting output growth. As illustrated by the impulse response functions in Figure 3, the NGDP-GT rule triggers a significantly deeper initial reduction in

the nominal interest rate compared to the DIT and CPIT frameworks. This expansionary stance reflects the rule's mechanical mandate to combat the deflationary gap and nominal income collapse. However, in this demand-driven scenario, the NGDP-GT regime appears to induce excessive volatility. Both DIT and CPIT demonstrate superior stabilization across the macroeconomic spectrum—effectively smoothing output, the output gap, inflation (both domestic and CPI), and external sector variables—more efficiently than the NGDP-GT rule. This suggests that while NGDP-GT is robust against productivity shifts, its sensitivity to period-over-period growth makes it prone to policy overshooting during purely preference-driven contractions.

The second-moment conditions presented in Table 4 corroborate the impulse response analysis, confirming the superior stabilization properties of inflation-targeting regimes under a negative preference shock. Specifically, the DIT rule demonstrates a significant efficiency advantage over both CPIT and NGDP-GT, yielding approximately 30% less volatility in output, consumption, domestic and CPI inflation, as well as external sector variables—including the terms of trade and the real exchange rate—relative to the NGDP-GT framework. Furthermore, the DIT rule achieves a minimum 10% reduction in the variance of both the output gap and the nominal interest rate.

Similarly, the CPIT regime outperforms the NGDP-GT rule by a significant margin, generating at least 20% less volatility across domestic and CPI inflation, the policy instrument, and external sector metrics. The CPIT rule also provides enhanced stability for the real economy, with at least a 10% reduction in the fluctuations of output and consumption.

In summary, these results illustrate a clear state-dependency in optimal policy selection. While the NGDP-GT rule is superior in absorbing supply-side disturbances—effectively mitigating the output-inflation tradeoff inherent in TFP and markup shocks—the stricter nominal anchors of DIT and CPIT are more effective against demand-driven volatility. Under a preference shock, NGDP-GT tends toward policy overshooting by responding aggressively to the simultaneous contraction in prices and growth. Consequently, the welfare-enhancing properties of NGDP-GT are functionally linked to the economy's shock profile: it offers Pareto-optimal improvements

in supply-sensitive environments but introduces a stabilization bias when demand fluctuations predominate.

6 Robustness

6.1 Structural Openness

To address whether the performance of the forward-looking NGDP-GT rule is contingent on high economic exposure or remains universally optimal, we subject the structural openness parameter to a comprehensive sensitivity analysis. The value of α is varied across a wide spectrum, ranging from a highly self-contained economy ($\alpha = 0.15$) to a highly integrated threshold ($\alpha = 0.5$).

Across all determinate parameter ranges, the robustness results shown in Table 5 are qualitatively consistent with our baseline model. The unconditional standard deviations reveal that the NGDP-GT rule systematically delivers the lowest volatility for both real output and the nominal interest rate under a negative TFP shock. When evaluating inflation stabilization, NGDP-GT operates as an intermediate framework—successfully balancing the stabilization of domestic inflation and aggregate CPI inflation. While DIT minimizes domestic price volatility at the cost of severe contractions in real activity, NGDP-GT permits temporary inflation absorption, preventing policy overreactions and shielding the real economy during structural supply disruptions.

When the economy is subjected to a cost-push shock as shown in Table 6, the robustness properties remain thoroughly consistent with our benchmark findings. The forward-looking NGDP-GT rule strictly dominates both the DIT and CPIT regimes, systematically yielding the lowest unconditional standard deviations for output, the output gap, and the nominal interest rate as in Table 6. By endogenously absorbing the markup disturbance through a balanced distribution of price and quantity adjustments, the NGDP-GT framework dampens stagflationary trade-offs and prevents the contractionary policy overreactions that plague traditional inflation targeting regimes in highly open environments.

6.2 Calvo Price Stickiness

A classic criticism of nominal income targeting is that it can lead to excessive inflation volatility if prices adjust too quickly. By testing a lower θ (more flexible prices), we prove whether the forward-looking NGDP-GT

rule triggers an unanchored hyperinflationary spiral when firms can change prices easily. Conversely, testing a higher θ (sticky prices) proves weather the rule can successfully shields real GDP even when structural gridlock prevents markets from clearing quickly.

Table 7 reveals that when the economy faces a TFP shock, as the price-stickiness index decreases from its baseline value of 0.75 to a highly flexible threshold of 0.50, the capacity of the NGDP-GT rule to stabilize real variables remains thoroughly consistent with the benchmark model. Even under heightened price flexibility, the framework structurally dampens fluctuations in real output, the nominal interest rate, the terms of trade, aggregate consumption, the real exchange rate, and the natural real interest rate.

However, a distinct structural shift occurs in the inflation stabilization dynamics: at this lower rigidity threshold, the NGDP-GT framework ceases to operate as an intermediate boundary between the DIT and CPIT regimes for price stabilization. Because increased price flexibility steepens the slope of the New Keynesian Phillips Curve, the mechanical balancing property of the growth target accommodates a larger, more immediate price adjustment to clear the real sector. Consequently, while the rule preserves its robust protection over real macroeconomic variables, it yields a localized trade-off of heightened contemporaneous inflation volatility when nominal rigidities are weak.

Conversely, when the economy is characterized by high nominal rigidity ($\theta = 0.85$), the forward-looking NGDP-GT rule successfully dampens both domestic inflation and CPI inflation volatility alongside the nominal interest rate. While it exhibits a marginal stabilization trade-off relative to DIT and CPIT in terms of output, the terms of trade, consumption, the real exchange rate, and the natural real interest rate, the losses remain quantitatively trivial. This confirms that while the rule's optimal deployment is fundamentally state-dependent, it maintains robust aggregate performance across distinct pricing environments.

When the economy is subjective to a cost-push shock, as shown in Table 8 the robustness results strictly mirror those of the benchmark model, reinforcing the structural stability of the framework.

6.3 Shock Persistence

If a supply shock is highly transitory ($\rho_a = 0.50$), future inflation is expected to immediately vanish, allowing the central bank to aggressively cut rates to save output growth without fear. But what if protectionist tariffs create a permanent structural drag ($\rho_a \to 0.98$)? In that case, expected future

inflation stays high, which might force a forward-looking central bank to keep interest rates high. Varying this parameter proves that NGDP-GT is a robust long-term framework for a structurally altered world, not just a lucky rule that only works for short-lived supply hiccups.

From Table 9, we observe three points. The first is the Macro-Stabilization Premium. Across all three horizons ($\rho_a = 0.5, 0.7, 0.98$), NGDP-GT consistently achieves the lowest volatility for output and aggregate consumption, and terms of trade compared to both DIT and CPIT. Second, the volatility trade-off shifts with persistence. Compare CPI inflation at $\rho_a = 0.5$ vs $\rho_a = 0.98$): (i) when shocks are transitory ($\rho_a = 0.5$), NGDP-GT performs almost identitally to the inflation targets (0.0013 vs 0.0012/0.0013), (ii) when the shock is near-permanent ($\rho_a = 0.98$), inflation volatility under NGDP-GT spikes to 0.0034, losing ground to DIT. However, it drastically outperforms CPIT (0.0057). Third, interest rate smoothing efficiency. NGDP-GT manages to keep nominal interest rate volatility exceptionally low across the board–especially when $\rho_a = 0.70$ and $\rho_a = 0.50$ (0.0029 under NGDP-GT vs 0.0065 under DIT), signaling a much less erratic policy instrument path.

Consistent with the baseline model, Table 10 demonstrates that NGDP-GT outperforms both DIT and CPIT in stabilizing all macroeconomic variables, with the sole exception of inflation

7 Conclusion

This paper demonstrates that the optimal choice of monetary policy framework for a small open economy is highly state-dependent and relies on the structural configuration of global trade. In an era historically dominated by hyper-globalization and demand shocks, traditional inflation targeting frameworks (DIT and CPIT) provided optimal stabilization.

However, as protectionism, tariffs, and deglobalization become the primary drivers of global economic fluctuations, the policy trade-offs of inflation targeting worsen. Central banks operating in highly integrated, supply-volatile, or tariff-exposed small open economies should consider shifting away from strict consumer price targets toward forward-looking nominal income targeting frameworks to protect real economic activity from structural supply shocks. Under both TFP and markup disturbances, NGDP-GT's built in balancing of inflation and real output growth prevents policy overreaction, yielding substantially lower volatility in output, consumption, external

variables, and the nominal interest rate. By allowing temporary inflation while stabilizing nominal income growth, NGDP GT achieves a superior output–inflation trade off relative to traditional inflation targeting regimes.

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Appendix

Table 1: Values of Parameters

Parameters	Description	Value
β	Household's discount factor	0.9900
σ	Risk aversion	1.0000
ϕ	Inverse of IES	1.0000
θ	Calvo price-stickiness	0.7500
θ_q	Open-economy wedge in labor supply	1.0000
κ	Slope of the NKPC	0.1717
ϕ_π	Inflation-response coefficient	2.0000
ϕ_y	Output-gap coefficient	0.5000
ϕ_{ngdp}	NGDP growth coefficient	2.0000
α	Structural import share in consumption basket	0.4000
$open$	Degree of openness	0.4000
ρ_ξ	Persistence of the preference shock	0.5000
ρ_a	AR(1) coefficient of TFP	0.9000
ρ_{y_f}	AR(1) coefficient on foreign output	0.9000
ρ_{π_F}	AR(1) coefficient on foreign inflation	0.7000
ρ_i	Interest-rate smoothing parameter	0.6000
ρ_μ	Persistence of cost-push shock	0.6000

Figure 1: Impulse Responses to a negative TFP shock

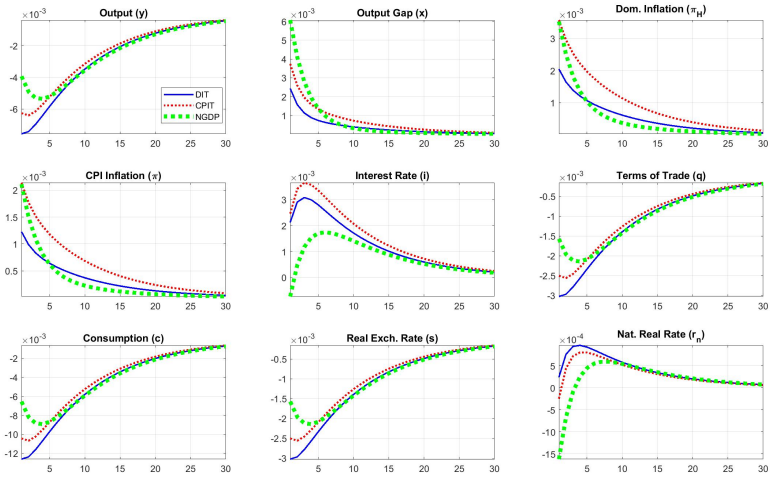


Table 2: Moment Conditions when the economy is subjective to a TFP Shock

Policies	Moments	y	x	π_H	π	i	q	c	s	r^{nat}
DIT	$std(d)$	0.0196	0.0036	0.0040	0.0024	0.0086	0.0078	0.0326	0.0078	0.0027
	$corr(d, y)$	1.0000	-0.9205	-0.9877	-0.9877	-0.9863	1.0000	1.0000	1.0000	-0.9419
	$autocorr(d)$	0.9219	0.7308	0.8594	0.8594	0.9626	0.9219	0.9219	0.9219	0.9725
CPIT	$std(d)$	0.0173	0.0060	0.0073	0.0044	0.0103	0.0069	0.0288	0.0069	0.0023
	$corr(d, y)$	1.0000	-0.9361	-0.9867	-0.9867	-0.9892	1.0000	1.0000	1.0000	-0.8607
	$autocorr(d)$	0.9312	0.7738	0.8705	0.8705	0.9643	0.9312	0.9312	0.9312	0.9391
NGDP-GT	$std(d)$	0.0165	0.0083	0.0052	0.0031	0.0054	0.0066	0.0274	0.0066	0.0025
	$corr(d, y)$	1.0000	-0.6787	-0.7688	-0.7688	-0.8930	1.0000	1.0000	1.0000	-0.3546
	$autocorr(d)$	0.9672	0.6842	0.7348	0.7348	0.9532	0.9672	0.9672	0.9672	0.6869

Note: $std(d)$ is the standard deviation of a variable, $corr(d, y)$ is the correlation between a variable and y $autocorr(d)$ stands for autocorrelation.

Figure 2: Impulse Responses to a cost-push shock

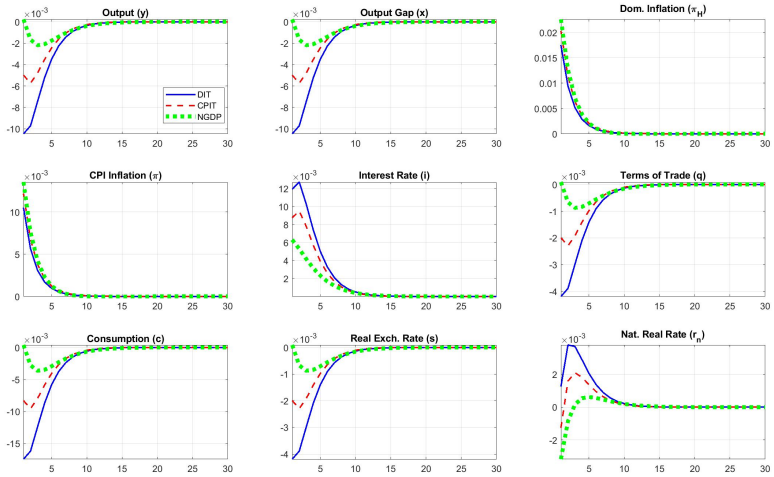


Table 3: Moment Conditions when the economy is subjective to a cost-push shock

Policies	Moments	y	x	π_H	π	i	q	c	s	r^{nat}
DIT	$\sigma(d)$	0.0175	0.0175	0.0208	0.0125	0.0225	0.0070	0.0292	0.0070	0.0067
	$corr(d,y)$	1.0000	1.0000	-0.9222	-0.9222	-0.9962	1.0000	1.0000	1.0000	-0.8884
	$autocorr(d)$	0.7950	0.7950	0.5404	0.5404	0.8340	0.7950	0.7950	0.7950	0.8869
CPIT	$\sigma(d)$	0.0102	0.0102	0.0245	0.0147	0.0169	0.0041	0.0170	0.0041	0.0039
	$corr(d,y)$	1.0000	1.0000	-0.8712	-0.8712	-0.9995	1.0000	1.0000	1.0000	-0.6359
	$autocorr(d)$	0.8532	0.8532	0.5575	0.5575	0.8412	0.8532	0.8532	0.8532	0.6523
NGDP-GT	$\sigma(d)$	0.0044	0.0044	0.0272	0.0163	0.0103	0.0018	0.0073	0.0018	0.0035
	$corr(d,y)$	1.0000	1.0000	-0.3781	-0.3781	-0.7059	1.0000	1.0000	1.0000	-0.2424
	$autocorr(d)$	0.8839	0.8839	0.5576	0.5576	0.7887	0.8839	0.8839	0.8839	0.3244

Table 4: Moment Conditions when the economy is subjective to a demand (preference) shock

Policies	Moments	y	x	π_H	π	i	q	c	s	r^{nat}
DIT	$\sigma(d))$	0.0028	0.0084	0.0022	0.0013	0.0053	0.0011	0.0047	0.0011	0.0039
	$corr(d, y)$	1.0000	0.9428	0.9543	0.9543	0.5947	1.0000	1.0000	1.0000	-0.9826
	$autocorr(d)$	0.1692	0.3762	0.3497	0.3497	0.7846	0.1692	0.1692	0.1692	0.2704
CPIT	$\sigma(d))$	0.0033	0.0089	0.0024	0.0014	0.0046	0.0013	0.0055	0.0013	0.0042
	$corr(d, y)$	1.0000	0.9679	0.9758	0.9758	0.6605	1.0000	1.0000	1.0000	-0.9910
	$autocorr(d)$	0.2270	0.3913	0.3669	0.3669	0.7937	0.2270	0.2270	0.2270	0.3077
NGDP-GT	$\sigma(d))$	0.0039	0.0097	0.0031	0.0019	0.0060	0.0016	0.0065	0.0016	0.0034
	$corr(d, y)$	1.0000	0.9991	0.9996	0.9996	0.9941	1.0000	1.0000	1.0000	-0.9997
	$autocorr(d)$	0.4549	0.4815	0.4722	0.4722	0.5252	0.4549	0.4549	0.4549	0.4702

Figure 3: Impulse Responses to a negative demand (preference) shock

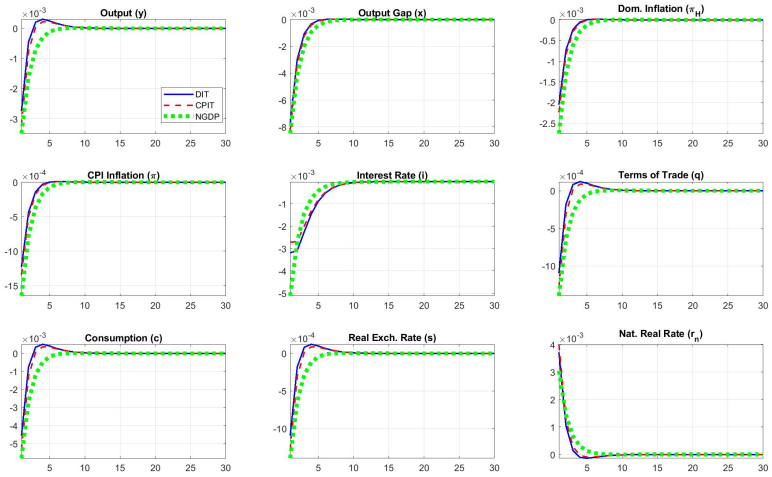


Table 5: Moment Conditions when the economy is subjective to a TFP shock

Policies	Moments	y	x	π_H	π	i
$\sigma(d)\|\alpha = 0.15$	DIT	0.0203	0.0029	0.0030	0.0025	0.0064
	CPIT	0.0199	0.0033	0.0036	0.0030	0.0068
	NGDP-GT	0.0177	0.0076	0.0033	0.0028	0.0030
$\sigma(d)\|\alpha = 0.40$	DIT	0.0196	0.0036	0.0040	0.0024	0.0086
	CPIT	0.0173	0.0060	0.0073	0.0044	0.0103
	NGDP-GT	0.0165	0.0083	0.0052	0.0031	0.0054
$\sigma(d)\|\alpha = 0.50$	DIT	0.0191	0.0041	0.0047	0.0023	0.0101
	CPIT	0.0151	0.0081	0.0104	0.0052	0.0129
	NGDP-GT	0.0150	0.0094	0.0077	0.0038	0.0077

Table 6: Moment Conditions when the economy is subjective to a cost-push shock

Policies	Moments	y	x	π_H	π	i
$\sigma(d)\|\alpha = 0.15$	DIT	0.0201	0.0201	0.0196	0.0166	0.0197
	CPIT	0.0174	0.0174	0.0208	0.0177	0.0182
	NGDP-GT	0.0080	0.0080	0.0245	0.0208	0.0099
$\sigma(d)\|\alpha = 0.40$	DIT	0.0175	0.0175	0.0208	0.0125	0.0225
	CPIT	0.0102	0.0102	0.0245	0.0147	0.0169
	NGDP-GT	0.0044	0.0044	0.0272	0.0163	0.0103
$\sigma(d)\|\alpha = 0.50$	DIT	0.0162	0.0162	0.0215	0.0108	0.0241
	CPIT	0.0072	0.0072	0.0261	0.0130	0.0158
	NGDP-GT	0.0031	0.0031	0.0284	0.0142	0.0102

Table 7: Moment Conditions when the economy is subjective to a TFP shock

Policies	Moments	y	x	π_H	π	i	q	c	s	r^{nat}
$\sigma(d)\|\theta = 0.50$	DIT	0.0218	0.0015	0.0060	0.0036	0.0107	0.0087	0.0363	0.0087	0.0032
	CPIT	0.0204	0.0032	0.0144	0.0086	0.0161	0.0081	0.0339	0.0081	0.0029
	NGDP-GT	0.0182	0.0074	0.0177	0.0106	0.0086	0.0073	0.0304	0.0073	0.0029
$\sigma(d)\|\theta = 0.75$	DIT	0.0196	0.0036	0.0040	0.0024	0.0086	0.0078	0.0326	0.0078	0.0027
	CPIT	0.0173	0.0060	0.0073	0.0044	0.0103	0.0069	0.0288	0.0069	0.0023
	NGDP-GT	0.0165	0.0083	0.0052	0.0031	0.0054	0.0066	0.0274	0.0066	0.0025
$\sigma(d)\|\theta = 0.85$	DIT	0.0175	0.0056	0.0024	0.0015	0.0068	0.0070	0.0291	0.0070	0.0024
	CPIT	0.0156	0.0075	0.0034	0.0020	0.0070	0.0062	0.0259	0.0062	0.0021
	NGDP-GT	0.0158	0.0087	0.0021	0.0012	0.0044	0.0063	0.0263	0.0063	0.0022

Table 8: Moment Conditions when the economy is subjective to a cost-push shock

Policies	Moments	y	x	π_H	π	i	q	c	s	r^{nat}
$\sigma(d)\|\theta = 0.50$	DIT	0.0072	0.0072	0.0095	0.0057	0.0097	0.0029	0.0119	0.0029	0.0032
	CPIT	0.0053	0.0053	0.0135	0.0081	0.0087	0.0021	0.0089	0.0021	0.0022
	NGDP-GT	0.0025	0.0025	0.0207	0.0124	0.0059	0.0010	0.0041	0.0010	0.0023
$\sigma(d)\|\theta = 0.75$	DIT	0.0175	0.0175	0.0208	0.0125	0.0225	0.0070	0.0292	0.0070	0.0067
	CPIT	0.0102	0.0102	0.0245	0.0147	0.0169	0.0041	0.0170	0.0041	0.0039
	NGDP-GT	0.0044	0.0044	0.0272	0.0163	0.0103	0.0018	0.0073	0.0018	0.0035
$\sigma(d)\|\theta = 0.85$	DIT	0.0230	0.0230	0.0264	0.0158	0.0289	0.0092	0.0383	0.0092	0.0084
	CPIT	0.0119	0.0119	0.0283	0.0170	0.0199	0.0048	0.0198	0.0048	0.0045
	NGDP-GT	0.0051	0.0051	0.0294	0.0176	0.0119	0.0020	0.0085	0.0020	0.0039

Table 9: Moment Conditions when the economy is subjective to a TFP shock

Policies	Moments	y	x	π_H	π	i	q	c	s	r^{nat}
$\sigma(d)\|\rho_a = 0.50$	DIT	0.0043	0.0076	0.0020	0.0012	0.0048	0.0017	0.0071	0.0017	0.0021
	CPIT	0.0037	0.0081	0.0022	0.0013	0.0042	0.0015	0.0062	0.0015	0.0018
	NGDP-GT	0.0032	0.0090	0.0021	0.0013	0.0019	0.0013	0.0053	0.0013	0.0011
$\sigma(d)\|\rho_a = 0.70$	DIT	0.0075	0.0067	0.0028	0.0017	0.0065	0.0030	0.0126	0.0030	0.0025
	CPIT	0.0064	0.0078	0.0034	0.0020	0.0059	0.0026	0.0107	0.0026	0.0021
	NGDP-GT	0.0058	0.0091	0.0030	0.0018	0.0029	0.0023	0.0097	0.0023	0.0015
$\sigma(d)\|\rho_a = 0.98$	DIT	0.0496	0.0007	0.0029	0.0017	0.0059	0.0199	0.0827	0.0199	0.0016
	CPIT	0.0483	0.0021	0.0094	0.0057	0.0120	0.0193	0.0806	0.0193	0.0015
	NGDP-GT	0.0474	0.0062	0.0056	0.0034	0.0067	0.0190	0.0790	0.0190	0.0031

Table 10: Moment Conditions when the economy is subjective to a cost-push shock

Policies	Moments	y	x	π_H	π	i	q	c	s	r^{nat}
$\sigma(d)\|\rho_\mu = 0.50$	DIT	0.0127	0.0127	0.0168	0.0101	0.0173	0.0051	0.0211	0.0051	0.0058
	CPIT	0.0075	0.0075	0.0189	0.0114	0.0123	0.0030	0.0125	0.0030	0.0032
	NGDP-GT	0.0026	0.0026	0.0211	0.0126	0.0062	0.0010	0.0044	0.0010	0.0024
$\sigma(d)\|\rho_\mu = 0.70$	DIT	0.0261	0.0261	0.0272	0.0163	0.0307	0.0104	0.0435	0.0104	0.0081
	CPIT	0.0148	0.0148	0.0341	0.0205	0.0253	0.0059	0.0247	0.0059	0.0052
	NGDP-GT	0.0078	0.0078	0.0378	0.0227	0.0180	0.0031	0.0130	0.0031	0.0053
$\sigma(d)\|\rho_\mu = 0.98$	DIT	0.2645	0.2645	0.1451	0.0871	0.1542	0.1058	0.4408	0.1058	0.0106
	CPIT	0.2014	0.2014	0.4789	0.2874	0.4642	0.0805	0.3356	0.0805	0.0284
	NGDP-GT	0.1912	0.1912	0.4973	0.2984	0.4687	0.0765	0.3186	0.0765	0.0335