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Monetary overhang in times of covid: evidence from the euro area

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ABSTRACT

This paper investigates the determinants of the monetary overhang in the euro area since the outbreak of covid-19. To this end, we estimate a long-run panel money demand function for 18 euro area countries over the period from 2003 to 2019. We calculate the monetary overhang since 2020 as the difference between the actual money stock and the value implied by the money demand function. Making use of cross-sectional heterogeneity and time variation in government responses to covid-19, we relate the monetary overhang to covid-19 response indicators, as well as to confidence indicators. We find that the monetary overhang is significantly related to the level of economic support, the stringency of the containment policy and the economic sentiment indicator.

KEYWORDS

Money demand; covid-19; EMU; panel estimation

JEL CLASSIFICATION

E41; E52

I. Introduction

Ever since central banks in developed countries started to implement unconventional monetary policy measures after the global financial crisis and the European sovereign debt crisis, concerns have been raised that the expansion of their balance sheets would lead to an increase in the money supply and ultimately to high inflation (Wolf 2014). Until recently, however, central banks' liquidity creation has not spilled over into a strong growth in monetary aggregates and has not rekindled inflation. Between 2015 and 2019 the monetary base in the euro area (EA) expanded from €1.2 trillion to €3.2 trillion, yet the broad money supply (M3) expanded from €10.4 trillion to just €13.0 trillion. During this period, the annual inflation rate averaged 0.98% and thus remained well below the ECB's goal of keeping inflation below, but close to, 2% over the medium term. This weak link between base growth, money growth and inflation since the start of the global financial crisis has been explained by a substitution of interbank transactions by central bank intermediation and by the sluggish recovery following the euro crisis (Reichlin 2014; Bonam et al. 2019).

The covid-19 pandemic has reawakened interest in money growth and inflation. As the ECB stepped up its bond buying with the introduction of the Pandemic Emergency Purchase Programme (PEPP), money growth increased to close to 10% in the spring of 2020. European inflation expectations, as measured by the spread between index-linked and nominal bonds, have increased steadily from the trough in March 2020. This has been followed by an increase in actual EA inflation in 2021. The inflation outlook has also become more uncertain, as forecasters grapple with the effects of pent-up demand, international supply chains disruptions, energy prices and government policies on inflation (Glick and Kouchekinia 2021). An important issue is whether high inflation is a transitory phenomenon or, possibly through a wage-price spiral, will become a more permanent feature of the European economy.

The simultaneous increase in money growth and contraction of output in the spring of 2020 May have resulted in a positive monetary overhang, which can be defined as the difference between the observed money stock and some equilibrium value (Liu and Kool 2018). The concept of monetary overhang is often used as a measure of the stance of monetary policy, whereby a positive overhang indicates excess liquidity and future inflation risks. A recent paper by Dreger, Gerdesmeier, and Roffia (2019) shows that the predictive accuracy of inflation forecasts can be improved by including

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a measure of excess liquidity. Understanding the nature of the monetary overhang is thus not only of academic but also of policy interest.

This paper aims to explain the determinants of the monetary overhang in times of covid-19. Several explanations have been put forward to explain the recent increase in money growth (Bundesbank 2020). Uncertainty about the impact of the pandemic may have led to a general increase in liquidity preference. Non-financial corporations have taken out more credit to bridge shortfalls in revenues. Credit to corporations may also have been stimulated by government support programs, such as loan guarantees. The buildup of liquidity in consumers' bank accounts may also have been driven by the postponement of consumer spending due to covid-19 restrictions. To date, the relationship between these explanations and the monetary overhang has not been empirically investigated. This paper uses a panel approach to exploit differences in the spread of covid-19 across the EA and in time. The resulting time and cross-sectional variation in government responses to covid-19 is used to identify the determinants of the monetary overhang.

We start off estimating a long-run panel money demand function for the EA, including 18 EA countries and using monthly data covering the period from 2003 to 2019. The estimation is done using the DOLS panel cointegration approach. In line with the literature, the standard money demand specification with scale and opportunity cost variables is extended to include wealth and uncertainty variables, as well as measures for financial innovation and foreign investment. We next use the coefficient estimates of this relationship to project the demand for money into 2020 and 2021. The monetary overhang is then calculated as the log difference between the actual money demand and the model-based projection. A second panel model is estimated to examine the relationship between the monetary overhang and covid-related variables, measuring government support, containment measures and confidence in the economy. We find that the monetary overhang is significantly related to the level of economic support, the stringency of the containment policy and the economic sentiment indicator.

The remainder of this paper is organized as follows. Section II discusses the data and methodological issues. Section III reports our empirical findings. Section IV summarizes the results and concludes.

II. Data and method

Data

When the euro was introduced in 1999, the ECB chose M3 as the relevant monetary aggregate for the second pillar of her monetary strategy and formulated a reference value for M3-growth. Following policy practice and most other studies on European money demand, we use the broad monetary aggregate M3 as our measure of money. As banknotes and coins cannot be traced to individual countries, we use M3 excluding currency holdings. This is an unavoidable drawback in research on regional money demand within a currency union (Mulligan et al. 1992). Monthly data on the national contributions to M3 excluding currency have been collected from the websites of the national central banks that are part of the eurosystem.[1] Figure 1 shows that the sum of the national contributions excluding currency closely tracks the ECB's aggregate measure of M3 (including currency). Over the period from 2003 to 2020, four phases in the development of M3 can be distinguished: 1) high growth up to the start of the global financial crisis; 2) zero to slow growth during the crisis; 3) medium growth from 2014 to 2019 and 4) the pick-up in growth in 2020.

Figure 1 does not suggest a different pattern for M3 including and excluding currency holdings. However, as a robustness check we construct an additional measure of national M3 for which EA currency holdings have been allocated to countries according to their share in the national contribution to M3. The monetary aggregates have been seasonally adjusted. To reduce the influence of outliers, the growth rates of the monetary aggregates have been winsorized at the 1st and 99th percentiles, after which the winsorized data have been converted back to levels. The monetary aggregates are deflated using the national harmonized indices

[1]For Cyprus, the national contribution to M3 was unavailable and data on total deposits have been used instead.

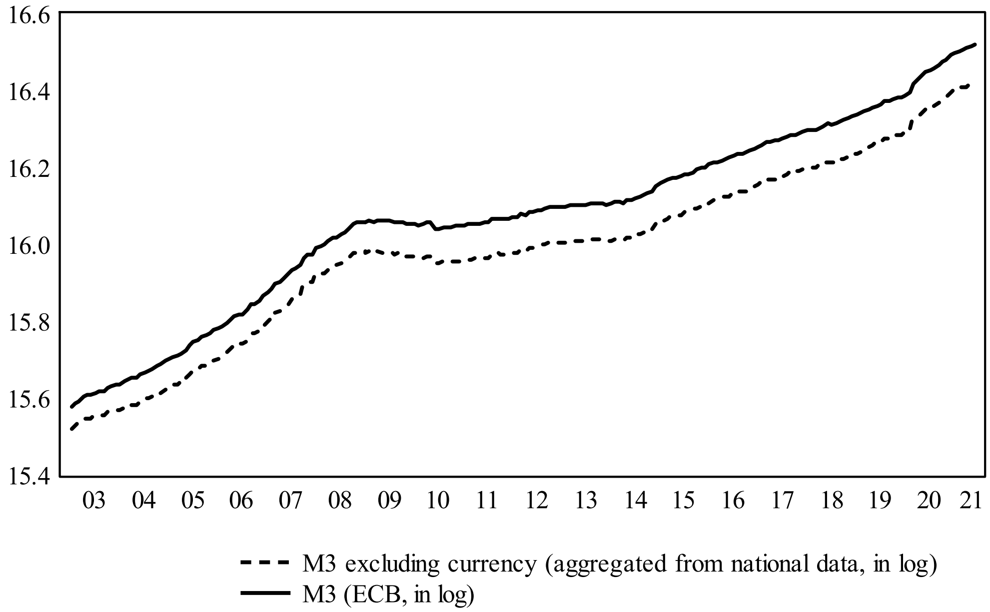

Figure 1. Development of M3 in the EA.

of consumer prices from Eurostat and are measured in log. The resulting variables are denoted *M3x* for the log of real M3 excluding currency and *M3* for the log of real M3 including currency. In addition to the M3 measures, we collect national data on deposits held by EA monetary financial institutions from the ECB's statistical data warehouse. The variables *DepNFC* and *DepHH* measure respectively the log of real deposits from non-financial corporations and households. *Dep* denotes the log of real total deposits (non-financial corporations and households).

Our benchmark money demand function includes scale and opportunity cost variables as explanatory variables. The scale variable is real GDP, which is also measured in log and is denoted *y*. Quarterly real GDP is converted to a monthly frequency using the Chow-Lin procedure, with industrial production and retail sales as related monthly time series. Real GDP, industrial production and retail sales have been collected from Eurostat. As we use a broad monetary aggregate, including interest-paying deposits, we use a long-term interest rate as our opportunity cost variable. For this we use the yield on 10-year government bonds, denoted *il*, which is taken from Datastream. We construct an own rate on M3, denoted *is*, by calculating a weighted average of the rates on new deposits from non-financial corporations and households. These rates have been obtained from the MFI interest rate statistics in the ECB's data warehouse.

In line with most recent empirical European money demand studies, the benchmark specification is expanded with wealth and uncertainty variables (Carstensen 2006; Boone and den Noord 2008). As a proxy for wealth we use the log of housing prices, denoted *hp*, which is taken from the BIS database. As uncertainty variables we use the country level index of financial stress (in log, denoted *clifs*), published by the ECB, and the economic sentiment indicator (*ESI*) from the European Commission's business and consumer survey. As *ESI* turned out to be insignificant next to the *clifs* measure, it was dropped from the long-run money demand specification. In addition to the wealth and uncertainty measures, we also include variables which are less prevalent in European money demand research. We follow Liu and Kool (2018) in including a measure of cross-border capital flows. Their rationale is that more foreign lending may reduce the scope for domestic growth in money and credit aggregates. As their BIS data on net foreign bank credit (NFC) are unavailable for several EA countries, we use ECB data on the international investment position instead. To stay as close as possible to the NFC data, we subtract foreign direct investments. The resulting measure is taken as a share of GDP and denoted *iip*. A well-known finding in the empirical literature is that financial innovation may destabilize money demand relationships (Ireland 1995). While the evidence for this effect is particularly strong for US money demand, EA money demand estimates seem to suffer less from this problem (Calza and Sousa 2003). Nevertheless, we include a measure of technological change in payments technology as a proxy for financial innovation. Fischer (2007) uses the density of ATM's as a measure for financial innovation. Due to the reduction in the use of cash, in many countries the number of ATM's is in decline. We instead use the number of point-of-sale terminals for electronic payments (per million inhabitants) as an alternative measure. Annual data on point-of-sale terminals are taken from the ECB website and have been linearly interpolated to a monthly frequency. The variable is in log and denoted *pos*. Finally, we consider the inclusion of the euro/dollar exchange rate in the money demand specification (Dreger, Reimers, and Roffia 2007).

To examine the relationship between monetary overhang and the covid-19 pandemic, we collect monthly data from the Oxford COVID-19 Government Response Tracker (OxCGRT) database. The OxCGRT-project aims to provide data on how government responses to covid-19 have evolved across countries and over time. To this end, data on a standardized series of 18 indicators have been collected from publicly available sources. Examples are school closings, stay at home requirements or income support. The full set of indicators is listed in Hale et al. (2020). As individual indicators may exhibit significant heterogeneity across countries, Hale et al. (2020) argue that combining different indicators into a composite index may 'mitigate the possibility that any one indicator may be over- or mis-interpreted' (3) Four composite indices have been constructed by averaging individual indicators that have been rescaled to create a score between 0 and 100.

Below we will use the composite response indices which summarize the diverse set of measures that governments have employed against the pandemic. The economic support index (denoted *EcSupIndex*) summarizes measures to provide income support and debt or contract relief for households. By easing the liquidity constraints of households, in combination with reduced spending opportunities during the pandemic, these measures may contribute to an increase in deposit holdings and thus to a positive monetary overhang. The stringency index (denoted *StringIndex*) summarizes indicators for closure and containment, such as school and workplace closings and restrictions on events, gatherings and mobility. Due to these restrictions consumers may have postponed spending, resulting in a buildup of liquidity in their bank accounts. The containment and health index (denoted *ContHealthIndex*) extends the stringency index by including health measures, such as test and tracing policies, emergency investments in health care and vaccines and protection measures such as the mandatory use of facemasks. A priori, one would expect these additional health indicators not to be strongly related to monetary overhang. Finally, the government response index (denoted *GovRespIndex*) encompasses the full range of policy measures, including closure and containment measures, economic measures and health measures. For all indices, a higher value indicates the presence of more or more stringent policy measures. Figure 2 plots the OxCGRT indices for the EA countries since 2020. Notwithstanding the cross-country similarities, especially the steep increase in the indices in the period February-April 2020, there is substantial cross-sectional variation in the level of these indices.

As *EcSupIndex* may not fully capture the extent of government support to the economy, especially to firms, we add the amount of government debt securities issued as an additional indicator of fiscal support. Monthly data on government debt securities are taken from the ECB website. The variable is included in log and denoted *GovDebt*.

Finally, we add two measures for the increase in economic uncertainty that firms and consumers faced following the covid-19 outbreak. The economic sentiment indicator (*ESI*) is a composite indicator of opinions and expectations of industry participants and consumers. The consumer confidence indicator (denoted *CSMCI*) measures consumers' expectations regarding their financial situation and the general economic outlook. In both cases, a higher indicator value reflects a more favorable assessment of the current economic situation. Both measures are taken from the European

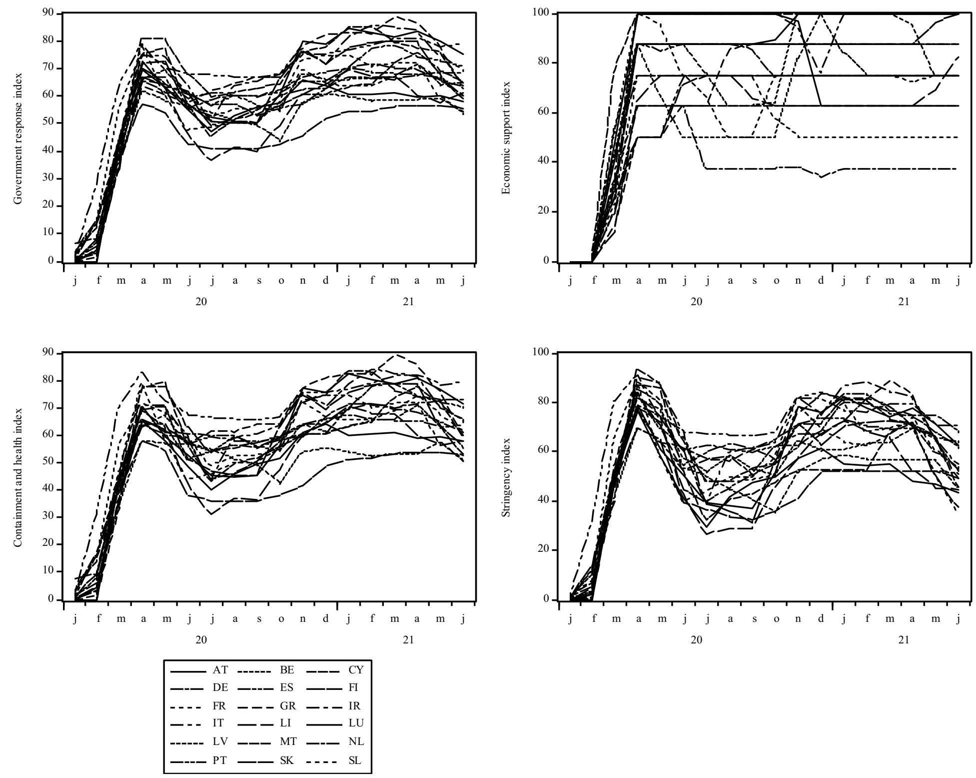

Figure 2. OxCGRT government response indices.

Commission's business and consumer survey. Figure 3 plots the confidence indicators for the EA countries since 2020. As in Figure 2, the data show similarities in the direction of change but cross-sectional differences in the levels of the indicators.

In contrast to much of the money demand literature, we use monthly instead of quarterly data. The higher data frequency allows us to better capture the dynamics of the covid outbreak, the government responses and the effect on monetary aggregates. The use of monthly data has the additional advantage of increasing the number of observations in the brief period since the outbreak of covid-19. Our sample consists of all members of the EA excluding Estonia, for which no data on *il* and *clifs* are available. As data for *clifs* are available from January 2003, the sample starts in that month. For countries that joined the EA at a later date, the sample starts at their date of accession. The sample runs through June 2021.

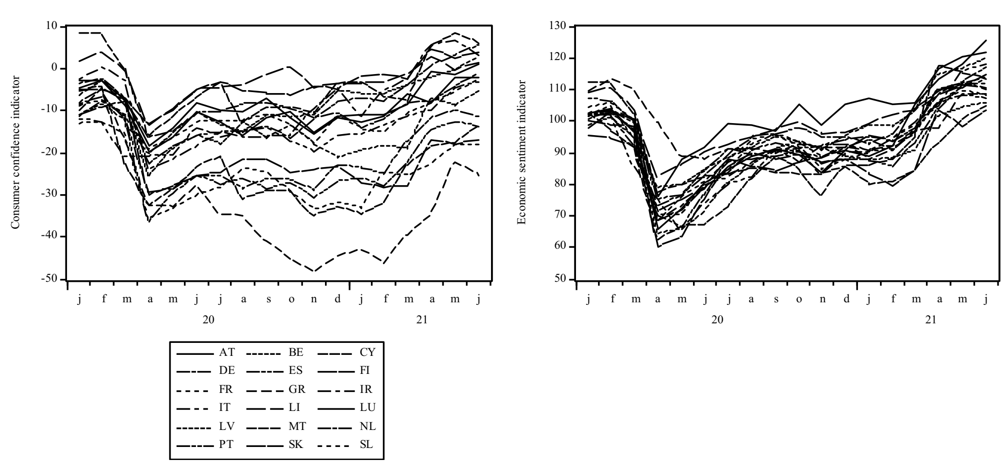

Figure 3. Confidence indicators from business and consumer survey.

Method

A large literature exists on European money demand. For a recent overview see Liu and Kool (2018). Two empirical approaches can be discerned in this literature. The traditional approach has been to estimate a money demand function for the EA as a whole, combining pre-1999 with post-1999 time series data to ensure a sufficiently long sample. Goodhart (2006) has coined the term 'pseudo-euro demand-for-money functions' for this line of research, to stress the methodological issues in using pre-1999 data (Arnold 1994; Bosker 2006; Rother 1998). Early examples of this approach are Artis and Beyer (2004), Coenen and Vega (2001) and Gerlach and Svensson (2003). More recently, Barigozzi and Conti (2018), Assenmacher and Beyer (2020) and Jung and Carcel Villanova (2020) have examined the long-run time-series properties of aggregate European money demand.

A second approach exploits the availability of cross-sectional macroeconomic data in the EA. The cross-sectional approach to money demand estimation has been applied to US money demand by Mulligan et al. (1992), who argue that it can solve several econometric issues associated with a pure time series approach. In contrast to the 51 US states, the more limited number of cross-sections in the EA hampers a pure cross-sectional approach. Both the short time that has passed since the introduction of the euro and the small size of the cross-section of EA countries therefore suggest panel modeling as a way of estimating European money demand with a sufficiently large number of observations. For the EA, panel money demand models have been used by among others Arnold and Roelands (2010), Dedola, Gaiotti, and Silipo (2004), Golinelli and Pastorello (2002), Liu and Kool (2018), Nautz and Rondorf (2011) and Setzer and Wolff (2013).

A standard semi-logarithmic panel specification of money demand can be written as:

$$m_{j,t} = \beta_{j,0} + \beta_1 y_{j,t} + \beta_2 il_{j,t} + \beta_3 is_{j,t} + \varepsilon_{j,t}, \qquad (1)$$

where m is the log of real money supply of country j at time t, y represents log real GDP, il is the long-term interest rate and is denotes the own rate on money. Studies using standard specifications have identified a stable pseudo-euro demand-for-money function using data up to 2001 (Dreger and Wolters 2010). However, adding data beyond 2001 led to a breakdown in the relationship, as money growth could no longer be adequately explained by the conventional explanatory variables. Subsequent research has shown that the addition of measures of economic uncertainty or financial instability (Carstensen 2006; Lemke and Greiber 2005) and wealth variables (Boone and den Noord 2008; Greiber and Setzer 2007; De Santis, Favero, and Roffia 2014) goes a long way toward accounting for the post-2001 monetary surge and can repair the money demand function. Liu and Kool (2018) include net foreign borrowing to explain the monetary overhang in the run-up to the 2008 global financial crisis. However, their model does not include wealth or uncertainty variables, which may also have been able to account for the pre-crisis money and credit boom. We follow the literature in including these variables in our extended panel specification:

$$m_{j,t} = \beta_{j,0} + \beta_1 y_{j,t} + \beta_2 il_{j,t} + \beta_3 is_{j,t} + \beta_4 hp_{j,t} + \beta_5 clifs_{j,t} + \beta_4 iip_{j,t} + \beta_5 pos_{j,t} + \varepsilon_{j,t}, \qquad (2)$$

where hp is the log of the house price index of country j at time t, $clifs$ measures financial stability, iip measure developments in the international investment position (excluding foreign direct investment) and pos is our measure of financial innovation. We have excluded the euro/dollar exchange rate from the reported specifications due to insignificance. As the specification in (2) includes all variables which have been known in the literature to be related to instability in European money demand, we are confident that any overhang measured in the covid-19 period cannot be attributed to any of these factors.

Due to the non-stationarity of the levels of money and income, we estimate all specifications using the DOLS panel cointegration approach (Stock and Watson 1993). DOLS has been first applied to panel money demand estimation by Mark and Sul (2003). By including leads and lags of first differenced explanatory variables, it accommodates individual heterogeneity in the short-run dynamics. The number of leads and lags in DOLS first differences is based on the AIC criterion. We include cross-section specific fixed effects. To account for cross-section heteroskedasticity, the equations are estimated using GLS with cross-section weights. Standard errors are calculated using the White cross-section method, which is robust to cross-equation correlation as well as different cross-sectional error variances. We also report statistics for the Kao (1999) panel cointegration test.

The panel money demand relationship is estimated over the period January 2003 to December 2019. We next use the estimated coefficients of the long-run relationship and substitute actual values for the explanatory variables to derive model-based projections of *m* for the period from January 2020 to June 2021. Our measure of monetary overhang during this period is the log difference between actual money demand and its model-based projection. In a second panel regression, we relate the monetary overhang to the OxCGRT indices and the confidence indicators. We test for stationarity of the variables in the second regression using the Levin, Lin, and James Chu (2002) panel unit root test.

III. Empirical findings

Panel money demand estimates 2003–2019

Table 1 reports panel estimates for various specifications of the demand-for-money function for M3 excluding currency. Specification (1) includes scale and opportunity cost variables only. The income elasticity is 1.31, which is in the range of estimates of standard pseudo-euro money demand functions (Arnold and Roelands 2010). The coefficients of both interest rates are negative and significant at a 10% level. In the case of *is*, the negative coefficient does not correspond to the hypothesized positive relationship between money demand and the own rate on money. The Kao panel cointegration test does not lead to a rejection of the null hypothesis of no cointegration, indicating that specification (1) is misspecified. When *hp* and *clifs* are added to the panel model, see specification (2), the Kao statistic become significant at a 1% level, leading to a rejection of the null hypothesis of no cointegration. This confirms the results of earlier studies that wealth and uncertainty variables need to be included to arrive at a stable money demand function in the EA. In line with Greiber and Setzer (2007), the income elasticity substantially decreases after the inclusion of house prices, from 1.31 to 0.98. The positive coefficient of *hp* suggests that the income channel of the wealth effect on money demand is stronger than the substitution channel. The positive link between wealth and money derives from the use of money to grease financial transactions and the positive relationship between mortgage lending, money creation and housing prices. In contrast, the substitution channel would predict that higher asset prices make it less attractive to hold money. The coefficient of *clifs* is

Table 1. Panel money demand estimations for M3 excluding currency.

Dependent variable:	(1) *M3x*	(2) *M3x*	(3) *M3x*	(4) *M3x* (small panel)	(5) *M3x* (2003M1-2011M6)	(6) *M3x* (2011M7-2019M12)
y	1.311***	0.977***	0.916***	0.887***	1.250***	0.992***
	(0.041)	(0.048)	(0.048)	(0.062)	(0.003)	(0.076)
il	−0.003*	−0.015***	−0.011***	−0.012***	0.003	−0.008***
	(0.002)	(0.002)	(0.002)	(0.002)	(0.004)	(0.002)
is	−0.016*	−0.008	−0.008	−0.005	−0.001	−0.057***
	(0.009)	(0.008)	(0.007)	(0.007)	(0.008)	(0.019)
hp		0.269***	0.274***	0.256***	0.338***	0.136***
		(0.024)	(0.024)	(0.028)	(0.036)	(0.035)
clifs		0.017***	0.022***	0.036***	0.037***	0.004
		(0.004)	(0.004)	(0.005)	(0.003)	(0.004)
iip			0.032***	0.030***	0.003	0.018***
			(0.003)	(0.000)	(0.017)	(0.003)
pos			0.077***	0.081***	0.203***	0.040***
			(0.009)	(0.010)	(0.029)	(0.008)
Adj. R-squared	0.996	0.998	0.998	0.996	0.999	0.999
# observations	3080	2923	2910	2212	1113	1756
Kao	−0.316	−2.691***	−3.017***	−2.594***	−1.988**	−1.893**

Note: Panels consist of all EA countries excluding Estonia. Small panel excludes Cyprus, Estonia, Latvia, Lithuania, Malta, Slovenia and Slovakia. Sample period is 2003M1–2019M12. Panel estimation with cross-section weights and fixed effects. White standard errors are in parentheses. Number of leads and lags in DOLS first differences based on AIC criterion. Kao shows t-statistics for the Kao panel cointegration test. Significance levels are indicated as * p < .10 ; ** p < .05 ; *** p < .01.

significantly positive, which supports the notion that higher financial uncertainty may increase the precautionary demand for nominally safe, monetary assets (Carstensen 2006; Lemke and Greiber 2005). In specification (2), the semi-interest elasticity of *il* increases to −0.015 and turns significant at a 1% level. The coefficient of *is* has the wrong sign and is insignificant. Specification (3) adds *iip* and *pos* to the panel equation. The addition of these variables has little effect on the coefficient estimates of the other variables. The evidence in favor of cointegration has become somewhat stronger, as shown by the Kao statistic. The coefficient of *iip* is significantly positive, which contrasts with the negative relationship between foreign lending and monetary aggregates in Liu and Kool (2018). A possible explanation for this difference is that, in contrast to Liu and Kool (2018), our model also includes housing prices and a measure for financial uncertainty. The coefficient of *pos*, our measure for financial innovation, is also significantly positive. This indicates a positive relationship between the density of point-of-sale terminals and M3.

The remainder of Table 1 contains the results of several robustness checks. As a first check, specification (4) reports panel estimates for a reduced sample of 12 EA member states, excluding countries that have joined the union after 2001. The purpose of this check is to examine whether the inclusion of small and, in most cases, less developed states in the original sample has a strong effect on the outcomes. Overall, the panel estimates in specification (4) are similar to those in specification (3). The income elasticity is somewhat lower and the coefficient for *clifs* higher. As in the large sample, the Kao statistic is significant at a 1% level, leading to a rejection of the null of no cointegration. As a second check we have split the sample in two equal parts: from 2003 to June 2011 and from July 2011 to December 2019. The sample split highlights that not all variables are equally important during the whole sample period. In particular, *hp* and *clifs* are more important in explaining money demand in the early period, which includes the pre-crisis boom in housing markets and the surge in financial uncertainty during the global financial crisis. In contrast, the interest rate variables are more significant in the later period.

Table 2. Panel money demand estimations for alternative monetary aggregates.

Dependent variable:	(1) *M3*	(2) *Dep*	(3) *DepNFC*	(4) *DepHH*
y	0.938***	1.098***	0.863***	1.046***
	(0.049)	(0.061)	(0.073)	(0.041)
il	−0.012***	−0.011***	−0.023***	−0.012***
	(0.002)	(0.002)	(0.003)	(0.002)
is	−0.021***	0.010	−0.020***	−0.018***
	(0.007)	(0.009)	(0.008)	(0.007)
hp	0.263***	0.068**	0.283***	0.014
	(0.024)	(0.027)	(0.033)	(0.023)
clifs	0.021***	0.027***	0.005	0.031***
	(0.004)	(0.005)	(0.006)	(0.004)
iip	0.033***	0.020***	0.088***	0.035***
	(0.003)	(0.003)	(0.004)	(0.003)
pos	0.082***	0.060***	0.040***	0.071***
	(0.010)	(0.011)	(0.014)	(0.010)
Adj. R-squared	0.999	0.998	0.995	0.998
# observations	2910	3079	3088	3094
Kao	−3.157***	−1.944**	−0.201	−2.995***

Note: Panels consist of all EA countries excluding Estonia. Small panel excludes Cyprus, Estonia, Latvia, Lithuania, Malta, Slovenia and Slovakia. Sample period is 2003M1–2019M12. Panel estimation with cross-section weights and fixed effects. White standard errors are in parentheses. Number of leads and lags in DOLS first differences based on AIC criterion. Kao shows t-statistics for the Kao panel cointegration test. Significance levels are indicated as * $p < .10$; ** $p < .05$; *** $p < .01$.

Table 2 next reports panel estimates for alternative monetary aggregates. Specification (1) shows the results using M3 including currency holdings (allocated according to the share in M3). The coefficient estimates are very similar to those for *M3x* in Table 1. Columns (2) to (4) in Table 2 report estimates for deposits instead of M3, the results of which are mixed. The Kao statistics show that the demand for deposits by non-financial corporations (*DepNFC*) has no cointegration relationship with the explanatory variables, in contrast to the demand for total deposits (*Dep*) and the demand for deposits by households (*DepHH*). The income elasticities for *Dep* and *DepHH* are somewhat higher than for *M3*. In contrast, the coefficients for *hp* are lower. A notable difference between the specifications for *DepNFC* and *DepHH* is the coefficient of *hp*, which is significantly positive for *DepNFC* but insignificant for *DepHH*. Another notable difference is the coefficient of *clifs*, which is significantly positive for *DepHH* but insignificant for *DepNFC*. Based on the findings in Tables 1 and 2, our preferred specification is (3) in Table 1, as *M3* is the relevant aggregate in European monetary policy and the use of deposits does not yield superior panel estimates.

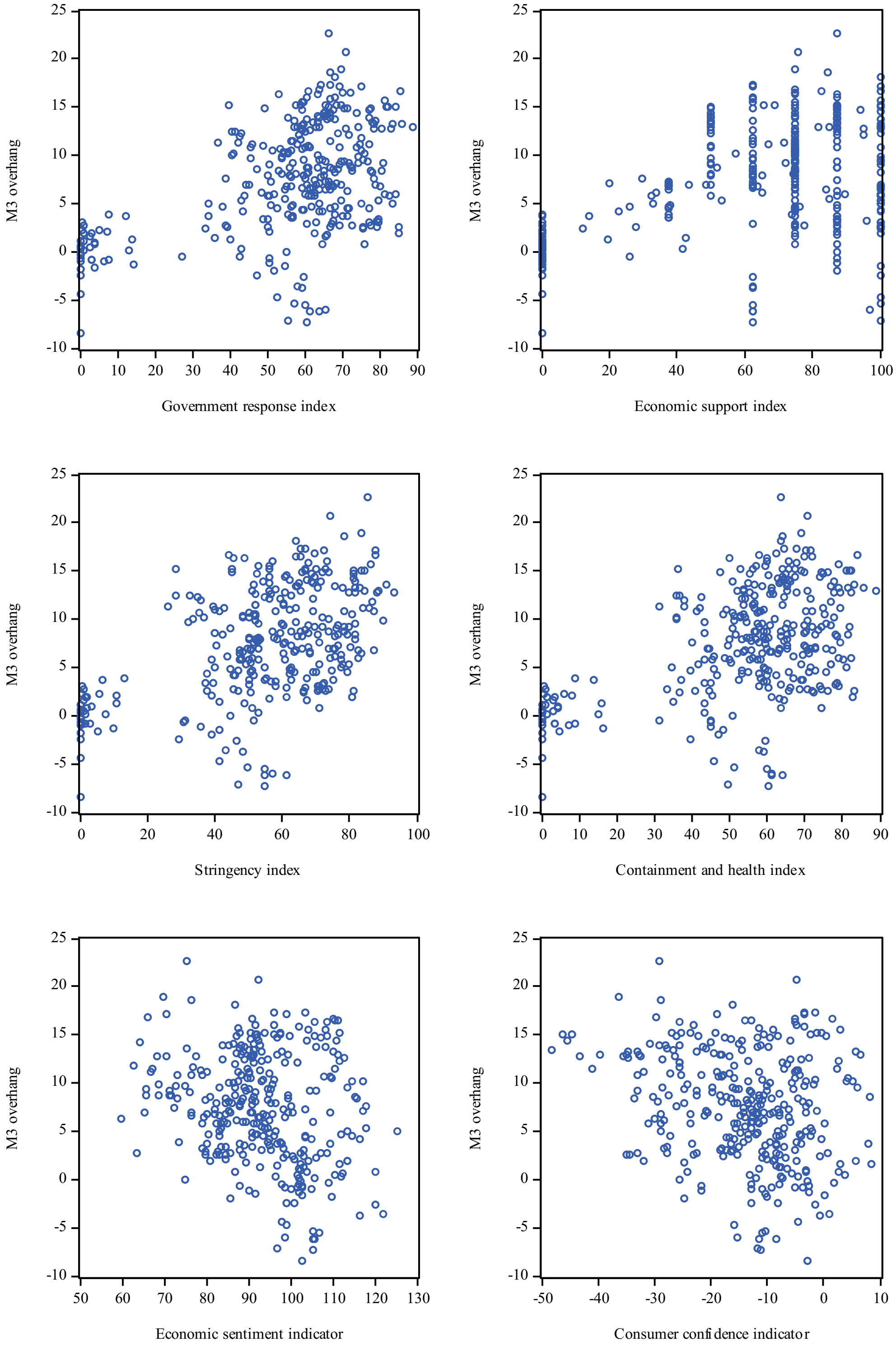

Figure 4. M3 overhang and explanatory variables (2020–2021, EA countries).

Panel estimates for the 2020–2021 monetary overhang

Using the long-run coefficients of specification (3) in Table 1 and specifications (1) to (4) in Table 2 and substituting actual values for *y*, *il*, *is*, *hp*, *clifs*, *iip* and *pos*, we calculate projections of the demand for money over the period January 2020 to June 2021. As 2021 values for *pos* were unavailable, we have substituted the latest available value. The DOLS leads and lags are excluded from this

Table 3. Panel unit root tests.

Overhang	
M3x	−5.22***
M3	−5.31***
Dep	−5.35***
DepNFC	−5.96***
DepHH	−4.62***
CSMCI	0.06
ESI	0.92
GovRespIndex	−7.50***
EcSupIndex	−6.35***
ContHealthIndex	−7.25***
StringIndex	−7.17***
GovDebt	−5.24***

Note: Panels consist of all EA countries excl. Estonia. Sample period is 2020M1–2021M06. The table shows t-statistics for the Levin, Lin & Chu panel unit root test. Significance level is indicated as: *** p < .01.

calculation, as they capture the short-run dynamics. The monetary overhang is calculated as 100 times the deviation between the actual money supply and the projection (which are both measured as log real values). Our second set of panel estimates explains the monetary overhang with the OxCGRT indices, the confidence indicators and government debt issued. Figure 4 shows scatter plots of the M3 monetary overhang, based on specification (3) in Table 1, and the explanatory variables. Each dot represents a month for one of 18 EA countries. The scatter plots for the four OxCGRT indices are strongly suggestive of a positive relationship, according to which a more stringent response goes together with a higher monetary overhang. The plots also show the similarity between *StringIndex* and *ContHealthIndex*, due to the large overlap in items included in these indices.

The scatter plots for the confidence indicators suggest a negative relationship, whereby less confidence corresponds to a higher M3 overhang.

Table 3 reports the statistics for the Levin, Lin, and James Chu (2002) panel unit root test. For all variables except *CSMCI* and *ESI*, the null hypothesis of a unit root is rejected. We therefore proceed to estimate the second panel model in levels, but include *CSMCI* and *ESI* in first differences.

Table 4 reports panel estimates for several specifications, which vary according to the choice of monetary aggregates and explanatory variables. In all specifications except those for *Dep* and *DepNFC*, *GovDebt* is significantly positive, suggesting that an increase in debt issuance during the pandemic may have contributed to the monetary overhang. By construction *GovRespIndex* encompasses the other three OxCGRT indices and *ContHealthIndex* encompasses *StringIndex*. Including all four OxCGRT indices simultaneously in a panel regression would therefore lead to severe multicollinearity. In addition to *GovDebt*, the first specification for the monetary overhang in *M3x* includes *GovRespIndex* and the two confidence indicators. The coefficient of *GovRespIndex* is positive and significant at a 1% level, indicating that a stronger government response to covid-19 increases monetary overhang. The coefficient of *d(ESI)* has the expected negative sign and is significant at a 1% level. In contrast, *d(CSMCI)* has a positive coefficient and is significant at a 5% level. Due to possible multicollinearity between

Table 4. Panel estimations for monetary overhang.

	(1) *M3x*	(2) *M3x*	(3) *M3x*	(4) *M3*	(5) *Dep*	(6) *DepNFC*	(7) *DepHH*
GovDebt	10.410***	7.516***	8.893***	7.171**	4.571	−0.005	12.877**
	(3.022)	(2.740)	(2.887)	(2.564)	(3.449)	(2.864)	(4.719)
d(ESI)	−0.103***	−0.058**	−0.056**	−0.060**	−0.066*	−0.031	−0.067**
	(0.038)	(0.024)	(0.023)	(0.024)	(0.032)	(0.027)	(0.029)
d(CSMCI)	0.063**						
	(0.027)						
GovRespIndex	0.104***						
	(0.020)						
EcSupportIndex		0.063***	0.064***	0.064***	0.067***	0.090***	0.067***
		(0.013)	(0.011)	(0.013)	(0.015)	(0.014)	(0.017)
StringIndex			0.039**				
			(0.015)				
ContHealthIndex		0.050***		0.053***	0.063***	0.060***	0.045
		(0.017)		(0.017)	(0.020)	(0.017)	(0.029)
Adj. R-squared	0.868	0.879	0.878	0.880	0.868	0.949	0.865
Durbin-Watson	2.181	2.192	2.195	2.178	2.130	2.188	2.175
# observations	324	324	324	324	324	324	324

Note: Panels consist of all EA countries excluding Estonia. Sample period is 2020M1–2021M06. Panel estimation with cross-section weights and fixed effects. AR (1) term included. White standard errors are in parentheses. Significance levels are indicated as * p < .10 ; ** p < .05 ; *** p < .01.

d(ESI) and *d(CSMCI)*, we drop *d(CSMCI)* from the remaining specifications. The following two specifications include two OxCGRT subindices: *EcSupIndex* and either *ContHealthIndex* or *StringIndex*. In both specifications, the OxCGRT indices have the expected positive sign and are significant at a 1% level. The coefficients are also economically meaningful: a 10-point higher score on the economic support index results in a 6% higher monetary overhang. A 10-point higher score on *ContHealthIndex* or *StringIndex* results in respectively a 5% or 4% higher overhang. Specifications (4) to (7) show that similar effects are found when we use M3 including currency holdings or deposits. For the panel regressions using the overhang in deposits, the effect of *EcSupIndex* is strongest for the deposits of non-financial corporations (*DepNFC*). As a final observation, the effect of *d(ESI)* is stronger for *DepHH* overhang than for *DepNFC* overhang, suggesting that household deposits are a preferred safe asset in times of uncertainty. In contrast, the effect of *ContHealthIndex* is weaker for household deposits. Overall, the estimates in Table 4 show a significant relationship between monetary overhang and measures of government responses to covid-19.

IV. Conclusions

Not since the ECB started with the implementation of unconventional monetary policy measures has M3-growth been so high as in the spring of 2020, following the outbreak of the covid-19 pandemic. The increase in money growth has broadened concerns about the inflationary impact of covid-19 and the government responses to covid-19, as evidenced by an increase in inflation expectations and in the uncertainty of the outlook for inflation. Understanding the reasons why economic agents have chosen to hold more money during the pandemic is a first step in any analysis of the effects of the monetary overhang on future inflation.

This paper has examined the determinants of the monetary overhang in the EA since the outbreak of covid-19 using a two-step procedure. The first step involved the estimation of a long-run panel money demand function for 18 EA countries over the period from 2003 to 2019. In line with previous money demand studies, we identify a long-run cointegrating demand-for-money relationship between real M3, real income, long and short-term interest rates, housing prices and measures for financial instability, foreign lending and financial innovation. We have used the estimated long-run parameters to calculate a monthly national measure of monetary overhang in the period from January 2020 to June 2021, defined as the difference between the actual money stock and the value implied by the long-run money demand function. In our second step, we made use of the cross-sectional heterogeneity and time variation in national government responses to covid-19 across the monetary union to relate the monetary overhang to OxCGRT response indicators, confidence indicators and government debt issuance. We find that the monetary overhang is significantly related to the level of economic support, the stringency of the containment policy and the economic sentiment indicator. This paper thus lends econometric support to several explanations that have been put forward to explain the rise in M3: that the economic uncertainty has increased the liquidity preference of firms and households; that economic support has enabled firms to remain liquid despite revenues shortfalls and that savings may have increased by the postponement of consumer spending due to covid-19 restrictions.

An important issue for monetary policymakers is whether the monetary overhang observed in this paper will spill over into higher inflation in the time to come. We leave this for future research.

Disclosure statement

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