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Multilateral Divisia monetary aggregates for the Euro area

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Abstract

In light of the "two-pillar strategy" of the European Central Bank, good measures of aggregated money across countries in the Euro area are policy relevant. The objective of this paper is to focus on the multilateral Divisia monetary aggregates for the Euro area. Based on theory developed in Barnett (2007), this paper produced the multilateral Divisia monetary aggregates for the economic union of all the 19 Euro area countries, EMU-19, (and the Divisia monetary aggregates for the individual 19 Euro area countries), which is a theoretically consistent measure of monetary services for the Euro area monetary union. The multilateral Divisia monetary aggregate indices for EMU-19 is found to provide a better signal of recession, when compared to the corresponding simple sum monetary aggregates.

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1. Introduction

The European Central Bank (ECB) attributes a special role to monetary aggregates under its two-pillar strategy. Economic analysis and monetary analysis are used to achieve and maintain price level stability. In light of the important role of the monetary aggregates in the Euro area, the need for an appropriate and theoretically consistent measure of monetary aggregates is highly relevant.

Simple sum monetary aggregates for the Euro area are widely used in economic research and are made available by the ECB. The simple sum approach is based on the assumption that the components are perfect substitutes. Barnett and Gaekwad (2018) found that monetary services in the Euro area are not perfect substitutes. Hence, simple sum aggregation over monetary services for the Euro area is not theoretically justified. Similar results have been found with U.S. data. See, e.g., Serletis and Robb (1986) and Serletis and Shahmoradi (2007).

The Divisia monetary aggregates are based on microeconomic aggregation and index number theory. Barnett's (1980) initial results were derived for a single closed economy. Studies with single country data have repeatedly demonstrated that Divisia monetary aggregates are better measures than simple sum monetary aggregates in terms of policy criteria, such as causality and information content of the aggregate and stability of the money demand function. See, e.g., Barnett (1983), Barnett, Offenbacher and Spindt (1984,1991), Belongia and Ireland (2006, 2014, 2105a, 2016), Celik and Uzun (2009), Serletis and Rahman (2013), and Serletis and Gogas (2014)).

For an economic union like the Euro area, the relevant theory for construction of multilateral Divisia monetary aggregates was developed in Barnett (2003, 2007). The theory in Barnett (2007) is developed for an economic union at various stages of integration: ranging from

a very minimally integrated economic union to a very highly integrated economic union. In previous studies, for example, Stracca (2004) and Darvas (2015), have constructed Divisia monetary aggregates for the Euro Area, but under a restrictive assumption that the Euro area behaves as a single aggregated country. That assumption implies homogeneity across the Euro area, including price levels, interest rates, and tastes.

The objective of this paper is to construct a multilateral Divisia monetary aggregates for the Euro Area that is representative of the level of integration for this economic union, without using heavily restrictive assumptions. The multilateral Divisia monetary aggregate is constructed in two stages. In the first stage, the Divisia monetary aggregates are constructed for the 19 single countries, that is, Austria, Belgium, Cyprus, Estonia, Finland, France, Germany, Greece, Ireland, Latvia, Lithuania, Italy, Luxembourg, Malta, Netherlands, Portugal, Slovakia, Slovenia and Spain. Then in the second stage, the multilateral Divisia monetary aggregate is constructed over the countries, taking into consideration diversity across the countries. The resulting multilateral Divisia monetary aggregates for the Euro area assume the existence of homogeneity within 19 Euro area countries, but heterogeneity across countries within the economic union, the Euro area. The representative agents for each country can have different tastes and preferences, while conditioning upon different after-tax prices and interest rates. These generalizations are very relevant to the Euro area, which is a union of heterogeneous countries having characteristics that have not yet converged to each other. These multilateral Divisia monetary aggregates are truly representative of the Euro area.

The contribution of this research paper can be postulated as following: first, in this paper the Divisia monetary aggregates is used to measure the monetary aggregates which are theoretically consistent and based on index number theory and microeconomic aggregation theory.

Second, the Divisia monetary aggregates are constructed for all the 19 EMU single countries, without omitting any of the Euro area member countries. Third, multilateral Divisia monetary aggregates are constructed for the economic union of 19 EMU countries based on the assumption of heterogeneous agents approach which takes into consideration the diversity across the countries. For example, the 19 countries of the Euro have different interest rates, price level, tastes and preferences etc. Finally, multilateral Divisia monetary aggregates indices for the economic union of 19 countries of Euro area (EMU 19) are lower than the corresponding simple sum monetary aggregates for the recession periods. This divergence of the multilateral Divisia monetary aggregates from the simple sum monetary aggregate for the recession periods can provide signal of a recession as shown in Barnett and Chauvet (2011).

The paper proceeds to discuss the theory of aggregation within the Euro area countries (section 2) followed by the aggregation over countries (section 3). Section 4 discusses the data sources and descriptions, followed by the Divisia monetary aggregates for 19 Euro area countries (section 5). The section 6 discusses the Multilateral Divisia monetary aggregates for the union EMU-19 is followed by the conclusion in section 7.

2. Aggregation within the Euro area

Let m_{kji} be nominal per capita holdings of asset $i \in \{1,2,3,\ldots,N\}$, located or purchased in country j, and owned by an economic agent in country k. Then let r_{kji} be the holding period after-tax yield on m_{kji}. The benchmark rate of return (on pure capital), R_k, is computed following Barnett et al (2013)[1].

[1] The details of computation of the benchmark rate of return, R_k, is explained in appendix A

The real user cost price of asset i, located or purchased in country j, and owned by residents of country k at time t, is given by $\pi^*_{kji}(t) = (R_t(t) - r_{kji}(t))/(1 + R_t(t))$, and the corresponding nominal user cost is $\pi_{kji} = p^*_k \pi^*_{kji}$. It measures the foregone interest or opportunity cost of holding monetary asset i, when the higher yielding benchmark asset could have been held (Barnett (1978)).

Assuming m_{kji} is positive, so that $S_k = \{(i, j) : m_{kji} > 0 \text{ for all } i, j\}$, the Divisia growth rate of the nominal per-capita monetary services aggregate, M_k, for each country, k, is

$$d \log M_k = \sum_{(i,j) \in S_k} w_{kji} \, d \log m_{kji} . \tag{1}$$

Similarly, the Divisia growth rate of the monetary, nominal, user-cost price aggregate, Π_k, is

$$d \log \Pi_k = \sum_{(i,j) \in S_k} w_{kji} \, d \log \pi_{kji} , \tag{2}$$

where

$$w_{kji} = \frac{\pi^*_{kji} m^*_{kji}}{\sum_{(i,j) \in S_k} \pi^*_{kji} m^*_{kji}} = \frac{(R_k - r_{kji}) m_{kji}}{\sum_{(i,j) \in S_k} (R_k - r_{kji}) m_{kji}} , \tag{3}$$
$$\sum_{(i,j) \in S_k} w_{kji} = 1$$

with $0 \leq w_{kji} \leq 1$ for all $k \in \{1, \ldots\ldots, K\}$, $j \in \{1, \ldots, K + Z\}$, $i \in \{1, \ldots\ldots, N\}$, and with $\sum_{(i,j) \in S_k} w_{kji} = 1$ for all k.

3. Aggregation over countries

The euro area's nominal per-capita monetary service flow, M, is given by

$$d\log M = \sum_{k=1}^{K} W_k \, d\log(s_k M_k), \tag{4}$$

while the euro area's nominal monetary user-cost price, Π, is defined by

$$d\log \Pi = \sum_{k=1}^{K} W_k \, d\log \Pi_k, \tag{5}$$

where $s_k = \frac{H_k}{\sum_{k-1}^{K} H_k}$ is the population share of country, k, and

$$W_k = \frac{M_k^* \Pi_k s_k}{\sum_{k=1}^{K} M_k^* \Pi_k s_k}. \tag{6}$$

The corresponding discrete-time Divisia index for the Euro area is acquired by replacing the instantaneous differentials $d\log(z_t)$ by finite changes between periods, $\log(z_t) - \log(z_{t-1})$, and the instantaneous shares, W_{kt}, by $(W_{kt} + W_{k,t-1})/2$.

4. Data source and description

The data for monetary services and the corresponding interest rates are from the European Central Bank (ECB) and the central banks of the member countries of the Euro area. The Divisia monetary aggregates in this paper are monthly and start from January 2003.

Our M1 and M2 monetary aggregate components follow the ECB definition. The ECB defines the M1 monetary aggregate to include currency in circulation and overnight deposits; M2 includes the components of the M1 aggregate, along with deposits with agreed maturity up to 2 years (DAM), and deposits redeemable at notice up to 3 months (DRN). In this analysis, Divisia

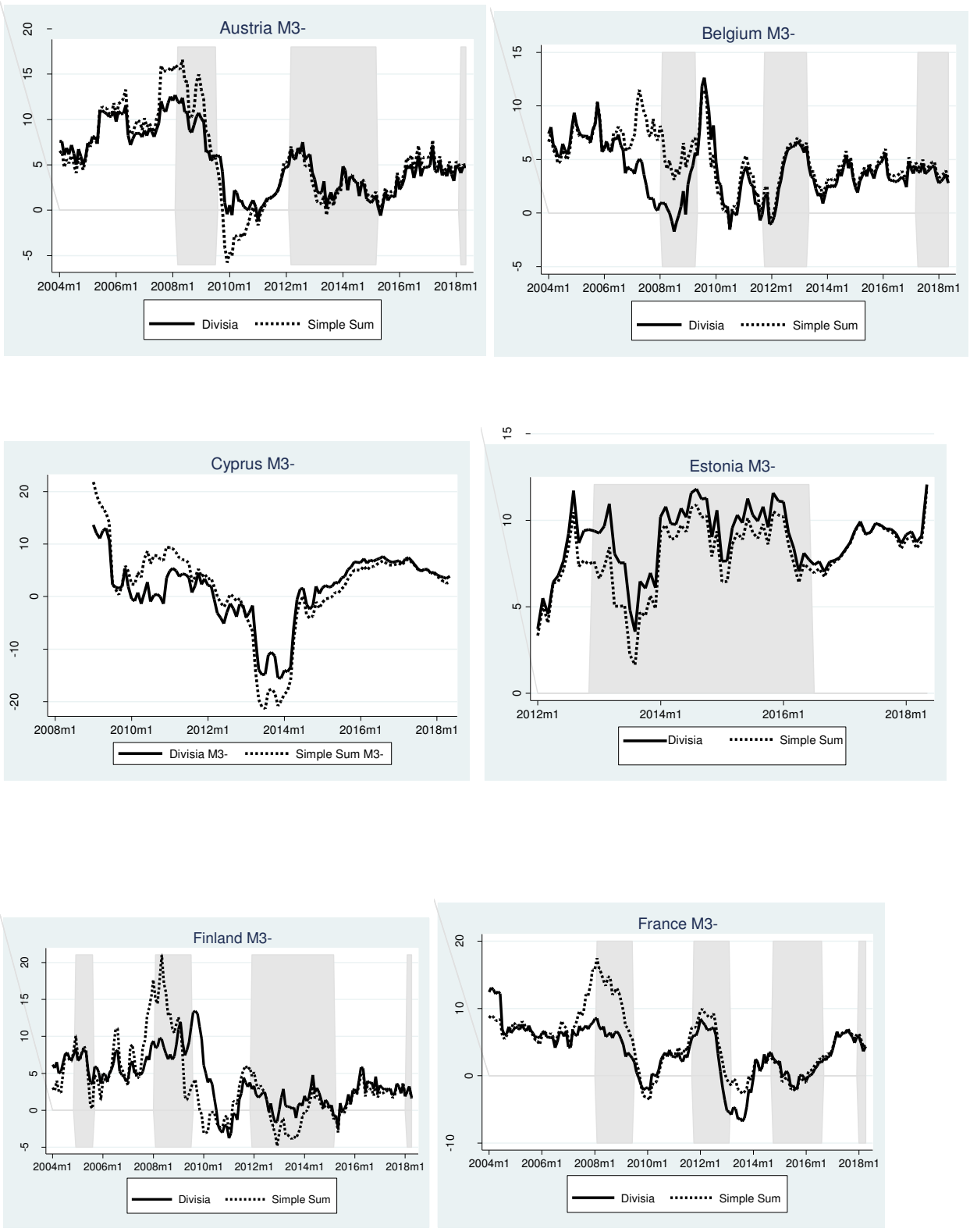
M3- (M3 minus) contains the components of M2 along with debt securities with a maturity of up to two years.[2]

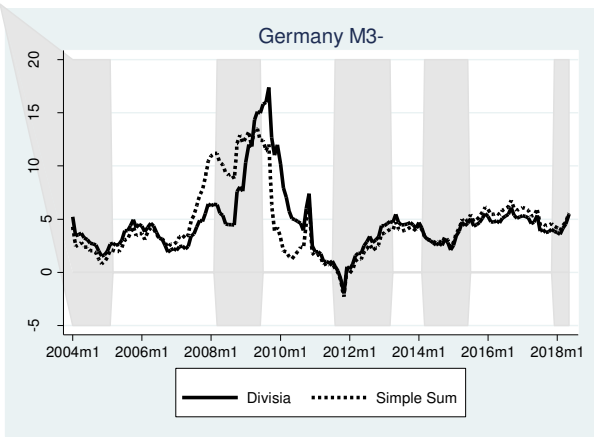
5. Divisia Monetary aggregates for the Euro area countries

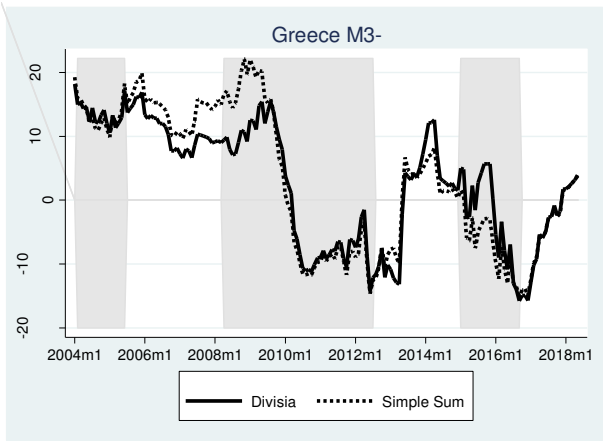
The construction of individual countries' Divisia monetary aggregates is prerequisite to the construction of multilateral Divisia monetary aggregates for the Euro Area. The single country Divisia monetary aggregates are constructed for the 19 Euro area countries: Austria, Belgium, Cyprus, Estonia, Finland, France, Germany, Greece, Ireland, Latvia, Lithuania, Italy, Luxembourg, Malta, Netherlands, Portugal, Slovakia, Slovenia and Spain. Figure 1 shows the Divisia M3- aggregate for 19 countries, the shaded grey area in the graph of the country shows the recession periods for that country. The year over year percentage change in the Divisia M3- aggregate is compared with the corresponding simple sum aggregate for the 19 countries.

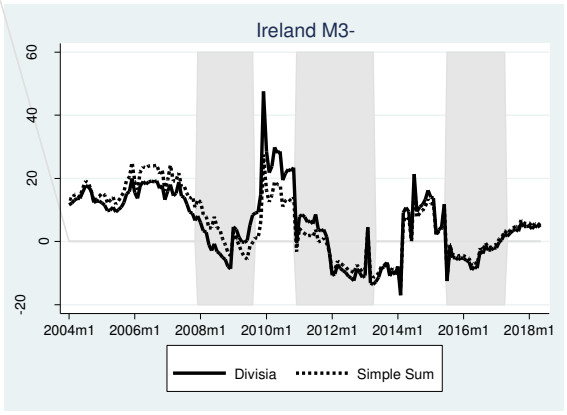
[2] The details of data sources are given in appendix A.

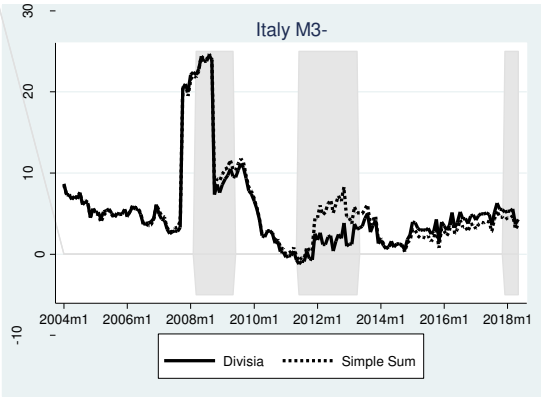
Figure 1: The year over year percentage change of the monetary aggregates for the 19 Euro area countries.

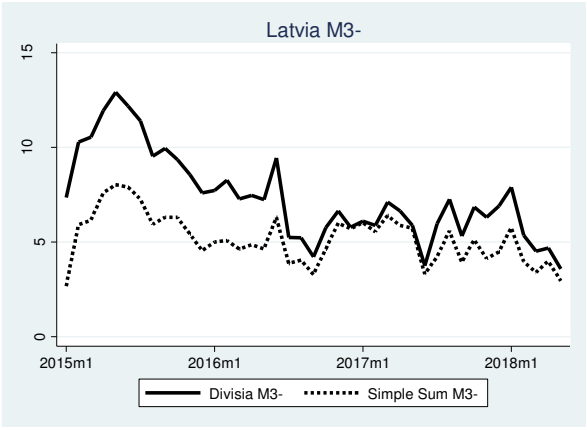


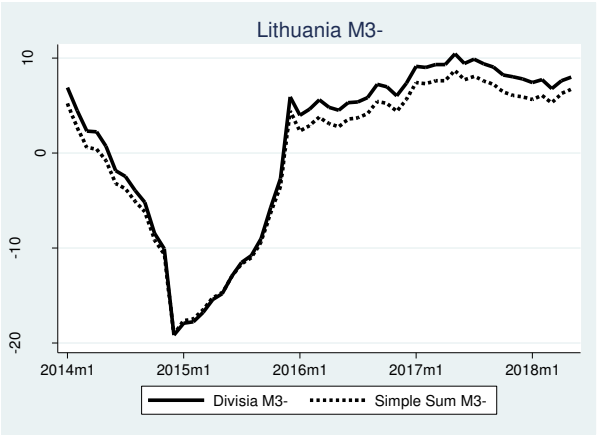

Germany M3-
20
15
10
5
0
-5
2004m1
2006m1
2008m1
2010m1
2012m1
2014m1
2016m1
2018m1
Divisia
Simple Sum

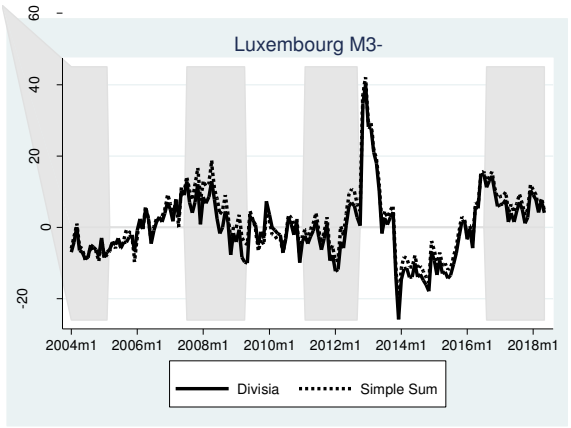

Greece M3-
20
10
0
-10
-20
2004m1
2006m1
2008m1
2010m1
2012m1
2014m1
2016m1
2018m1
Divisia
Simple Sum

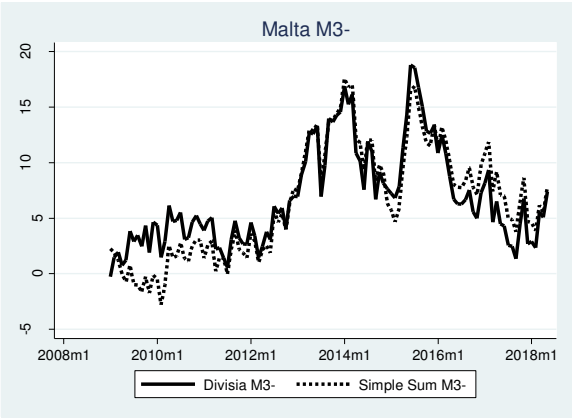

Ireland M3-
60
40
20
0
-20
2004m1
2006m1
2008m1
2010m1
2012m1
2014m1
2016m1
2018m1
Divisia
Simple Sum

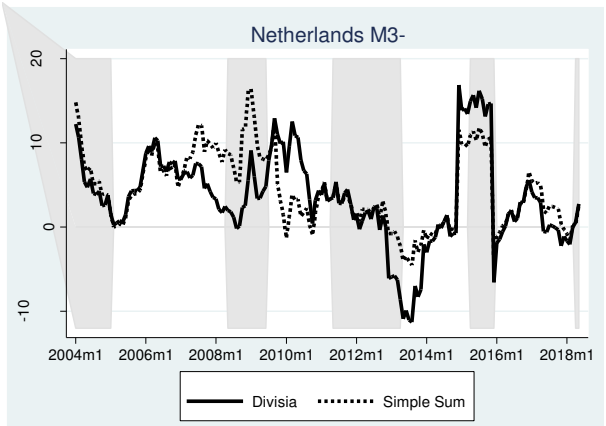

Italy M3-
30
20
10
0
-10
2004m1
2006m1
2008m1
2010m1
2012m1
2014m1
2016m1
2018m1
Divisia
Simple Sum

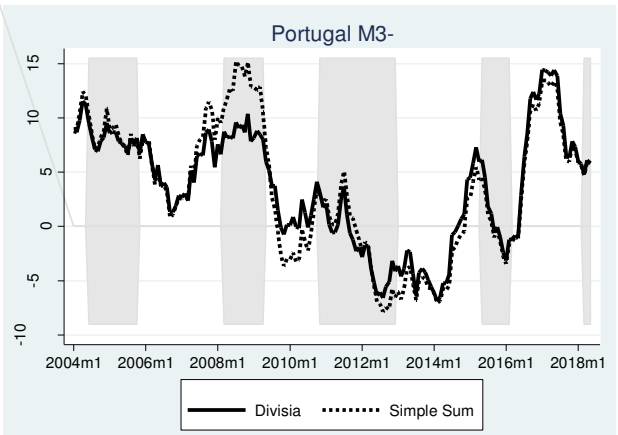

Latvia M3-
15
10
5
0
2015m1
2016m1
2017m1
2018m1
Divisia M3-
Simple Sum M3-

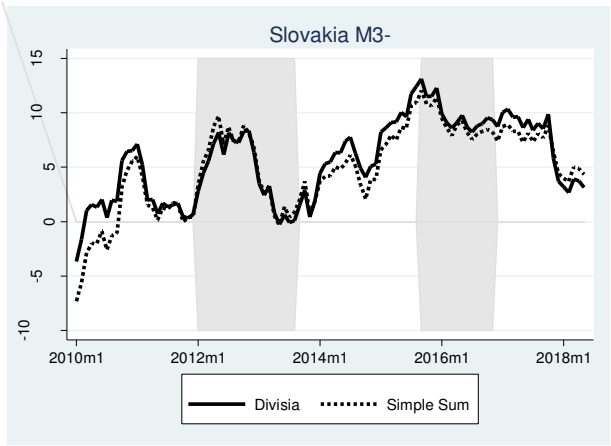

Lithuania M3-
10
0
-10
-20
2014m1
2015m1
2016m1
2017m1
2018m1
Divisia M3-
Simple Sum M3-

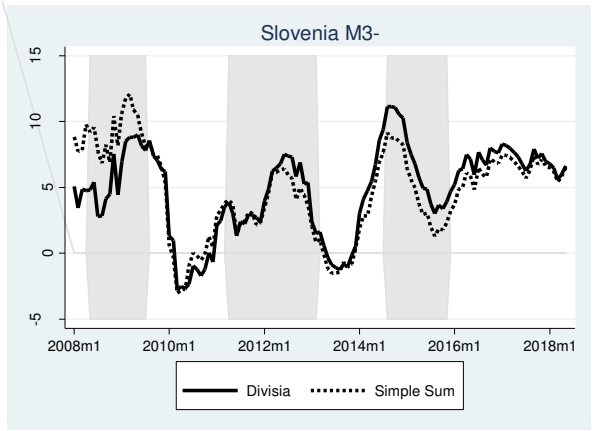

Luxembourg M3-
60
40
20
0
-20
2004m1
2006m1
2008m1
2010m1
2012m1
2014m1
2016m1
2018m1
Divisia
Simple Sum

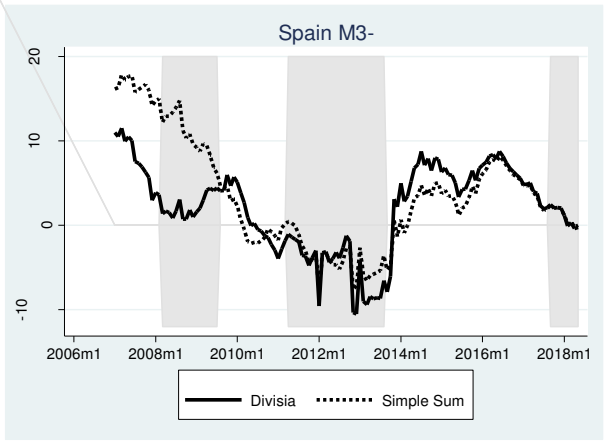

Malta M3-
20
15
10
5
0
-5
2008m1
2010m1
2012m1
2014m1
2016m1
2018m1
Divisia M3-
Simple Sum M3-


Netherlands M3-
20
10
0
-10
2004m1
2006m1
2008m1
2010m1
2012m1
2014m1
2016m1
2018m1
Divisia
Simple Sum


Portugal M3-
15
10
5
0
-5
-10
2004m1
2006m1
2008m1
2010m1
2012m1
2014m1
2016m1
2018m1
Divisia
Simple Sum


Slovakia M3-
15
10
5
0
-5
-10
2010m1
2012m1
2014m1
2016m1
2018m1
Divisia
Simple Sum


Slovenia M3-
15
10
5
0
-5
2008m1
2010m1
2012m1
2014m1
2016m1
2018m1
Divisia
Simple Sum



6. Multilateral Divisia monetary aggregates for the union EMU-19

The growth rates of the multilateral Divisia monetary aggregates are weighted averages of the growth rates of the countries' Divisia monetary aggregates. The weights used in the aggregation include the country's population share in the union, the countries' monetary aggregates, and the countries' user-cost aggregates. Figure 2 shows the expenditure weights for the countries, computed using equation 6. Figure 3 shows the multilateral Divisia M3- monetary aggregate and the user-cost aggregate for the EMU 19 union, where the shaded grey areas show the recession periods for the European Monetary Union.

Figure 2: Expenditure weights (average) for the 19 Euro area countries.

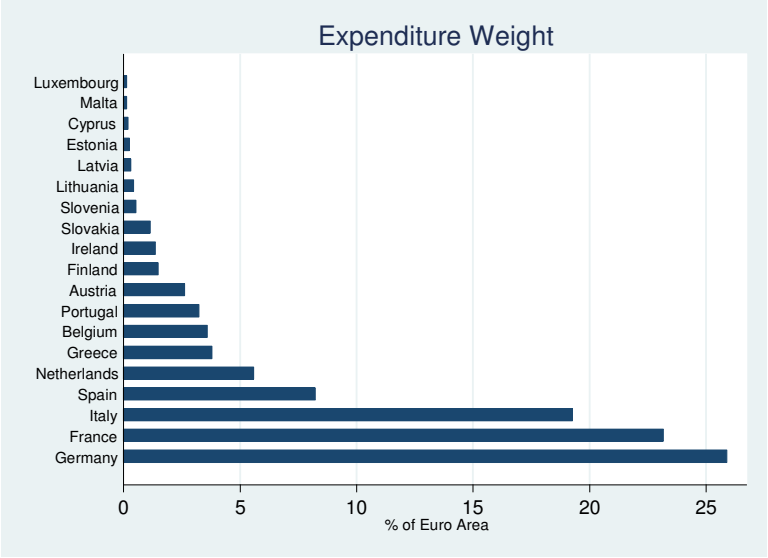
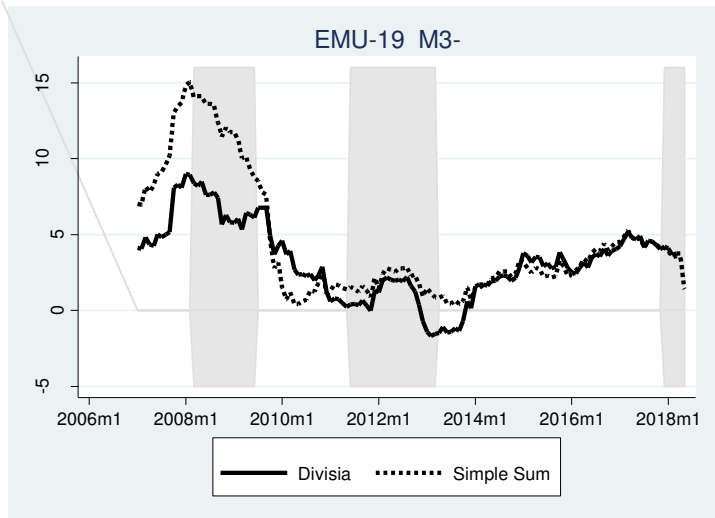
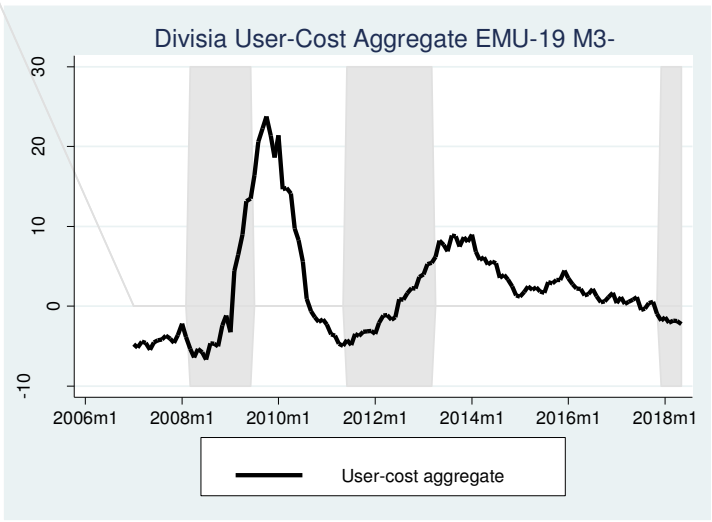


Figure 3: The year over year percentage change of the monetary aggregates and the user cost aggregate for the EMU 19 union.





The Divisia monetary aggregate at the country level is a weighted aggregate of the user-costs (opportunity cost of holding an asset, which in turn depends on the interest rate of the monetary services) and price level of the country. The multilateral Divisia monetary aggregate at the union level is a weighted aggregate of the user-cost aggregates of countries, monetary aggregates of the countries, population share of the countries and the price level of the countries. This higher information content of the multilateral Divisia monetary aggregates makes them more representative of the economic union EMU-19. The multilateral Divisia monetary aggregate deviated from the simple sum monetary aggregates for the EMU-19 during the times of recession or the periods of uncertainty (where the interest rates are high or low). For example, in case of a few countries like Finland, France, Latvia and the Netherlands, the interest rate on deposits with agreed maturity of 2 years (DAM) was very high for few months, (even higher than the loan rate).[3] These high interest rates of the monetary services lowers the user-cost of the monetary services,

[3] The countries and the periods have been discussed in the Appendix A.1 Benchmark rate.

in turn lowering the Divisia monetary aggregate and the user cost aggregate for these countries. These country Divisia monetary aggregates and its use-cost aggregates which have the information content of interest rates of the monetary services of the country, are used in the multilateral Divisia monetary aggregates for Euro area. Hence the multilateral Divisia monetary aggregates capture the information content of the interest rates of the monetary services of the countries.

The Divisia monetary aggregates for the 19 EMU countries and the multilateral Divisia monetary aggregates for the economic union EMU, show the following two features: Firstly, the Divisia monetary aggregates deviate from the simple sum aggregates during the times of recession (the shaded grey area in the graphs). Secondly, the Divisia monetary aggregates are lower than the corresponding simple sum aggregates for the recession. These observations are consistent with the findings of Barnett and Chauvet (2011) for the US data.

7. Conclusion

With US monetary data, Barnett and Chauvet (2011) have observed that a divergence of the Divisia monetary aggregates from their simple sum monetary aggregates can provide a signal for impending financial instability. Rayton and Pavlyk (2010) have shown that the Divisia and the simple sum monetary aggregates did not correlate at the start of the recent economic crisis. Chan and Nautz (2015) found that the information content of the two indices diverged for the Great recession in Germany. Our individual country Divisia monetary aggregates and the multilateral Divisia monetary aggregates for the EMU 19 union show a divergence from the corresponding simple sum monetary aggregates and are lower than the corresponding simple sum monetary aggregates during the recent 2008-2009 economic crisis and the Euro area debt crisis.

In the single country case, the Divisia monetary aggregates have repeatedly been found to be better measures in terms of policy criteria than the simple sum (see, e.g., Barnett, Offenbacher and Spindt (1981, 1984), Belongia and Ireland (2006, 2014, 2015a,b, 2016), Serletis and Xu (2020), Schunk (2001)). Given the prominent role assigned to money in the two-pillar strategy of the ECB, the country Divisia aggregates and the multilateral Divisia monetary aggregates for the Euro Area can be helpful tools in policy research.

This paper focuses on the multilateral Divisia monetary aggregates for the Euro area. The multilateral Divisia monetary aggregates are a theoretically consistent monetary services measure for an economic union, such as the Euro area (Barnett 2007). The multilateral Divisia aggregates assume the existence of homogeneity within the Euro area countries, but heterogeneity across countries within the economic union. Hence, these indices can capture the impact of interest rates of different countries more precisely. For example, the interest rates in Spain are different from interest rates in Germany, this difference is captured in the multilateral Divisia monetary aggregates. This kind of important information content will be lost if an analysis assumes homogeneity across the Euro area, assuming it to be single country. The multilateral Divisia monetary aggregates being theoretically consistency and are based on the assumption of heterogeneity across countries make these indices a useful tool in policy research. The multilateral Divisia monetary aggregates indices for the economic union of 19 countries of Euro area (EMU 19) are lower than the corresponding simple sum monetary aggregates for the recession periods. This divergence of the multilateral Divisia monetary aggregates from the simple sum monetary aggregate for the recession periods can provide signal of a recession as shown in Barnett and Chauvet (2011).

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