

Hayek's Rule, NGDP Targeting, and the Productivity Norm: Theory and Application

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Abstract

The 2008 crisis demonstrated that, absent inflationary pressures, significant economic stress can occur as a consequence of loose monetary policy. This scenario raises the question as to whether there is a better alternative to price stability as a guiding principle for monetary policy. In this paper, I explore the theoretical insights of the productivity norm, its superiority to price stability in the form of Hayek's Rule and market monetarism's NGDP Targeting as the focus of monetary policy, and the challenges of applying such principles by central banks.

Keywords: Inflationary pressures; Economic stress; Monetary policy; Productivity norm; Hayek Rule; NGDP targeting; Nominal income

Introduction

The 2008 crisis demonstrated that serious economic imbalances can take place even in the absence of inflationary problems. An important consensus regards monetary policy that kept interest rates *too low for too long* as a major driver of the financial crisis [1-11]. The absence of inflation introduces the question of whether price level stability is in fact a good guide to monetary policy. Borio and Lowe [12] and Cochran [13] point out to this problem.

Following what Selgin [14] calls the "productivity norm," alternative monetary policies focusing on nominal income rather than price level stability, such as NGDP (Nominal GDP) Targeting and Hayek's Rule, have been proposed as better options [15-26]¹. I explain the difference between a price level stability policy and the productivity norm as well as the challenges of a monetary policy rule inspired in the productivity norm. Murphy [27] offers a comparative institutional analysis between NGDP Targeting and free banking. In this study I will focus less on the institutional problems and compare Hayek's Rule and NGDP Targeting as well as the policy challenges of applying a productivity norm rule. To do this I combine the work of Selgin [14,28,29] with insights and research on the subject by Beckworth [20], Cachanosky [30], Christensen [25,26], McCallum [15], Evans and Thorpe [31], Gustavson [19], Murphy [27], Niskanen [23,24], Salter [32], Sumner [16,21,22], and White [18] in the context of the 2008 financial crisis.

Section 2 presents the productivity norm and its relation to monetary equilibrium. Section 3 discusses the challenges of applying a monetary policy inspired by the productivity norm. Section 4 concludes the study.

Monetary Equilibrium

The productivity norm

The term *productivity norm* is associated with the idea that the price level should be allowed to adjust inversely to changes in productivity. If total factor productivity increases, the price level (P) should be allowed to fall, and if total factor productivity falls, the price level should be allowed to increase. A general increase in productivity affecting the economy at large changes the relative supply of goods and services with respect to money supply. Therefore, the relative price of money ($1/P$) should be allowed to adjust accordingly. In other words, money

¹Much of the NGDP Targeting discussion, also associated with the term Market Monetarism, is channelled through blogs such as Scott Sumner's *The Money Illusion*, Lars Christensen's *The Market Monetarist*, David Gleaser's *Uneasy Money* and David Beckworth's *Macro and Other Market Musings*.

supply should react to changes in money demand, not to changes in production efficiency.

This relationship is usually shown with the aid of the quantity theory of money, where M is money supply, V is the inverse of money demand or velocity of circulation, P is the price level and y is real output. Monetary equilibrium occurs where quantity demanded and quantity supplied is equal. This means that, with equilibrium as the starting point, money supply should change when money demand changes. For instance, an increase in money demand producing a fall in V requires an increase in M to maintain equilibrium. Because a change in productivity is not in itself a sign of monetary disequilibrium, an increase in money supply to offset a fall in P moves the money market outside equilibrium and puts into motion an unnecessary and costly process of readjustment.

First, note that under particular conditions, the productivity norm is not a rule at odds with price stability (at zero or low inflation). What the productivity norm accomplishes is to separate monetary shocks from real shocks. Should there be no changes in productivity, price stability and the productivity norm yield the same behavior as a consequence of actions taken by the monetary authority. The productivity norm is superior to the price stability rule in the sense that it differentiates between "good (or secular) deflation" and "bad deflation." In the case of productivity gains, the economic profit that results from the increase in efficiency is passed on to consumers in the form of lower prices in a competitive marketplace.

Second, the price stability rule does away with inflation at the consumer level by shifting inflationary pressures to the prices of capital goods and factors of production, not by eliminating the problem of inflation. An increase in efficiency resembles the "good deflation" reflected as a positive shock to aggregate supply in the AD-AS model, in contrast to a negative monetary shock, which pushes for a reduction of prices in the presence of sticky wages (i.e., a negative shock to aggregate

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demand)². When, despite productivity gains, loose monetary policy prevents the price level of consumer goods and services from falling, the price of factors of production increases. Price level stability does not eliminate the problems associated with inflation in circumstances where there are productivity gains and the price level remains stable; instead, it moves the inflationary problems from final prices to intermediate prices.

As Selgin [29] points out, whether the price of final goods should fall or the price of factors of production should increase is a trivial question in a model with one factor of production. Either adjustment is as costly as the other. However, the adjustment process becomes an important issue of choice once a multiplicity of prices is recognized; a price level stability requires more price adjustments than the productivity norm when a productivity shock does not affect the whole economy evenly. Assume there are n final goods and f factors of production, where $f < n$. A productivity shock that affects the production of $m < n$ goods requires m prices to move under the productivity norm, but $n + f$ prices to move under price level stability. The price of the m goods affected by the productivity shock would still fall under a price level stability policy, but to a lesser extent than under the productivity norm. Only in the case where the productivity shock affects all goods to the same extent such that their relative prices remain the same and $f < n$ a price level stability requires less price movements than the productivity norm. In the former case only f prices will adjust upward, but in the latter case n prices need to adjust downward. The assumptions required for a price level stability norm to be less costly than the productivity norm, in terms of number of price movements, makes it an inferior guide next to the productivity norm³.

In theory, then, the productivity norm stabilizes the prices of factors of production (labor and capital). In practice, this principle is associated with stabilization of nominal income of factors of production. Therefore, monetary equilibrium requires that nominal income grows at the same rate as the supply of factors of production.

Even if the productivity norm differentiates between changes in productivity and money demand, these two factors are related to each other. As Selgin [33] notes, only under specific conditions does a change in productivity require no change in money supply to maintain monetary equilibrium. First, if the supply of factors of production is inelastic in the event of changes in productivity, there is no effect in the money market. However, if the supply of factors of production is elastic in the face of changes in productivity, an adjustment in the money supply will be necessary as well. If new factors of production enter the market as productivity increases, the demand for money will also increase, requiring an adjustment of M to offset the fall in V (increase in demand due to more factors of production in the market). For instance, an increase in labor population increases the total demand for money. The productivity shock and the increase in the supply of factors of production, both of which increase y , should be conceptually separated. P should fall only to the extent that y is affected by the increase in productivity, not by the change in the supply of factors of production. At a constant demand of money per factor of production,

²While recessions are associated with deflation, deflation should not be associated with a depression. It is possible to have a decreasing price level due to increases in productivity without a depression. Namely, to observe the behavior of price level is not safe guide to spot period with economic depression. See the discussion in Selgin [29, Ch IV].

³It should also be taken into account that a policy that aims to keep the price level stable in the presence of productivity gains can affect interest rates if the increase in money supply is channelled through the credit markets. This changes the relative price of time (interest rates) with respect to final and intermediate goods. The lower price of time can increase the average period of production and misallocate factors of production adding distortions to the economy [6, 34, 66-72].

an increase in the latter requires an increase in M to satisfy the increase in total money demand.

Second, it can also be the case that the elasticity of money demand to changes in monetary income is not unitary. If an increase in monetary income results in a more (less) than proportional increase in money demand, an increase (reduction) in money supply is needed to let the price level reflect only the increase in productivity; the isolated effect of change in money demand should result in an increase in money demand. In other words, a non-unitary elasticity of money demand to changes in nominal income has spill-over effects on V .

There are instances where the productivity norm illuminated economists that talked about monetary policy. Two important instances are Hayek during his debate with Keynes on the Great Depression and the market monetarists in the context of the Great Recession. Both, Hayek and market monetarism are concerned with a policy that would keep monetary equilibrium and therefore macroeconomic stability⁴. Hayek's Rule (as labeled by Gustavson [19]) and NGDP Targeting are the denominations that describe Hayek's and market monetarism position respectively⁵. Taking the presence of a central bank as a given, Hayek [34] argues that a neutral monetary policy is one that keeps constant nominal income (MV) stable. Sumner [16] argues instead that

"NGDP level targeting (along 5 percent trend growth rate) in the United States prior to 2008 would similarly have helped reduce the severity of the Great Recession."

Hayek's Rule of constant nominal income can be understood in total values or as per factor of production. In the former, Hayek's Rule is a notable case of the productivity norm in which the quantity of factors of production is assumed to be constant. In the latter case, Hayek's rule becomes the productivity norm. However, for NGDP Targeting to be interpreted as an application that does not deviate from the productivity norm, it should be understood as a target of total NGDP, with an assumption of a 5% increase in the factors of production. In terms of per factor of production, however, NGDP Targeting implies a deviation of 5% from equilibrium in the money market.

Challenges of a Productivity Norm Based Monetary Policy Rule

The transition of the productivity norm from theory to practice is not a small one. Despite the superiority of a productivity norm-inspired rule to a price level stability rule, the productivity norm nevertheless faces important challenges in the policymaking arena. Unless specified otherwise, from this point forward I will assume a constant supply of factors of production.

Emergent order versus designed outcome

One of the attractive features of productivity norm-inspired monetary policy rules is the tendency of the results to mimic the

⁴In fact, the productivity norm was a common stance between monetary economists before the Keynesian revolution. Selgin [14, Ch 7,8] recalls that Edgeworth, Giffen, Haberler, Hawtrey, Koopmans, Laughlin, Lindahl, Marshall, Mises, Myrdal, Newcome, Pierson, Pigou, Robertson, Tausig, Roepke and Wicksell are a few of the economists from different geographical locations and schools of thought who, at some point, viewed the productivity norm positively.

Selgin also points out to that the high inflation rates of the 1970s left out of consideration a rule allowing for secular deflation in the presence of productivity gains and that the new generation of economists became broadly unaware of the productivity norm as they were trained in Keynesian inspired models with little consideration for the history of economic thought in their curricula.

⁵Note that Hayek has later revised his position. See Hayek's Denationalisation of Money [77], and White's [78] discussion.

potential outcome of a free banking system, one defined as a market in money and banking with no central bank and no regulations. Among the conclusions of the free banking literature is that monetary equilibrium yields a stable nominal income [14,28,30,35-41].

It is important to distinguish between NGDP as an emergent order and NGDP as a designed outcome. Consider the emergent order first. Assume commodity money (i.e., gold) and a free banking market where banks issue their own banknotes convertible to gold. Assume, in addition, a developed free banking market, meaning gold is deposited into banks and that economic agents use banknotes rather than specie to perform exchanges. In the event of an increase in money demand (a decrease in V), reserves at the banks rise above the bank's desired level, signaling the need for banks to increase banknote supply (M). Conversely, a decrease in money demand (an increase in V) causes bank reserves to fall below the desired level, requiring a contraction of issued banknotes to maintain monetary equilibrium. The inverse movement between M and V keeps MV constant and therefore stabilizes NGDP which is the productivity norm. The theoretical convenience of stabilizing NGDP derives from this result. A stable NGDP is the result of a stable economy where monetary equilibrium is achieved through banks that maximize profits.

However, to have a stable nominal income as the result of a free banking system is not the same as a central bank aiming for an NGDP growth rate of 0% (Hayek's Rule) or 5% (NGDP Targeting). In the former, NGDP does not exist as an object of choice. Salter [32] addresses two problems where NGDP is treated as an object of choice instead of an emergent outcome of the market. First, the execution of the policy to target the appropriate level of NGDP can have an effect on the allocation of resources, depending on the injection points of money supply chosen by a central bank. The injection point is the first place where an increase in money supply lands in the market. A different starting point where the increase in money supply enters the market affects the path it will follow until it reaches the whole economy producing different effects on relative prices. Under free banking the injection points of changes in money supply consist of those specific banks where changes in reserves occur along with changes in money demand. In the case of a central bank, the injection point may differ, producing a different result than that of a free banking system. A

central bank has to define an injection point and a mechanism to inject money into the economy; it may decide, for instance, to perform an open market operation limited to banks of a certain size or to a certain type of financial institution⁶. In other words, for Salter, injection points are part of the emerging market order affected by the presence of a central bank. The injection point of an increase in money supply defines, at least in the short-run, the effect on relative prices and, as such, the inefficient reallocation of factors of production⁷.

Second, NGDP level matters, but its composition matters as well. Nominal income must be channeled to produce goods and services that consumers want, and they need to be produced with a sustainable technology of production. Salter's critique is that an NGDP Targeting rule may overlook this problem by focusing on nominal income as a target and not as an emergent outcome of the market. In other words, NGDP Targeting-type rules should not confuse cause with effect. That a sound and healthy economy yields a stable NGDP does not mean that to produce a stable NGDP necessary yields a sound and healthy economy.

This is not to say that NGDP Targeting is futile or senseless, but that it is wise to keep the causal relation clear. Take for example the fall of NGDP during the 2008 crisis. Some market monetarist economists support the idea of having NGDP return to its previous level as a measure to improve economic performance rather than disregarding past mistakes⁸. It may well be the case that the problem resides not so much in the level of NGDP as in the misallocation of resources across industries (Figure 1)⁹. To get out of a crisis it is necessary to correct resource misallocation and not just the level of NGDP. If resources continue to be misallocated the economy will be less efficient and

⁶Political pressure and lobbying should not be overlooked as influences of monetary policy.

⁷Whether the injection point defined by a central bank affects relative prices differently than the market depends on the financial market's mechanics and institutional regulations.

⁸Given the time that has passed since the crisis, some market monetarists are revising this position and have argued for an increase in the level of NGDP that may not necessarily return to the previous trend [75].

⁹Also, problems with measurement inaccuracies in economic indicators such as NGDP should not be overlooked [76]. See also de discussion by William R. White [72].

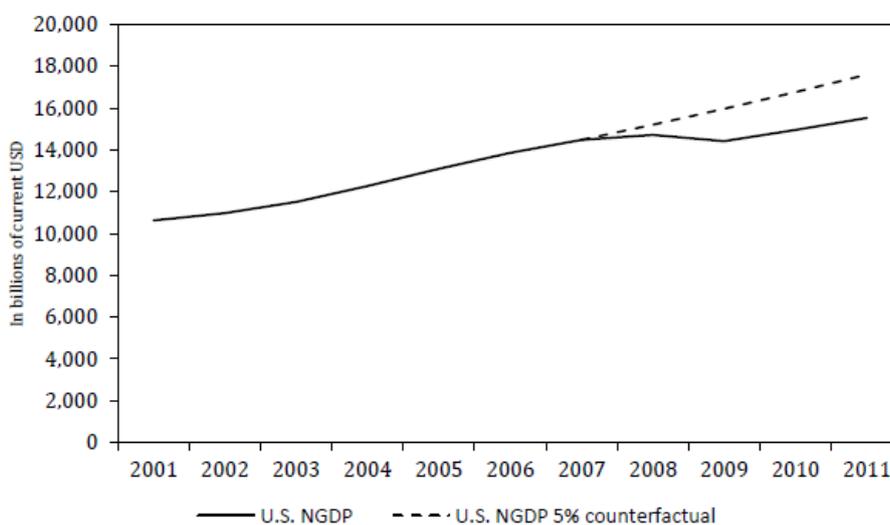


Figure 1: Level of NGDP.

some industries may be unsustainable. The housing bubble can be interpreted as misallocation of resources despite the fact that NGDP was at the desired growth level (5%) of the NGDP Targeting rule. To correct resources allocation in one sector of the economy is costly not only for sector directly involved, but also to other industries and as well as the banks closely associated to this sector.

Which nominal income?

Just as productivity norm-type rules must define the geographical limits of NGDP, usually a country; they must also define how nominal income is measured¹⁰. NGDP is one of several options, but even this choice is not without problems. There are two considerations worth mentioning: the effect of looking at output rather than total transactions in the quantity theory of money and the ratio of capital to labor.

Total output or total transactions?: Monetary equilibrium depends on the requirement of all transactions (T) and not only on the purchase of final goods and services. NGDP as a reliable proxy for monetary equilibrium rests on the assumption that the ratio of total transactions to output (T/y) is constant or at least does not change significantly. The quantity theory of money ($MV=Py$) is the merging of Fisher's equation of exchange ($MV=PT$) and the Cambridge version ($M=kPy$), where k is money demand, or the proportion of real income that economic agents wish to hold in the form of money¹¹. The quantity theory of money takes V from Fisher's equation and y from the Cambridge equation.

According to Evans and Thorpe [31], while it may be the case that in the long run T/y is stable, there is no reason to assume this ratio is constant in the short run, especially during a boom and bust. An investor that decreases his demand for money in order to make new investments affects y with a delay because the direct effect is on the

price of capital goods, not on output or on the price of final goods and services. In such a case, targeting NGDP can be off-mark from the goal of achieving monetary equilibrium. The meaning of V and P depends on whether the quantity theory of money uses y or T as a measure of economic activity.

It is possible, therefore, to have different behaviors for P and V depending on the measure of economic activity employed. For example, an increase in investment (financed with a decrease in the demand for money) increases the purchase and production of capital goods and will have no effect either on P or V in $MV=Py$, but it will have an effect on P and V in $MV=PT$. The decrease in the demand for money that is used to increase investment is not captured in the V associated to y , but it is captured in the V associated with T . It is expected that during a boom the increase in investment makes the ratio y/T decrease. During the bust, for the opposite reason the ration y/T increases. The fall in investment has a delayed effect on y .

A policy maker that looks at $MV=Py$ would not see signs of monetary disequilibrium until NGDP is affected, for instance, after misallocation of resources has taken place; but a policy maker that looks at $MV=PT$ will spot then earlier, for example, while the misallocation of resources is taking place. If monetary equilibrium depends on all transactions and not only on the purchase of final goods and services, then MV associated with PT should be held stable, not MV associated with Py . The housing bubble before the 2008 crisis is an exemplary symptom of this problem, where PT increases at a faster pace than Py .

Figure 2 shows the evolution of U.S. CPI, core-CPI, and PPI-IM [January 2002=100]¹². If there is a positive productivity shock and the monetary authority reacts by increasing money supply such that the price level remains stable the PPI-IM will be affected upwards. To keep the CPI from falling, the central bank needs to increase money supply through the financial markets. This produces a fall in interest rates and an increase in investment that pushes the price of intermediate goods upwards. But in the absence of the expansionary monetary policy the

¹⁰This problem relates to the problem of optimal currency areas. A productivity norm inspired monetary policy needs to consider what the optimal currency area of his policy is if it intends to maintain monetary equilibrium. Leith and Wren-Lewis [77], for instance, argue that Taylor Rule can be unstable or mis-specified in open economies. To the best of my knowledge Murphy [27] is the only work that touches on this subject. The problem of defining the optimal currency area can also be a serious challenge for NGDP Targeting and rules alike. On optimal currency areas see [78-80].

¹¹For a discussion see Evans and Thorpe [31].

¹²CPI is the Consumer Price Index. Core-CPI is the CPI without the price of commodities like food and energy that are more volatile and are defined in the international market and not just domestically. PPI-IM is the Producer Price Index for intermediate goods.

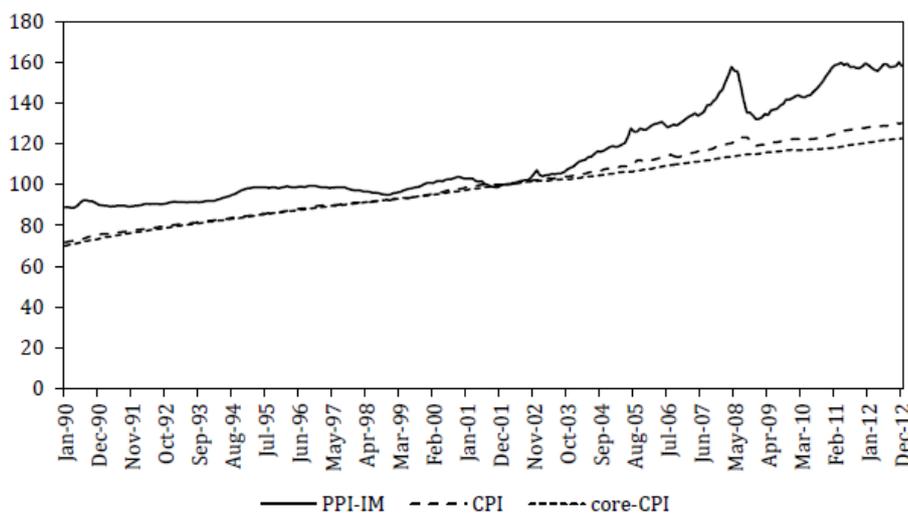


Figure 2: Evolution of U.S. CPI, core-CPI, and PPI-IM [January 2002=100].

price of final goods and services fall as producers compete with each other and economic profits vanish. The productivity shock results in a new ratio of the price of final goods to intermediate goods (CPI/PPI-IM). The new ratio is achieved either through a fall in the price of final goods or through a rise in the price of intermediate goods. The graph shows that PPI-IM grows at a higher pace between the dotcom and 2008 crises than CPI and core-CPI. Even if NGDP grew at a similar pace before and after the dotcom crisis, the increase in the growth rate of PPI-IM and stability of CPI suggest an excess of money supply. Between December 2001 and December 2007, CPI, core-CPI, and PPI-IM grew at a yearly average of 2.5%, 1.8%, and 4.9% respectively. PPI-IM grew at twice the speed of CPI and 2.7 times the speed of core-CPI. In addition, as McCallum [15] points out, a monthly indicator like PPI-IM offers a larger frequency of data than the quarterly NGDP¹³.

It is also possible that NGDP is not the best nominal income proxy with which to conduct monetary policy. Niskanen [24], for instance, argues that the U.S. "Final Sales To Domestic Purchases" (FSDP) (as defined by the Department of Commerce) is a better variable than NGDP because "the demand for money in the United States appears more closely related to total purchases by Americans than to the dollar level of total output by Americans"¹⁴.

Niskanen [23] points to an upward deviation in the trend of NFSDP prior to the dotcom crisis that is not observed in NGDP. Niskanen [23] illustrates the yearly growth rates for NGDP and nominal FSDP (NSFDP) for the U.S. between 1992 and 2001 (Figure 3). While NGDP exhibited stable growth rates in the 1990s, NFSDP exhibited increasing growth rates beginning in 1997 until the crisis in 2001. The NGDP growth rates are slightly above 5%, the desired level proposed by Sumner. The NGDP Targeting of 5% would have shown no signs of monetary disequilibrium, but the nominal FSDP tell a different story.

Factors of production: The productivity norm implies the stability of nominal income of factors of production under monetary equilibrium, but looking at the nominal income of factors of production is not free of challenges to the policy maker either. Just as total output

¹³Note also that PPI-IM grows faster than CPI and core-CPI after the 2008 crisis as well until 2011.

¹⁴Nominal FSDP equals NGDP minus net exports and minus change in business inventories.

may be used as a proxy for total transactions under certain conditions, labor nominal income may be used as a proxy for nominal income of all factors of production under certain conditions. Selgin [29] notes that for this to be the case, the ratio of capital to labor (K/L) must remain constant.

Labor productivity can be affected by new technology, a shock to Total Factor Productivity (TFP), or by an increase in K/L. A labor productivity norm requires an increasing money supply at the growth rate of quality labor. Namely, money supply should increase with an increase in labor supply adjusted by productivity. This rule indicates that in the case of an increase in K/L, nominal wages will remain constant and all price adjustments will fall on rent to capital.

A total factor productivity norm instead requires stabilizing the nominal income of an index of labor and capital weighted for its share of the cost of production. An increase in K/L will result in an upward adjustment of nominal wages and a fall in rent to capital rather than a fall in the cost of capital alone. Note that even if there is a change in K/L but not in productivity, the productivity norm is equal to a zero inflation rule.

If free-banking market equilibrium is the benchmark of monetary policy, the TFP rule is a more suitable guide to the objective than labor productivity. However, as long as the data on wages are more accurate and accessible than data on the cost of capital, a tradeoff exists between a relatively accurate labor productivity norm and an inaccurate TFP rule.

Commodity money versus fiat money

The extended equation of exchange as presented by Christensen, Beckworth, and Hendrickson [25,42,43] can be used to compare monetary institutional arrangements like central banking and free banking. By opening M , the quantity theory of money can be adapted to show gold (G) and the money multiplier (m) under free banking:

$$1) MV=GmV=Py$$

Note that money supply (M) has two components, G and m . Under free banking, both components are endogenous outcomes of the market process, which means that changes in money demand can be satisfied by either G or m . Bank money, in this representation captured in m , is

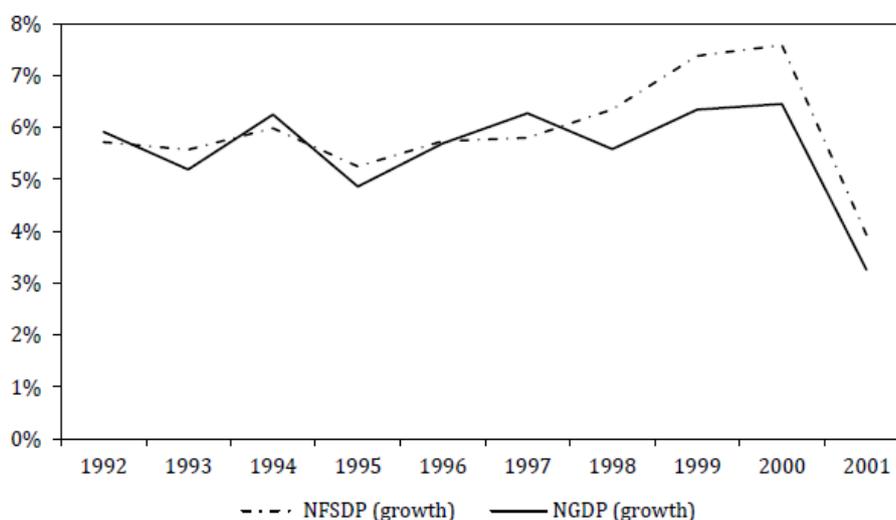


Figure 3: Yearly growth rates for NGDP and nominal FSDP (NSFDP) for the U.S. between 1992 and 2001.

endogenous to the financial markets. G is endogenous to the market as a whole even if it is exogenous to the financial system. This differs from the case of fiat currency (F) where base money is exogenous to the market as a whole as well. An increase in money demand can be satisfied with an increase in circulation of convertible banknotes without the need for new gold resources. Seasonal changes in the demand for money do not necessitate seasonal movements in the supply of commodity money because commercial banks provide the required elasticity for money supply by issuing banknotes. It is important to note that what a bank issues under this regime is money in the form of credit (i.e. a convertible banknotes) and not high power money.

Some scholars argue that fractional reserve banking is problematic and that the financial market should operate with a 100-percent reserve requirement. This position is built on two arguments. On one side proponents of the 100-percent reserve requirement argue that fractional reserve banking is unstable and produces business cycles due to an increase in credit. On the other side the argument is that fractional reserve banking is a fraudulent activity and that it should be prohibited. A long debate on this topic has taken place [36,44-62]. There is, however, one issue that deserves to be addressed in this paper. Under a 100-percent reserve requirement the money multiplier becomes 1; then the extended equation of exchange becomes:

$$2) MV=GV=Py$$

This poses a problem for monetary equilibrium. There is no reason why G can adjust better to changes in the demand for money ($1/V$) than Gm . In addition, to the extent that under a 100-percent reserve requirement can manage to efficiently adjust money supply to money demand this will occur at a larger cost than the one when fractional reserve banking is allowed. Since all change in V has to be offset by a change in G , the cost of digging and processing gold exceeds the cost of issuing convertible banknotes. Oddly enough for defenders of the 100-percent reserve requirement, this difficulty to achieve monetary equilibrium only through changes in the supply of gold could be used as an argument in favor of a central bank that issues fiat money rather than a monetary system based in a commodity. To issue fiat paper is cheaper than to dig and process a commodity like gold. But the 100-percent argument sustains that in the case of an increase in demand of money depreciation should be allowed to take place. The shortage of money

supply, however, puts into motion the same distortion in relative prices than an excess of money supply does with the caveat that the price level is moving downward rather than upwards. In other words, a legal 100-percent reserve requirement yields an inelastic supply of money that can result in financial stress.¹⁵ In the case of a central bank that issues fiat currency, the quantity theory of money becomes:

$$3) MV=FmV=Py$$

There are two differences with respect to the free banking case. First, base money is not endogenous to the market process, but exogenously administered by a central bank monopoly. Second, commercial banks do not issue banknotes convertible to base money¹⁶. These differences provide two important challenges for monetary policy to emulate the free banking outcome.

First, the central bank's supply of base money (F) should be at least as efficient as the supply of base money under free banking (G). While it is conceivable to imagine a perfect central bank that commits no mistakes, a realistic comparison in monetary policy is between the behavior of a real central bank and a real free banking system. To compare the real and imperfect case of free banking to an imaginary and perfect central bank is to fall for the Nirvana fallacy. Selgin et al. [63] present evidence casting doubt on the Federal Reserve's ability to outperform the monetary institutions it replaced (which were far from being an example of free banking).

In addition, the concern that a monetary arrangement built on commodity money such as gold would be vulnerable to inflationary shocks is not reflected in the empirical evidence [64]. As pointed out by Hogan [65], the inflation peaks in the U.S. during the gold standard era were caused not by a gold rush but by armed conflicts and the issuance of means of payment such as the Greenback. Figures 4 and 5 show the CPI for the period 1775-1912 and 1775-2012 respectively. The first plot indicates, as Hogan sustains, that the pikes in the level of prices correspond to the War of 1812 and the Civil War, not to the California

¹⁵For a comparison on money supply elasticity to changes in money demand between the United States and Canada under different institutional frameworks prior to the foundation of the Federal Reserve see Selgin [81].

¹⁶For a few cases, such as Hong Kong, Scotland and Northern Ireland, where commercial banks still issue their own notes see Hogan [82].

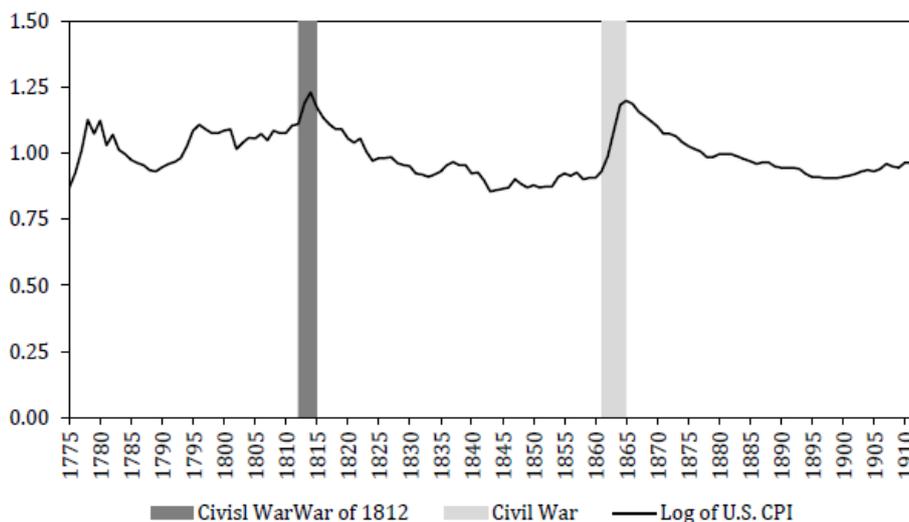


Figure 4: CPI for the period 1775-1912.

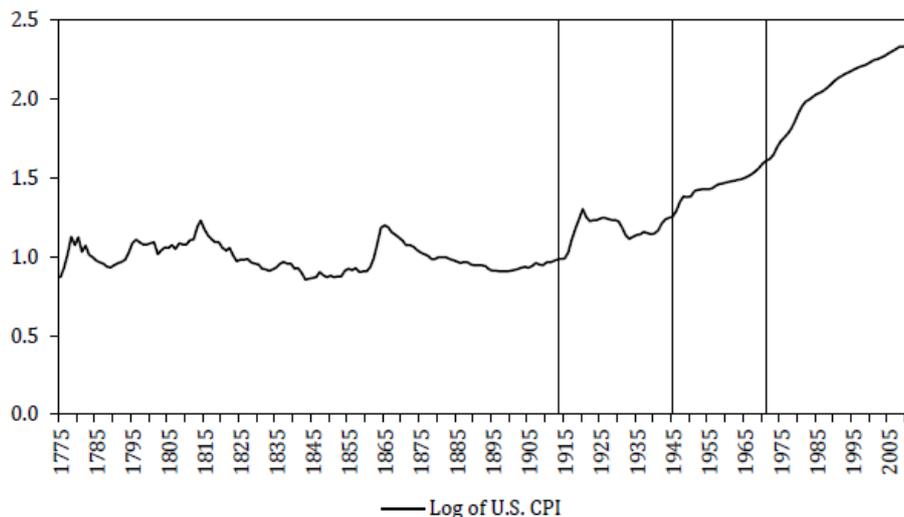


Figure 5: CPI for the period 1775-2012.

and Colorado gold rushes of the 1840s and 1850s. The second plot shows that the CPI growth markedly increases after the foundation of the Federal Reserve System in 1913 (shown with a black line.) The two other lines show the start and end of the Bretton Woods monetary arrangement¹⁷.

Another example of the potential weakness of a commodity standard is the price revolution in the 16th century. The six-fold increase in the price level occurred over a period of 150 years, a yearly inflation rate of 1.1%. In this case the commodity involved was silver, not gold, but this case still reflects a potential problem with commodity standards in general. While it is theoretically possible to have a large shock in the supply of commodity money under commodity standard monetary system, in reality, inflation produced by central banks has been worse than the real shocks that occurred without a central bank.

The absence of convertible banknotes is the source of the second challenge. If an issuer bank over-expands its banknotes, the loss of reserves through adverse clearing signals to the bank to reduce the circulation of banknotes. Conversely, an accumulation of reserves signals to the issuer bank to increase the circulation of banknotes. A central bank that issues base money in the form of fiat currency and commercial banks that do not issue convertible notes lack this market signal. In addition, because fiat money has no use other than for exchanges, its excess cannot be consumed or assigned to industrial uses such as gold.

Finally, because under central banking paper currency is not convertible, commercial banks treat paper money as good as gold reserves under gold standard. Namely, when a commercial bank receives a fiat paper, the bank does not send it back to the issuer for redemption of gold, it treats it as if it were gold in a commodity standard. This means that for the central bank the signs of excess or shortage of money supply behave erratically with respect to free banking or even to a gold standard with central banks. This is why monetary policy needs to look at a substitute of monetary equilibrium like the price level; this article argues that nominal income measure like NGDP would be a better choice. If under a 100-percent requirement the supply of money

becomes too inelastic, under central banking it can become too elastic. Because commercial banks do not issue convertible banknotes, the central bank does not receive information through adverse clearing, and there is no fail-safe proxy of nominal income, the central bank is likely to misperceive the conditions of monetary equilibrium.

Conclusions

The productivity norm offers superior guidance for monetary policy compared to the principle of price stability because it does not confuse a fall in the price level due to negative shock to aggregate demand to a fall in prices due to a positive shock to aggregate supply. Still, the application of a rule informed by the insights of the productivity norm is not an easy matter. Targeting NGDP does not only pose the challenge of choosing the right target, it may be a measure that overlooks monetary imbalances captured in other indicators like nominal final sales to domestic purchasers or a price index of factors of production.

Notwithstanding the important challenges, the potential shortcomings of an application of the productivity norm are present in other rules as well, such as price stability. Still, by acknowledging that changes in the price level due to productivity improvement is not a sign of a monetary disequilibrium it offers a superior guidance to price level stability rules. Although the productivity norm is not part of the core of monetary policy today, there was a time when its consideration was important.

Market monetarists use the productivity norm to assess macroeconomic performance and explain the financial crisis of 2008. But the 2008 crisis can also be interpreted as a challenge to the 5% NGDP growth rule. Is the crisis the result of a fall in NGDP or is the fall in NGDP the result of the crisis? Does the economy show resistance to recover because NGDP does not go back to trend after 2008 or because of the economic distortions that took place in the years prior to 2008 that remain concealed in the aggregate economic variables? An NGDP Target that is too expansionary with respect to what the productivity norm indicates can produce the problem it tries to avoid in the first place.

The revision of macroeconomic business cycle models and

¹⁷I thank Thomas Hogan for sharing the data source: Lawrence H. Officer and Samuel H. Williamson, 'The Annual Consumer Price Index for the United States, 1774-2011,' *Measuring Worth*, 2012.

monetary policy in light of the 2008 crisis offers a convenient opportunity to revisit the insights of the productivity norm.

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