Money Demand and the Quantity Theory[*]

Peter N. Ireland[†]

Boston College and NBER

February 2015

> The quantity theory is in the first instance a theory of the *demand* for money.
>
> – Milton Friedman (1956, p.4)

1   Using The Quantity Theory Today

The quantity theory of money attributes sustained price inflation to excessive growth in the money supply. Milton Friedman's (1956) celebrated "restatement" elaborates, by explaining how the quantity theory distinguishes between the real quantity of money demanded by the public and the nominal quantity of money supplied by the government and banking system, so as to form the heart of a fully-fledged model of price level and nominal income determination. In fact, because it traces the behavior of these important economy-wide variables back to the basic forces of demand and supply, the quantity theory must surely qualify as one of the oldest microfounded models in all of macroeconomics!

But as clean and aesthetically pleasing as its microfoundations might be, they alone are not enough to convince us of the quantity theory's usefulness. Instead, the most compelling

---

[*]Discussant's comments: "On the Stability of Money Demand," by Robert E. Lucas, Jr. and Juan Pablo Nicolini, presented at the November 2014 Carnegie-Rochester-NYU Conference on Public Policy and available at `https://www.minneapolisfed.org/research/wp/wp718.pdf`.

[†]Please address correspondence to: Peter N. Ireland, Boston College, Department of Economics, 140 Commonwealth Avenue, Chestnut Hill, MA 02467-3859. `peter.ireland@bc.edu`.

reasons to believe in the quantity theory are empirical, with the most persuasive evidence presented in studies, like Sargent's (1982), that focus on the hyperinflationary episodes that have occurred in various places at various times throughout world economic history. In each and every one of these episodes, where inflation rates in excess of 100 percent per year can be observed, these very high rates of inflation are accompanied by equally high rates of growth in the money supply. And in each and every one of these episodes, the hyperinflation stops as soon as the central bank takes decisive action to restrain the monetary expansion. Thus, these episodes come close to being controlled, laboratory experiments in which the independent variable, money growth, is deliberately manipulated holding all else constant and the dependent variable, inflation, responds as predicted by the theory.

Perhaps because hyperinflations seem so extreme, however, central bankers operating under more normal conditions rarely describe their policy actions in terms of their implications for the money supply. Instead, central bankers manage interest rates. Following suit, academic economists seldom discuss money demand and supply anymore. As emphasized by Eggertsson and Woodford (2003), for instance, the popular New Keynesian models of today assume that the entire thrust of monetary policy, expansionary or contractionary, is felt through changes in the current and expected future values of the short-term nominal interest rate alone.

Recent events, however, invite us to reconsider the usefulness of the quantity theory. Specifically, both the European Central Bank and the Federal Reserve lowered sharply their targets for short-term policy rates during the financial crisis of 2008 and the Great Recession that followed. Typically, such actions signal that monetary policy has become enormously accommodative, as it usually needs to be in the aftermath of severe disruptions to financial and aggregate economic activity. In both the Euro Area and the United States, however, the zero lower bound has prevented policy rates from falling any further and has shifted central bankers' efforts back towards influencing flows and stocks of monetary and financial assets. Against this backdrop, it is natural to ask, as for example Barnett (2012) does,

whether the stance of monetary policy can still be summarized based on observations of interest rates alone. Furthermore, as Friedman (1968) explains, very low interest rates like those seen around the world during the Great Depression and perhaps again today can sometimes reflect deflationary expectations that signal that monetary policy, far from being appropriately accommodative, is highly restrictive instead. Under such circumstances, Friedman emphasizes, movements in money growth can be more useful indicators of the effects that monetary policy is having on the economy.

Thus, figure 1 plots year-over-year growth of the broad M3 monetary aggregate for the Euro Area before, during, and since the financial crisis. The graph shows, quite strikingly, that there has been virtually no broad money growth in Europe since 2009. Might the very low inflation, and perhaps at least some of the sluggish real economic growth, experienced in Europe over the same period have something to do with this monetary stagnation? The quantity theory certainly suggests so.
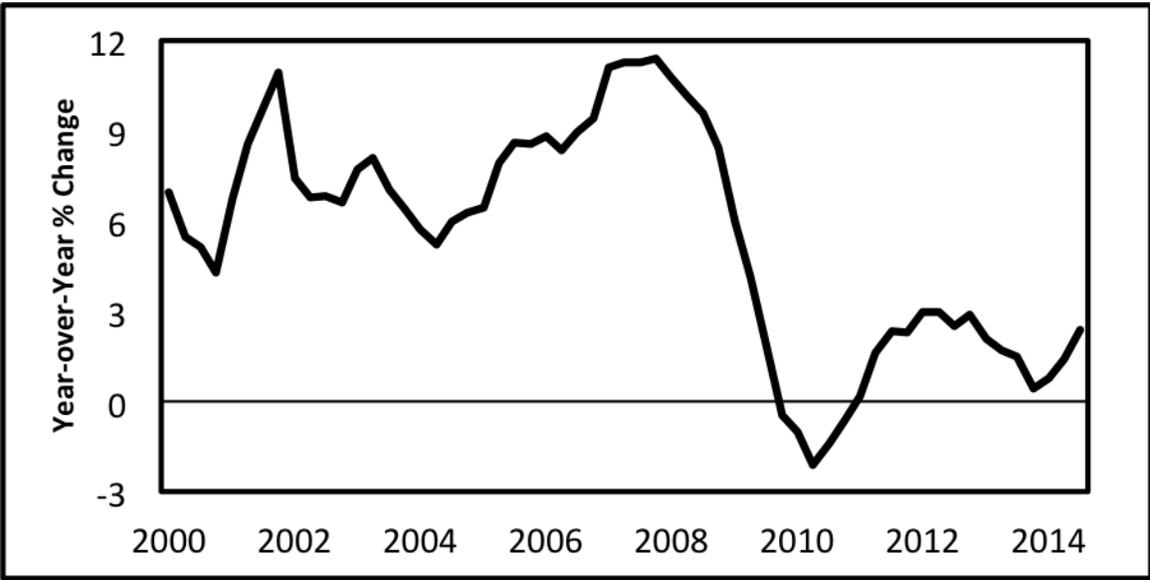

Figure 1: Euro Area M3 Growth. Source: Federal Reserve Bank of St. Louis FRED database.

Figure 2, meanwhile, shows data for the United States: year-over-year growth of the Divisia M2 aggregate. The figure reveals, first and foremost, that U.S. money growth has exhibited large fluctuations that appear to lead corresponding movements in output and

3

inflation over the entire period since 2000; Belongia and Ireland (2014*b*, forthcoming) study these co-movements in more detail. For the past several years, however, broad measures of money have grown at more stable and apparently more healthy rates. Do these observations portend a faster return of inflation to the Federal Reserve's two percent target, and perhaps explain why the economic recovery, while flagging in Europe, has accelerated in the United States? Again, the quantity theory suggests so.
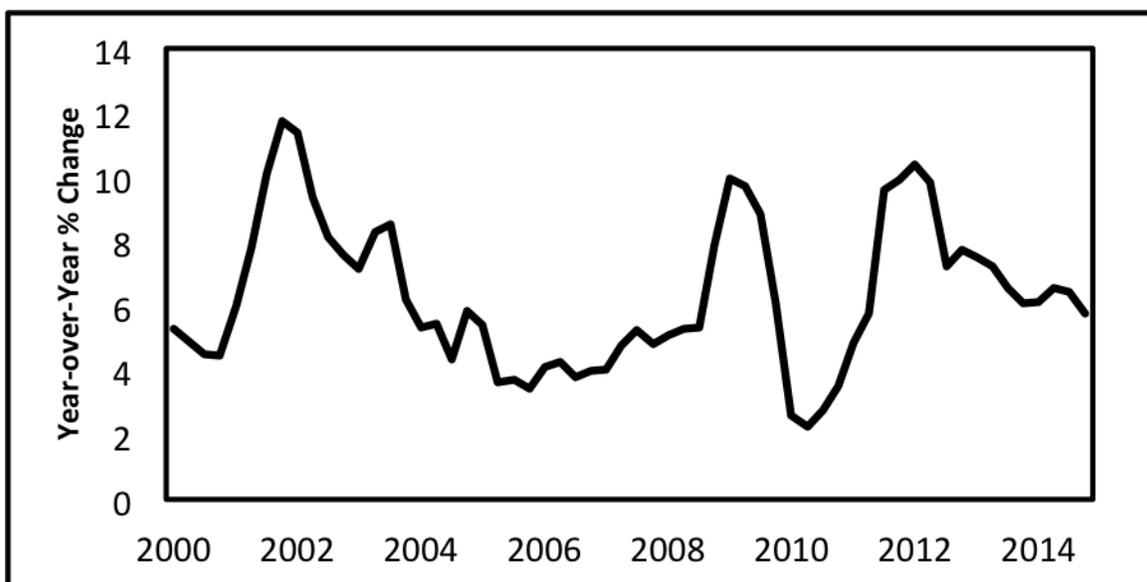

Figure 2: United States Divisia M2 Growth. Source: Center for Financial Stability.

As Friedman (1956) makes clear, however, applying the quantity theory to understand the effects of monetary policy in practice requires a careful consideration of money demand as well as money supply. This is what makes Lucas and Nicolini's conference paper so timely. It provides exactly what Friedman calls for: a state-of-the-art theory of money demand, coupled with a careful attempt to validate, empirically, the implications of that theory.

2   Combining Theory and Data

Indeed, while Lucas and Nicolini's paper is impressive along many dimensions, it is absolutely masterful in the way that it weaves together theory and evidence to make its case that the

demand for money is stable and, by extension, that the quantity theory of money remains useful. Think, by contrast, of how a more ordinary research article in monetary economics is organized. After an introductory section, with motivation and a review of the literature, comes the description of the model: a set of equations, at least some of which might have the variable M in them. Then, at the beginning of the next, empirical section – if there even is an empirical section – the author must admit that the model is silent on the issue of how the variable M ought to be measured in the data. Should it be M1, M2, MZM, or the monetary base? Without explicit guidance from theory, the best the author can do is to arbitrarily pick one the Federal Reserve's official aggregates to derive the benchmark results and perhaps experiment with one or two alternatives to assess the robustness of the findings.

Lucas and Nicolini's model, by contrast, tells them quite specifically how to measure the variable M in the data. And because the theory implies that the correct measure is not among those that the Fed officially compiles, Lucas and Nicolini must dig into the source data to construct their preferred NewM1 aggregate for themselves. Very impressive! This paper stands quite clearly as an example for anyone who wishes to conduct serious research in monetary economics.

Lucas and Nicolini's theory implies, in particular, that there should be a stable long-run relationship between (i) a simple-sum monetary aggregate that includes currency, checking accounts (both demand deposits, which until 2011 could not pay interest, and NOW accounts, which since 1980 have paid interest), and money market deposit accounts, (ii) nominal GDP as a scale variable, and (iii) the short-term nominal interest rate as an opportunity cost variable. The theory implies, as well, that the income elasticity of money demand equals one, so that, for a given interest rate, demand for the simple-sum monetary aggregate scales up and down proportionately with nominal GDP.

Here, a "simple-sum" monetary aggregate means a monetary aggregate that is formed, in the same way as the Federal Reserve's official M1 and M2 measures, just by adding up the total dollar value of funds held in the form of its various components. In Lucas

and Nicolini's model, the cash and deposit-in-advance constraints specifically imply that the NewM1 aggregate takes this simple-sum form. For although these constraints enter separately into the representative household's optimization problem, they all bind at the optimum, so long as the opportunity cost of holding each monetary asset instead of illiquid but higher-yielding bonds remains positive. Thus, summing over all of them leads directly to a quantity-theoretic relation of the form

$$n(r)m^s = n(r)(c + d + a) = px. \tag{1}$$

The first equality in (1) defines NewM1 m^s as the simple sum of currency c, checking account balances d, and money market deposit account balances a. The product of the price level p and aggregate consumption x on the far right-hand side provides a measure of nominal income. Finally, Lucas and Nicolini's adaptation of Freeman and Kydland's (2000) framework makes n, the number of trips the household takes to the bank each period, a stable function of the interest rate r on illiquid bonds, which if traded would in steady state have to offer a return equal to the Fisherian sum of the real interest rate ρ and the inflation rate π. In Lucas and Nicolini's model, therefore, n also equals the velocity of money: the number of times the broad money stock turns over each period.

Hence, (1) makes clear that Lucas and Nicolini are writing a sequel to Friedman (1956). Both they and Friedman start with the quantity equation – velocity times money equals nominal income – which by itself is just an identity. Then, they give that identity predictive content by layering on top of it a theory of money demand that relates velocity to a small number of observable variables: in this case the short-term nominal interest rate r alone.

After painstakingly assembling a time series for the NewM1 aggregate, Lucas and Nicolini present persuasive graphical evidence that its velocity varies with the short-term interest rate in precisely the way predicted by their theory. This represents another major accomplishment, for stable money demand specifications have been very hard to find, going all

the way back to the days of the "missing money" chronicled by Goldfeld (1976). Lucas and Nicolini's theory, however, has more difficulty accounting for the observed patterns of substitution between the components of NewM1 as interest rates have changed over the years. This leaves one important task for future research: modifying or extending their model to better capture these patterns of substitution between currency and various types of deposits.

3   Modeling Currency-Deposit Substitution

Belongia and Ireland (2014a) suggest one way this might be done. The model in that paper replaces Lucas and Nicolini's cash-in-advance structure with an alternative, shopping-time specification in which total hours spent shopping, h^s, increase with the total dollar volume of spending px but decrease with holdings of a monetary aggregate m^a according to

$$h^s = \frac{1}{\chi}\left(\frac{px}{m^a}\right)^\chi,$$

with $\chi > 1$. The monetary aggregate m^a also differs from Lucas and Nicolini's m^s since it is formed from currency c and deposits d according to the constant elasticity of substitution function

$$m^a = [\nu c^{(\omega-1)/\omega} + (1-\nu)d^{(\omega-1)/\omega}]^{\omega/(\omega-1)}, \tag{2}$$

where $0 < \nu < 1$ and $\omega > 0$. Of course, moving away from the cash-in-advance specification means that the model in Belongia and Ireland (2014a) loses some of the elegant microfoundations that make Lucas and Nicolini's model so appealing. But, the added flexibility gained through (2) makes this alternative framework ideally-suited for confronting issues pertaining to agents' ability to substitute between currency and deposits when making transactions.

The specification in (2) complicates the analysis in another way, because whereas inside the model, where agents are assumed to know the true values of ν and ω, the monetary aggregate m^a is observed and is, in fact, a choice variable for the representative household,

outside the model, where ν and ω are unknown and must be estimated, the exact value of m^a is unobservable. Belongia and Ireland (2014a) show, however, that Barnett's (1980) formulas for Divisia monetary aggregation can be used to approximate the true value of m^a very closely and do not require knowledge of the parameter values, or even the functional form of the aggregator, on the right-hand side of (2). Thus, the model in Belongia and Ireland (2014a) also has explicit implications for the measurement of money, but points towards the Divisia monetary aggregates instead of the simple-sum used by Nicolini and Lucas.

For exactly this reason, Belongia and Ireland's (2014a) specification has other advantages, beyond simply allowing for more flexibility in capturing substitutions between currency and deposits seen in the data. Barnett's (1980) formulas, for example, extend readily to cases with more than just one or two types of deposits, potentially allowing for an even richer description of how various liquid assets combine to provide households and firms with monetary services than that given by Lucas and Nicolini's framework as it stands now. The specification in (2) also provides theoretical support for empirical findings, like those presented in Belongia (1996), Hendrickson (2014), and Belongia and Ireland (2014b, forthcoming), which show that the Divisia monetary aggregates are more tightly linked than their simple-sum counterparts to movements in aggregate output and prices.

Finally, associated with (2) is a theoretically-consistent measure of the price dual to the quantity aggregate m^a, given by

$$r - r^a = [\nu r^{1-\omega} + (1-\nu)(r-r^d)^{1-\omega}]^{1/(1-\omega)}, \tag{3}$$

where r^d is the interest rate paid on deposits and, by assumption, currency pays no interest, so that r^a is an aggregate of the interest rates paid on the components of m^a. Belongia (2006) explains how a measure based on (2) serves more appropriately than the short-term nominal interest rate r alone as the user, or opportunity cost, variable in empirical demand specifications for the Divisia monetary aggregates. In addition, Belongia and Ireland (2006)

demonstrate that user-cost aggregates such as (3) serve as direct measures of time-varying inflation tax effects that monetary policy can have on output and employment even in flexible-price models such as Cooley and Hansen's (1989); building on that insight, Belongia and Ireland (2006) also present evidence that cyclical inflation tax effects do appear in U.S. time series data.

Lucas and Nicolini's work can be extended along these dimensions and more, to address a host of theoretical and empirical issues concerning monetary policy and its effects on the economy. They have written a great paper, which rekindles our interest and deepens our confidence in a quantity-theoretic approach to monetary analysis.

4   References

Barnett, W.A., 1980. Economic monetary aggregates: An application of index number and aggregation theory. Journal of Econometrics 14, 11-48.

Barnett, W.A., 2012. Getting it wrong: How faulty monetary statistics undermine the Fed, the financial system, and the economy. MIT Press, Cambridge.

Belongia, M.T., 1996. Measurement matters: Recent results from monetary economics reexamined. Journal of Political Economy 104, 1065-1083.

Belongia, M.T., 2006. The neglected price dual of monetary quantity aggregates. In: Belongia. M.T., Binner, J.M. (Eds.), Money, measurement and computation. Palgrave Macmillian, New York, pp. 239-253.

Belongia, M.T., Ireland, P.N., 2006. The own-price of money and the channels of monetary transmission. Journal of Money, Credit, and Banking 38, 429-445.

Belongia, M.T., Ireland, P.N., 2014a. The Barnett critique after three decades: A new Keynesian analysis. Journal of Econometrics 183, 5-21.

Belongia, M.T., Ireland, P.N., 2014*b*. Money and output: Friedman and Schwartz revisited. Manuscript. Boston College, Department of Economics, Chestnut Hill.

Belongia, M.T., Ireland, P.N., forthcoming. Money and interest rates in the measurement of monetary policy. Journal of Business and Economic Statistics.

Cooley, T.F., Hansen, G.D., 1989. The inflation tax in a real business cycle model. American Economic Review 79, 733-748.

Eggertsson, G.B., Woodford M., 2003. The zero bound on interest rates and optimal monetary policy. Brookings Papers on Economic Activity, 139-211.

Freeman, S., Kydland, F.E., 2000. Monetary aggregates and output. American Economic Review 90, 1125-1135.

Friedman, M., 1956. The quantity theory of money–A restatement. In: Friedman, M. (Ed.), Studies in the quantity theory of money. University of Chicago Press, Chicago, pp. 3-21.

Friedman, M., 1968. The role of monetary policy. American Economic Review 58, 1-17.

Goldfeld, S.M., 1976. The case of the missing money. Brookings Papers on Economic Activity, 683-730.

Hendrickson, J., 2014. Redundancy or mismeasurement? A reappraisal of money. Macroeconomic Dynamics 18, 1437-1465.

Sargent, T.J., 1982. The ends of four big inflations. In: Hall, R.E. (Ed.), Inflation: Causes and effects. University of Chicago Press, Chicago, pp. 41-97.