A.A. 2013 – 2014
Paper di Storia dell'analisi economica

Expansionary Monetary Policy: a brief analysis

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Introduction

In the begining economic theory considered money just a veil. But the wave of economic theories during keyneisian's time changed that veil into something more powerful, meaningful and most of all useful: the basics of the modern monetary policy. It seemed like the time of viewing economy as an uncontrollable, untouchable mother nature were over. It seemed like we could actually use scientifically conceived theories to define and shape our economic future just by controlling that famous veil. But if the first great crisis, which shocked governaments and economist into action in 1929, ushering the era of keynesian monetary policy and thus defining their success, the last great crisis, almost a century later, it is showing those theories limit, our hopes to control, to define, to shape economy are shattered again. Was it too bold to think that "the veil" could be the powerful leash to control the complex and vast economic world? Or has that world changed breaking the tool that was once taming it?

For fifty yeas until now many prominent economists theorized and annunced the fate of the once powerful tool. And time seems to be proving them right. Is it the time of the lassez-faire again? Or is it a limit in our ability to shape our economy smoothly?

(Without pretending to answer to those questions yet and without taking sides for the sake of belonging to one faction or another, we understand that)

The nature of economic problems and their solutions changes: with times, regions, laws and societies, making it impossible for a single theory to always be the best choice, thus the hystory of economical analysis and the key factors and relations undelined by them is a crucial factor in understanding the range of possibilities that can emerge in the future.

As time passes we can rely on more and more powerful instruments to a point where the future's brightests thinkers might not even be organic.

So if chaos and uncertainty are just concepts to mark the boundaries of our knowledge, as scientists, as economists what we aim at is to push that boundary forward until the theories, the tools, the "veils" that we create and study will be solely limited by their potential and proved by being in the long run undoubtely helpful in building a prosper, fairer and richer society.

1. Logic and assumptions behind the theories.

We can safely assume that modern monetary policies stragies around the world nowday are a mixup resulting from the influences of the two preminent theories of the last century: keynesianism and monetarism.

In this paper we will try to analyze and debate the effects of a monetary expansion, in particular when it is used to counter crisis and depression on economies. We will rielaborate and expand the shady aspects of those theories while adding some new thoughts and investigating further. In doing so we will try when possible to pair our elaborations with empirical data and hystorical facts.

The main use of monetary expansion has been in the last years that of "inflation targeting" and monetary expansion to boost GDP growth. Sadly the latter hasn't been as succesful as the first. We've been trying to understand why and how by analizing one of the many reason that might have halted its effectivness while applied to real economy which is one of the main theories' assumptions: the aggregation that takes places while moving from micro model to macro ones.

Aggregation is usually the sum of individual curves so that the outcome of an aggregate n-lenght sample would be the average of its defining features, such as an average slope and an average intecept in case of linear models. Also the individual elasticities will be summarized in the average one of the macro version.

The logic problem lies in the fact that micro assumptions are not true in macro environments. In these ones assumptions such as rational behaviour and perfect knolwdge become invalid after our sample becomes slightly bigger: it would be much more accurate to suppose that herd behaviours and limited knowledge are at work in these environments. With this reasoning it is much more easier for a CB to commit an error in estimating monetary demand while attempting to boost GDP growth by monetary expansion, rather than making mistakes in "inflation targeting".

Inflation's variable is just price indexes, while monetary demand it's much more complex to define and estimate. Thus it's harder to gauge effectively the shape and position of an LM or AA curve.

In short: inflation targeting is easier to perform also because the "aggregation bias" does not affect it direclty, inflation estimates are more accurate than aggregate monetary demand estimation.

In the case of FED's monetary expansion to counter the financial crisis the results have been less that those expected not to mention BoJ's ones, besides "inflation targeting" has been flawlessly performed by ECB for example.

2. Aggregation Bias: a possible origin.

Going deeper into Friedman's theory of monetary demand and money velocity, which is the one in current use in today's central banks, we find among the assumption the one of homoskedasticity for which the distribution of values around the mean is costant. Homoskedasticity is a very strong assumption which is not very likely to happend in real data, and that alone is a source of error, but in recent years modern statistics has developed various tool that can easily deal with that assumption by accounting for heteroskedasticity.

The problem lies instead in the nature of the variables of monetary demand, which are in Friedman's theory:

$M^d = f(P; r_b; r_e; \frac{1}{P}\frac{dP}{dt}; w; Y; u)$ for simplicity let's call x the whole group of variables.

Now using analysis let's aggregate the single monetary demand in a series of n-lenght to have:

$$M^d = f_n(x); \sum_{n=0}^{\infty} f_n(x) = S_n(x)$$

Now for the theorem of uniform convergence we'd have the error of the series collapse to null if sample lenghts is independent from the variable. All limits are for $n \to \infty$

Error: $\lim |S_n(x) - f_n(x)| = 0$ but for $n \to m$ $\lim |S_n(x) - f_n(x)| = u$

Thus ending up with an error that might be justified by theory as results of unmeasurable or exogenous factors. It would be useful indeed to be able to measure the economic relevance of such errors.

Moreover the assumption behind uniform convergency in spite of being true for a theoretical n-lenght sample becomes false when we are trying to estimate a real open market monetary demand. From QTM applying $MV = PQ$ to a real market will cause the quantities traded to be not only function of the price, they'd be also affected by herd behaviour and market size. Besides other variables like P can heavily influence market size and thus the aforementioned n in a real economy. As an example certain ranges of P might add or remove market barriers as for Porter's theories, thus changing the number of agents active on a market. Agents whose utility functions and monetary demand related to that market were null up to that point.

These considerations force us to drop uniform convergency for the lighter assumption of pointwise convergency that solely requires for our function to be in the same domain and codomain. But at this point our series doesn't collapse to zero anymore, but to a discontinous function:

$\lim |S_n(x) - f_n(x)| = f(x)$ an example might be: $f(x) = \lim \cos(\pi x)^{2n}$

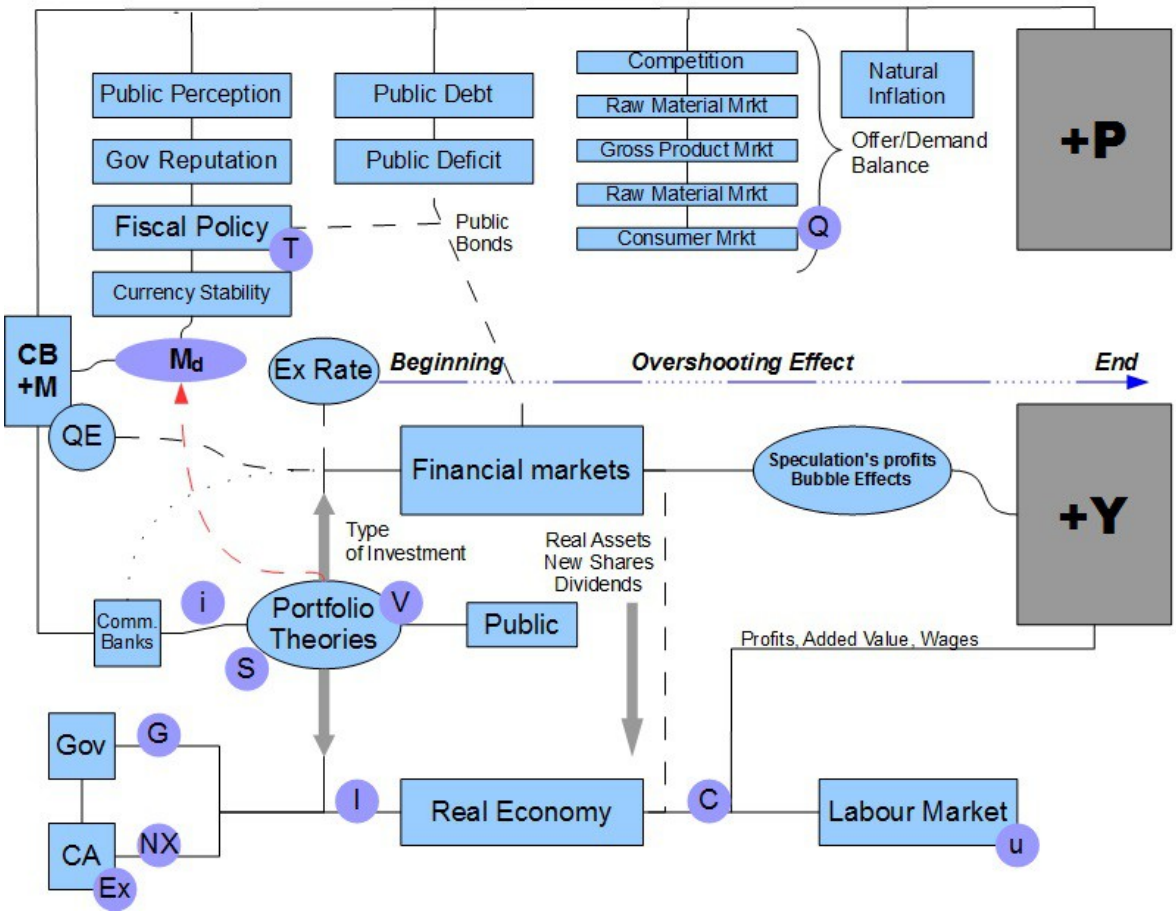
In any case that will be the form of the aggregation bias for monetary demand, and its shape once calculated might be helpful to:

- understand trend and hardly measurable behaviours of specific markets and their monetary demand
- used to fine-tune the type of heteroskedasticity involved in the aggregation to match the real demand better
- gauge the economic relevance of the error itself compared to the other variables to gauge its importance

3. Effects of a monetary impulse

So far economic studies have determined that the outcome of a monetary policy is highly affected by its qualitative features as well as its quantitative features. As qualitative features the role of expectations is underlined in Lucas' theory and in the studies that analizes the effects on economy due to how the communication between central banks and public is handled.

We tried to analize further the mean of transmission between monetary policy and real effects used in those theories by considering one monetary impulse at time, and it's effect on the economic system by recostructing and following the flow of a single monetary impulse in said system.



The outcome is better summarized in this graph with two main paths: the lower part follows the increase in GDP by aggregate demand theory, adjusted with the portfolio theories, the upper one is instead a collection of "inflationary effects": a series of variables which have an effect on prices according to Lucas expectation's theories, the quantitative theory of money and also including the qualitative effects due to information.

The lower part shows the formation that leads to an increase in GDP as per aggregate demand theory, it's effectivness and speed depend on:

- commercial banks and their lending policy, measurable with various index or with i
- portfolio theories which directs the flow of investments inbetween real economy and financial markets, which can be gauged by amount of investments and savings
- The income of both real economy and financial markets, their relationship and the boost given by bubbles effects, which incomes affects money velocity and investments. Both firm gross incomes and stock indexes are a good measure of them.
- The effectivness of labour market, which affects both real economy and consumption measured with unempoyment rate
- Government public expenditures and current account balance which are measured both by G and NX

All these agents do affect GDP both as an increase when positive incomes are coming from them, and decrease when losses occour instead.

The upper part wants to represent how inflation is formed:

- The role of information and expectation do affects prices and can cause them to raise quickly in response to a monetary stimulus or not in the case of a well handled monetary policy by the central bank. Such effects are not easy to measure but since nowdays government do loan themselves on financial markets a decent estimation can be taken by how government bonds are perfoming there.
- CB's monetary policy which effects the currency stability and can be gauged by how the exchange rate is doing on forex market
- Public finance and fiscal policy also affects inflation, and they be measured by tax level and public debts
- The estimation of monetary demand that comes from Friedman's theory
- The offer and demand balance which depends on quantities traded in all market types and the rate of competition in them. Less competition will lead to higher prices as per monopoly theories.

- The economies natural rate of inflation is included to define the inflation attitude of a certain area
- The overshooting effect could be used as a time reference: when the effect fades sticky prices are becoming flexible and inflation is rising

The final outcome will be the inflation rate and the increase in GDP both due to the monetary impulse. If monetarism nullifies the effects of monetary policy in the long run, rational expectations expands that conclusion to the short run: any effect on real economy is due to a random variable. Nonetheless if we assume to have perfect rational expectation it would be safe to state that for each increase in monetary base we'd have an increase of the same amount in price, thus this ratio would be costant:

$$\frac{(\Delta P)}{(\Delta Y)} = 1 = \rho$$

In this case we have no monetary policy effect as stated in the rational expectation theory.
We can call inflation velocity this ratio between a price deflator and a GDP increase assuming that this is the perfect velocity at which inflation take place into the economic system matching the pace of the "income boost effect" given by a certain expansionary monetary impulse nullifing its effects.
But if we suppose to start from full occupation income level we can substitute both terms espectively with M V = P Q and the outcome of rational expectation hypotesis:

$$\frac{(\Delta M\, \Delta V\, \Delta Q^{-1})}{(Y_t - Y_0)} = \frac{(\Delta M\, \Delta V\, \Delta Q^{-1})}{\left(\frac{(ad\,[Z - Z_e] + b\,u_t)}{(b+d)}\right)} = \rho$$

So if we take out the influence of monetary policy to just leave the random term "u" we'll have:

$$(\Delta M\, \Delta V\, \Delta Q^{-1})(b+d) = (b\,u_t)\rho$$

$$\frac{[(\Delta M\, \Delta V\, \Delta Q^{-1})(b+d)]}{\rho} = (b\,u_t)$$

In this case the random "term" will be determined by the monetary policy itself if $\rho = 1$, in which case it won't be random anymore. Given the previous equation we can state the effect of inflation velocity in nullifing the effect of a monetary policy as:

$$\frac{[(\Delta M\, \Delta V\, \Delta Q^{-1})(b+d)]}{(b\,u_t)} = \rho$$

The terms "b+d" come as a measure of elasticity of P towards Y in Lucas' model, they could be measured by a price sensitivity meter like the Van Westendorp's PSM.

If such an event occurs for a single monetary impulse, it is reasonable to assume that it would work for a series of monetary impulse in time, thought the effect may vary depending on the business cycle:

$0 < \rho < 1$ will mean a steady real growth

$\rho > 1$ will mark a growth due to inflationary process

$\rho < 0$ can both represent a deflationary process and a growth or an inflation paired with a GDP regression, which is unlikely to happend.

These trends can be explained by the overlapped interaction between the effect of a monetary expansion over another that's already in the system, not to mention the trend in which the system itself is already in.

4.Unconventional monetary policy: Quantitative Easing

Speaking of quantitative easing we usually refer to a specific economic operation which belongs to the entirety of the possible monetary policies which can be adopted by central banks.

Quantitative easing, also known as permanent open market operations, is a particular monetary policy used in order to increase the monetary base of the country which adopted it. It is mainly used when conventional monetary policies, like buying or selling government bonds, do not work anymore.

It is known United States have used it in the past simply by making the Federal's Reserve buy bonds from its member banks. The money used to buy the bonds is simply created by the Federal's Reserve itself, just like every central bank is capable of doing. The purpose of this expansionary monetary policy is to lower interest rates, since the purchase of bonds by the bank should increase their demand and at the same time lower their costs, and promote economic growth by increasing the liquidity circulation in the system. At the moment the Federal's Reserve disposed the purchase of bonds for a total of 40 billions dollars per month, with no deadline, until the USA economy will be self-sustainable.

Quantitative easing is slightly different from Europe to the rest of the world: while in the USA, for example, quantitative easing can not be considered “money printing” since it's merely an exchange of bonds for reserves, in other words nothing more than an asset swap, and not a deliberate expansion of the Fed's balance sheet, in Europe (outside of the Great Britain) it is essentially a form of fiscal policy that actually funds the countries. From a theoretical point of view the increase of the monetary base should be nullified in the long term period since when the economy recovers, the central Bank sells the bonds it has bought and destroys the cash it has received.

Quantitative easing has been adopted only in 2008 by United States Federal's Reserve and in 2009 by the Bank of England, but Japan was the first country to try this monetary policy in the late 1990s and enjoyed its strongest period of growth between 2002 and 2007. The quantitative easing policy adopted by Japan aimed to decrease the deflation and increase the inflation in the country. While it surely stabilized Japan's financial system and stimulated its economy, it certainly failed at replacing deflation with inflation. In 2013, March, the Bank of Japan announced that it would expand its asset purchase program by US$1.4 trillion in two years hoping to bring Japan from deflation to inflation, and aiming for a 2% inflation index.

So is quantitative easing working or not? The correct answer is “we don't know”. We can not know, in fact, where the economies of the world would be without it. It produced wanted effects like boosting economies and lowering interest rates, but at the same time failed at reaching others, like it did in Japan. However Europe's quantitative easing, which, as stated before, can not be truly associated with the real quantitative easing adopted by the rest of the world, since it unofficially is a form of lending money created out of thin air, was surely effective, since its aim of assisting helpful countries of the United Europe was fulfilled.

4. Quantitative easing data analysis

To put our equation to the test we choose a timeframe using US Federal Reserve data to build a regressive model, the specific timeframe when Fed's QE1 and QE2 plans were set into motion: November 2008 to December 2012.

Besides monetary base and money velocity, total business sales to and total business to inventory measures are included to represent respectively a measure of offer/demand balance quantity. For the random term and to also account for the qualitative part of monetary policy an Economic Policy Uncertainty index measured on US population has been added.

$$\frac{[(\Delta M\ \Delta V\ \Delta)(b+d)]}{[(\Delta Q u_t) b]} = \rho$$

Monetary Base M2 in percentage change	*M2*	ΔM
Money Velocity in percentage change	*V2*	ΔV
Total Business Sales	*TBssSale*	ΔQ
Total Business to Inventory	*TBStI*	ΔQ
Economic Policy Uncertainty index	*Epu*	u_t

**Data source: Federal Reserve Economic Data*

$$\rho = \beta_0 + \beta_1 M2 + \beta_2 V2 + \beta_3 TBssSale + \beta_4 TBStI + \beta_5 EPu + e$$

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Linear regression                               Number of obs =      17
                                                F(  5,    11) =    8.05
                                                Prob > F      =  0.0021
                                                R-squared     =  0.8555
                                                Root MSE      =  .42626
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PY	Coef.	Robust Std. Err.	t	P>|t|	[95% Conf.	Interval]
V2	-1.79455	.3304853	-5.43	0.000	-2.521943	-1.067157
M2	-1.401868	.2907461	-4.82	0.001	-2.041796	-.7619399
TBssSale	.6447834	.1103534	5.84	0.000	.4018971	.8876697
TBStI	24.89226	6.739536	3.69	0.004	10.05864	39.72587
EPu	-.0109176	.005154	-2.12	0.058	-.0222614	.0004263
_cons	2.412683	.6938638	3.48	0.005	.8854992	3.939867

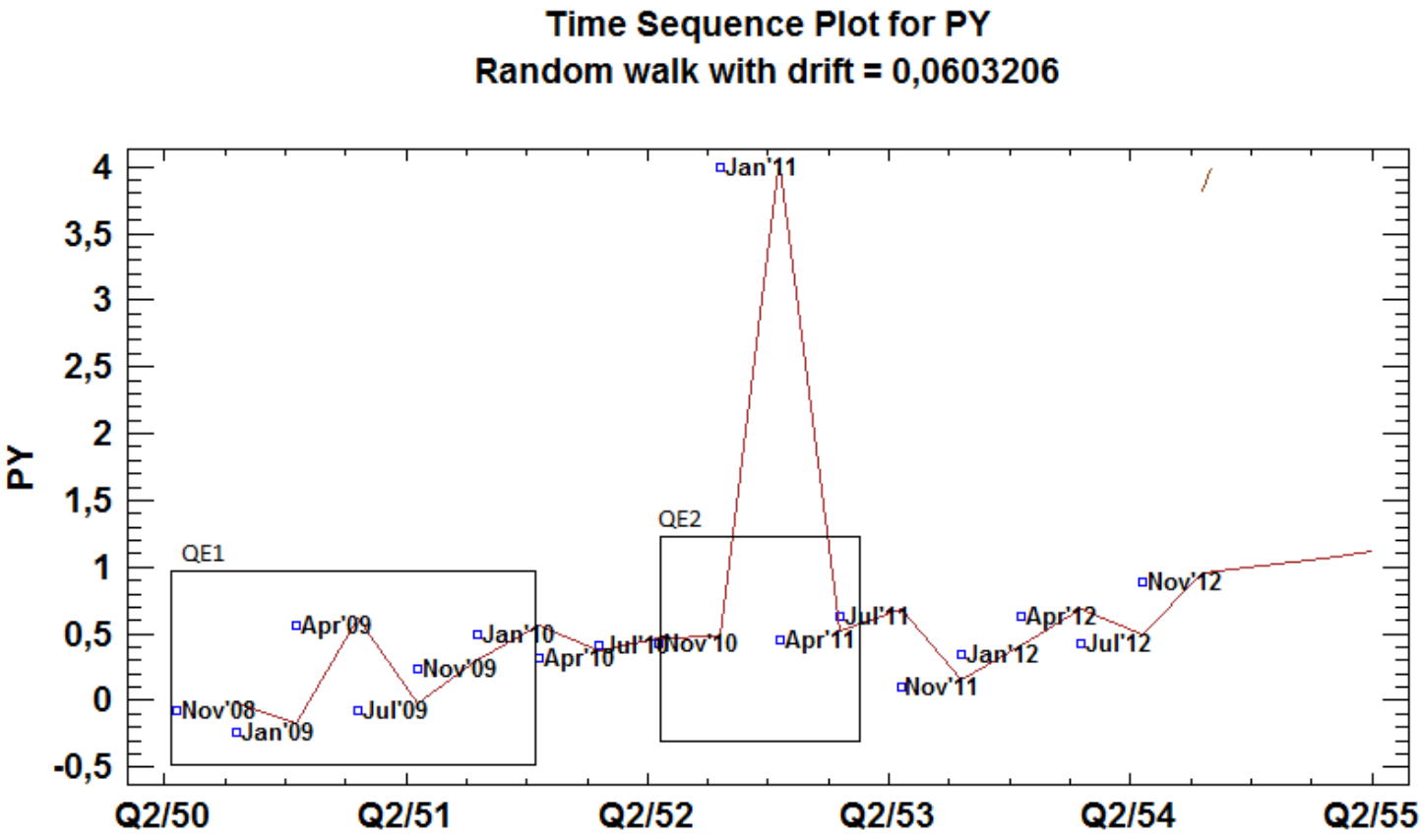
Even with a small sample made of 17 quarters the high R-squared shows the strong correlation between the regressors and the dependent variable. Moreover every term in the equation is statistically significant at the 99% level for all variables except for Epur which is significant at 95%. The coefficients' signs do match the proportionality of the initial equation except for Epu index:

- the negative signs in V2 and M2 do indicate that there's still room for monetary expansion since their increase would boost the GDP faster than prices
- the positive signs for the quantities instead does indicates a possible mismatch in market's offers-demands, probably due to a post-recession reduction in demands, and for that reason a boost in quantities would reduce the effectivness of a monetary expansion
- the negative index in EPu instead would mean that an increase in EP uncertainty among the population would increase the effect of a monetary policy. We have to take into account that the index is calculated on the whole aspect of economic policy, while the equation analizes a monetary phenomenon. So considering the monetary policy effect of that index it is true, accordingly to expectation theories, to affirm that a monetary policy is most effective when unexpected
- A forecast performed using the model is about 5% more efficient than an autoregressive forecast model of the dependent variable.

It is possible to confirm that the relationship is true for the timeframe and the data considered and the remaining 15% of the variability could be found in a more accurate estimation of public expectation.

The next graph instead shows how the ratio fared during the timeframe considered, and underlines how the effect of both QE1 and QE2 changed the ratio: the first 600 billion dollars injection by QE1 started in december 2008 did not push the ratio over 1, instead it brought it off the negative zone after the recession; after the second injection started in november 2010, at a rate of 75 billion dollars

per mounth for a total of another 600 billion dollars, there is a raise in the average ratio from 0.5 to a 0.65.



During the QE2 operation timeframe there is an anomal value that skyrockets over 4 for the inflation velocity ratio with also an increase of 16 percentage point, that is due to the combined effect of the two monetary injections (for a billion dollar increase we have an increase of just 1.3 percentage point in the ratio).

After a 1200 billion dollar expansion the average increase is still far below the 1, considering this and given the M and V coefficent in the regression, it is possible to affirm that the economic system in this phase lacks liquidity and that there are still 20 percentage points of margin for a monetary expansion. The anomaly of Jan'11 may also indicate that the timeframe for QE2 was probably too short. The ratio still being below 1 also indicates that the expectation are not rational and that the economy is willing to absorb the monetary expansion, channel it for a growth of real GDP, without losing faith in the monetary institution thus causing a rapid inflation growth.

Ultimately the monetary policy led by the Fed in this time period is satisfactory by this analysis, even if the system at the time could have tolerated another QE instead of Operation Twist (with which the Fed swapped long-term bonds with short-terms one on the markets).

5. Conclusions

From this brief analisys we can draw the conclusion that monetary policy still has a vivid role in defining the shape of the economy: it can counter depression without being nullified by inflation in the short run if the central bank can handle the qualitative side of the monetary expansion operation. To prove that point we can mention the latest attempt in trying new monetary policy instruments, and in the recent amount of research and consideration given to the qualitative aspect of such policies.

Behaviours and human nature are certainly unpredictable in the end, but even if that remains true it is still possible to limit them as much as we need to make our monetary tools still effective. Regarding the specific time period analyzed it's undeniable that the great effectivness of the monetary policy is also due to the dollar being the major vehicle currency in the world. With that being true is also important to say that the whole US economy has some social special features and even if its institutions didn't do enough to avoid the recession, they worked well toward creating a positive national feeling which can favour a steady comeback.

This experiences and the theories analyzed may lead us to say that economy, with a special regard to monetary policy, is ultimately a science to educate collective human behaviour in controlling scarce resources effectively.