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Does money matter in inflation forecasting?

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ABSTRACT

This paper provides the most fully comprehensive evidence to date on whether or not monetary aggregates are valuable for forecasting US inflation in the early to mid 2000s. We explore a wide range of different definitions of money, including different methods of aggregation and different collections of included monetary assets. In our forecasting experiment we use two nonlinear techniques, namely, recurrent neural networks and kernel recursive least squares regression—techniques that are new to macroeconomics. Recurrent neural networks operate with potentially unbounded input memory, while the kernel regression technique is a finite memory predictor. The two methodologies compete to find the best fitting US inflation forecasting models and are then compared to forecasts from a naïve random walk model. The best models were nonlinear autoregressive models based on kernel methods. Our findings do not provide much support for the usefulness of monetary aggregates in forecasting inflation. Beyond its economic findings, our study is in the tradition of physicists' long-standing interest in the interconnections among statistical mechanics, neural networks, and related nonparametric statistical methods, and suggests potential avenues of extension for such studies.

1. Introduction

It is a widely held belief among macroeconomists that there exists a long-run relationship between the growth rate of the money supply and the growth rate of prices (i.e., inflation). This belief forms the foundation for monetary policymaking at the world's central banks, and hence is extraordinarily important for the conduct of public policy. Its importance makes it one of the most commonly tested hypotheses in economics. Yet, the mechanism through which money affects an economy's overall, average price level, is necessarily complex—as complex as the economies themselves. The mechanism almost surely is not linear, and the short-run dynamics may disguise the long-run relationship, confusing tests of the relationship. Linkages need not be univariate, and fluctuations in other variables (including the growth rate of productivity, and international economic conditions) may affect the near- and medium-term correspondence between money growth and inflation. Such interactions raise the possibility that the correspondence may be both nonlinear and time-varying, perhaps with complexity beyond capture in parametric frameworks. In a recent paper, Bachmeier et al. [1], for example, soundly reject both linear autoregressive (univariate) and vector-autoregressive (multivariate) models.

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If indeed there exists a dynamic, long-run relationship between the money supply and increases in prices, then it is a reasonable proposition that the near-term growth of the money supply might have predictive power for inflation. This study explores that relationship. In this paper, we investigate a wide range of measures of the money supply (i.e., monetary aggregates) for the United States, and evaluate their usefulness as leading indicators for inflation in the early to mid 2000s. We derive inflation forecasts using two nonlinear techniques with varying degrees of input memory, namely, recurrent neural network operating with potentially unbounded input memory, and a kernel regression technique with finite input memory.

In addition to the economic analysis, our study contributes to physicists' long-standing interest in the interconnections among statistical mechanics, neural networks, and related nonparametric statistical methods. A number of the statistical issues addressed in this paper are similar to those addressed in econophysics. Consider the problem of linear versus nonlinear models. Galluccio et al. [2], Laloux et al. [3], Plerou et al. [4] and Plerou et al. [5], for example, study correlations among returns on different stocks by applying random matrix theory to the stock returns' cross-correlation matrix. This approach imposes a linear model on the statistical linkages among the entities under consideration (e.g., stock returns, monetary aggregates, inflation); the assumed linearity is a limitation of the approach despite the approach being 'model-free' to the degree that the correlation measure is a model-free quantity. Our analysis proceeds in a nonlinear, model-based fashion to consider possible linkages among future inflation, past inflation, interest rates, and monetary aggregates. We assume, specifically, that the structure of such relationships can be explained through two classes of nonlinear models: one with infinite and the other with finite input memory. In addition to their importance in their own right, our findings suggest possibilities for generalizations and extensions of previous econophysics financial-market studies that have used the correlation-based or mutual-information-based method.[1] In this regard, our study adopts the argument made by Plerou et al. [6] that "In economics, one often starts with a model and tests what the data can say about the model. The physics approach to this field differs in that it starts in the spirit of experimental physics where one tries to uncover the empirical laws which one later models." Saito [7], for example, studies the possibility of using a neural network to statistically learn an economic time series—but his network validation was performed using data generated by a model developed in econophysics rather than observed data. Finally, we note that our methodology also lies within the discipline of computational intelligence, a topic of interest to many physicists. Chen et al. [8], for example, illustrate the application of computational intelligence in many fields, including computer science, engineering, psychology and, especially, physics.

2. Monetary aggregates and monetary policymaking

Policymakers worldwide seek to foster economic conditions of robust economic activity and low, stable rates of inflation. In that regard, it is important to identify indicators of macroeconomic conditions that will alert policy makers to impending inflationary pressures sufficiently early to allow the necessary actions to be taken to control and remedy the problem. Equally important, such indicators must not falsely signal future increases in inflation that cause policymakers to slow the pace of economic output in vain efforts to temper inflation. Given the widely held belief in the existence of a long-run relationship between money and prices, monetary aggregates would seem to hold much promise as indicator variables for central banks. The European Central Bank (ECB), for example, employs a "two-pillared" approach, which includes monetary analysis. Specifically, ECB [9] states that "…the [President's Introductory] statement will [after identifying short to medium-term risks to price stability] proceed to monetary analysis to assess medium to long-term trends in inflation in view of the close relationship between money and prices over extended horizons." Evidence to date has not provided strong support for the proposition that monetary aggregates assist forecasting inflation for the United States; see, for example, [10,11].[2] Moreover, as noted by Federal Reserve Board chairman Ben Bernanke, monetary aggregates have not played a central role in the formulation of US monetary policy since 1982. He further states [12]: "Why have monetary aggregates not been more influential in US monetary policymaking, despite the strong theoretical presumption that money growth should be linked to growth in nominal aggregates and to inflation? In practice, the difficulty has been that, in the United States, deregulation, financial innovation, and other factors have led to recurrent instability in the relationships between various monetary aggregates and other nominal variables."

Recently, some economists have issued cautionary notes on the importance of money. See, for example, [13–15]. In particular, Carlstrom and Fuerst [16] state "…we think the current de-emphasis on the role of money may have gone too far. It is important to think seriously about the role of money and how money affects optimal policy." In a similar vein, the Governor of the Bank of England Mervyn King [17] stated "My own belief is that the absence of money in the standard models which economists use will cause problems in future, and that there will be profitable developments from future research into the way in which money affects risk premia and economic behavior more generally. Money, I conjecture, will regain an important place in the conversation of economists."

Linkages between money and inflation have become increasingly important during the recent financial crisis as, in a number of countries, the instrument of monetary policy has shifted towards the quantity of money and away from overnight

[1] A generalization to admit nonlinear relationships might be achieved by considering information theoretic measures such as multivariate mutual information.

[2] Stock and Watson [11] also conclude that most "real" economic variables, including real GDP, are not helpful in predicting future inflation.