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The Information Content of Monetary Statistics for the Great Recession: Evidence from Germany

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The Information Content of Monetary Statistics for the Great Recession: Evidence from Germany

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Abstract

This paper introduces a Divisia monetary aggregate for Germany and explores its information content for the Great Recession. Divisia money and the corresponding simple sum aggregate are highly correlated in normal times but begin to diverge before the crisis. Out of sample forecast analysis and a conditional forecast exercise show that the predictive content of this divergence for the Great Recession is not only statistically significant, but also economically important.

Keywords: Monetary aggregates, Divisia index, recession indicator, Great Recession

JEL classifications: E27, E32, E51, C43

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1 Introduction

In the early years of the European Monetary Union, the European Central Bank placed a lot of emphasis on the information content of monetary aggregates. Following the tradition of Deutsche Bundesbank, the European Central Bank even published a reference value for the growth of a broad monetary aggregate through 2003. In view of increasing doubts concerning the ability of monetary aggregates to provide reliable information about the stance of monetary policy and future output, monetary aggregates almost disappeared from monetary analysis. It was only after the onset of the financial crisis, when short-term interest rates reached their lower bound, that the analysis of monetary aggregates regained attention.

However, monetary analysis is not restricted to monitoring the growth of only traditional simple sum monetary aggregates. The Divisia monetary aggregates introduced by Barnett (1980) especially stand out because they are the optimal aggregate measure of liquidity services provided by monetary assets with different opportunity costs. This allows Divisia aggregates to provide additional information for monetary analysis. In particular, shifts from one type of monetary asset into another may significantly change the liquidity conditions of the economy and, thus, the Divisia aggregate. In contrast, simple sum aggregates do not change even if there are large shifts in their composition. Early evidence of superior forecasting ability of U.S. Divisia aggregates for output relative to simple sum aggregates is provided by Schunk (2001).

Barnett and Chauvet (2011) observe that from the 1960s to 2005, the U.S. monetary aggregates and their Divisia counterparts diverge more during times of high uncertainty than in times of stability. They suggest that this divergence can be used as a signal for impending recessions. For the U.K. Rayton and Pavlyk (2010) demonstrate that the correlation between Divisia and simple sum monetary aggregates broke down before the start of the recent crisis. Our paper builds on these contributions and provides new evidence about the information content of Divisia monetary aggregates for the Great Recession.

To that end, we construct the Divisia M3 for Germany, the largest economy in the Euro Area. We focus on German data because, as Barnett (2003) already emphasized, constructing a Divisia index for the entire Euro Area would require strong homogeneity assumptions throughout Euro Area economies. In light of the heterogeneous economic development across member countries in the aftermath of the financial crisis, analyzing country-specific data has become even more important. This paper provides first evidence on the predictive content of the divergence between M3 and its Divisia counterpart for German output growth in the run-up to the Great Recession.

Our empirical results clearly demonstrate that there is an additional information content of Divisia money for German output. First, in line with earlier evidence found for the U.S. and the U.K. we find that M3 and its Divisia counterpart start to diverge before the Great Recession in Germany as well. Second, we find that output forecasts based on the divergence between M3 and Divisia M3 significantly outperform those based on a single aggregate, either Divisia or simple sum. A conditional forecasting exercise illustrates that the information content of the divergence is not only statistically significant, but also economically important. In Germany, the crisis-related movements in the divergence of monetary aggregates are mainly due to significant changes in the volume of time deposits. This finding is in line with recent evidence provided by Acharya and Mora (2015). They show that fluctuations in both the interest rates and the quantity of time deposits in the U.S. are caused by weak banks in the run-up to the financial crisis.

The rest of the paper is structured as follows. In Section 2, we describe how Divisia money is constructed for Germany and compare it with its simple sum counterpart. Section 3 provides the out of sample forecasts of output growth rates for the crisis period and compares the forecasting ability of competing models. Section 4 summarizes our findings and offers some concluding remarks.

2 A Divisia Monetary Aggregate for Germany

2.1 Divisia Monetary Aggregates in Theory

Different components of monetary aggregates, such as cash and long-term deposits, are characterized by very different levels of liquidity and monetary service. Yet, in a conventional simple sum monetary aggregate cash and long-term deposits are treated as perfect substitutes for each other. As a consequence, the simple sum aggregate does not change even if there are significant shifts in its composition. For example, when time deposits are withdrawn on a large scale and completely changed into cash, the simple sum aggregate remains unaffected while the liquidity conditions of the economy change dramatically.

The Divisia monetary aggregate introduced by Barnett (1980) is based on the optimization of a decision maker's utility function subject to an expenditure budget for monetary services with different user costs. Therefore, the substitution effects that are typically ignored in the simple sum aggregate are captured by the Divisia aggregate. Suppose the simple sum monetary aggregate contains I different components M_i $(i = 1, , , I)$. The growth rate of the corresponding Divisia monetary aggregate is obtained as a weighted average of the growth rates of its components:

$$\Delta ln \text{ Divisia} = \sum_{i=1}^{I} \tilde{w}_i \Delta ln M_i \tag{1}$$

where the weights $\tilde{w}_i$ are a moving average of $w_i = \frac{u_i M_i}{\Sigma u_i M_i}$. u_i is the relative user cost defined as $u_i = \frac{R - r_i}{1+R}$. r_i is the rate of the i_{th} component where the rate of cash is set to be zero. R is the benchmark rate, which theoretically is defined as the rate of return on pure capital that provides no liquidity services. The spread $R - r_i$ thus measures the foregone price or opportunity cost of holding monetary asset i, which is an indicator of its degree of liquidity. $\tilde{w}_i \Delta ln M_i$ is the weighted contribution of the i_{th} component to the Divisia growth. These weighted contributions are often used to provide more detailed information about the factors driving the development of Divisia aggregates over time.[1]

If the monetary components are perfect substitutes of each other, i.e., if r_i are identical for all i, then the Divisia money collapses to the simple sum money. In reality, however, interest rates r_i may well differ. Therefore, the instruments are generally imperfect substitutes. The higher a monetary component's rate r_i, the less liquid it is. When a monetary component has less liquidity, the Divisia aggregate accounts for this by giving that component less weight. As a consequence, changing interest-bearing time deposits into non-interest bearing cash leads to no change in simple sum money, but to an increase of the Divisia aggregate.

2.2 Constructing a German Divisia Index

The European Central Bank does not officially publish Divisia monetary aggregates, either for its member countries or for the entire Euro Area. In this subsection, we construct a M3 related Divisia monetary aggregate for Germany in accordance with Stracca (2004) and Barnett et al. (2013).

Choosing an appropriate proxy for the benchmark rate R is the first and foremost step in constructing Divisia money. We follow Barnett et al. (2013) and use the interest rates of loans to non-financial corporations with a maturity up to one year as the proxy for the benchmark rate.[2] This short-

[1] Weighted contributions of US Divisia monetary aggregates are reported on a monthly basis by the Center for Financial Stability.

[2] The Bank of Israel also uses this type of short-term loan rate for computation of their

term loan rate is always greater than the interest rates on deposits, since a bank will not pay out to depositors more than it earns on short-term loans.

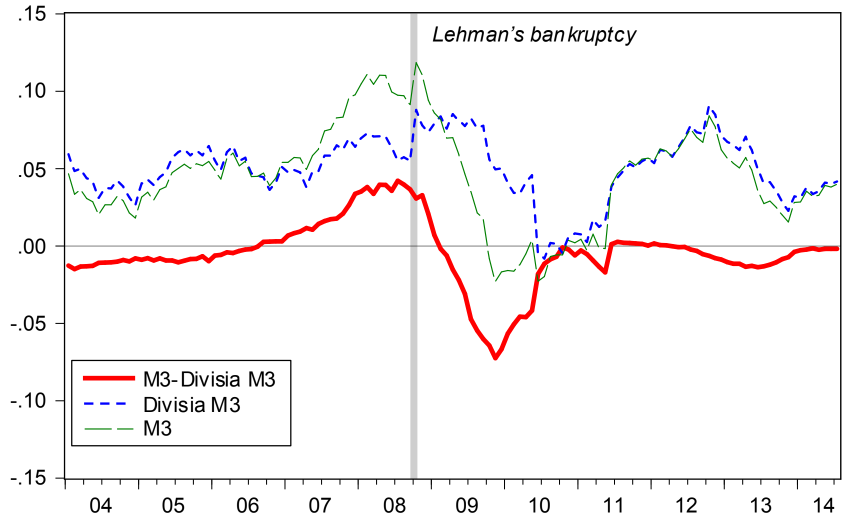
We break down M3 into five components: (i) currency in circulation, (ii) overnight deposits, (iii) deposits redeemable at three months' notice, (iv) time deposits with maturity up to two years, and (v) marketable instruments. Seasonally adjusted monthly observations of quantities of German monetary assets are obtained from the website of the Deutsche Bundesbank. The only exception refers to currency circulated in Germany because the outstanding amount of currency can be only observed for the whole Euro Area. The proxy for currency circulated in Germany is the one published by ECB. Accordingly, it is defined as the total currency in the Euro System multiplied by the share of the European Central Bank's capital belonging to the Deutsche Bundesbank.

The interest rate data are taken from the MFI interest rate statistics set out in Regulation ECB/2001/18, see Figure 5 in the appendix. MFI interest-rate statistics are available from 2003 onwards. Accordingly, our sample period runs from January 2003 up to July 2014. Rates of return to marketable instruments are represented by the short-term money market rates, see Stracca (2004). More details about the data used in the construction of Divisia M3 are provided in Table 3 in the Appendix.

Figure 1 shows the annual growth rates of the Divisia M3, the simple sum M3 and the divergence between the two series. Note that the growth rate of M3 starts to rise faster than the Divisia M3 before the crisis. In fact, the greatest difference between the two occurs just before the bankruptcy of Lehman Brothers. After the outbreak of crisis, the divergence shifts to negative values because growth of Divisia M3 became significantly larger than M3 growth. Interestingly, the behavior of the German Divisia aggregate is in line with Barnett and Chauvet (2011), which point out that the U.S. simple sum monetary aggregates and their Divisia counterparts diverge the

Divisia monetary aggregates, see Offenbacher and Shachar (2011).

Figure 1: M3, Divisia M3, and their divergence



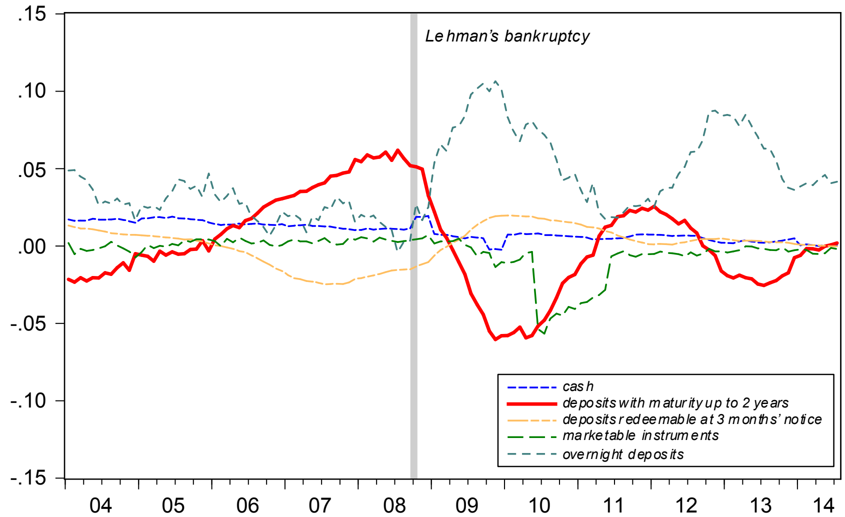
Notes: Annual growth rates of the Divisia M3, the simple sum M3 and their divergence for Germany. The divergence is the largest right before the bankruptcy of Lehman Brothers.

most around recessions.

2.3 What Drives the Divergence Between M3 and its Divisia Counterpart?

Why did M3 and Divisia M3 start diverging before the crisis? Figure 2 depicts weighted contributions of the five monetary components to Divisia M3 growth. It is striking that the share contributed by time deposits has experienced accelerating growth before the crisis. In 2007, the growth rate of the time deposits' contribution increased dramatically, in contrast to little growth or a slight decrease in the other types of monetary assets. After the default of Lehman Brothers, the time deposits' contribution fell sharply.

Figure 2: Weighted contributions to Divisia M3 growth



Notes: The weighted contribution of the i_{th} *monetary asset is* $\tilde{w}_i \Delta ln M_i$*, see Eq. 1. The weighted contribution of deposits up to two years to Divisia M3 growth kept rising until the Lehman's bankruptcy and fell sharply afterwards.*

Both the magnitude and timing of the turning points of the time deposits' contribution match well with those of the divergence between M3 and Divisia M3 shown in Figure 1.

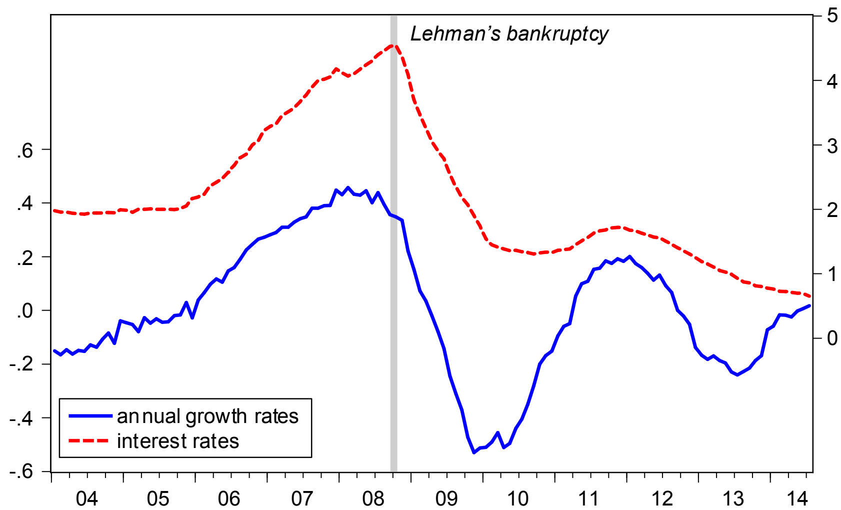
In order to illustrate the effects of the weighting scheme on the divergence between Divisia M3 and M3, consider the following simple numerical example. Suppose in the simple sum aggregate, each of the five monetary components is given the same weight, 20%. Suppose further that in the Divisia monetary aggregate, time deposits are given a weight of only 10% because of their lower opportunity cost.[3] As a result, a 40% growth in time deposits leads to a 8% ($0.2 \times 40\%$) rise in the simple sum growth, but only

[3]Figure 6 in the appendix depicts the actual weight of each monetary component used for the construction of the Divisia index.

a 4% (0.1 × 40%) rise in the Divisia money growth. The strong growth of time deposits has a more dramatic impact on the simple sum aggregate because the lower liquidity of time deposits is not appropriately accounted for. Before the crisis, this effect was further amplified by the increase in the interest rate for time deposits, see Figure 3.

A possible explanation for the rapid growth of time deposits before the Lehman bankruptcy and the subsequent sharp fall has been recently proposed by Acharya and Mora (2015). Investigating the deposit rates and inflows during the crisis periods in the U.S. they found that banks that are weak and short of liquidity tended to offer high rates in order to attract deposits, especially when competition for deposits was intense.

Figure 3: The interest rate and the growth rate of time deposits



Notes: The interest rate (right scale) and the annual growth rate (left scale) of the volume of deposits with maturity up to 2 years in Germany. Source: Deutsche Bundesbank.

Before the outbreak of the crisis, Germany was the second largest source of asset-backed securities (ABS) next to the US. In 2007, when ABS was no longer highly rated, some German financial institutions also faced a liquidity shortage. Figure 3 shows that the interest rate of time deposits kept rising to as high as almost 4.5% by the end of 2008. The annual growth rate of time deposits in Germany peaked up to 46% just before the Lehman Bankruptcy. This pattern was reversed in the subsequent months and bottomed out at minus 53% in November 2009. Therefore, the soaring growth of time deposits in Germany might have also be related to fundamentally weak banks actively seeking deposits to meet their liquidity needs.

3 Forecasting Output Growth in the Great Recession With Monetary Statistics

3.1 Out of Sample Forecasts

In this section, we investigate the information content of M3, Divisia M3 and their divergence using an out-of-sample forecasting exercise for German output growth. Following Barnett and Chauvet (2011), the focus of the analysis is on whether monetary statistics could have been used as a signal for the Great Recession. Therefore, all forecasting models are estimated using pre-crisis data only. Specifically, the estimation period ends in August 2008, right before the Lehman breakdown. The resulting forecasts are evaluated for the subsequent crisis-related period of economic turbulence. In Germany, a plausible ending point of the Great Recession and the corresponding recovery period is December 2010, but our main results are not affected by that choice.[4]

Following Schunk (2001) , we base our analysis on VAR models including

[4]Note that a forecast comparison of M3 and Divisia M3 for longer periods is less interesting because the growth of M3 and Divisia M3 is very similar in these normal times, see Figure 1.

the monetary statistic under consideration and monthly data for the annual growth rate of industrial production, the common proxy for output growth. For each of the three monetary statistics under consideration, the lag-length of the VAR is three, as selected by the AIC criterion.[5]

Table 1: MSE of forecast errors for output during the Great Recession

	Divisia Model	M3 Model	Divergence Model
3 month ahead	0.188	0.153	0.125
4 month ahead	0.280	0.232	0.181
5 month ahead	0.350	0.286	0.224
6 month ahead	0.363	0.295	0.225

Notes: The table shows the MSE of forecast errors for German output growth. Forecasts are based on VARs estimated over the pre-crisis period including output growth and one of the following monetary statistics: M3, Divisia M3, and their Divergence. The out-of-sample period (2008M09 -2010M12) consists of 28 month which allows us to evaluate 23 rounds of output forecasts for each horizon.

We evaluate the forecast ability of monetary statistics and the corresponding VARs based on the mean squared error (MSE) of forecasts from 3 to 6 month ahead. Table 1 summarizes the results of the out-of-sample forecasting exercise. Apparently, confirming the conjecture of Barnett and Chauvet (2011), the Divergence Model estimated for Germany outperforms its competitors for all forecasting horizons.[6] However, in contrast to Schunk (2001), our results do not indicate a superior forecasting ability of the pure

[5]KPSS tests confirm that the forecasting models are stationary over the sample period. For brevity, results of KPSS tests and further diagnostics of the estimated VARs are not presented but are available on request.

[6]For sake of completeness, we also compare the forecasting performance of the monetary models to a benchmark AR model. The results show that the Divergence Model outperforms the AR model for longer horizons.

Divisia index. In fact, irrespective of the forecasting horizon, the second best forecasting model is the VAR based on M3, i.e., the simple sum aggregate.

3.2 Forecast Accuracy Tests

Let us now investigate whether the superior information content of the Divergence Model suggested in Table 1 is also statistically significant. To this end, we employ the forecast accuracy test proposed by Diebold and Mariano (1995) that has become a standard tool to compare the forecasting ability of non-nested models. The DM-test statistic is based on the loss differential $d_t = e_{1,t}^2 - e_{2,t}^2$, where $e_{1,t}$ and $e_{2,t}$ are the forecast errors of the two models under investigation. Specifically, the DM-statistic is defined as follows:

$$DM = \frac{\bar{d}}{\sqrt{\frac{2\pi \hat{f}_d(0)}{T}}} \tag{2}$$

where the numerator $\bar{d}$ is the mean of the loss differential. The denominator stands for the heteroscedasticity and autocorrelation-consistent (HAC) variance estimator by Newey and West (1994), which uses the Bartlett kernel and a data-determined bandwidth. Under the null of equal forecast accuracy the DM statistic is asymptotically normally distributed. However, empirical applications of the DM-test may suffer from a small sample bias. Therefore, we also apply the modified DM test proposed by Harvey et al. (1997). This modified DM test differs from the original DM test in two ways. First, the DM test statistics is adjusted by $\sqrt{\frac{T+1-2h+h(h-1)/T}{T}}$, where $T = 23$ denotes the number of forecast errors, and $h = 3, 4, 5, 6$ is the forecasting horizon. Second, the statistic is compared to the critical values from a Student's t distribution rather than a normal distribution. As confirmed by Clark (1999), the modified DM test suffers relatively small size distortions in small samples compared against the DM test and several other competing tests with HAC variance estimators.

Table 2: Tests of equal predictive accuracy between the M3 Model and the Divergence Model

	the DM test	the modified DM test
3 month ahead	3.142^{***}	2.787^{***}
4 month ahead	2.359^{**}	1.984^{*}
5 month ahead	3.186^{***}	2.533^{***}
6 month ahead	2.907^{***}	2.179^{***}

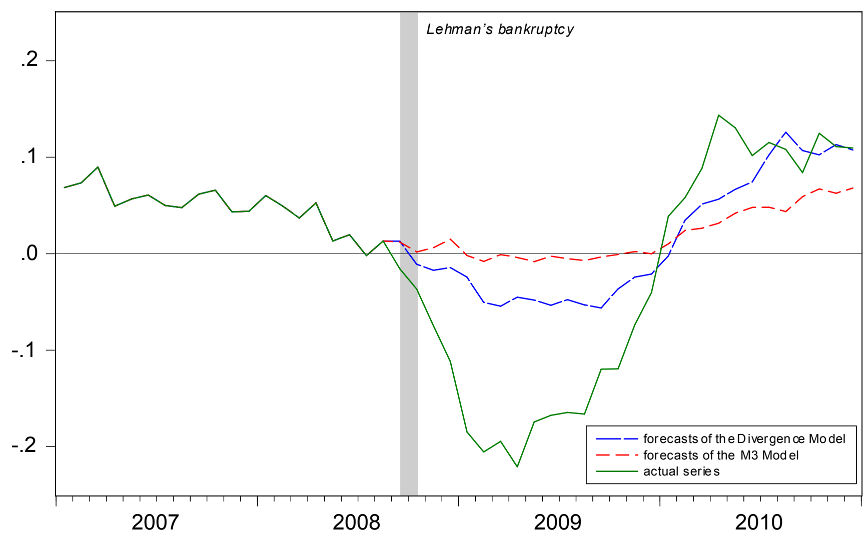
Notes: This table presents test results on H0: forecast errors from the Simple sum Model and the Divergence Model are equal. Forecasting periods cover from September 2008 to December 2010. **significant at the 10% level ,* ** *significant at the 5% level,* *** *significant at the 1% level.*

Table 2 presents the results from both version of the DM tests applied to the M3 Model and the Divergence Model. For all forecast horizons, the null hypothesis of equal forecasting accuracy is rejected by the DM test at either 1% significance level or 5% significance level. After small sample correction, the modified DM test results still show rejection of the null hypothesis at 1% significance level for most forecast horizons. Overall, forecast accuracy tests provide strong evidence that the forecasts from the Divergence Model outperform those from the M3 Model during the Great Recession and the subsequent recovery period.

3.3 Conditional Forecasts

In order to shed more light on the economic relevance of the additional information content of the divergence relative to M3, we also conduct a conditional forecasting exercise for output growth. The forecasts are conditional in the sense that they are generated using the observed values rather than the estimated values of monetary statistics.

Figure 4: Conditional forecasts of output growth around the crisis



Notes: Conditional forecasts of German output growth are based on the bivariate VAR models estimated in Section 3.1.

Figure 4 presents the conditional forecasts of output growth from the Divergence Model and the M3 Model. Forecasting the downturn in industrial production in the Great Recession is clearly more reliable using the information gleaned from the divergence between M3 and Divisia M3. In contrast to the divergence variable, the simple sum monetary aggregate did not signal the severe downturn of the German economy stirred by the Lehman breakdown. Conditional forecasts of output growth obtained from the Divergence Model are also more accurate during the subsequent recovery period.

4 Conclusion

This paper re-investigates the role of money for output during the Great Recession period. In addition to the conventional simple sum monetary aggregates, we consider the theory-founded Divisia monetary aggregate proposed by Barnett (1980). Confirming earlier evidence from the U.S. and the U.K. we find that the German M3 and its Divisia counterpart behave quite differently around the Great Recession. This difference is most clearly seen in the volatile growth of deposits with up to 2 years maturity. As argued by Acharya and Mora (2015), volatile fluctuations in both the interest rates of time deposits and the growth of the quantity of time deposits might be related to weak banks actively seeking deposits when facing a liquidity shortage.

Our quantitative analysis indicates that forecasts of German output growth during the Great Recession and the subsequent recovery period are the most accurate when using a model that includes the information contained in the divergence between Divisia money and simple sum money. This confirms the findings of Barnett and Chauvet (2011) who suggest that this divergence is able to signal U.S. recessions. Our results suggest that the information content of money can be restored if monetary analysis is not restricted to the traditional simple sum monetary aggregates, but is expanded to include Divisia monetary aggregates as well.

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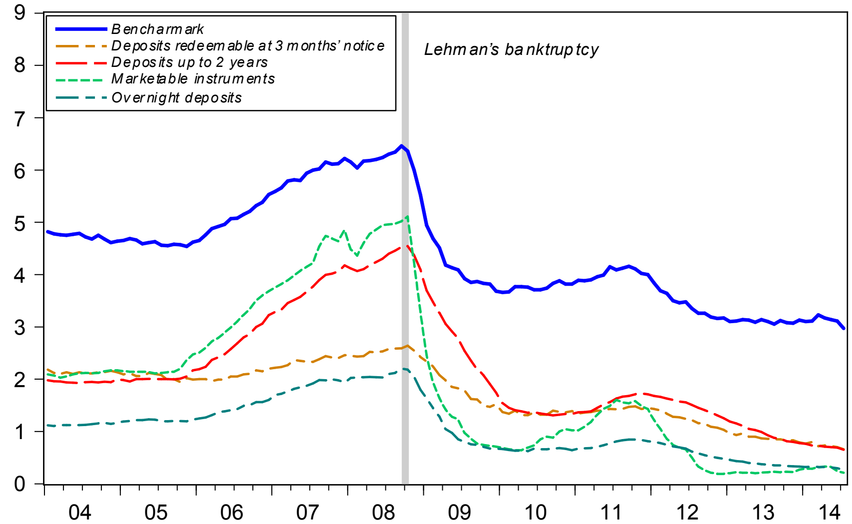
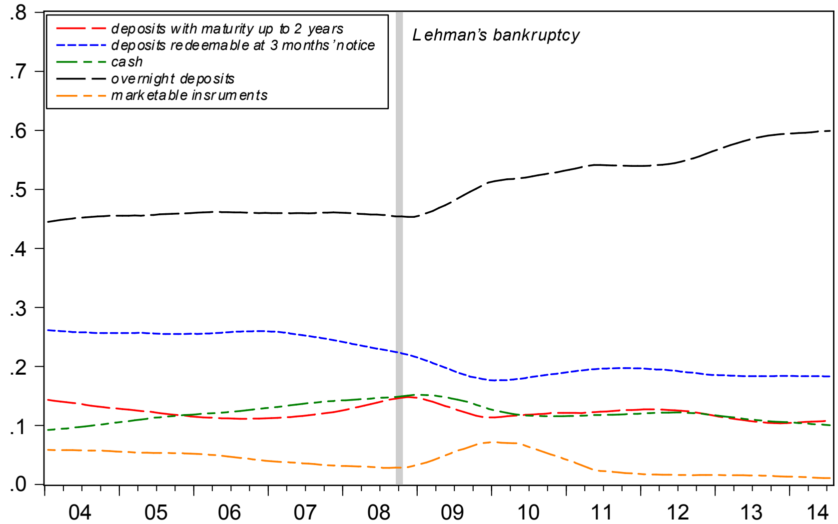
Appendices

Figure 5: The benchmark rate and interest rates of Divisia M3 components



Notes: This graph depicts the benchmark interest rate and the interest rates of monetary components(except cash) included in Divisia M3 aggregate.

Figure 6: The weights of monetary components contained in Divisia M3



Notes: This graph depicts the 12-month moving average of weights attached to each of the five monetary components included in Divisia M3 aggregate, see Equation 1.

Table 3: Sources of monetary time series

	code	source
Currency in circulation	BDTXI300A	Datastream
Overnight deposit (total)	BBK01.TSD304	Deutsche Bundesbank
Overnight deposit (volume from household)	BBK01.SUD201	Deutsche Bundesbank
Overnight deposit (interest rate for household)	BBK01.SUD101	Deutsche Bundesbank
Overnight deposit (volume from non-financial corporations)	BBK01.SUD207	Deutsche Bundesbank
Overnight deposit (interest rate for non-financial corporations)	BBK01.SUD107	Deutsche Bundesbank
Deposits redeemable at 3 months' notice	BBK01.TSD306	Deutsche Bundesbank
Interest rate on deposits redeemable at 3 months' notice	BBK01.SUD105	Deutsche Bundesbank
Deposits with up to 2 years maturity (total)	BBK01.TSD305	Deutsche Bundesbank
Deposits with up to 2 years maturity (volume from household)	BBK01.SUD021	Deutsche Bundesbank
Deposits with up to 2 years maturity (interest rate for household)	BBK01.SUD001	Deutsche Bundesbank
Deposits with up to 2 years maturity (volume from non-financial corporations)	BBK01.SUD023	Deutsche Bundesbank
Deposits with up to 2 years maturity (interest rate for non-financial corporations)	BBK01.SUD003	Deutsche Bundesbank
Marketable instruments	BBK01.TS5379O	Deutsche Bundesbank
EURIBOR three-month	BBK01.SU0316	Deutsche Bundesbank
Rate on loans to non-financial corporations up to 1 year	BBK01.SUD012	Deutsche Bundesbank

Notes: All volume data are seasonally adjusted by the Deutsche Bundesbank except for cash, where we use x-12 ARIMA procedure for seasonally adjustment.

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