DOES MONEY GRANGER CAUSE INFLATION IN THE EURO AREA?*

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Joaquim Pina**

1. INTRODUCTION

This study aims at establishing whether money is a leading indicator of inflation in the euro area. This is an important issue because it is usually understood that if money is to play a role in a monetary policy strategy then an important request is that current monetary developments help forecasting future inflation.

Previous work on assessing the leading indicator properties of money for future inflation in the euro area have used the formal testing on whether money helps to predict future inflation, i.e. the Granger-causality approach, or have used alternative approaches that evaluate the information content of money for forecasting prices. Their conclusions are mixed, in the sense that it is not fully clear whether money provides useful information for future price developments.

This study adds to the existing literature by re-evaluating the empirical evidence on money-inflation causality with a new dataset, as well as some new modelling choices, and by identifying the relevant transmission lags.

Methodologically the article does not significantly depart from Trecroci and Vega (2000) (henceforth TV (2000)), but uses a different data set. Our dataset is an update up to 2000 of that in the money demand paper of Brand and Cassola (2000) (henceforth BC (2000)), whose data set has become of widespread use in empirical studies for the euro area.

The main conclusion of this study is that for the sample period analysed (1980-2000) money does help to predict future price developments in the euro area for most of the alternative estimated VAR (Vector AutoRegressive) models. The study also concludes that it takes about one year and a half for changes in money growth to start passing on to inflation and that the adjustment is completed by the end of the fifth year.

Despite this new empirical evidence supporting the role of money as a leading indicator of inflation one should be cautious in claiming that past evidence on money-inflation causality would stand in the future under a very different inflation regime. In particular, in an environment of low and stable inflation the leading indicator property of money is expected to become considerably weakened.

The remaining part of this article is organised as follows: section 2 describes the data used and the econometric models chosen along with the discussion of the results on money-inflation causality tests for the euro area; section 3 identifies the relevant transmission lags in simple money-prices dynamic models defined in the year-on-year growth rates, and section 4 concludes.

2. EVIDENCE ON MONEY-INFLATION CAUSALITY IN THE EURO AREA

Previous studies, namely TV (2000), carried out the causality analysis with the data set of Coenen and Vega (1999) (henceforth CV (1999)), which differs from the dataset used later in BC (2000). For our study we updated the BC (2000) data set, as it has become of widespread use in empirical studies.

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* The views expressed in this article are those of the authors and not necessarily those of the Banco de Portugal. This paper is an abridged version of Marques and Pina (2002).
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for the euro area. We restricted the sample to the period 1980:1 to 2000:4 to avoid statistical problems with the entry of Greece and for comparability with TV (2000) analysis.

Let \( m \) stand for the natural log of the nominal M3 money stock, \( p \) for the natural log of the GDP deflator, \( y \) for the natural log of real GDP, \( l \) and \( s \) for the long and short run interest rates respectively. We denote a VAR model in these variables as \( \text{VAR}(m, y, l, s) \).

We basically estimated two types of VAR models. The first type is composed of VAR models where some variables are assumed as potentially integrated of order two \((m, p)\) and the others as integrated of order one \((y, l, s)\). It includes the \( \text{VAR}(m, p, y, l, s) \) as the general case and the \( \text{VAR}(m - p, \Delta p, y) \) and \( \text{VAR}(m - p, \Delta p) \), as special cases. Besides these two sets of VAR models we also pay attention to the simpler \( \text{VAR}(\Delta m, \Delta p) \) and \( \text{VAR}(\Delta m, \Delta p, \Delta y) \) models. These two models can also be seen as special cases of the \( \text{VAR}(m, p, y, l, s) \) type of models.

To test for Granger causality in these VAR models we resorted to the different approaches suggested in the literature. These include the different testing procedures suggested in Toda and Phillips (1993, 1994), Toda and Yamamoto (1995) and Phillips (1995), which are usually denoted as the ECM-approach, the LA-VAR approach and the FM-VAR approach, respectively.

The main results on money-prices Granger causality tests for all the systems are summarised in the Table 1, where we bring together the findings in TV (2000)(1).

First, we notice that the overall picture is now different from the one obtained in TV (2000). In fact, for most of the studied cases we reject the annul of non-causality of \( m \) on \( p \) or \( \Delta m \) on \( \Delta p \). Only for the general VAR with interest rates it is not possible to reject non-causality from money to prices. However, the use of a large system raises more problems of statistical weaknesses for estimation and testing.

The difference in the conclusion for money to prices causality between this study and the one by TV (2000) stems basically from the fact that we have worked with a different data set. However, had Trecroci and Vega estimated the VAR models in the growth rates of the variables \((\Delta m, \Delta p)\) and \((\Delta m, \Delta p; \Delta y)\) and their picture on money-prices causality might have been less negative.

As a second point we notice that \( \Delta m \) and \( \Delta p \) are cointegrated but \((m - p)\) and \( \Delta p \) are not. This suggests that the \( \text{VAR}(\Delta m, \Delta p) \) is more appropriate than the \( \text{VAR}(m - p, \Delta p) \) to analyse the Granger non-causality hypothesis. The money-prices Granger non-causality hypothesis is strongly rejected in the \( \text{VAR}(\Delta m, \Delta p) \) and \( \text{VAR}(\Delta m, \Delta p; \Delta y) \) models. However, the evidence against Granger non-causality clearly weakens as we move to the \( \text{VAR}(m - p, \Delta p, y, l, s) \) type of models. It may be the

\( (1) \) For technical details on the implementation of the causality tests and a full discussion of the results for the estimated VAR models, the interested reader is referred to Marques and Pina (2002).

### Table 1

<table>
<thead>
<tr>
<th>TESTS</th>
<th>Our results</th>
<th>Trecroci and Vega (2000)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>ECM approach</td>
<td>LA-VAR approach</td>
</tr>
<tr>
<td>YES</td>
<td>YES</td>
<td>YES(b)</td>
</tr>
<tr>
<td>--</td>
<td>YES</td>
<td>YES(b)</td>
</tr>
<tr>
<td>YES</td>
<td>YES</td>
<td>YES(b)</td>
</tr>
<tr>
<td>NO</td>
<td>YES</td>
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<td>--</td>
<td>YES</td>
<td>--</td>
</tr>
<tr>
<td>--</td>
<td>NO</td>
<td>--</td>
</tr>
</tbody>
</table>

Notes

(a) The usable sample period actually taken for the computations is 1980/4-2000/4, except otherwise stated.

case that these type of VAR models are imposing important restrictions on the short run dynamics or lacking parsimony or both, with important consequences for the Granger causality tests.

Finally, the null of Granger non-causality from prices to money is basically rejected in the same models in which money to prices non-causality is. We note, however, that it is mainly the long run causality that appears as significant. Essentially, the overall conclusion is that money and prices have a joint long run behaviour.

In order to get an idea on the robustness of the conclusions presented above we repeated the analysis for the 1985-2000 period for the models \( \text{VAR}(\Delta m, \Delta p) \), \( \text{VAR}(\Delta m, \Delta p; \Delta y) \) and \( \text{VAR}(m - p, \Delta p, \Delta y) \). For none of the estimated models do the main conclusions change. Money to prices non-causality is strongly rejected according to the ECM approach and rejected (with 90% confidence) according to the LA-VAR approach. Prices to money non-causality is also rejected according to the ECM approach for the three estimated models, and to the LA-VAR approach for the two first models.

3. HOW SHALL WE READ THE MONEY-PRICES CAUSALITY EVIDENCE?

Given the major conclusion from the previous section that money leads inflation, i.e., that money Granger causes inflation in the euro area, the natural question is how to turn this evidence into a useful tool for monetary assessments.

If we look at Chart 1 we readily see that \( \Delta m - \Delta p \) is a stationary variable. However it is also the case that \( \Delta m - \Delta p \) may stay above (or below) the mean for quite a large period of time. This was so, especially between 1986/3 and 1990/1 (15 consecutive quarters). If instead we look at the real money growth adjusted for GDP growth, \( \Delta m - \Delta p - \Delta y \), we realise that the mean reversion increases (especially in the second half of the eighties), but on the other hand the volatility also increases (throughout the whole sample period) due to the volatility of the \( \Delta y \) series. This suggests that looking to \( \Delta m - \Delta p \) or to \( \Delta m - \Delta p - \Delta y \) is probably not the best way to draw interesting conclusions, in what concerns the money-prices relationship. It may also be argued that probably it is more useful to look at the year-on-year growth rates instead, as economic agents or at least economic analysts in their price and monetary assessments look at these growth rates more, than they do at the monthly or quarterly growth rates.

This section tries to answer the following questions: if we look at the year-on-year money and GDP growth rates, what should we expect the reaction of the inflation rate to be? How many lags, if any, should we expect it to take for money growth to pass on to inflation?

In order to try to answer these questions we start by looking at the static relation between the year-on-year price changes measured as \( \Delta_4 p_t \) and the year-on-year money growth rate measured as \( \Delta_4 m_t \). After some experimentation it was possible to conclude that the maximum correlation between inflation and money growth occurs at lag six. As can be seen from Chart 2 \( \Delta_4 p_t \) and \( \Delta_4 m_{t-6} \) (mean adjusted) almost coincide. So, the empirical evidence accords with economic theory, which suggests that the effects from money to prices take time to materialise and are expected to occur with a lag between one year and two years (four to eight quarters). This first result already tells us that in order to identify the relevant lags we must specify a model with a large number of lags\(^{(2)}\).

\(^{(2)}\) This of course does not necessarily call into question the VAR models estimated above to test for causality, as we are now looking at year-on-year and not quarterly growth rates, and this may significantly change the relevant lags in the identified VAR models.
Starting with a very general autoregressive distributed lag model for the year-on-year price changes as a function of the year-on-year money and GDP growth rates and following the well-known general-to-specific methodology we end up with a parsimonious error correction model specification, which implies that changes in money growth take six quarters before starting to pass on to inflation (4 lags in case of GDP growth). Table 2 depicts the accumulated effects on $\Delta_4 p_t$ of a change in the money growth rate (permanent increase of 1 p.p. in $\Delta_4 m$), showing that, in fact, it takes six quarters before the effect on inflation of a permanent increase in money growth becomes significant. The accumulated effect after two years (8 quarters) is only 43.53% but it is completed by the end of the fifth year.

It seems useful to note that this outcome on the relevant lags involved, basically accords with the empirical evidence obtained for other countries. For instance, thirty years ago, Friedman (1972), even though following a different statistical approach, found that the “the highest correlation for consumer prices was for money leading twenty months for M1, and twenty-three months for M2”. More recently Bernanke et al. (1999) describe a two-year lag between policy actions and their effect on inflation as a “common estimate” (pp. 315-320).

4. CONCLUSIONS

This study re-evaluates the evidence on money-prices Granger causality for the euro area. Methodologically the study does not significantly depart from Trecroci and Vega (2000), but uses a different dataset, namely an update (up to 2000) of that in Brand and Cassola (2000) as it has become of widespread use in empirical studies for the euro area.

In contrast to TV (2000), who could not reject the money to prices non-causality for any of the estimated VAR models, we were able to reject this hypothesis for most of the estimated VAR specifications. This different new conclusion mainly stems from the fact that we use a different data set and, to some extent, also from the fact that we estimate variant VAR models not considered in Trecroci and Vega (2000), which do not impose restrictions on the short run dynamics and/or correspond to more parsimonious specifications.

It is also seen that it takes about a year and a half for changes in money growth to start passing on to inflation and that the adjustment is completed by the end of the fifth year. This outcome is

<table>
<thead>
<tr>
<th>Number of quarters</th>
<th>Accumulated effect</th>
<th>Percentage of total effect</th>
</tr>
</thead>
<tbody>
<tr>
<td>6</td>
<td>22.3</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>43.53</td>
<td></td>
</tr>
<tr>
<td>12</td>
<td>87.87</td>
<td></td>
</tr>
<tr>
<td>16</td>
<td>90.52</td>
<td></td>
</tr>
<tr>
<td>20</td>
<td>99.89</td>
<td></td>
</tr>
</tbody>
</table>
in line with the empirical evidence for other countries.

Despite this new empirical evidence supporting the role of money as a leading indicator of inflation one should be cautious in claiming that past evidence on money-inflation causality would stand in the future under a very different inflation regime. Indeed, the findings in this study were obtained for a sample period during which inflation and money growth exhibited large sample variation with significant changes on the average levels of both variables. Monetary theory predicts that monetary developments following a monetary shock or brought about by changes in the inflation objective of the monetary authority should be expected to act as leading indicators of inflation. These are likely to be the type of past monetary developments underlying the main findings in this study. However, monetary developments that are mainly brought about by velocity shocks, or that result from the reaction of the monetary authority to other type of shocks hitting the economy (such as technology shocks, preference shocks, real demand shocks) should not be expected to significantly impact on future inflation.

In an environment of low and stable inflation one would expect the first type of shocks to have a diminished role in explaining inflation developments. Thus, it is likely to be case that the more successful the central bank is in delivering low and stable inflation, the more likely it is that money growth will see its property as a leading indicator of inflation considerably weakened.

REFERENCES


