Facts, Fears, and Functionality of NGDP Level Targeting
A Guide to a Popular Framework for Monetary Policy

---Preliminary Draft---

David Beckworth
Senior Research Fellow
Monetary Policy Program
The Mercatus Center
George Mason University

Abstract: Nominal GDP level targeting (NGDPLT) has become an increasing popular monetary policy framework over the past decade. This rising popularity has led to increased interest in, as well as some confusion over, how this framework actually works. This paper attempts to address these questions by summarizing basic facts of NGDPLT and addresses some of the fears surrounding it. The paper also demonstrates how a NGDPLT might work in practice.

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I. Introduction

Does the Federal Reserve need a new monetary policy framework? A growing number of observers believe the answer is yes. Some see the Great Recession, the slow recovery from it, and the persistent shortfall of inflation relative to its target as evidence that the current approach to monetary policy is inadequate.[1] Others worry that the secular decline in interest rates is permanent and leaves insufficient room for the Fed to cut interest rates in future recessions.[2] These concerns have caused many to call for an overhaul of the way the Fed does monetary policy.

One proposal for revamping the monetary policy framework is for the Federal Reserve to adopt a nominal GDP level target. This approach would have the Fed target a stable growth path for the total amount of spending in the economy. While not a new idea, nominal GDP level targeting (NGDPLT) became popular in the aftermath of the Great Recession. [3]

This rise in popularity can be seen in the first panel of Figure 1 which shows the number of articles on NGDP targeting based on a Google search of regular and scholarly articles. Panel B of Figure 1 indicates that not only does NGDPLT remain popular, but it appears to be generating more interest than some of the other monetary policy framework proposals like price level targeting or a higher inflation target.[4]

Like many popular phenomenon, however, NGDPLT has been misunderstood by some observers and this has led to confusion over what it would mean for monetary policy. Some believe, for example, that it would fail to anchor inflation expectations or that it would increase economic volatility.[5] Others worry NGDPLT is an impractical framework for monetary policy because of changes in potential real GDP, data revisions, public confusion, and the mechanics of implementing it.

While all of these impressions about NGDPLT are understandable, they are ultimately misplaced. This policy primer illustrates why by clarifying what exactly is NGDPLT and by addressing the misconceptions about it. Ultimately, this paper shows that this monetary policy framework can be implemented in a stabilizing manner.

To that end, this policy primer provides a guide to the facts, fears, and functionality of NGDPLT. It does so in an accessible and executive summary-styled format so that interested parties can

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[1] See, for example, Romer (2011), Sumner (2011), Woodford (2012), Frankel (2012), and Beckworth (2014).

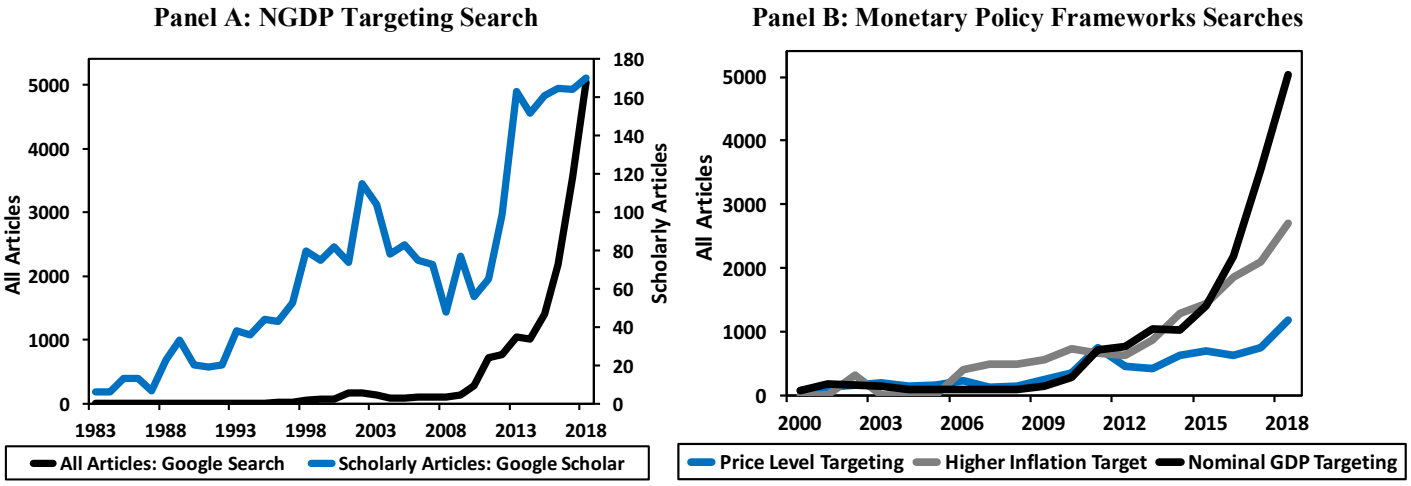
[2] See, for example, Kiley and Roberts (2017), Summers (2018), and Bernanke et al. (2019).

[3] The renewed interest began with blogging, spread to more traditional news media, and then made its way to influential academics (Thompson, 2012). Former CEA Chair Christina Romer, for example, urged the Fed in 2011 to adopt a NGDP level target while around the same time prominent monetary theorist Michael Woodford made the case for it at an important conference for central bankers (Romer, 2011; Woodford, 2012). Wall Street firms, like Goldman Sachs, also got interested in this new framework and added momentum to NGDP targeting conversation (Hatzius et al., 2011). Selgin (2018a) notes, however, that NGDP targeting has a long history with the notion of a total spending target going back to at least 1837

[4] The search criteria used for nominal GDP targeting was as follows: "nominal gdp targeting" or "nominal gdp target" or "ngdp targeting" or "ngdp target" or "nominal income targeting" or "nominal income target". For price level targeting the search criteria used was "price level targeting" or "price level target".

[5] See for example Goodhart et al. (2013) for a recent critique. A more dated critique of NGDP is Ball (1999) to which McCallum (1999) and Dennis (2001) reply.

Figure 1: Google Search Results for Nominal GDP Targeting



easily find specific issues surrounding NGDPLT while still being able to get a complete picture of this approach to monetary policy. The paper first looks at seven facts and seven fears of NGDPLT. It then shows how a NGDPLT might be implemented in practice. The paper concludes with some practical suggestions for making the transition to a NGDPLT.

II. Facts about Nominal GDP Level Targeting (NGDPLT)

Fact 1: NGDPLT is a Dollar-Denominated Target

NGDPLT anchors the dollar size of the U.S. economy. This mooring is accomplished by having the central bank target the level of total dollar spending in the economy. The total amount of money spent, in turn, generates an equal amount of money earned in the economy. The former is officially called nominal gross domestic product (NGDP) while the latter is called nominal gross domestic income (NGDI).[6] Because these are equal, NGDPLT can be viewed both as a target for total dollar spending or for total dollar income earned. As a consequence, some commentators call this approach *nominal income targeting*.

To better understand this connection, note that total dollar spending on the economy is equal to the stock of money times how often it is used. This decomposition of NGDP can be summarized as follows:

$$NGDP = MV, \tag{1}$$

where M is the total amount of money and V is the velocity, the number of times money gets used. Total dollar income can similarly be decomposed into two parts: the price level times real income. This can be summarized as follows:

$$NGDI = PY, \tag{2}$$

where P is the price level and Y is real income. Real income is inflation-adjusted income and is the real gains from working in the economy. Since $NGDP = NGDI$, we can combine (1) and (2) to get the following:

[6] Technically, NGDP equals consumption spending, investment spending, government purchases, and net exports while NGDI equals wages, rental income, interest income, and profits.

$$MV = PY. \quad (3)$$

Equation (3) is the famous equation of exchange, an accounting identity, that relates money transactions to money incomes. It implies that a NGDP target that stabilizes *MV* is equivalent to a nominal income target that stabilizes *PY*. In either case, the monetary policy goal is a dollar-denominated target.

All of this means, as mentioned earlier, that NGDPLT anchors the dollar size of the economy. Put differently, NGDPLT is a *nominal anchor* that keeps the growth of prices, wages, and other dollar-denominated activity moored so that they do not expand too rapidly.

Fact 2: NGDPLT is a Growth-Path Target

NGDPLT requires the Fed to stabilize the level or *growth path* of nominal GDP. This means the Fed would have to make up for past misses from its target so that the targeted dollar level of NGDP is always be maintained. This is illustrated in Figure 2. It shows a scenario where the Fed is targeting some growth rate—the slope of the line—for NGDP and makes up for periods of below and above-target growth so that the trend growth path is maintained.

Panel A shows a case where NGDP falls in year one (Y_1). The Fed would make up for this miss the next two years (Y_2,Y_3) by growing total dollar spending faster than the target—the steeper slope—until it is caught up to its target dollar level. Panel B shows that a similar response would follow a spending boom that pushed money spending above the targeted path. The growth rate of NGDP would temporarily slowdown until the targeted growth path was reached.

Table 1 further illustrates this idea of monetary policy correcting for past misses by putting numbers to the scenarios in Figure 2. The actual NGDP dollar size in 2018 is used a starting point, while the table assumes the NGDP growth path is targeted at 4 percent trend growth.

The first few rows of Table 1 outline the baseline case where the NGDP level target is maintained every year at 4 percent growth. The second set of rows shows what happens when NGDP grows below 4 percent in 2019 (Y_1). The missed growth is made up in the next two years by having NGDP grow faster than four percent. The third set of rows shows the scenario where NGDP grows faster than 4 percent in 2019 (Y_1). This miss is corrected for in the next two years by having NGDP grow lower than four percent. In all cases, the dollar size of NGDP returns to its targeted value by the end of 2021 (Y_3). NGDP, then, is able to also return to its normal target growth rate of 4 percent in 2022 (Y_4).

Figure 2: A Nominal GDP Level Target

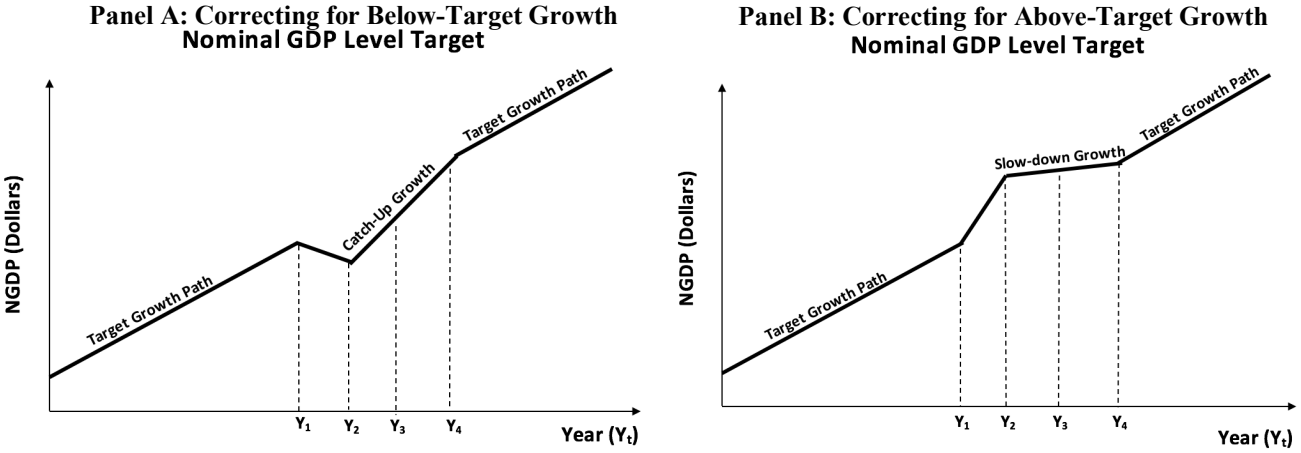


Table 1: Nominal GDP Level Targeting Scenarios

On-Target NGDP Growth	**2018(Y_0)**	**2019(Y_1)**	**2020(Y_2)**	**2021(Y_3)**	**2022(Y_4)**
Dollar Size (Trillions)	$20.87	$21.70	$22.57	$23.47	$24.41
Growth Rate	*4.00%*	*4.00%*	*4.00%*	*4.00%*	*4.00%*
Below-Target NGDP Growth					
Dollar Size (Trillions)	$20.87	$20.66	$22.02	$23.47	$24.41
Growth Rate	*4.00%*	*-1.00%*	*6.59%*	*6.59%*	*4.00%*
Above-Target NGDP Growth					
Dollar Size (Trillions)	$20.87	$22.53	$23.00	$23.47	$24.41
Growth Rate	*4.00%*	*8.00%*	*2.05%*	*2.05%*	*4.00%*

If this target was understood by the public and was credible, it would create expectations of stable money spending growth that would become self-fulfilling. That is, households and firms would have less incentive to rapidly spend or hoard money in the first place if they believed the Fed would always correct past misses in its targeted growth path.[7] A credible NGDP level target, in other words, would lead to the public doing most of the adjustment in spending needed to keep NGDP on its target growth path. This stabilizing feature is why most proponents of this framework favor a *growth path* target rather than a *growth rate* target. For only the former make up for past misses.

[7] To further illustrate this point, imagine the opposite case where the public expects total dollar spending to sharply fall in the future and cause a recession. This expectation would drive up the demand for money in the present and make the expected spending collapse a self-fulfilling event. Conversely, an expected boom where prices are expected to soar would cause the public to spend their money balances in the present creating another self-fulling outcome. A NGDP level target minimizes this swings by managing the publics expectations of the future path of total dollar spending

Fact 3: NGDPLT is a Velocity-Adjusted Money Supply Target

Total dollar spending, as noted earlier, is equal to the money supply times its use. Since NGDPLT stabilizes total dollar spending, it is therefore effectively stabilizing the interactions between the stock of money and its velocity. Some observers, consequently, call NGDPLT a velocity-adjusted money supply target.

This understanding can be better understood by noting that changes in the supply of money are automatically offset by changes in the demand for money under NGDPLT. For example, monetary conditions would automatically ease when people were more inclined to hold money balances—when, for example, they were afraid of economic trouble and wanted liquid assets—and monetary conditions would automatically tighten when people were rapidly spending money. The Fed, therefore, would be indirectly constraining money supply growth when money is circulating quickly and encouraging it when turnover is low.[8]

These offsetting actions do not require special effort by the Fed since they happen automatically when Fed stabilizes the growth path of total dollar spending. These naturally-occurring offsets that characterize NGDPLT can be viewed as a "monetary seesaw" as seen in Figure 3.

This monetary seesaw view of NGDPLT can be illustrated by comparing two periods in U.S. NGDP history. The first is the *Great Unanchoring* period of 1960-1979 when total dollar spending growth was not anchored and rapidly accelerated. The second period is the *Great Reanchoring* of roughly 1985-2007 when the Fed did effectively stabilize the growth of total spending (Hendrickson, 2012).

Figure 3: Monetary Seesaw View of

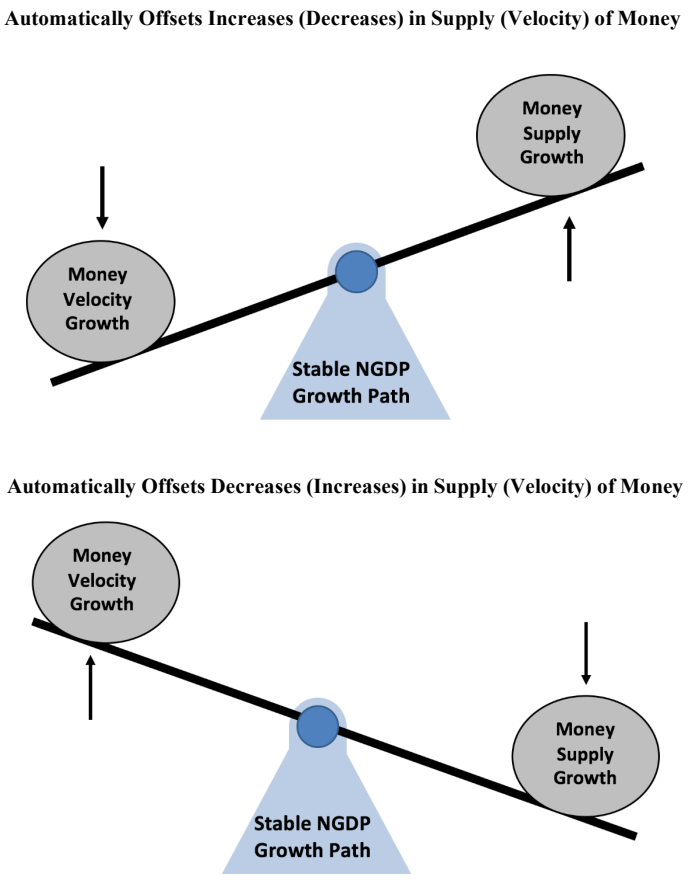
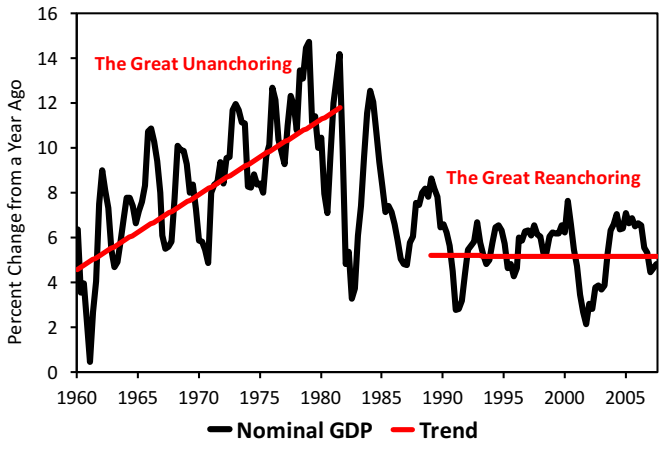
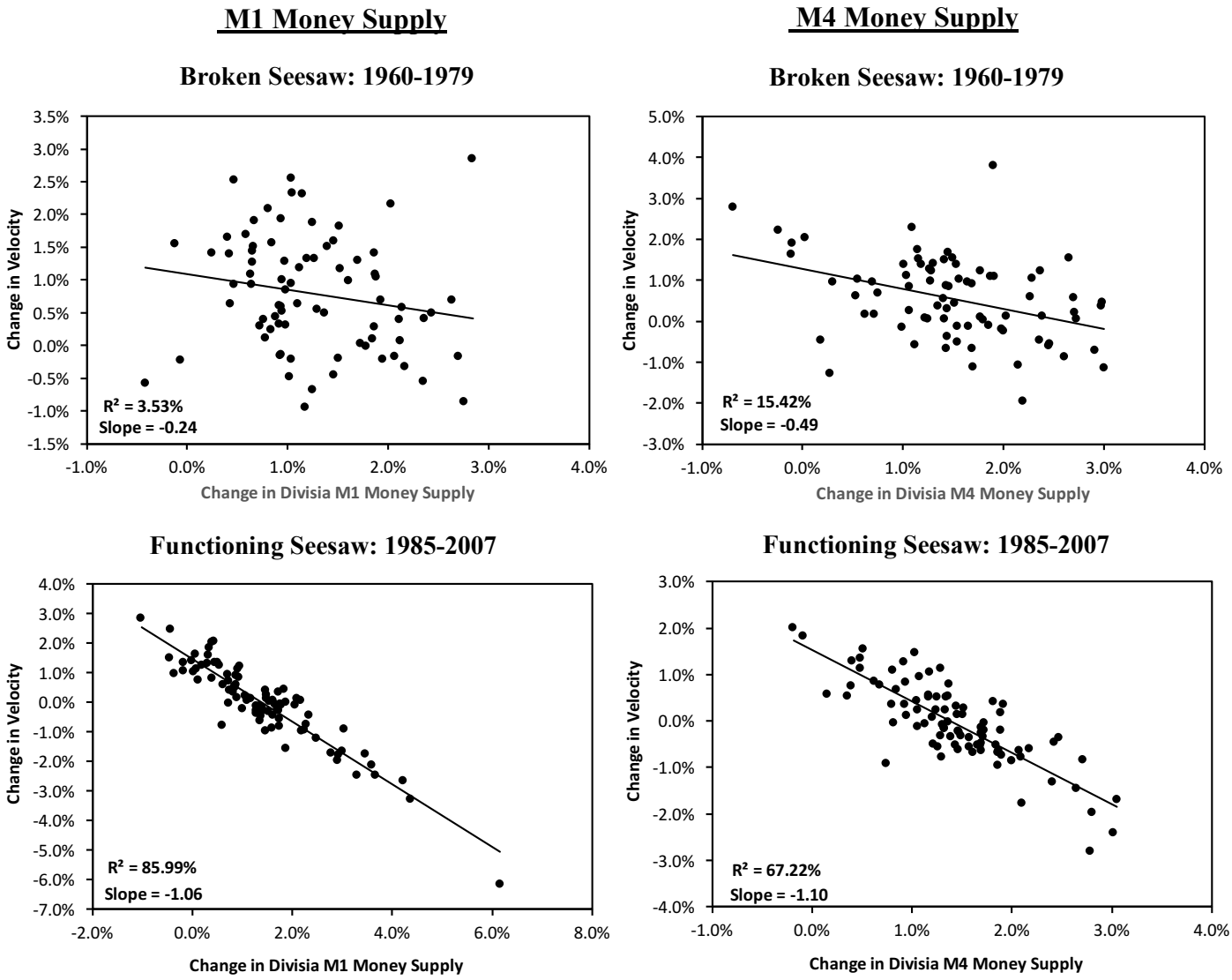


Figure 4: Two NGDP Periods



[8] To be clear, most money is created by banks and other financial firms when they make loans. So the Fed cannot directly adjust the money supply in response to changes in money demand. What it can do is adjust monetary policy to influence how much spending households and businesses will wish to make. This influence, in turn, will influence both the demand for money and how much money is created by banks.

Figure 5: A Tale of Two NGDP Seesaws



Note: changes are calculated as percent change from previous quarter.

These periods can be seen in Figure 4, which shows the year-on-year growth rate for NGDP and its trends.[9] The trend growth rate during the *Great Unanchoring* was increasing 0.33 percentage points a year while it flat during the *Great Reanchoring*.

The Seesaw view of NGDPLT implies that during periods of unstable NGDP growth, like the *Great Unanchoring*, changes in the money supply and velocity are not offsetting each other while during periods of stable NGDP growth, like the *Great Reanchoring*, they are offsetting each other. The scatterplots in Figure 5 show this to be case, using two measures of the money supply: Divisia

[9] These periods correspond to the *Great Inflation* and *Great Moderation* periods which are affiliated with different inflation regimes for the Fed.

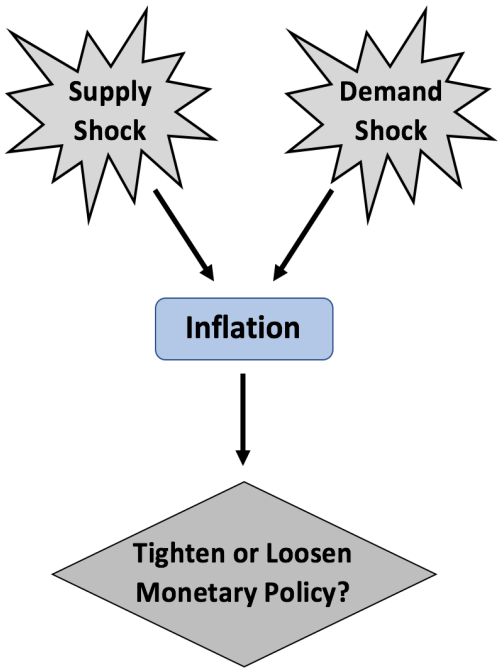
M1 and Divisia M4. The former is a narrow measure of retail money assets while the latter is broader and includes retail and institutional money assets.[10]

The scatterplots in the first row of Figure 5 reveals a very weak negative correlation between changes in the money supply and changes in velocity during the 1960-1979 period. The second row, however, shows a much stronger negative correlation with slopes that are close to -1. This means the Fed was proportionally offsetting swings in money supply and money demand such that there was a relatively stable growth path for total dollar spending during the 1985-2007 period. This is the velocity-adjusted money supply targeting view of NGDPLT.

Fact 4: NGDPLT is a Workaround to the Supply Shock Problem

One of the tougher challenges Fed officials face is how to deal with supply shocks. These are unexpected changes to the productive capacity of an economy that push economic activity and inflation in opposite directions. A sudden reduction in the labor force, oil supply, or technology, for example, would increase production costs and temporarily raise inflation. This development might tempt a central bank to tighten monetary policy. In this case, however, tightening would further choke an economy already weakened by the reduction in its productive capacity. When movements in the price level reflect changes to the productive capacity of the economy, it is best for the Fed is to ignore them.

Figure 6: Underlying Causes of Inflation



On the other hand, the Fed should tackle inflation arising from demand shocks. These shocks push economic activity and the price level in the same direction and are therefore easier to handle. The Fed's influence on the economy, moreover, comes from altering demand conditions that underlie such activity. For example, if there were an unsustainable surge in spending that raised inflation too high, the Fed's tightening of monetary policy would simultaneously fix inflation and rein in the excessive spending growth.

The problem is that Fed officials are unlikely to know in real time what kind of shock is causing inflation, as seen in Figure 6. Nonetheless, knowing the difference is crucial because responding to supply-shock-driven movements in inflation is generally destabilizing to the economy.

Recent examples include the 2002-2004 period, when a productivity boom (a positive supply shock) created a disinflationary environment. The declining inflation caused Fed officials to worry about deflation and keep interest rates low for an extended period, even though the credit boom was emerging. This response intensified the business cycle (Selgin et al. 2015). In 2008, Fed

[10] The data come from The Center for Financial Stability.

Table 2: Nominal GDP Targeting and Supply Shocks

NGDP Target	***Type of Shock***	$\%\Delta PY \approx \%\Delta P + \%\Delta Y$
4%	No Shock	$\%\Delta PY \approx 2\% + 2\%$
4%	Positive Supply Shock	$\%\Delta PY \approx 1\% + 3\%$
4%	Negative Supply Shock	$\%\Delta PY \approx 3\% + 1\%$

officials were concerned about rising inflation coming from surging commodity prices (a negative supply shock). As a result, the Fed decided against further easing between April and October of 2008 despite the economic slowdown. This too intensified the business cycle. Across the Atlantic, the European Central Bank (ECB) also misread supply-side caused inflation in 2008 and 2011 and, as a result, tightened monetary policy. These ECB actions helped create and deepen the Eurozone crisis (Beckworth, 2017a).[11]

NGDPLT provides a simple workaround to this supply-shock problem: focus directly on demand and ignore inflation in the short-run. NGDPLT automatically does this by stabilizing the growth path of total dollar spending.

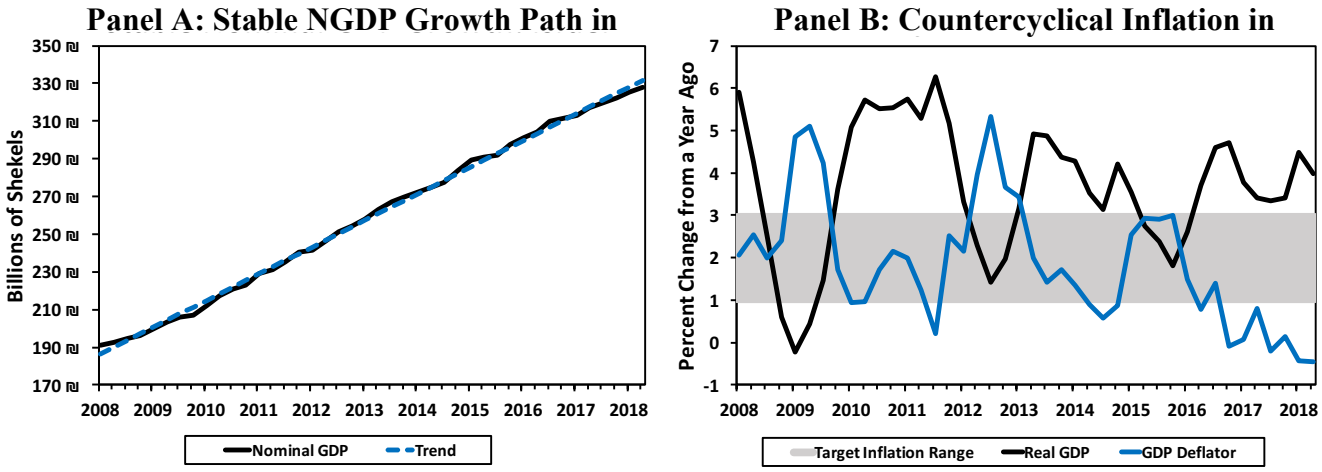
Table 2 illustrates this feature. It assumes a NGDP target of 4 percent, potential real GDP growth of 2 percent, and a resulting trend inflation rate of 2 percent. These values are depicted in the first row of the table. The second row assumes a positive supply shock that temporarily raises real GDP growth to 3 percent. Because NGDP is targeted 4 percent growth, inflation temporarily falls to 1 percent. The third row shows a negative supply shock that temporarily lowers real GDP growth to 1 percent. Now the 4 percent NGDP target temporarily raises inflation to 3 percent. Table 2, in short, shows how NGDPLT stabilizes total dollar spending growth while allowing its composition of inflation and real economic growth to temporarily vary.

One country that illustrates what this approach might look like in practice is Israel. Though officially targeting an inflation range of 1-3 percent, the Bank of Israel (BoI) has effectively stabilized the growth path of nominal GDP over the past decade. The BoI, therefore, has prevented demand shocks from destabilizing overall demand growth in Israel, as seen in Figure 7, Panel A.

The BoI has allowed, on the other hand, supply shocks to manifest themselves in countercyclical inflation. This can be seen in Panel B of Figure 7 where real GDP growth has been matched by almost mirror opposite movements in the GDP deflator growth rate. This inverse relationship is strong enough that the inflation rate has been allowed to temporarily move outside the inflation target range when there have been large supply shocks. For example, in 2009 during the global financial crisis the inflation rate just topped 5 percent. Despite this inflation flexibility, inflation over the entire period has averaged near the center of its targeted range at 1.9 percent.

[11] Orphanides (2000, 2002a, 2002b, 2004) shows how supply-side confusion contributed to the high inflation of the 1970s. Negative supply shocks lowered the productive capacity of the economy in the 1970s, but policymakers were slow to realize it. Consequently, they assumed there was more spare capacity in the economy than existed and ran the economy too hot. Beckworth and Hendrickson (2019) show how such output gap confusion continues to plague Fed policy and how a NGDPLT would solve this problem. Along these lines, Garin et al. (2016) show how a NGDP target tends to outperform an inflation target in the presence of supply shocks.

Figure 7: What NGDP Targeting Would Look Like in Practice



An explicit NGDP target for the Fed would similarly result in short-run inflation flexibility while anchoring long-run inflation. In such a framework, the Fed would cease worrying about the inflation rate in the short-run—while still anchoring it in the long-run—and therefore avoid making destabilizing mistakes like those in 2002-2004 and 2008 when it got confused by supply-side driven changes in inflation. This feature of NGDPLT is further illustrated in section two of the appendix using a Monetary Policy-Phillips Curve model.

Fact 5: NGDPLT is a Workaround to Incomplete Financial Markets

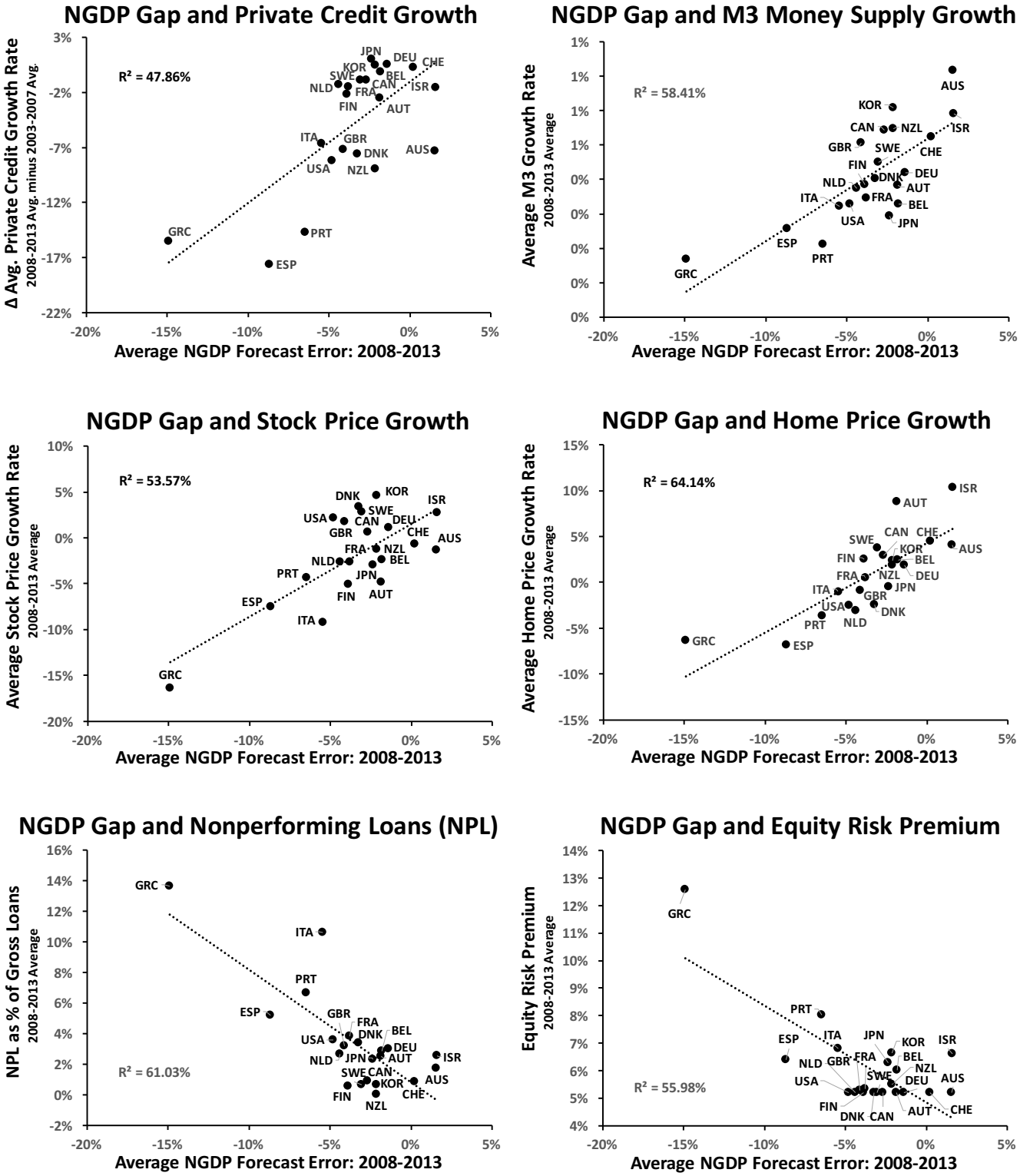
One implication of NGDPLT highlighted above is that it will tend to create countercyclical inflation. A spate of recent papers show that this feature of NGDPLT leads to better risk sharing between debtors and creditors (Koenig 2013; Sheedy 2014; Azariadis et al. 2016; Bullard and DiCecia 2018). The basic idea is that the countercyclical inflation will cause real debt burdens to change in a procyclical manner. As a result, debtors will benefit during recessions and creditors will benefit during booms. Fixed nominal-priced loans will act more like equity than debt and therefore promote financial stability.

Another way to view this feature is that in a world of incomplete financial markets where one cannot insure against all future risks, an NGDP level target provides a workaround solution to this market deficiency. NGDPLT effectively provides insurance against future risks that could affect debtors' ability to repay their debts and also provides insurance against potential returns creditors might miss out on because their funds are locked up in fixed-price dollar-denominated loans.

To see how, note first that the countercyclical tendency of inflation under NGDPLT means a sudden decline in real GDP will lead to an unexpectedly higher price level and, as a result, a lower real debt burden for the debtor. The creditor, consequently, receives a lower real debt payment than expected and shares in the loss. It is not all borne by the debtor. The risk of a real income loss is shared more evenly between the debtor and creditor under NGDPLT.

Now note that a sudden increase in real GDP will lead to an unexpectedly lower price level and an unanticipated higher real debt payment from the debtor to the creditor. This feature can be seen as

Figure 8: NGDP Gaps and Financial Stability



providing insurance to a creditor against having their funds locked up in a fixed-price dollar-denominated loan while real earnings in the rest of the economy rise. This way, the creditor gets to share in some of unexpected "windfall gains" in the economy.

NGDPLT should be, then, a financial stability-enhancing tool given the global growth of debt over the past few decades. Beckworth (2019a) tests this implication by noting those countries whose NGDP stayed closest to its expected precrisis growth path during the financial crisis should have experienced the least financial instability. He tests this implication for 21 advanced economies using a number of empirical tests and finds it is borne out.

Figure 8 provides a glimpse of this analysis. It plots the NGDP gap—the percent difference between where NGDP was expected to be and where it actually ended up—against a number of financial measures for the year 2008-2013. A negative NGDP gap means NGDP ended up being less than expected and vice versa. In general, the scatterplots indicate there is a systematic relationship between realizations of stable NGDP growth and financial stability.[12]

Beckworth (2019a) goes on to more carefully test these relationships and finds support for causality running from NGDP stability to financial stability. The evidence, then, also points to NGDPLT being a workaround to incomplete financial markets.

Fact 6: NGDPLT is an Anti-ZLB Tool

A big monetary policy concern is that the decline in the natural real interest rate over the past decade will push the Fed to the zero lower bound (ZLB) more regularly. A ZLB situation arises when a sharp negative aggregate demand shock contracts the economy and, as a result, lowers the short-term natural real interest rate below zero. These forces also pull down nominal short-term interest rates until they get stuck near zero percent. As a result, real short-term interest rates fail to reach their market-clearing levels and the recession is prolonged.[13] Kiley and Roberts (2017) estimate the U.S. economy will hit such ZLB traps 30 to 40 percent of the time going forward given the sustained fall in the natural real interest rate. This presents a serious problem for conventional monetary policy.

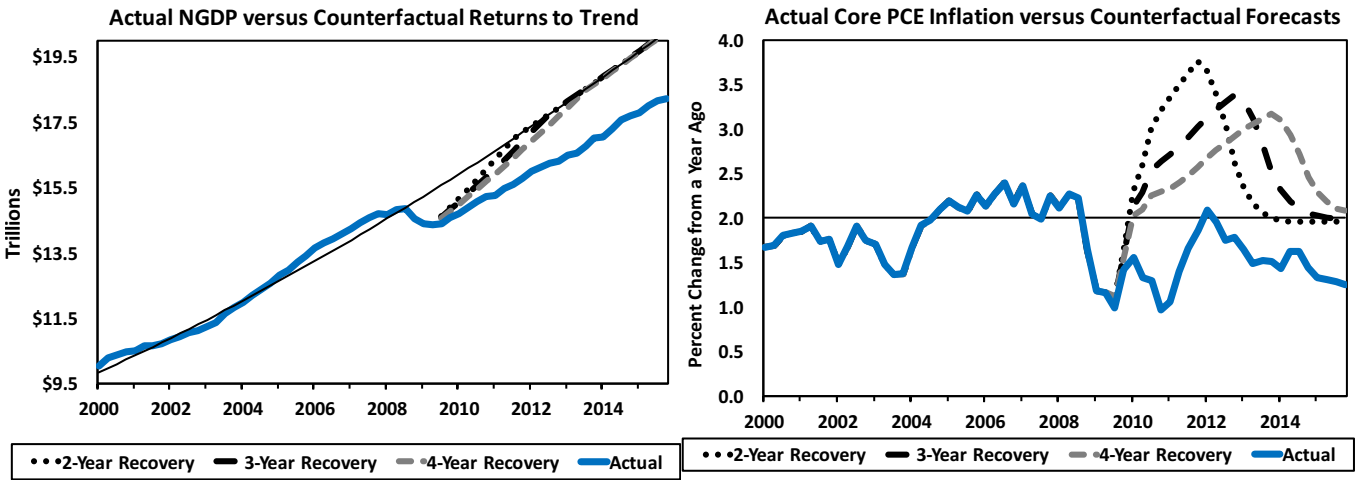
NGDPLT is an effective way to deal with such ZLB experiences for two reasons. First, as noted earlier, NGPLT makes up for past misses and allows for more inflation flexibility over the business cycle. Specifically, NGDPLT makes inflation countercyclical so that it would temporarily rise in a ZLB environment. This temporary surge in inflation serves to ease real debt burdens, as noted above, and to lower real interest rates to their market-clearing levels. A NGDPLT, in short, generates the temporary rise in inflation needed to escape a ZLB, something that is difficult to do with the Fed's current inflation target.

Figure 9 shows a counterfactual exercise from Beckworth (2017b) that demonstrates what a NGDPLT might have meant for inflation following the Great Recession. It shows, starting in mid-

[12] Beckworth (2019) also checks the strength of these relationship excluding Greece and finds that in all but the equity premium case the relationships remain statistically and economically significant.

[13] Per the Fisher equation, the real interest rate equals the nominal interest rate minus expected inflation. Consequently, if the nominal interest rate and inflation are both near zero, then the real interest rate cannot fall to the natural interest rate level and markets fail to clear.

Figure 9: Returning to Trend NGDP Growth Path



2009, a series of counterfactual inflation forecasts conditional on NGDP returning to its trend path. It is based on an estimated reduced-form VAR containing core PCE inflation, nominal GDP, and the output gap.[14]

The right panel of Figure 9 shows three different paths of nominal GDP returning to its pre-crisis trend: a two-year path, a three-year path, and a four-year path. These three different counterfactual paths for nominal GDP are plugged into the estimated VAR to create three different counterfactual forecasts for core PCE inflation.

The inflation forecasts are shown in the second panel of Figure 9. Although temporary, inflation is notably higher than both the actual inflation rate that occurred and the 2 percent target rate under each of the counterfactual nominal GDP return paths. The inflation rate would get as high as 3.8 percent for the two-year path and 3.2 percent for four-year path. Overall, counterfactual inflation paths would average about 2.5 percent during the catch-up periods. This compares to an actual average of 1.5 percent. Given the ZLB was bindng during this time, the short-term real interest rate would have fallen farther in these three scenarios than it actually did with the Fed's inflation target. The recovery would have been stronger.

The second reason a NGDPLT is an effective tool is that it creates expectations that should prevent the ZLB from arising at the outset. That is, if the public understands NGDPLT and finds it credible then people will have less incentive to cut back on spending in first place. Put differently, the public's expectation of stable total dollar spending growth will become self-fulfilling. This feature makes NGDPLT an "ounce of prevention is worth a pound of cure" solution for the ZLB.

[14] The only restriction imposed on this VAR is that core PCE inflation cannot influence nominal GDP or the output gap. All other interactions are allowed. This restriction is imposed for several reasons. First, the PCE deflator is already in Nominal GDP so this is one way to increase degrees of freedom. Second, the restriction means the output gap is being solely determined by nominal demand shocks and past lags of itself. Theses interactions are then allowed to feed into the inflation, creating a kind of reduced-form Philips curve.

Fact 7: NGDPLT is a Way to Do Rules-Based Monetary Policy

A widely-held view among monetary economists is that central bankers perform best when their behavior is constrained by monetary policy rules. As Taylor (1993) noted, "If there is anything about which modern macroeconomics is clear however—and on which there is substantial consensus—it is that policy rules have major advantages over discretion in improving economic performance" (p. 197). For many observers, then, decision making guided by monetary policy rules is a desired feature for central banking.

This understanding emerged over the past half-century and is based on several influential arguments. First, monetary authorities have a hard time committing to time-consistent behavior in the absence of rules. That is, with full discretion, it is easier for central bankers to make promises than to keep them as circumstances change (Kydland and Prescott, 1977; Barro and Gordon, 1983). Second, monetary authorities face 'long and variable' lags in the conduct of monetary policy and therefore can be inadvertently destabilizing if not constrained by simple rules (Friedman, 1968). Third, central bankers are subject to the same cognitive biases that afflict any human decision making process. Monetary policy rules, consequently, guard against such cognitive biases (Orphanides, 2015; Calabria, 2016). Finally, historical periods where the U.S. monetary policy acted in a non-rule like fashion also happened to be periods where there was less macroeconomic stability (Taylor, 1999; Nikolsko-Rzhevskyy, 2014).

Taylor (1993) showed how monetary policy rules that worked and were robust to different situations could be characterized by a simple reaction function. Specifically, monetary policy that systematically responded to deviations of inflation from target and deviations of real GDP from potential real GDP appeared to work well at stabilizing the economy. This feedback rule became prominently known as the Taylor Rule and most monetary policy rules today are some version of it.

A Taylor Rule, however, can be modified so that monetary policy responds to a NGDP target. This is demonstrated later in the paper and builds upon the work of McCallum (1987, 1988) who shows that NGDP targeting can provide a rules-based approach to monetary policy. A NGDP target, moreover, is arguably closer in spirit to Friedman's (1968) call for simple rules since it only responds to a single, nominal target. Recent work by Garin et al. (2016) and Beckworth and Hendrickson (2019) corroborate this by showing in a standard New Keynesian model how a simple monetary policy rule that targets NGDP often improves economic outcomes relative to other monetary policy rules.

Empirically, Hendrickson (2012) provides evidence that the *Great Reanchoring* of NGDP growth seen in Figure 4 was a consequence of the Fed's reaction function changing so that it began to systematically respond to changes in forecasted nominal income growth. His findings suggest that the Fed was doing a rules-based approach to monetary policy during this 1985-2007 period implicitly based on something like a NGDP level target.

Both theoretically and empirically, then, NGDPLT has been shown to provide a rule-like approach for the conduct of monetary policy.

III. Fears about Nominal GDP Level Targeting

Fear 1: Changes in Potential Real GDP Will Create Problems for NGDPLT

As noted above, one desirable feature of NGDPLT is that is allows more inflation flexibility over the shortrun. Over the medium-to-longer run, however, the trend inflation rate will be tied down to the difference between the targeted growth rate for NGDP and trend real GDP growth. In other words, since $\%\Delta PY \approx \%\Delta P + \%\Delta Y$, the trend inflation rate that emerges from a NGDPT target is as follows:

$$\%\Delta P^{Trend} \approx \%\Delta PY^{Target} - \%\Delta Y^{Trend}. \quad (4)$$

The trend real GDP growth rate, in turn, is determined by 'potential' real GDP growth, the fastest sustainable growth of real GDP given technology and resource constraints. Potential real GDP growth is therefore a big determinant of the trend inflation rate under NGDPLT.

One fear of NGDPLT is that once it is up and running, potential real GDP may change and cause the trend inflation rate to be different than what Fed officials expected it to be when they established the NGDP target.

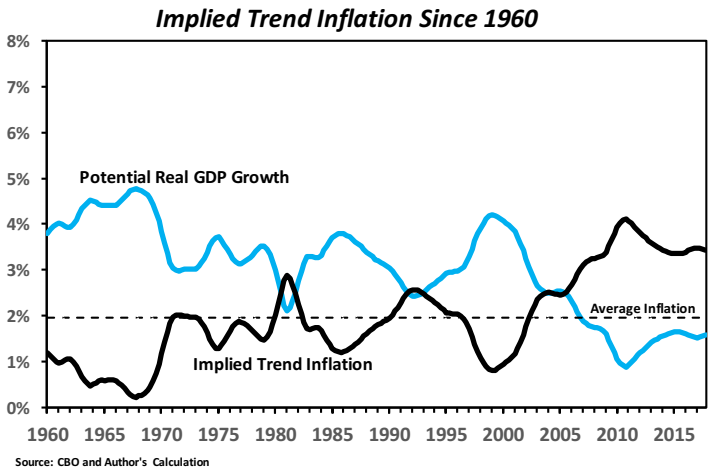
There are several ways to address this concern. Some observers, like Frankel (2019), would have the Fed recalibrate its NGDP target every 3 to 5 years to account for changes in potential real GDP. This would give the Fed enough time to be certain of trend changes and, as noted earlier, should not cause problems in the short-run because of the increased inflation flexibility.

A second approach, championed by Selgin (2018b), is to simply to allow changes in potential real GDP to translate into changes in the trend inflation rate. Doing so would still provide a nominal anchor since total dollar income growth is stabilized. More importantly, though, this approach avoids the potentially destabilizing effects on the economy that can arise if the Fed were to correct such changes in the trend inflation rate.

It is hard to know in real time if a supply shock is a temporary or permanent one since both kinds push, upon impact, inflation and output in the opposite direction. Only a permanent supply shock can change potential real GDP, but it can take several years to know the temporal status of a supply shock. The concern is that by the time the Fed figures out a supply shock is permanent, the change in the trend inflation rate it has created is likely to have changed the inflation expectations that are priced into wage, debt, and other financial contracts. If so, changing the trend inflation rate after the fact could exacerbate the business cycle because of sticky prices in these contracts. This idea is further illustrated in section three of the appendix using a Monetary Policy-Phillips Curve model.

Figure 10 provides an example of what this second approach might look like. It assumes a 5 percent NGDP target and subtracts from it the year-on-year growth rate of the Congressional Budget Office's (CBO) estimates of potential real GDP. The result is the black line and represents a counterfactul implied trend inflation rate that changes over time. This inflation series averages 1.96 percent over the full sample and gets as low as 0.25 percent in 1967 and as high as 4.00 percent in 2010. There is no runaway inflation or sharp deflation, but instead increased inflation flexibility that is anchored near 2 percent over the long run. To the extent the CBO's estimate of potential real GDP is not completely exogenous to the business cycle as some recent studies suggest, a credible NGDP target that stablized total dollar spending and lessened business cycles might actually lead to even less inflation volatility than depicted in Figure 10.[15]

Figure 10: Counterfactual 5% NGDP



Fear 2: Data Revisions Make NGDPLT an Impractical Framework

NGDP is a quarterly measure of nominal economic activity that is released by the Bureau of Economic Analysis (BEA) in three stages: the advance, preliminary, and final estimates. The estimates are sequentially released the three months after the quarter ends. Typically, each estimate is a revision of the previous one. The BEA further revises its estimate of NGDP in the years that follow.

These revisions cause some observers to question whether NGDPLT is a practical framework for monetary policy. They question how the Fed can guide monetary policy according to an indicator that is revised so often. Will not this uncertainty over NGDP create more macroeconomic instability?

This fear can be addressed in three ways. First, given the data revision problem, one can show that NGDPLT is actually easier to implement than the common approach of using a Taylor rule to guide monetary policy. The standard Taylor Rule takes the following form:

$$i_t = i_t^* + \phi_\pi \tilde{\pi}_t + \phi_y \tilde{y}_t, \qquad (5)$$

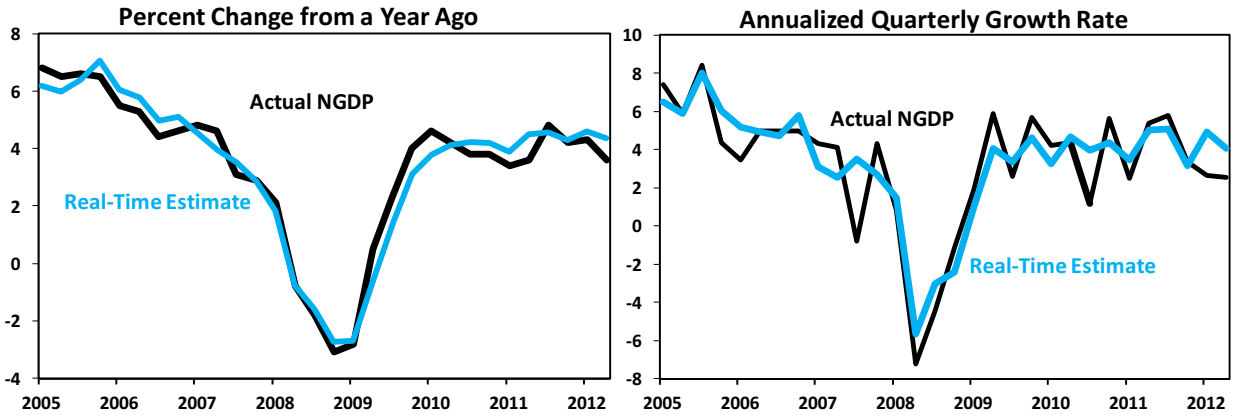
where the target policy interest rate, i_t, is set equal to a baseline neutral interest rate, i_t^*, and responds to deviations of inflation from its target, $\tilde{\pi}_t$, and the output gap, $\tilde{y}_t$. The output gap measures the amount of slack in the economy and is defined as the percent difference between actual real GDP and potential real GDP.

[15] Studies that show that at least some endogeneity of the potential real GDP to the business cycle, especially at the ZLB, include Reifschneider et al. (2015) and Mason (2017).

The Taylor Rule requires Fed officials to know *both* real GDP and potential real GDP in real time. A NGDP target requires Fed officials to only know NGDP in real time. The information requirements are therefore *greater* for the standard Taylor Rule than for a NGDP target. This is an important distinction. Orphanides (2000, 2002a, 2002b, 2004) shows how real time uncertainty over the output gap contributed to the high inflation of the 1970s. Beckworth and Hendrickson (2019) show output gap uncertainty continues to be a problem for Fed policy and that a NGDP target provides a work around solution to this knowledge problem.[16]

A second way to address this fear is to note that there are ways to get better real-time estimates of NGDP. Aruoba et al. (2013) show that GDI often is subject to less revision than GDP and use it to create a measure called *GDP-Plus*, a more reliable real-time estimate of GDP. Along the same lines, Figure 11 provides two real-time estimates of NGDP using real-time estimates of NGDI and another real-time proxy for the NGDP. This second measure is the summation of the growth rate of the Philadelphia Fed's coincident indicator for the U.S. economy and the expected 'breakeven'

Figure 11: Real-Time Estimates versus Actual



inflation rate implied from a 5-year inflation-indexed treasury bond, called hereafter the CI-BI. Figure 11 takes the average of the real-time estimates of NGDI and CI-BI to calculate both a year-on-year growth rate and an annualized quarter-on-quarter growth rate. These real-time estimates are fairly close to the actual, final growth rate of NGDP. For example, these real-time measures would have indicated in real time to the Federal Reserve in early-to-mid 2008 that total dollar spending growth decline was accelerating. A NGDPLT during that time could have used these metrics to better inform the stance of monetary policy during this time.

Another approach to real-time forecasts of NGDP is to use the higher-frequency 'nowcasting' techniques created by the Atlanta and New York Federal Reserve Banks. These measures provide multiple real-time updates of real GDP in the current quarter. The nowcasting models could be easily adjusted to also provide 'nowcasts' for NGDP in the current quarter to help guide a Fed that was had a NGDPLT.

[16] If a Taylor Rule uses the unemployment gap instead of the output gap, then information requirement is lessened since the unemployment rate is released on a monthly frequency. Still, even this approach requires an estimate of the natural rate of unemployment which has undergone significant revisions over the past decade (Ozimek and Ferlez, 2018).

Relatedly, there are various 'big data' endeavors to measure real-time transactions that could inform monthly estimates of NGDP. For example, the JPMorgan Chase Institute has a monthly aggregate measure of debit and credit card spending for over 64 million anonymized Chase customers across 14 metro areas. Researchers at the Fed have also began constructing their own measure of real-time transactions using similar payment methods. The Fed could use such data to get monthly estimates of NGDP (Aladangady et al., 2019).

A final way to address this fear about data revisions is to use NGDP forecasts. Fed officials could target the NGDP forecast as suggested by Sumner (1989, 2013). He suggests creating a NGDP futures market for the Fed to target, but there are other more modest forecasting approaches that could also be adopted. The Fed could use, at the monthly frequency, the year-ahead Blue Chip NGDP forecast or the year-ahead household nominal income forecast from the University of Michigan Consumer Sentiment survey. Alternatively, at the quarterly frequency, the Fed could use the year-ahead NGDP forecast from the Philadelphia Federal Reserve Bank's Survey of Professional Forecasters (SPF). The Fed could use anyone of these measures in a Taylor-like rule to help guide the setting of the Fed's target interest rate. The final section of the paper illustrates one such rule that uses the SPF NGDP forecast.

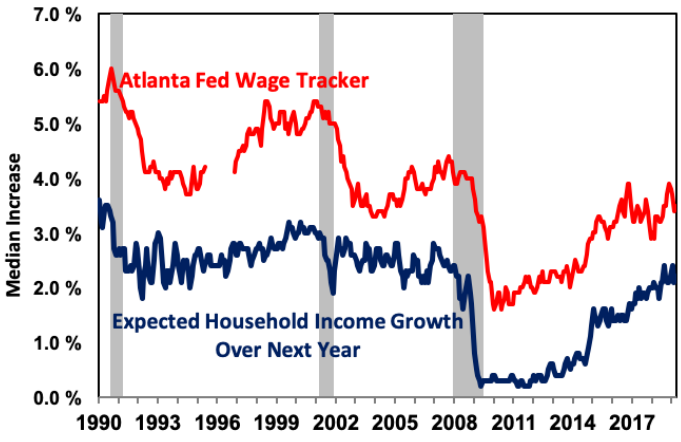
Fear 3: The Public Will Not Understand NGDP Targeting

Most people do not know what NGDP is, let alone a target based off of it. If the Fed announced NGDPLT as the new monetary policy framework, could it be effective given the public's unfamiliarity with it? Why abandon a framework the public does understand, inflation targeting, for one that is not understood?

This fear of NGDPLT can be addressed by recalling that NGDPLT stabilizes the growth path of total dollar income. That is, this target can be framed from a nominal income targeting perspective and be explained to the public as a policy that aims to stabilize their dollar income growth. This is something the public can understand and presumably appreciate.

Some narrower versions of a NGDP target, such as in Selgin (2018b), explicitly call for the Fed to stabilize labor income growth. In this case, the Fed could describe its framework as a policy that aims to stabilize wage and salary growth. In that vein, the Fed could point to charts like Figure 12 that shows the Atlanta Fed's nominal wage tracker and the year-ahead household nominal income forecast from the University of Michigan Consumer Sentiment survey as indicators of wage inflation that would guide monetary policy. Presumably, over time indicators like these would become as common to public discourse on monetary policy as is now the case with the CPI and PCE deflators. In general, the idea would be to shift the public's focus from changes in the cost of living to changes in dollar income growth.

Figure 12: Labor Income Growth Indicators



To be clear, this framing would not be without it challenges. Just as the public often confuses relative price changes for price level changes in their assessment of inflation under the current framework, it is likely similar confusion could arise between relative and aggregate income changes under a NGDPLT framework. This challenge, though, is common to any monetary policy framework and underscores the importance of good communication by the central bank.

One big advantage of NGDPLT is that it should be relatively easy to marshal support for it in a severe recession. This is not the case for a price stability target. Former Fed chair Ben Bernanke, for example, had a hard time explaining to Congress why the Fed was trying to generate additional inflation with its unconventional monetary policy programs. There are good reasons for some temporarily higher inflation during a severe downturn, including the explanations outlined above. But they are not intuitive and often seem unfair to a public already burdened with a contracting economy. Had Ben Bernanke instead pointed to charts like those in Figure 12 and advocated for temporarily faster growth in salaries and wages there probably would have been a warmer reception in Congress. Likewise, the broader public would also probably be fairly receptive to the idea of the Fed allowing temporarily faster income growth in order to hit a NGDP level target.

Fear 4: NGDPLT Doesn't Satisfy the 'Price Stability' Part of the Dual Mandate

Some observers worry that a NGDPLT fails to satisfy the price stability part of the Fed's dual mandate legislated by Congress. While there is increased inflation flexibility under a NGDPLT, one can still view this framework as satisfying the price stability mandate in two ways. First, a NGDP level target creates a nominal anchor that determines the dollar size of the economy, a feature consistent with the spirit of the price stability portion of the mandate. In particular, nominal income growth is stabilized so that wage and salary growth remain well anchored. Second, over longer periods, the trend inflation rate will also be anchored by the NGDP target. As seen in Figure 10, the average inflation rate over the 1960 to 2018 period in a counterfactual U.S. economy where there had been a 5 percent NGDP target would be close to 2 percent. There is not 'Great Inflation' of the 1970s in this counterfactual world. Trend inflation, in other words, is bound over the longrun while being more flexible over the shortrun. If adopted, a NGDP level target would therefore avoid any explosive inflationary or deflationary experiences.

It is worth recalling that there is often a tradeoff between price stability and full employment in the dual mandate. Supply shocks, in particular, create a challenge since they push output and inflation in opposite directions.[17] Negative oil shocks, for example, can temporarily raise the inflation rate while lowering economic activity. Should the Fed respond to the higher inflation by tightening, it would further weaken the economy. Bernanke et al. (1997) show that Fed has effectively done just that in its systematic response to oil shocks since the 1970s.[18] This has worsened the business cycle.

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[17] New Keynesian models (NKM) frame this discussion differently. They show that only in special cases does stabilizing inflation also stabilize output. Such 'divine coincidences' are rare and they do not depend on the absence of supply shocks in the NKM, but rather on the absence of real rigidities. Kim (2016) shows, however, this NKM result is not robust to different forms of the production function. Once this issue is fixed, NKM show that this inflation-output tradeoff can exist because of supply shocks alone.

[18] Ironically, the Bernanke Fed fell prey to this same tendency in 2008. Though there were many factors that caused the Great Recession, the Fed deciding not to ease between April and October 2008 because of inflationary pressures

Positive supply shocks create a similar dilemma for the Fed. They raise economic activity and temporarily lower inflation. If the Fed were to offset the lower inflation, it may turn a sustainable expansion based on the positive supply shock into an unstainable boom. Figure 13 illustrates this point by replicating an empirical exercise found in Selgin et al. (2015).

This figure shows, using an estimated vector autoregression, how the Fed systematically responded to total factor productivity (TFP) shocks between 1954 and 2008 and the effects this response had on the economy.[19] The figure does this by reporting impulse response functions (IRFs). The IRFs reveal how each economic variable responds over time to the typical TFP shock. The solid line is the point estimate while the dashed lines show confidence intervals.

The figure shows that positive TFP shocks typically created disinflationary pressures as seen in the first row. This is a clear example of a supply shock pushing real economic activity and inflation in oppositive directions.

The Fed's typical response to such positive TFP shocks and the disinflation they created was to lower the federal funds rate as seen in the second row of Figure 13. As Selgin et al. (2015) notes, however, the temporary acceleration of the TFP growth rate implied by the one-time increase in the TFP level should lead, all else equal, to a similar temporary rise in the neutral real federal funds rate. This is the level of the inflation-adjusted federal funds rate that does not cause tightening or loosening of monetary policy.

The second row reports the implied change in this neutral real federal rate given the positive TFP shock against the implied change in the actual real federal funds interest rate. The Fed's response to this supply shock pushes these two measures of interest rates in opposite direction. This easing of monetary policy gives rise to a boom-bust cycle in real economic activity as seen in the final row. That row reports a temporary decline in the unemployment rate and a temporary realization of a positive output gap.

In short, Figure 13 shows that the Fed's systematic attempts to offset inflation movements created by productivity shocks intensify the business cycle. This example demonstrate the tradeoffs the Fed faces in managing its dual mandate.

A key takeaway, then, is that the dual mandate actually *requires* inflation to fluctuate at times if it is to be implemented in a stabilizing manner. NGDPLT provides this inflation flexibility exactly when it is needed during the business cycle while still providing a secure nominal anchor over the medium-to-longrun.

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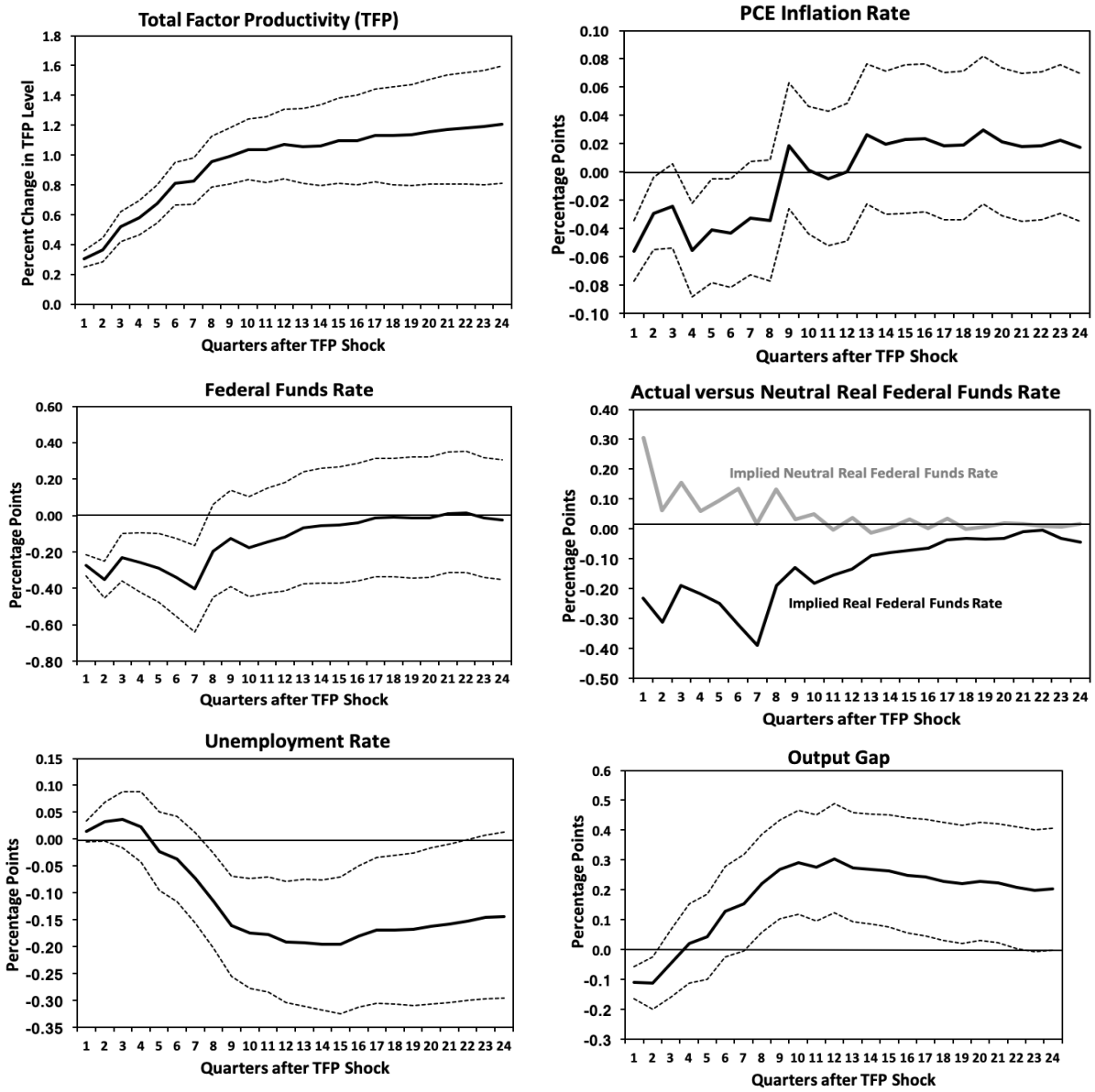
and the Fed signaling that it would actually tighten policy during this time was a contributing factor to the downturn. For more on this view see Hetzel (2009) and Beckworth and Ponnuru (2016).

[19] The impulse response functions come from an estimated vector autoregression where longrun restrictions are imposed such that only productivity shocks can permanently influence productivity in the longrun. This replication uses PCE inflation and the CBO's output gap. It closely follows Selgin et al. (2015). The sample only runs through 2008Q3 since after that time the zero lower bound becomes binding.

Figure 13: Fed Response to a Typical Productivity Shock
1954Q1-2008Q3



Fear 5: NGDPLT Doesn't Address Financial Stability Concerns

The Great Recession created a new appreciation for the role financial fragility plays in the business cycle. Some observers fear NGDPLT is just another way of doing monetary policy that fails to address these new financial stability concerns. This framework, however, actually has both preventative and curative features that better aligns monetary policy with financial stability.

The preventative features of NGDPLT begin with the observation that financial boom-bust cycles in advanced economies often begin with above-average economic growth and below-average inflation. That is, many financial cycles start with improved fundamentals, including improved

productivity growth, before turning into a boom period of unsustainable growth in asset prices and credit (Bordo and Wheelock 2004, 2007; White 2009; Christiano et al. 2010). One explanation for this pattern is that central banks respond to the low inflation in early stages of the financial boom-bust cycle by easing monetary policy. This easing helps turn a sustainable expansion into an unsustainable boom. Christiano et al. (2010) formally demonstrate this process while Selign et al. (2015) show that it helps explain the housing and credit boom of the early-to-mid 2000s.

A key part this financial boom-bust story is that low inflation caused by real economic gains, particularly productivity growth, is accommodated by the monetary policy. NGDPLT would avoid this temptation since it does not worry about inflation over the shortrun. It would allow a surge in current and expected productivity growth to be manifested in higher real growth and lower inflation. An inflation-targeting central bank, on the other hand, would lower interest rates just as the natural interest rate was rising.[20] NGDPLT, in short, would empower the Fed to keep its target interest rate closer to the natural interest rate and thereby better avoid the buildup of financial imbalances in the first place. This is NGDPLT's preventative feature.

Should a financial cycle emerge anyways, NGDPLT also has curative feature that minimizes financial distress. It is the improved risk sharing between creditor and debtor feature outlined in Fact 5 above. To recap that section, the idea is that the countercyclical inflation created by a NGDP level target will cause real debt burdens to change in a procyclical manner. As a result, debtors will benefit during recessions and creditors will benefit during booms. Fixed nominal-priced loans will consequently act more like equity than debt and this will promote financial stability.

In summary, NGDPLT provides both preventative and curative features currently not found in the Fed's inflation targeting framework that would cause monetary policy to operate in a manner that better supports financial stability

Fear 6: Overshoots of a NGDP Target Would be Politically Tough to Correct

Another fear some folks have with NGDPLT is that it will be politically tough to correct an overshoot of the target. That is, a level target requires a course correction back to the targeted growth path if NGDP rises above it. Can the Fed actually engineer a tightening without political blowback?

This concern is more academic than practical since the big challenge since the 1980s has usually been NGDP falling below its trend, not above it. Nonetheless, there are several ways to address this unease. First, as mentioned earlier, if the public understands NGDPLT and finds it credible then it will have less incentive to engage in excessive spending that pushes NGDP above target in the first place since the Fed will be expected to offset it. The public's expectation of stable total dollar spending growth, then, will become self-fulfilling. This lowers the likelihood of the Fed having to correct an overshoot of the target. Second, even if there were an overshoot, the Fed need not engineer an outright contraction of NGDP. As seen in Figure 2 Panel B, the Fed could simply slow down the rate of NGDP growth until its level returned to the targeted growth path. Finally, the existing monetary policy framework faces its own version of this fear. Yet, policymakers have found ways to tighten monetary policy when needed. It should be no different under a NGDPLT.

[20] All else equal, a rise current and expected productivity growth should raise the natural real rate of interest.

Fear 7: NGDPLT is too Radical. Why Not Settle for Price Level Targeting?
A final concern is that NGDPLT is too radical a change for the Fed. Why not settle on something more modest like price level targeting or average inflation targeting? While these frameworks would incorporate the makeup properties that are useful at the ZLB, they still suffer from all the challenges outlined above with price stability targets. Specifically, they would still be subject to the supply shock confusion problem and not consistently deliver the real-time countercyclical inflation of NGDPLT that causes it to enhance financial stability.

Imagine, for example, if the Fed had been following a price level target going into 2008. The surge in inflation that year probably would have caused the Fed to do several rate hikes, given the Fed's concerns about inflation at that time. A NGDPLT would have seen through the temporary spike in inflation and instead focused on total dollar spending.[21] Alternatively, imagine a future where current and expected productivity growth is rapidly accelerating and pushing down inflation. A price level target would force the Fed to ease even though the natural interest rate would be rising. It would be similar in spirit to the confusion the productivity boom of 2002-2004 created for the Fed during that period (Selgin et al. 2015). For these reasons, NGPLT is a more robust framework for the Fed.

IV. Functionality: How to Implement NGDPLT

So how would the Fed actually implement NGDPLT? Many of the studies that formally examine NGDP targeting do so using a modified Taylor rule that replaces the inflation gap and output gap terms with some measure of NGDP deviating from its targeted value. To calculate this NGDP gap one could use one of the real-time NGDP measures listed earlier—GDP Plus, nowcasting, big data, labor income—and subtract it from the target NGDP growth rate to calculate the NGDP gap measure. This would be a straightforward extension of the Taylor rule.

A slightly different tactic is implemented here. This paper follows the "targeting the forecast" approach of Svensson (1997, 2003) where the stance of monetary policy is adjusted so that the forecast of NGDP converges to its targeted value. This idea is not new and can be dated back to at least James Tobin (1980) who made the case for targeting the forecast of NGDP:

"I think it would be preferable for the Federal Reserve to announce target ranges for MV growth a year ahead, indeed several years ahead" (p.51).

Sumner (1989, 2013) more recently has promoted targeting the NGDP forecast using a NGDP futures market that the Fed would setup and run. A more modest forecasting approach is adopted here where existing NGDP forecasts are used in a modified Taylor rule. Specifically, this paper uses the year-ahead NGDP forecast from the Philadelphia Federal Reserve Bank's *Survey of Professional Forecasters* (SPF). The baseline monetary policy rule is as follows:

$$i_t = i_t^* + \lambda_1 NGDP_{t,t+h}^{Forecast\ Gap}, \tag{6}$$

[21] Along these lines, Fackler and McMillan (2019) show that a NGDPLT would have outperformed a price level target in terms of minimizing a loss function in the period leading up to the Great Recession.

where the target policy interest rate, i_t, is set equal to a baseline neutral rate, i_t^*, and responds to the NGDP forecast gap, the percent difference between the SPF NGDP forecast at horizon $t+h$ and its targeted value. Since the SPF is at a quarterly frequency, a year ahead forecast sets $h = 5$.

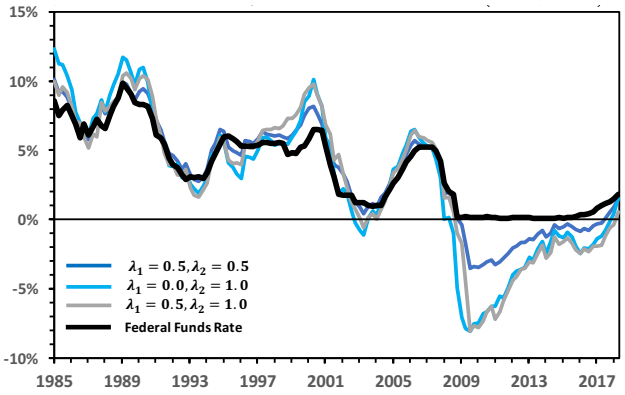
The framework being considered is a level target so the baseline rule also needs to account for past misses. Equation (6) is therefore amended so that it also has a makeup term:

$$i_t = i_t^* + \lambda_1 NGDP_{t,t+h}^{Forecast\ Gap} + \lambda_2 NGDP_t^{Level\ Gap}, \tag{7}$$

where $NGDP_t^{Level\ Gap}$ is the percent difference between the actual and targeted level value of NGDP at time t. This term, independent of the forecast gap, forces the stance of monetary policy to change if NGDP drifts off its targeted growth path.

Figure 14, Panel A illustrates what this rule might have implied for the Fed's target interest rate for the 1985-2018 period given several assumptions about monetary policy. First, the 2-year treasury yield is used for the baseline neutral rate. Second, the $\Delta\%NGDP^{Target}$ is set to 5.5 percent for 1985-2008 and 4 percent for 2009-2018 to reflect the actual trend NGDP growth rates allowed by the Fed during those periods. Third, the NGDP level gap is calculated as the difference between the actual and sticky forecast level measure of NGDP as constructed in Beckworth (2019b).

Figure 14: A Nominal GDP Level Target Rule

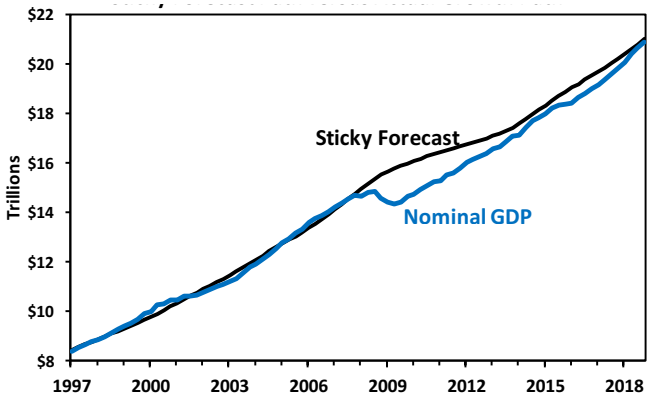


The sticky forecast measure is the average level of NGDP the public expected during the five years leading up to a certain point in time. It can be viewed as the expected NGDP level the Fed implicitly created through its monetary policy.[22] Figure 15 shows the sticky forecast series in level form and Figure 16 shows the percent difference between it and actual NGDP. The sticky forecast gap in Figure 16 is what enters the $NGDP_t^{Level\ Gap}$ term in (7). It is worth noting that this setup requires no knowledge of any natural rate variables. It only requires forecasts and the target growth rate of NGDP.

[22] Five years are chosen for the sticky forecast path for NGDP since it assumed that all constraints created by decisions based on the forecast can be fully unwound within five years. There are two motivations for this measure. First, the public makes many economic decisions based on a forecast of their nominal incomes. For example, households may take out a 30-year mortgage based on an implicit forecast of their nominal income over this horizon. The actual realization of nominal income may turn out to be very different than expected, but the households may not be able to quickly adjust their plans given sticky debt contracts and other commitments that constrain them. Therefore, the consequences of previous forecasts are often binding on them and slow to change even if their nominal income forecasts have been updated. Second, in addition to these old forecasts and decisions whose influence lingers, new forecasts and new decisions are being made each quarter for subsequent periods that will also have lingering effects. Together, this means future periods have many overlapping and different forecast applied to them that only gradually adjust. See Beckworth (2019b) for more details on how it is measured.

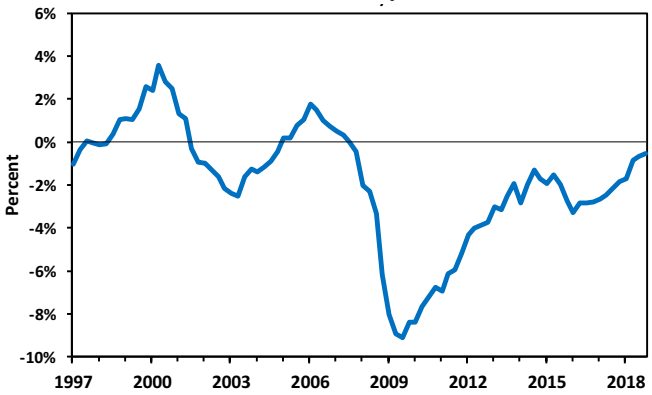
Figure 14 reveals this rule would have created a target interest rate path that fits the standard narrative of U.S. monetary policy. That is, the rule indicates fairly reasonable monetary policy during the Great Moderation period, but then effectively too tight monetary policy when the ZLB hit in late 2008. It also indicates that the Fed's tightening of policy that started in 2015 was a bit premature.

Figure 15: Sticky Forecast Level



The counterfactual interest rate path in Figure 14 takes the economy as given. It is likely, however, that had (7) been followed by the Fed the economy would have responded very differently since this rule is targeting the level of NGDP. As mentioned earlier, a credible NGDP level target is likely to prevent a ZLB experience from occurring in the first place.

Figure 16: Sticky Forecast Gap
NGDP Deviation from Sticky Forecast Path



Still, Figure 14 shows that a NGDP rule creates reasonable policy prescriptions given existing economic conditions. It implies that it should not be too hard for the Fed to transition to such a rule since it would not be too radically different.[23] Moreover, as Gagnon (2019) and Frankel (2019) note, not only could a NGDPLT could be incorporated fairly easily by the Fed, but it should also make the Fed's existing tools more effective. Implementing NGDPLT is a functionally feasible and desirable objective. [24]

V. Conclusion

This paper has addressed the basic facts and fears of NGDPLT. It has shown that this framework provides a firm nominal anchor, is a velocity-adjusted money supply target, is a workaround to the supply shock and incomplete financial market problems, is an anti-ZLB tool, and a rules-based approach to monetary policy. The paper has also shown that the standard concerns about NGDPLT, while understandable, have viable fixes.

The real challenge, then, is likely to be the transition to a NGDP level target not the framework

[23] Once can also target NGDP using a reaction function with the monetary base as the instrument, such as in the famous McCallum rule (1987). The Fed's paying of IOER complicates this approach, but Beckworth (2019b) shows how one can still implement a McCallum rule by looking at the non-excess reserve portion of the monetary base. Belongia and Ireland (2015) similarly show how to target NGDP using the monetary base and Divisia monetary aggregates.

[24] Michel (2019) notes it would also make life easier for the Fed since it would narrow the Fed's focus down to one objective. Congress would need to ratify a change to a single mandate approach like NGDPLT.

itself. While a thorough discussion of the transition process to NGDPLT is beyond the scope of this paper, some basic transition steps are as follows. First, as suggested by Frankel (2019), the FOMC's Summary of Economic Projections should have as its top line a NGDP forecast. The Board of Governors could also add an explicit NGDP rule to its website along with the existing benchmark monetary policy rules. FOMC officials could also start citing real-time indicators of NGDP in their speeches and interviews. These moves would introduce and condition the public to NGDP thinking and build up credibility for an eventual NGDP level target. After some time of following these and other similar conditioning steps, the Fed could then announce a transition to a NGDP level target.

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Appendix: Supply Shocks in a Monetary Policy-Phillips Curve Model

This appendix outlines a graphical model that illustrates how a NGDP target better handles temporary and permanent supply shocks than does an inflation or a price level target. The model is a version of the dynamic Aggregate Demand-Aggregate Supply (AD-AS) framework found in the Cowen-Tabarrok macroeconomic textbook modified to better reflect the goals of NGDP targeting and the thinking of modern central bankers. It does so by making two changes. First, there is a monetary policy (MP) curve rather than an AD curve and second, there is a Phillips Curve (PC) instead of a short-run aggregate supply curve. Consequently, this framework is called the MP-PC model. The details are sketched out below followed by the two applied scenarios of temporary supply shocks and permanent supply shocks in a graphical format.

I. The MP-PC Model

The MP-PC model is what Blanchard (2017) would call a toy model, but it illustrates clearly the supply shock challenges faced by central banks. This model also demonstrates nicely how NGDP targeting is a workaround to this problem. The model consists of a Phillips Curve (PC) equation, a monetary policy (MP) equation, and full-employment (FE) equation:

$$PC: \qquad \pi_t = E_t\pi_{t+1} + \phi\Delta\tilde{y}_t + e_t^{PC}$$

$$MP: \qquad \pi_t + \Delta y_t = NGDP^{Target}$$

$$FE: \qquad \Delta y_t^P = \Delta y_{t-1}^P + e_t^{FE}$$

In the PC equation, π_t is the current inflation rate, $E_t\pi_{t+1}$ is the expected inflation rate next period, $\Delta\tilde{y}_t$ is the change in the output gap, and the PC shock, e_t^{PC}, is an inverse temporary supply shock.[25,26] The shock is temporary since it does not carry over to the next period. The change in the output gap is defined as $\Delta\tilde{y}_t = \Delta y_t - \Delta y_t^P$, where Δy_t is the change in the log of real GDP and Δy_t^P is the change in the log of potential real GDP.

The MP equation assumes the NDGP target is credible and thus the monetary authority can easily adjust the NGDP growth rate—$\pi_t + \Delta y_t$—to its targeted value. The FE equation shows the growth of potential real GDP, Δy_t^P, is equal to last period's potential real GDP plus a permanent supply shock, e_t^{FE}. Given that monetary policy is credible, expected inflation becomes the difference between the targeted NGDP growth rate and the expected potential real GDP growth:

$$E_t\pi_{t+1} = NGDP^{Target} - E_t\Delta y_{t+1}^P. \qquad \text{(A1)}$$

Figure A1 illustrates this model in graphical form with the assumption that the current and expected future value of potential real GDP growth rate is 2 percent. The central bank is also assumed to be targeting NGDP at 4 percent. That results in a current and expected inflation rate of

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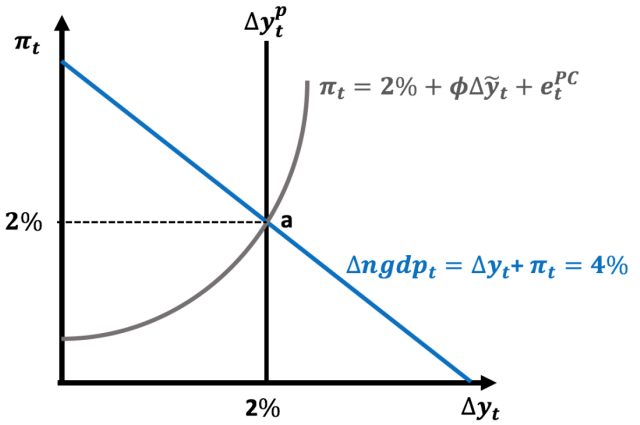
[25] To be consistent with the graphical representation of the Phillips Curve, the parameter ϕ assumed to be nonlinear: $\phi = \lambda^{\Delta\tilde{Y}^2}$, with $\lambda > 1$.

[26] The Phillips Curve can be derived from a Short-Run Aggregate Supply Curve and consequently, e_t^{PC}, can be viewed as an inverted supply shock.

2 percent. Shortrun and longrun equilibrium is at point a where the PC, MP, and FE curves all intersect each other. The central bank can shift the MP curve by changing the targeted NGDP growth rate. For a given NGDP target, any point on MP curve reflects a combination of $\pi_t + \Delta y_t$ that sums to the target NGDP growth rate. In the case of Figure A1, any combination sums to 4 percent.

Figure A1: Equilibrium in MP-PC Model



Shifts in the PC are caused by changes in either the expected inflation rate or a temporary supply shock. Shifts if the FE curve are created by permanent supply shocks. The two types of supply shocks and what they mean for NGDP targeting versus inflation targeting are considered next.

II. A Temporary Supply Shock

Figure A2 shows how a temporary supply shock will affect this economy. Starting in equilibrium, this supply shock shifts the PC but only temporarily since the shock, e_t^{PC}, does not carry over to the next period nor does it change the expected inflation rate. The left side of Figure A1 shows specifically what happens when there is a negative version of this shock. The PC shifts inward to point ***b***, temporarily raising inflation to 3 percent and temporarily lowering real GDP growth to 1 percent. The NGDP-targeting central bank allows this temporary change in the composition of the NGDP since the overall targeted growth rate of 4 percent is still maintained.

Now imagine the monetary authority had instead been targeting inflation at 2 percent. The initial equilibrium at point ***a*** would be fine, but not the new one at point ***b***. Here, inflation is above target. The inflation-targeting central bank would have to respond as seen in the bottom left panel of Figure A2. There, the central bank lowers NGDP growth—an inward shift of the MP curve—until the inflation target is reached at point ***c***. This response, however, further contracts an already weakened economy.

Conversely, consider a temporary supply shock that is positive. As seen on the right side of Figure A2, the PC curve shifts outward to point ***b***, temporarily lowering inflation to 1 percent and temporarily raising real GDP growth to 3 percent. Again, the NGDP-targeting central bank allows this temporary change in the composition of the NGDP since the overall targeted growth rate of 4 percent is still maintained.

An inflation-targeting central bank, on the other hand, would respond to the positive supply shock as seen in the bottom right panel of Figure A2. There, the central bank raises NGDP growth—an outward shift of the MP curve—until the inflation target is reached at point ***c***. This response, however, further stimulates an already strengthened economy.

This discussion highlights that inflation targeting, in general, leads to more volatility in real GDP in response to temporary supply shocks. It does so because it causes the central bank to worry

about all inflation movements, including ones caused by supply shocks. Ideally, monetary authorities would ignore changes in inflation caused by supply shocks and respond only to changes in inflation caused by demand shocks. This is hard to know in real time, as noted in the paper. Moreover, even if a central bank could divine the sources of inflation movements and respond only to demand shocks, this approach would amount to a NGDP target. So why not just do NGDP targeting?

III. A Permanent Supply Shock

Figure A3 considers the case of the permanent supply shock, e_t^{FE}. Starting in equilibrium, this shock shifts the FE curve as it changes the potential real GDP growth rate. The left side of Figure A3 shows a negative version of this shock. It shifts the FE curve inward to point ***b*** and lowers potential real GDP growth to 1 percent. The negative supply shock also shifts the PC inward since the shock causes the expected inflation rate to rise to 3 percent for the given NGDP target of 4 percent. That is, $E_t\pi_{t+1}$ rises as $E_t\Delta y_{t+1}^P$ declines via equation (A1).

This change in the expected inflation rate occurs immediately in the model since it is understood that the negative supply shock is permanent. In practice, the updating of inflation expectations may take a while since it is not clear in real time whether a supply shock in temporary or permanent. The PC shift inward eventually will occur, however, for a fixed NGDP target.

The question then becomes whether the central should adjust its NGDP target in response to a permanent supply shock in order to keep expected inflation constant. Doing so, however, is difficult to do in practice for three reasons. First, a NGDP-targeting central bank wants to ignore temporary supply shocks for the reasons laid out above. Second, it is impossible for a central bank to know whether a supply shock in temporary or permanent in real time. Consequently, if monetary authorities attempt to ignore temporary supply shocks they are likely to be ignoring permanent supply shocks as well. Third, by the time the central bank realizes they have been inadvertently ignoring a permanent supply it is likely inflation expectations will have already adjusted to the new level of potential real GDP growth. If so, the PC will have already shifted.

This is the story depicted as the top left panel of Figure A3. Both the FE curve and the PC have adjusted and the 4 percent NGDP target is left unchanged. As a result, trend inflation rate changes to 3 percent. The bottom left panel shows what happens if the central bank decides to adjust its NGDP target so that the trend inflation stays at the original 2 percent. This requires lowering the target NGDP growth rate—an inward shift of the MP curve—until the 2 percent inflation is hit. Given the new PC with 3 percent expected inflation, this lowering of NGDP growth leads to a further contraction of real GDP.

The right panels of Figure A3 tell a similar story for a positive permanent supply shock. It too assumes that by the time the central bank is certain the supply shock is permanent, inflation expectations and the PC have already adjusted. Changing the NGDP target growth rate at that point further stimulate an already strengthened economy.

In practice, then, the model suggests that to minimize real GDP volatility it is best to ignore both temporary and permanent supply shocks.

Figure A2: Temporary Supply Shocks: NGDPT Targeting versus Inflation Targeting

Economy in Equilibrium

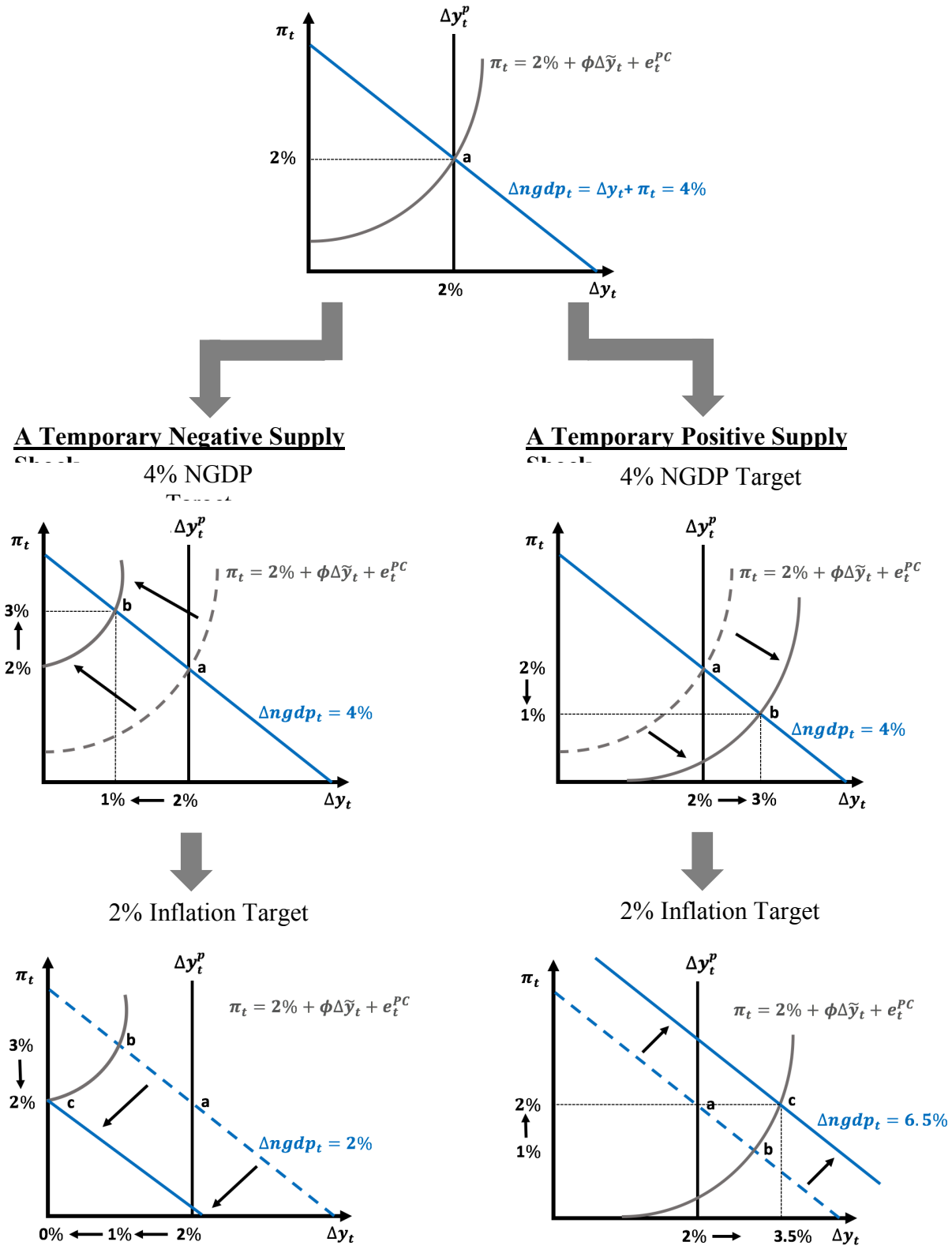


Figure A3: Permanent Supply Shocks: Fixed versus Varying NGDP Target