## Does money matter in the euro area?: Evidence from a new Divisia index

### 1. Introduction

Money has a minor role in monetary policy and macroeconomic modelling. One important cause for this disregard is empirical: estimated money demand functions have been found to be unstable and money has proved to be less effective in predicting economic outcomes[1]. However, such empirical failures are challenged by the literature on aggregation-theoretic measurement of money. The most widely used measures of money, like M2 and M3, are simple-sum measures. Simple-sum aggregation implies that all components of the money stock are perfect substitutes, which is an improbable assumption. Correct aggregation can be obtained by using either aggregation theory or index number theory, as first underlined by Barnett (1980), who suggested the discrete-time Törnquist-Theil approximation of the Divisia-index.

Recent studies using US data also underlined the usefulness of Divisia indicators for monetary analysis. Within a cointegrated vector-autoregressive model, Hendrickson (2013) identified a stable money demand equation using Divisia-aggregates and demonstrated that they Granger-cause output and prices. The same analyses with simple-sum money indicators led to weaker results. Keating *et al* (2014) showed that a structural vector-autoregressive (SVAR) model with Divisia-money worked as well as the model with the Federal funds rate before the crisis. It worked equally well in the sample period that includes the zero lower bound when the Federal funds rate model could not be used. Using a different SVAR model, Belongia and Ireland (2014) found support for the inclusion of Divisia-money in the US monetary policy rule and also identified reasonable money demand and monetary system shocks.

Our article creates a new euro-area Divisia-money dataset and examines the impacts of shocks to money, user cost and interest rate on output, prices and monetary variables in the euro area, using SVAR models.

### 2. A new euro-area Divisia money dataset

No Divisia monetary aggregates are available for the euro area, in contrast to the US and UK. We create and make available a euro-area Divisia-money dataset corresponding to the simple-sum

[1] Other reasons include policy shifts by central banks to focus on interest rates and the development of theories suggesting that money is redundant (Leeper and Roush 2003, Belongia and Ireland 2014, Keating *et al* 2014).

aggregates published by the European Central Bank (ECB), ie M1, M2 and M3, for January 2001-February 2015. We plan to update the dataset regularly[2].

Earlier academic works on the euro-area Divisia aggregates include Wesche (1997), Reimers (2002), Stracca (2004), Barnett (2007), Binner *et al* (2009), Jones and Stracca (2012) and Barnett and Gaekwad-Babulal (2014), while El-Shagi and Kelly (2013) calculated Divisia-money indicators for six euro-area countries. In contrast to most of these papers, we base our calculations on euro-area data as opposed to aggregating country-specific data at the euro-area level. Furthermore, instead of relying on an *ad-hoc* spread assumption to approximate the benchmark rate (the return on a monetary asset that does not provide transaction services), as generally done in the literature, we derive it by considering longer maturity bank debts.

The ECB indicators of euro-area outstanding money stocks are subject to two major shortcomings. First, they relate to the changing country-composition euro-area and hence there was a level shift in these indicators whenever a new member joined the euro area. Second, they are subject to reclassification changes, such as halving the outstanding stock of the measure of repurchase agreements in June 2010. For economic analysis, such level shifts should be eliminated. We create a Divisia index for the first twelve euro-area members based on transactions data, which does not suffer from level shift problems. Details are provided in the on-line Appendix.

## 3. Models and data

We estimate impulse response functions with SVAR models including five variables: GDP, GDP deflator, money, the user cost of money and interest rate. The sample period is quarterly between 2001Q1 and 2014Q4, which is shorter than sample periods available for the US, so we are obliged to use relatively small-scale models and cannot study sub-sample stability[3]. Output, prices and money enter the model in log-levels, while the interest rate and user cost are included in percent. Such a specification leads to consistent estimation, irrespective of whether or not there is a cointegration relationship between the variables.

For GDP and GDP deflator we use the seasonally adjusted euro-area twelve (i.e. constant country composition) aggregates published by Eurostat.

For money, we use seasonally adjusted end-of-quarter M2 data from our new dataset (results with M3 are very similar). We compare the results obtained with Divisia and simple-sum measures. To

[2] Our dataset is downloadable from: http://www.bruegel.org/datasets/divisia-dataset/

[3] We allow four lags in the VARs, which reduces our effective sample period by 4 to 52. We need to estimate 21 parameters per equation (four lags of each of the five variables plus an intercept), which leaves reasonable degrees of freedom.

facilitate the comparison, we calculate the simple-sum measure for the first twelve euro-members using transactions data to exclude level shifts, similarly to the Divisia-index.

The user cost of a monetary asset is the function of the interest forgone by holding that asset rather than the benchmark asset[4]. Thereby, a higher user cost reduces the demand for that asset. Note that the impact of a higher interest rate on the demand for monetary assets (other than the zero-yielding cash) is ambiguous, because, for example, a higher central bank interest rate may increase the interest rate paid on deposits, which in itself makes deposits more attractive.

For the interest rate we use the 10-year maturity German government bond yield, because the ECB policy rate or a measure of short-term interest rate cannot be used due to reaching zero lower bound in the latter part of our sample period. The expectation hypothesis of the term structure of interest rates defines the relationship between current and expected short-term interest rates and the long-term interest rate. Thereby, the long-term rate can be informative about monetary policy actions, including when various unconventional measures, such as large-scale asset purchases, are implemented. We use the German rate and not the euro-area average, because the average was influenced by redenomination risk during the euro-area sovereign debt crisis, while the German rate is the closest to a euro-area risk-free asset.

Our relatively short sample period does not allow a rich identification of structural shocks. We therefore use the generalised impulse response function derived by Pesaran and Shin (1998), which does not depend on the variable ordering, in contrast to the frequently used Cholesky-decomposition. Thereby we cannot interpret any of our shock as a 'monetary policy shock', yet shocks to the interest rate may capture most of such shocks. A shock to user cost is not a pure money demand shocks, but may approximate it, while a shock to money may comprise money supply shocks.

## 4. Results

Figure 1 shows that the response of output to a Divisia-money shock is positive and statistically significant about 3-9 quarters after the shock, which corresponds to the horizon at which monetary policy is thought to have an effect on the economy. The output level response is temporary as the impulse-response function returns to zero, which is sensible and in line with the long-run neutrality hypothesis. While the shape of the response to a simple-sum money shock is similar, it is significant for a shorter period (3-6 quarters).

[4] See Barnett (1978) for a derivation of the user cost formula.

The price response is marginally significant for Divisia-money, but not significant for the simple-sum aggregate. The estimates suggest that prices increase after a money shock, which is sensible. The price response to an interest rate shock is negative, as expected, and is significant in the Divisia-model, but not in the simple-sum model.

The interest rate decreases significantly in the short-term after a Divisia-money shock and thereby no liquidity puzzle arises. When simple-sum money is used, the short-term impact is not significant. Starting from about a year after the money shock, the interest rate response turns to positive, which is significant for both measures of money. To the extent that the long-term interest rate reflects ECB monetary actions, this finding suggests that the ECB reacted to monetary developments, e.g. by cutting its policy rate or by adopting unconventional monetary measures following a negative money shock.

A shock to user cost reduces money, which is consistent with a money-demand function. This effect is significant for up to three years after the shock in the Divisia-model and for less than two years in the simple-sum model.

Finally, in the Divisia-model an interest rate shock increases the user cost, which may explain why the reaction of money is negative to an interest rate shock. These findings imply that the ECB can influence monetary developments by measures which impact long-term interest rates. However, these findings do not hold in the simple-sum model, as the impacts of an interest rate shock on user cost and money are not significant and even the point estimates are virtually zero.

**Figure 1: Impulse responses to interest rate and money shocks**

**A: Using M2 Divisia**

**B: Using M2 simple sum**

*Note. Solid line: estimated impulse-response function; dashed lines: 95 percent confidence band. The horizontal axis indicates the number of quarters after the shock.*

## 5. Conclusions

We create and make available a new dataset on euro-area Divisia monetary aggregates and estimate theoretically correct responses to money, user cost and interest rate shocks in the euro area using structural vector-autoregressions. A Divisia-shock has significant impacts on output and prices. Following a short-term liquidity effect, interest rates increase after a money shock, suggesting that the ECB reacted to developments in money aggregates. We also find that Divisia-money declines

after a shock to user cost, consistently with a money-demand function, while an interest rate shock increases user cost and decreases Divisia-money, suggesting that the ECB can influence monetary developments. Most of these results are not significant when we use simple-sum measures of money. Therefore, our findings for the euro area complement the evidence from US data that Divisia monetary aggregates are useful in assessing the impacts of monetary policy and that they work better in SVAR models than simple-sum measures of money.


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