The Taylor Curves

Sebin Nidhiri, David H. Papell, and Swati Singh*

University of Houston

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Abstract

The Taylor curve depicts the long-run trade-off between inflation and output variability. The original 1979 version characterizes the trade-off both quantitatively and qualitatively through a model but does not contain a policy rule. The 1994 version incorporates a Taylor rule but does not contain a model and only characterizes the trade-off qualitatively. We update the Taylor curve by incorporating a variety of policy rules and compare the tradeoffs using the Linearized Version of the Federal Reserve Board/United States model. We find evidence of a downward sloping Taylor curve for inflation and output variability for non-inertial and inertial Taylor rules with a variety of individual and sums of coefficients on the inflation and output gaps. Economic performance has improved over time. The coefficients from estimating Taylor rules are on the efficient Taylor curve for the Great Moderation, slightly outside the curve for the pre- and post-Great Recession period, and considerably outside the curve for the Great Inflation and Volker disinflation periods.

JEL Classification*:* E5; E52; E58

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*Sebin Nidhiri (sbnidhir@CougarNet.UH.edu), David Papell (dpapell@uh.edu), and Swati Singh (ssingh72@CougarNet.UH.edu), Department of Economics, University of Houston, Houston, TX, 77204

1. Introduction

The Taylor (1979) curve depicts the long-run trade-off between inflation and output variability. In a model with predetermined prices, staggered wage and price contracts, a long-run vertical Phillips curve, and rational expectations, "inflation-regarding" optimal monetary policy that sharply reduces the growth rate of real balances when inflation is above its target level decreases inflation variability while increasing output variability. "Output-regarding" optimal monetary policy with little-to-no response of real balances to inflation above its target level increases inflation variability while decreasing output variability. This "second-order" Phillips curve was designed to replace the (discredited) Phillips curve with a long-run trade-off between the levels of inflation and unemployment.[1]

The Taylor (1993) rule prescribed that the Federal Open Market Committee (FOMC) should conduct monetary policy by setting the federal funds rate equal to the neutral real interest rate plus the inflation rate plus 0.5 times the inflation gap, the inflation rate minus the Federal Reserve's two percent inflation target, plus 0.5 times the output gap, the percentage deviation of Gross Domestic Product (GDP) from potential GDP.

Taylor (1994) replaced the optimal response of real balances to inflation with a Taylor rule where the Federal Funds Rate (FFR) responds to inflation and output gaps, although not necessarily with Taylor's original coefficients. He showed that as interest rates respond more to inflation gaps and less to GDP gaps, the variance of inflation falls and the variance of GDP rises. In contrast to Taylor (1979), the analysis in Taylor (1994) is purely graphical. While Taylor (1979) mapped the weight on output fluctuations in the loss function to the optimal standard deviations of output and inflation, Taylor (1994) does not map numerical values of the Taylor rule coefficients into variances of output and inflation.[2]

We update the Taylor curve by incorporating a variety of policy rules and use the rules to evaluate the tradeoff with the Linearized Version (LINVER) of the Federal Reserve Board/United States (FRB/US) model described in Brayton, Laubach, and Reifschneider (2014)

[1] Papers analyzing the Taylor curve include Chatterjee (2002), Friedman (2006), Taylor (2006), Olson and Enders (2012), and Olson, Enders, and Wohar (2012). Svensson (2010) proposes a Taylor curve using inflation and output gap forecasts. There is also a large literature on short-run trade-offs between inflation and real economic activity, a recent example being Forbes, Ha, and Kose (2025)

[2] There is no standard way to depict the Taylor curve. Taylor (1979) reports standard deviations of output and inflation with output on the vertical axis. Taylor (1994) reports variances of output and inflation with inflation on the vertical axis.

and Brayton and Reifschneider (2022). We use non-inertial versions of the rules where the FFR adjusts immediately to its target and inertial versions of the rules where the FFR adjusts slowly to its target.

The paper produces a family of Taylor curves indexed by the sum of the coefficients in the Taylor rule. The choice among points on each Taylor curve depends on the coefficients on the inflation and output gaps in the Taylor rule. For a fixed sum of coefficients on the inflation and output gaps, policy rules with larger coefficients on inflation gaps than on output gaps have lower inflation and higher output variability than rules with larger coefficients on output gaps than on inflation gaps. For a fixed ratio of coefficients on the inflation and output gaps, policy rules with larger coefficients have lower inflation and output variability than rules with smaller coefficients.

We consider three groups of rules where the sum of the inflation and output gap coefficients equal 1.0, 1.5, and 2.0. For each group, the coefficient on the output gap is the sum of the coefficients minus the coefficient on the inflation gap. We analyze seven rules for each group with the coefficient on inflation and output gaps ranging from 0.0 to the sum of the coefficients. Three rules have larger output gap than inflation gap coefficients, three have larger inflation gap than output gap coefficients, and one has equal coefficients. The Taylor (1993) rule sets a coefficient of 0.5 on the inflation and output gaps and is an example of the first group. The balanced approach rule in Taylor (1999) and Yellen (2012) raises the output gap coefficient to 1.0 while maintaining the coefficient of 0.5 on the inflation gap and is an example of the second group.

The optimal control calculations that determine the Taylor (1979) curve are subject to the problem of time inconsistency because, under rational expectations, policymakers will have an incentive to change their original plans at a later date. Taylor justifies using optimal control techniques by assuming that policymakers, concerned about long-run effects, will not change plans midstream. Our version of the Taylor curve is not subject to the time inconsistency problem because it is not determined by optimal control techniques.[3]

For all versions of the Taylor curve, economic loss can, in theory, be decreased by moving the curve towards the origin and lowering both inflation and output loss. For the original version, this cannot be accomplished through monetary policy, which can only choose a point

[3] Nidhiri, Papell, and Singh (2025) investigate a different, although related, problem of inconsistent rules. The policy rules in this paper are not subject to time inconsistency because there are no incentives to change the rule.

along the curve. Taylor (1994) focuses on the ratio of the response of the FFR to inflation and output gaps rather than the size of the individual coefficients, although he did warn that very high output gap coefficients could result in large interest rate fluctuations. Hall and Taylor (1997), using the model in Taylor (1994), suggest moving the curve towards the origin by streamlining the labor market, improving wage indexation, avoiding government price shocks, and eliminating protectionist trade measures.

We report four major results for the Taylor curve with the Taylor rule. First, all versions display the same tradeoff between inflation and output variability as the Taylor (1979) curve, with a downward-sloping relation between the standard deviation of inflation and the standard deviation of output. Second, higher sums of the coefficients move the curve towards the origin with better economic performance. For the two best-known versions of the Taylor rule, the standard deviations of output and inflation are lower for the Taylor (1999) rule with coefficients of 0.5 on the inflation gap and 1.0 on the output gap than the Taylor (1993) rule with coefficients of 0.5 on both gaps.

Third, while economic performance monotonically improves as the sum of equally weighted inflation and output loss increases from 1.0 to 10.0, it becomes non-monotonic when the change in the FFR is added to the loss function. Fourth, economic performance has improved over time. The coefficients from estimating Taylor rules are on the efficient Taylor curve for the Great Moderation, slightly outside the curve for the pre- and post-Great Recession period, and considerably outside the curve for the Great Inflation and Volker disinflation periods.

2. **Monetary Policy Rules and Loss Functions**

The Taylor (1993, 1999) policy rule is a non-inertial rule where the FFR adjusts immediately to its prescribed value is as follows,

$$R_t = r^* + \pi_t + \alpha\left(\pi_t - \pi^*\right) + \beta(y_t) \tag{1}$$

where R_t is the level of the short-term federal funds interest rate prescribed by the rule, π_t is the annual inflation rate, π^* is the 2 percent target level of inflation, y_t is the output gap, the percentage deviation of GDP from potential GDP, and r^* is the neutral real interest rate that is consistent with inflation equal to the target level of inflation and GDP equal to potential GDP in the longer run. When inflation equals its 2 percent target and GDP equals potential GDP, the federal funds rate equals the neutral real interest rate plus the 2 percent inflation target. The policy rules incorporate the Taylor principle that the nominal interest rate is increased more than point-for-point when inflation rises if $\alpha > 0$. The Taylor (1993) rule sets $\alpha = \beta = 0.5$ and the Taylor (1999) and Yellen (2012) balanced approach rules set $\alpha = 0.5$ and $\beta = 1.0$.

The inertial Taylor rule where the FFR adjusts slowly towards its prescribed value is

$$R_t = 0.85\, R_{t-1} + 0.15[r^* + \pi_t + \alpha\left(\pi_t - \pi^*\right) + \beta(y_t)] \tag{2}$$

where R_{t-1} equals the rate prescribed by the rule if it is positive and the ELB rate of 0.125 if the prescribed rate is negative, 0.85 is the coefficient on the lagged FFR and 0.15 is the coefficient on the non-inertial Taylor rule prescription. We set the coefficients (0.85, 0.15) as in Bernanke, Kiley, and Roberts (2019), Bernanke (2020), and Fuentes-Albero and Roberts (2021).

Taylor (1979) evaluates economic policy with a quadratic loss function where the goal of policy is to minimize the weighted sum of inflation loss $\left(\pi_t - \pi^*\right)^2$ and output loss $\left(y_t\right)^2$.

$$L(t) = \lambda\left(\pi_t - \pi^*\right)^2 + (1 - \lambda)\left(y_t\right)^2 \tag{3}$$

where $0 \leq \lambda \leq 1$. Inflation loss is the variance of inflation and output loss is the variance of output. If $\lambda > 0.5$, inflation loss is weighted more than output loss, if $\lambda < 0.5$, inflation loss is weighted less than output loss, and $\lambda = 0.5$, inflation and output loss are equally weighted.

Levin, Wieland, and Williams (1999) show that loss minimizing policy with the loss function in Equation (3) will produce unrealistically high coefficients on the inflation and output gaps in Equation (1) and very large fluctuations in interest rates. One solution is to add the squared change in the FFR to penalize large responses when evaluating different policy rules,

$$L(t) = \lambda\left(\pi_t - \pi^*\right)^2 + (1 - \lambda)\left(y_t\right)^2 + (\Delta\, FFR_t)^2 \tag{4}$$

3. Evaluating Monetary Policy Rules in LINVER

The Federal Reserve Board/United States (FRB/US) model is a large scale, non-linear, estimated general equilibrium model of the US economy developed by economists at the Federal Reserve Board and is the workhorse model at the Fed. Originally described in Brayton and Tinsley (1996), the model has been revised over the years to reflect the changing nature of the US economy. We provide a brief overview of the current FRB/US model here.

The model has two types of consumers; hand-to-mouth who consume their income every period and unconstrained who can also save. Both households earn different types of income and consume durables, non-durables and housing. Firms have a Cobb-Douglas production function and make decisions regarding hiring labor and making investments in different inputs like equipment, intellectual property and buildings. There is an extensive financial market that has treasury securities of varied maturities, corporate bonds, auto loans, residential mortgages and equity. The government sector is modelled with disaggregated spending components and a wide range of taxes. There is a foreign sector with trade of goods and services and uncovered interest parity.

LINVER is the linearized version of FRB/US. LINVER is written in MATLAB, Octave, and EViews and the code is made available to the public. This paper uses the LINVER package written in MATLAB to study the differential impact of various policy rules on the economy. The MATLAB version requires the use of the add-on package Dynare. The advantage of using the LINVER version of the FRB/US model is the reduction in computational costs while still enabling the implementation of both linear and non-linear rules.

Papers conducting policy rule evaluation with the LINVER version of the FRB/US model, include Reifschneider and Williams (2000), Kiley and Roberts (2017), Bernanke, Kiley, and Roberts (2019), Bernanke (2020), Arias et al. (2020), Brayton and Reifschneider (2022), and Kiley (2024). Agents in LINVER can have either forward-looking model consistent (MC) rational expectations or backward-looking vector autoregressive (VAR) expectations. We follow Reifschneider and Williams (2000), Arias et al. (2020), and Kiley (2024) and use the version with MC expectations in financial markets and wage-price setting and VAR expectations in other sectors. Model consistent expectations used in the model mean that the agents have a complete understanding of how the effects of past and current shocks will play out in the model over time. Absent any future shocks, the expectations of these agents regarding endogenous variables are the same as the predictions of the model. This is different from perfect foresight where agents know the realizations of future shocks. For agents with VAR expectations, their expectations equal the predictions of a small VAR model based on past data.

The LINVER model can be run either with the Effective Lower Bound (ELB) imposed or not imposed. When the ELB is imposed, the FFR is set equal to 0.125 when it would otherwise be lower and even negative. Since the FOMC has never attempted to enact negative nominal interest rates, this is the most straightforward interpretation of Fed policy. The problem with this interpretation, however, is that the FOMC conducts quantitative easing once the ELB is attained to provide additional stimulus. We therefore use the version of LINVER where the ELB is not imposed and the FFR can be interpreted as a "shadow" interest rate that reflects the full extent of the stimulus.

The user can specify a monetary policy rule for the economy and how agents form expectations. LINVER then uses Dynare to solve the macroeconomic model under these conditions. The solution is composed of matrices that specify the decision rules of agents and the future paths of model variables conditional on the state of the economy in the current quarter. Subsequently, LINVER runs simulations of the economy by drawing a matrix of shocks that can be applied to the behavioral equations in the model. Shocks are drawn from residuals created based on historic US data ranging from 1970:Q1 to 2019:Q4 for the general analysis. Shocks are drawn by a stratified random sampling method developed in González-Astudillo and Vilán (2019).[4] The current state of the economy is first determined using a Markov-switching model with three states: normal, mild slump, and severe slump state. Based on this given state of the economy, shocks are then drawn randomly from historical data where the period matches the state of the simulated economy as determined by the Markov model.

Nikolsko-Rzhevskyy, Papell, and Prodan (2019) show that there are four different eras in monetary policy since 1970 characterized by different Taylor rules that best describe the Fed's policy. In keeping with this finding, we rerun our analysis for each era separately. Such era-specific simulations are implemented by drawing shocks from that era alone. For each subsample, shocks are randomly drawn with replacement from the historic residuals to create the matrix of shocks, unlike the general analysis where draws were state-dependent.

[4] The model has the feature to generate stochastic simulations based on a bootstrap approach in which errors are assumed to be independent across time. However, this approach had longstanding concerns about the capacity of the model to replicate certain business cycle features. González-Astudillo and Vilán (2019) proposed a new methodology using Markov-Switching methods to address these concerns.

These simulations result in a distribution for the paths of output, unemployment, inflation, and interest rates. Given a large enough number of simulations, these distributions approximate the population distribution, making the calculated moments the same across various rounds of running the LINVER program. This allows for the comparison of summary statistics for these distributions and evaluation of the performance of various monetary policy rules by only changing the policy rule between different rounds of running the program.

We run multiple rounds of simulations for the policy rules in Section 2, one round for each Taylor rule. Each round has 5000 simulations, and each simulation has an economy that runs for 200 quarters. Before comparing the distributions across various rounds, the first 100 quarters are dropped so that differences between the outcomes are not influenced by differences in initial conditions across simulations in the rounds. This is consistent with how LINVER results are evaluated in Bernanke, Kiley, and Roberts (2019) and Brayton and Reifschneider (2022).

Summary statistics from the distribution of the path of the endogenous variables are calculated for the mean and standard deviation of the output and inflation gaps. The output gap in LINVER is defined as the log difference between the actual and potential real GDP times 100. Potential GDP is determined based on the parameters of the equation's models. The inflation gap is the difference between core PCE inflation and the inflation target.

The above means are calculated as the average in the last 100 quarters across the 5000 simulations. The standard deviations are the standard deviations from the same subset of the results. To compare the performance of policy rules in keeping macroeconomic outcomes close to the target, the loss functions in Section 2 are calculated to quantify deviations from targets. The loss function in Equation (3) that considers inflation gaps and output gaps is calculated from the simulation results as follows.

$$Loss = \frac{1}{5000}\frac{1}{100}\sum_{s=1}^{5000}\sum_{t=101}^{200}\left(\pi_{t,s} - \pi^{*}\right)^{2} + y_{t,s}^{2} \tag{5}$$

Loss functions that also penalize changes in the FFR as in Equation (4) are calculated from the simulation results as follows.

$$Loss = \frac{1}{5000}\frac{1}{100}\sum_{s=1}^{5000}\sum_{t=101}^{200}\left(\pi_{t,s} - \pi^{*}\right)^{2} + y_{t,s}^{2} + (\Delta FFR_{t,s})^{2} \tag{6}$$

When the loss function has unequal weights on inflation and output loss, the weights are multiplied by the inflation and output gaps in Equations (5) and (6) before calculating the total loss.

4. The Taylor Curve and The Taylor Rule

Taylor curves depict the long-run trade-off between inflation and output variability. The Taylor (1979) curve is the optimal control solution to a model with an aggregate demand equation and a price determination equation. The aggregate demand equation specifies the output gap as depending on two lagged output gaps, current and lagged real balances, and expected inflation. The price determination equation specifies inflation depending on lagged inflation and the expected output gap. Expectations are for the current period given information through the previous period.

The Taylor (1979) curve in Figure 1 depicts the downward-sloping relation between the standard deviation of output and the standard deviation of inflation. The two standard deviations are determined by the optimal rate of growth of real balances when inflation rises or falls relative to target which, in turn, depend only on the relative weight on inflation and output loss in Equation (3). The equation describing the rate of growth of real balances is not a policy rule and is not part of the solution of the model. The relation between the weight on output fluctuations and the standard deviations is given in Table 1, where lower (higher) weight on output fluctuations produces higher (lower) standard deviations of output and lower (higher) standard deviations of inflation. The model is estimated from 1953:Q1 – 1985:Q4.

Taylor (1994) replaced the optimal response of real balances to inflation with the Taylor rule in Equation (1) but did not conduct numerical analysis using a model. We analyze the Taylor curve by combining the Taylor rule with the LINVER version of the FRB/US model. The Taylor curve in our paper is determined by the sum of the coefficients $\alpha + \beta$ on the inflation and output gaps when they are equally weighted, the individual coefficients α and β when their sum is fixed and the weights λ and $1 - \lambda$ on inflation and output loss. The model is estimated from 1970:Q1 – 2019:Q4.

4.1 *Coefficients in the Policy Rules*

The objective of the paper is to evaluate the Taylor curve using a macroeconomic model as in Taylor (1979) and policy rules as in Taylor (1994). The main results are contained in Table 2, which reports the standard deviation of the inflation and output gap for various specifications. Results are reported for non-inertial rules where the FFR immediately attains its target value and inertial rules where the FFR adjusts slowly towards its target.

Panels A, B, and C report results where the sum of the inflation gap and output gap coefficients equal 1.0, 1.5. and 2.0. The inflation gap coefficients are reported for each panel. Because the output gap coefficients equal the sum of the coefficients minus the inflation gap coefficients, this also defines the output gap coefficients. For each sum of coefficients, the individual coefficients range from zero weight on the inflation gap coefficient α and full weight on the output gap coefficient β to full weight on the inflation gap coefficient α and zero weight on the output gap coefficient β.

The standard deviation of inflation decreases and the standard deviation of output increases as the coefficient on the inflation gap rises. This result is monotonic and holds for both non-inertial and inertial policy rules where the sum of the coefficients equals 1.0, 1.5, and 2.0. While the standard deviation of inflation is smaller for inertial than for non-inertial rules in all cases, the standard deviation of output is smaller for non-inertial than for inertial rules in all cases.

Taylor curves using the results in Table 2 are depicted in Figure 2. The dots correspond to the seven inflation gap standard deviations for each rule with zero on the upper left and the sum of the coefficients on the lower right. While the downward slope of the Taylor curve replicates the slope in Taylor (1979, 1994), the mechanism is different. While the Taylor (1979) curve is a depiction of the quantitative solution of a macroeconomic model, it is driven by preferences rather than by policy. While the Taylor (1994) curve is driven by a Taylor rule, it is not a depiction of the quantitative solution of a macroeconomic model. Our version of the Taylor curve is both driven by Taylor rules and is the quantitative solution of the linearized version of the FRB/US model that is used for policy analysis presented to members of the FOMC at each meeting.

Taylor (1994) analyzed the relative sizes of the inflation and output gap coefficients but did not consider the sum of the coefficients except to note that high coefficients could result in large changes in interest rates. Figure 2 depicts Taylor curves when the sum of the coefficients equal 1.0, 1.5, and 2.0. The Taylor curves are closer to the origin when the sum of the coefficients is larger for non-inertial and inertial rules. The Taylor curves are also closer to the origin for inertial than for non-inertial rules.

4.2 Interest Rate Loss

The results in the previous section show that economic performance improves with higher coefficients in the Taylor rule. We analyze this further by reporting results with larger sums of inflation gap and output gap coefficients in the Taylor rules. The results for inflation and output loss using non-inertial and inertial rules with equal coefficients on the two gaps for each sum of the gaps are reported in Table 3 for sums of coefficients between 1 and 10. Inflation and output loss decrease monotonically as the sums of the coefficients increase for both non-inertial and inertial rules.

The loss functions in Equation (3) with equal weights on inflation and output loss are also reported in Table 3. The losses decrease monotonically as the sum of the inflation and output gap coefficients in the Taylor rule increase for non-inertial rules. This is an example of a result in Levin, Wieland, and Williams (1999), who show that loss minimizing policy with the loss function in Equation (3) will produce unrealistically high coefficients on the inflation and output gaps in Equation (1).

We implement their recommendation by adding the squared change in the FFR to Equation (3) to produce Equation (4). Table 3 reports the change in the FFR. In contrast to inflation and output loss, the change in the FFR increases monotonically as the sum of the inflation and output gap coefficients increases for non-inertial and inertial rules. This is in accord with Taylor (1994), who noted that high coefficients in the policy rule could result in large changes in interest rates. The loss functions in Equation (4) display non-monotonic responses in both cases. The minimum loss occurs when the sum of the inflation and output gap coefficients equal 2.5 for the non-inertial rule with output loss and 7.0 for the inertial rule with output loss.

5. **Evaluating Monetary Policy with Taylor Curves**

While optimal monetary policy can, in theory, be determined by finding the tangency of a Taylor curve with a social indifference curve, this has proven elusive to implement in practice. Taylor (1979) suggested that, because of the sharp curvature of the tradeoff curve, only very steep or very flat indifference curves would lead policymakers to choose a monetary rule which generates inflation or output variability outside a 1 to 2 percent range. Taylor (1994) made a similar suggestion while noting that which utility function to use is not obvious. Hall and Taylor (1997) show that social indifference curves which bend outward from the origin produce tangencies with tradeoff curves with a balance between inflation loss and output loss but don't provide any numbers.

A more promising way to evaluate policy is to compare standard deviations of points on the Taylor curve with those from estimated rules. Since the points on the Taylor curve represent the locus of efficient points, combination of standard deviations of inflation and output outside the curve (further from the origin) could be improved on and points inside the curve (closer to the origin) are not attainable. Taylor (1979) calculates the combination of inflation and output standard deviations for actual U.S. performance for 1953:Q1 – 1975:Q4 and simulations of a constant money supply growth rate rule. While the points representing both combinations lie outside the Taylor curve and are therefore inefficient, the constant growth rate rule is preferred because it has a lower standard deviation of output and about the same standard deviation of inflation.

We conduct policy analysis by comparing combinations of standard deviations of inflation and output from estimated Taylor rules with combinations from postulated Taylor rules using LINVER. Nikolsko-Rzhevskyy, Papell, and Prodan (2019) use Bai and Perron (1998) tests to identify structural breaks in Taylor rule deviations, the absolute value of the difference between the FFR and the FFR prescribed by Taylor rules and estimate coefficients of the rules over the identified sub-periods. We use real-time quadratic detrended real GDP for the output gap and real-time GDP deflator through 2000 and real-time core PCE inflation thereafter. [5]

Table 4a reports the breaks and the coefficient estimates. We conduct the analysis over sub-periods because there are statistically significant breaks in 1979:Q4, 1987:Q2, and 2000:Q4 which define periods for the Great Inflation from 1970 – 1979, the Volker Disinflation from 1980

[5] Nikolsko-Rzhevskyy and Papell (2012) show that quadratic detrended output gaps are much closer to output gaps calculated from unemployment rates and real-time measures of the natural rate of unemployment using Okun's Law than those calculated from Hodrick-Prescott detrending. Real-time core PCE inflation is only available since 1996.

– 1987, the Great Moderation from 1987 – 2000, and the pre- and post-Great Recession from 2001 – 2019. The coefficient estimates are conventional. The Taylor principle, that the nominal interest rate increases by more than point-for-point when inflation rises, so the real interest rate rises, is supported by the magnitude and statistical significance of the estimates for the Volker Disinflation and Great Moderation periods, supported by the magnitude, but not the significance, of the coefficients, for the pre- and post-Great Recession period, and not supported for the Great Inflation period. The coefficient estimates for the output gap are significantly greater than zero for all periods except the Volker Disinflation.

Taylor curves for the different sub-samples are depicted in Figure 4 with the sum of the coefficients equal to one. Table 4Table 4b reports the standard deviations of inflation and output on the horizontal and vertical axes. The four sub-samples are downward-sloping and display the same trade-off between inflation and output variability as in the full sample. As the inflation gap coefficient rises and the output gap coefficient falls, the standard deviation of inflation falls and the standard deviation of output rises for each sub-sample.

Standard deviations of inflation and output for policy rules with estimated coefficients are given in Table 4c and depicted in Figure 3. The estimated rule is on the Taylor curve for the Great Moderation with a coefficient of approximately 0.3 on the inflation gap and 0.6 on the output gap, close to the original Tylor rule with coefficients of 0.5 on each gap. The estimated rule for the pre- and post-Great Recession period is close to the Tylor curve, followed by the Volker disinflation and Great Inflation periods.

6. **Conclusions**

The Taylor curve depicts the long-run trade-off between inflation and output variability. Taylor (1979) characterizes the trade-off both quantitatively and qualitatively through a model but does not contain a policy rule. Taylor (1994) incorporates a Taylor (1993) rule but only characterizes the trade-off qualitatively. We update the Taylor curve by incorporating a variety of policy rules and compare the tradeoffs using the Linearized Version of the Federal Reserve Board/United States model.

We find evidence of a downward sloping Taylor curve for inflation and output variability for non-inertial and inertial Taylor rules with a variety of individual and sums of coefficients on the inflation and output gaps. These include individual coefficients from zero to one and sums of coefficients from one to two. Holding the sum of coefficients constant, the standard deviation of inflation decreases and the standard deviation of output increases as the inflation gap coefficient increases and the output gap coefficient decreases. For equal values of the coefficients, economic performance is better for Taylor curves with larger coefficients. Economic performance is better with inertial rules than with non-inertial rules.

Economic performance has improved over time. The standard deviations of inflation and output with coefficients from estimating Taylor rules are on the efficient Taylor curve for the Great Moderation, slightly outside the curve for the pre- and post-Great Recession period, and considerably outside the curve for the Great Inflation and Volker disinflation periods. Since economic performance is measured relative to the efficient curve, the coefficients in the Taylor rule are determined by the FOMC, and the shocks are the same for the estimated and postulated rules, this provides evidence for "good policy" rather than "good luck" as an explanation for better economic performance in recent decades.

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Table 1: Weights in Taylor (1979)

Weight on Output Fluctuations	Optimal Standard Deviation of Output (Per cent)	Optimal Standard Deviation of Inflation (Per cent)
0.01	2.14	1.64
0.10	1.35	2.04
0.20	1.19	2.28
0.50	1.01	2.88
0.70	0.93	3.32
0.90	0.85	3.96

Table 2: Standard Deviation of Inflation and Output Gaps for Different Taylor Rules

Panel A - Sum of Coefficients Equals 1							
Inflation Gap Coefficient	**0**	**0.1**	**0.25**	**0.5**	**0.75**	**0.9**	**1**
Non-Inertial							
Inflation Standard Deviation	2.04	2.02	1.98	1.93	1.89	1.86	1.85

Output Standard Deviation	2.98	3.06	3.20	3.51	3.94	4.29	4.56
Inertial							
Inflation Standard Deviation	1.95	1.93	1.9	1.85	1.82	1.8	1.79
Output Standard Deviation	3.02	3.1	3.26	3.59	4.05	4.42	4.73

Panel B - Sum of Coefficients Equals 1.5							
Inflation Gap Coefficient	**0**	**0.1**	**0.5**	**0.75**	**1**	**1.4**	**1.5**
Non-Inertial							
Inflation Standard Deviation	1.84	1.82	1.78	1.75	1.73	1.70	1.69
Output Standard Deviation	2.44	2.49	2.77	3.01	3.32	4.07	4.34
Inertial							
Inflation Standard Deviation	1.76	1.75	1.71	1.69	1.67	1.65	1.64
Output Standard Deviation	2.52	2.57	2.86	3.11	3.45	4.27	4.56

Panel C - Sum of Coefficients Equals 2							
Inflation Gap Coefficient	**0**	**0.1**	**0.5**	**1**	**1.5**	**1.9**	**2**
Non-Inertial							
Inflation Standard Deviation	1.73	1.72	1.69	1.66	1.63	1.62	1.61
Output Standard Deviation	2.10	2.14	2.33	2.68	3.23	3.96	4.21
Inertial							
Inflation Standard Deviation	1.67	1.66	1.64	1.61	1.58	1.57	1.57
Output Standard Deviation	2.21	2.25	2.45	2.81	3.4	4.2	4.49

Table 3: Losses with Various Taylor Rules

	Sum of Inflation Gap and Output Gap Coefficients									
	1	**1.5**	**2**	**2.5**	**3**	**3.5**	**4**	**5**	**7**	**10**
Non-Inertial										
Inflation Loss	3.74	3.08	2.75	2.57	2.45	2.37	2.32	2.24	2.17	2.12
Output Loss	12.35	9.06	7.18	5.99	5.18	4.59	4.14	3.52	2.84	2.36

ΔFFR	0.73	1.07	1.50	1.98	2.55	3.19	3.91	5.58	9.85	18.80
Loss = (0.5 * Inflation Loss + 0.5 * Output Loss)	8.05	6.07	4.97	4.28	3.82	3.48	3.23	2.88	2.51	2.24
Loss = (0.5 * Inflation Loss + 0.5 * Output Loss + ΔFFR)	8.78	7.14	6.47	6.26	6.37	6.67	7.14	8.46	12.36	21.04
Inertial										
Inflation Loss	3.44	2.87	2.59	2.44	2.34	2.28	2.23	2.18	2.12	2.08
Output Loss	12.86	9.70	7.90	6.73	5.93	5.35	4.90	4.27	3.56	3.05
ΔFFR	0.09	0.13	0.17	0.22	0.28	0.33	0.41	0.54	0.88	1.51
Loss = (0.5 * Inflation Loss + 0.5 * Output Loss)	8.15	6.29	5.25	4.59	4.14	3.82	3.57	3.23	2.84	2.57
Loss = (0.5 * Inflation Loss + 0.5 * Output Loss + ΔFFR)	8.24	6.42	5.42	4.81	4.42	4.15	3.98	3.77	3.72	4.08

Table 4a: Estimated Coefficients for Taylor Rules using Real-Time Data

	1970:Q1-1979:Q4	1980:Q1-1987:Q2	1987:Q3-2000:Q4	2001:Q1-2019:Q3
Output Gap	0.71 (0.077)	0.15 (0.080)	0.63 (0.058)	0.47 (0.046)
Inflation	1.00 (0.105)	1.49 (0.100)	1.31 (0.112)	1.39 (0.425)
Constant	2.57 (0.612)	3.24 (0.560)	1.21 (0.346)	-0.50 (0.774)

Table 4b: Taylor Curves in Subsamples

Sum of Coefficients 1							
Inflation Gap Coefficient	**0**	**0.1**	**0.3**	**0.5**	**0.7**	**0.9**	**1**
1970:Q1-1979:Q4							
Inflation Standard Deviation	1.93	1.89	1.84	1.79	1.75	1.71	1.69
Output Standard Deviation	3.10	3.19	3.40	3.66	4.01	4.46	4.74
1980:Q1-1987:Q2							
Inflation Standard Deviation	2.50	2.47	2.41	2.37	2.32	2.29	2.27
Output Standard Deviation	3.20	3.29	3.51	3.79	4.17	4.68	4.99
1987:Q3-2000:Q4							
Inflation Standard Deviation	1.10	1.09	1.06	1.04	1.02	1.00	0.99
Output Standard Deviation	1.87	1.93	2.08	2.26	2.51	2.82	3.02
2001:Q1-2019:Q3							
Inflation Standard Deviation	1.73	1.71	1.67	1.64	1.62	1.60	1.59
Output Standard Deviation	2.43	2.50	2.68	2.91	3.22	3.64	3.91

Table 4c: Performance of Policy Rules with Estimated Coefficients

Estimated Coefficients in Policy Rules				
	1970:Q1-1979:Q4	**1980:Q1-1987:Q2**	**1987:Q3-2000:Q4**	**2001:Q1-2019:Q3**
Inflation Standard Deviation	2.18	2.58	1.07	1.71
Output Standard Deviation	3.59	4.87	2.15	3.01

Figure 1: The Taylor (1979) Curve

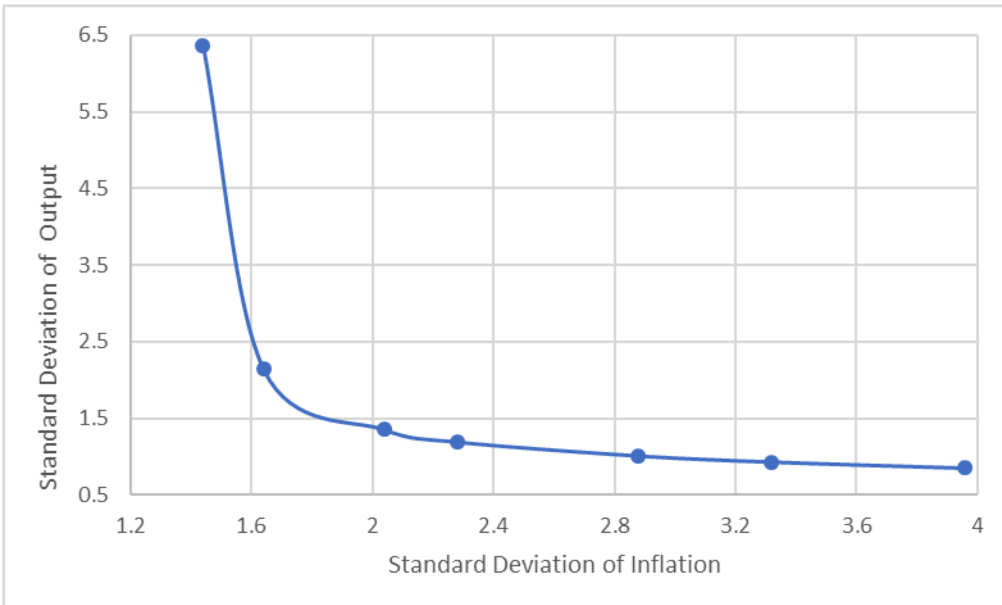
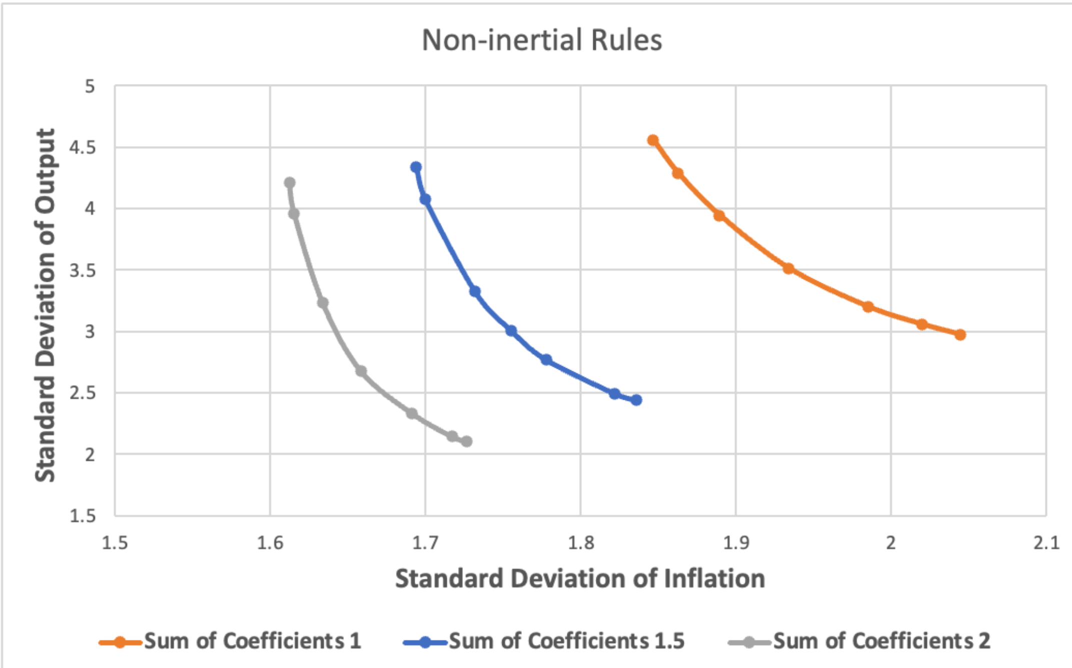


Figure 2: Taylor Curves with the Taylor Rule

Panel A: Non-Inertial Rules



Panel B: Inertial Rules

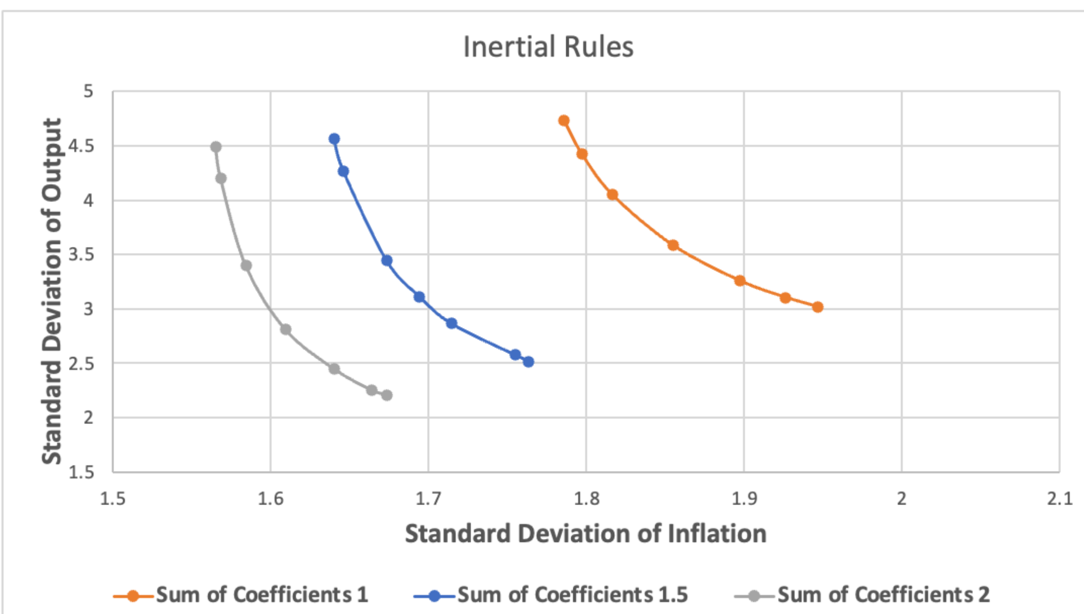


Figure 3: Taylor Curves for Different Sub-Samples