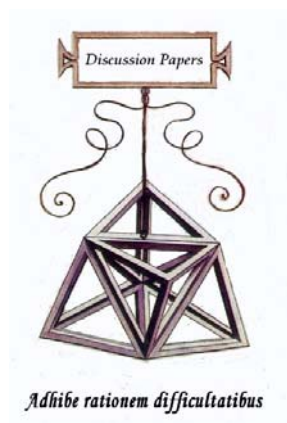




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Paolo Di Martino

Was the Bank of England responsible
for inflation during the Napoleonic
wars (1897-1815)?

Some preliminary evidence from old
data and new econometric techniques

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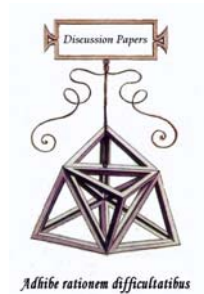
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Paolo Di Martino

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Abstract

Was the Bank of England responsible for inflation during the Napoleonic wars (1897-1815)? Some preliminary evidence from old data and new econometric techniques

Inflation during the Napoleonic wars is a widely investigated and interesting case study; it generated a fantastic contemporary theoretical debate, which *per se* is a stimulating subject, and provides a revealing perspective on more generic topics such as the gold standard, the Bank of England behaviour and the level of price. The bullionist position had a short-living initial victory, but since Tooke's study, the anti-bullionist perspective dominated the scene and remained relatively unchallenged. Although still provisional, our findings are in contrast with the outcome of the two centuries-long debate and provide a possible solution to this puzzle. Granger tests show very little about the causal relation between paper issue of the Bank of England and price levels and no definitive answer can be inferred by these measurements. The structure of monetary payments of the time, however, suggests that the use of the Bank of England issue could be a poor and misleading proxy of the amount of monetary means. Problems with the estimations of both

gold coins and country bank issue do not allow providing a better proxy. The solution we found is to use, instead, the level of advances and discounts. This variable shows a higher level of long-term correlation with prices as well as better results when used to run Granger test with price changes. Granger causality from price to currency does not emerge, but the opposite relation stands, at least with broader interval of confidence.

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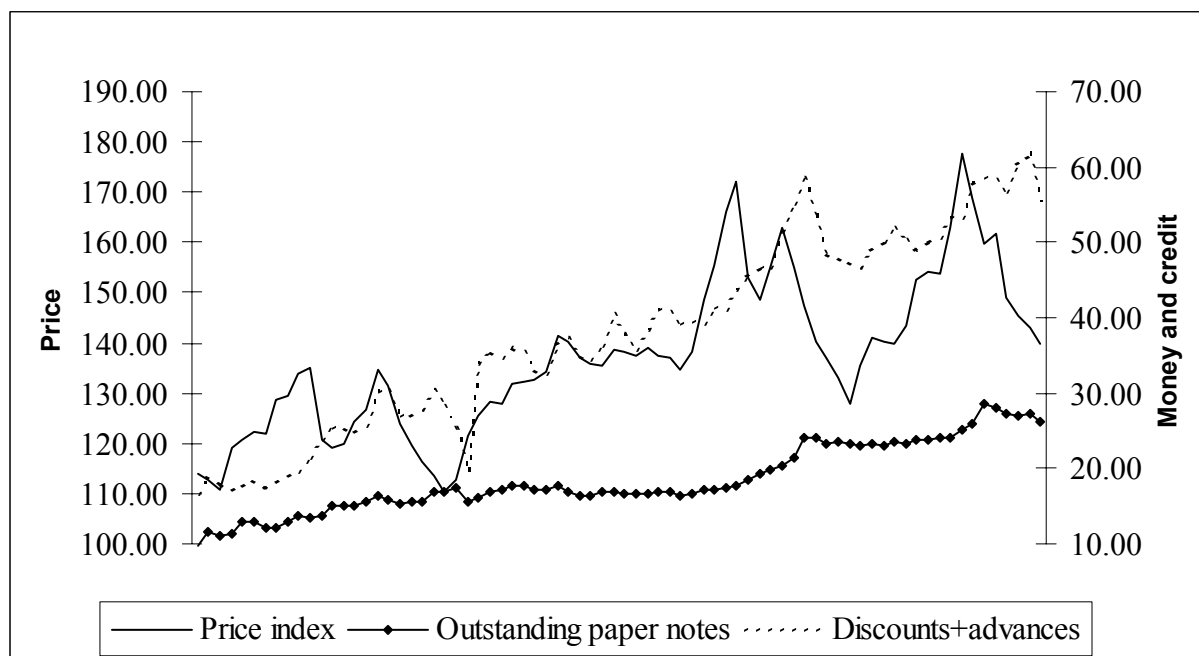
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I Introduction

In Britain, the years between the suspension of gold standard (1797) and the end of Napoleonic wars (1815) were characterised by phases of raising prices, in particular between 1897-1802, 1808-1810 and 1813-1814. The period on the whole saw a strong, although irregular, increase of price level. According to Gayer, Rostow and Schwartz (1953; hereafter GRS) data, general price index, which equalled to 113.93 at the beginning of 1797, reached the peak of 177.47 in 1814. A similar picture emerges using older data set provided by Simberling (1923): annual price level moved from 141 in 1797 up to 198 in 1814. The problem of inflation paralleled the growth of money issue (i.e. paper notes) and credit supply (i.e. discounts and advances) by the Bank of England. During the first quarter of 1797 the former was 9,8 million pounds and the latter 12.6 million pounds. At the end of 1815 the two values were 26.1 and 38.6 million pounds respectively.¹

¹ Source: Simberling (1923)

Fig 1: Price index (Average 1821-5 = 100), money supply, and credit supply (Millions £) Quarterly, 1879-1815



Source: see Appendix 2

The relation between price level and monetary and credit supply was one of the main issue discussed in the contemporary “bullionist” debate, a wide theoretical dispute which included the problems of gold premium over paper money as well as the consequences of foreign remittances on the exchange rate.² Contemporary observers believed in the presence of a causal relation

² The bullionist debate has been surveyed in a number of publications and it is thus not worthwhile to provide a further summary. For references see, among many others, Clapham (1944), Viner (1937), Fetter (1965), Laidler (1987), Einzig (1970), and Perlman (1986).

Basically, the bullionist debate saw the emergence of two main positions. The Bullionist suggested that the high level of the exchange and the rising premium of gold were the consequences of domestic inflation caused by the Bank of England over issue. The anti-bullionist pointed out that the devaluation of the Pound was the effect of deficits in the balance of trade, originated by massive wheat import and foreign remittances due to war expenditures.

between money supply and price level, and put the blame for inflation on the Bank of England.³

The following long-standing debate, on the contrary, tended to revenge the anti-bullionist position, stressing the passive role of the Bank in accommodating exogenous price changes.

Until the early 1990s, however, most of these studies had a strong limitation, as they focused more on theoretical aspects than on empirical measurement of relations among the variables at work.⁴ In particular there was almost no use of data and statistical methodologies to analyse the role played by currency and credit supply in affecting the level of prices.⁵

More recently a new approach to the debate flourished, thanks to improvements in the field of time series analysis, in particular cointegration analysis and causality tests. Using such techniques O'Grada (1993) studied the problem of Irish paper Pound depreciation, Nachane and Hatekart (1995 hereafter NH), tested the Bullionist vs. the anti-Bullionist position using annual data, while Officier (2000) run a similar analysis using quarterly figures.

The present paper finds its natural collocation within such "new wave", but its coverage is far less ambitious, focusing only on the relation between the behaviour of the Bank of England and the level of price during the inflation period 1879-1815. More specifically, the aim of this work is to explore the causal relation between currency issue and credit policy (discounts and advances) by the Bank of England and price level, testing whether the Bank of

³ The 1810 report can be considered as the surrender of the anti-bullionist position and the triumph of Ricardo view.

⁴ This is not surprising considering the exceptionally high level of the theoretical debate, in particular Thorton's *An Enquiry into the Nature and Effects of the Paper Credit of Great Britain* (1802). Scholars such as Viner (1937), Hayek (1939), Schumpeter (1954) and Hicks (1967) pointed out that the bullionist debate provided some basic contributions to the development of modern monetary theory. According to Viner (1937), "the contemporary literature of the bullionist controversy is of great importance in the history of the theory of international trade in its monetary aspects. The germs at least of most of the current monetary theories are to be found in it." (p. 120). On the theoretical relevance of the bullionist debate, see also Hollander (1911), Hetzel (1986), Peake (1995), and Skaggs (1995).

⁵ Simberling (1923), Morgan (1939), and GRS (1953) are among the few exceptions .

England's expansionary policies caused inflation, as argued by the Bullionist, or whether they simply responded to exogenous price movements, as pointed out by the anti-Bullionists and by later analyses. Compared to NH and Officer studies, this paper has one main element of novelty; it uses credit policy, and not only the "traditional" currency issue, as a proxy for the Bank of England behaviour. Because of pitfalls contained in the paper issue data, we believe that the use of alternative measures can lead to more consistent assessments of the responsibility, if any, of the Bank for 1879-1815 inflation. Furthermore, following NH suggestion, the present paper focuses on the inflationary period only (1879-1815).

This paper is structured as follows. The first section contains a brief survey of the theoretical debate on the relation between money supply and prices during the considered period. The second part is dedicated to the econometric test of this relation. In the third section the attention is focused on the debate about the impact of the credit policy of the Bank of England on level of price. This subject is addressed with econometric techniques in the forth part of the paper. Concluding remarks follow.

II Prices level and notes issue during the Suspension era: an overview of the debate

In order to analyse the role of the Bank of England in the inflationary process, we can first focus on the relation between money supply and price level. Since the early 1800 contemporary writers proved aware of the importance of money-price link. Although the early dispute was mainly based on the relation between the monetary issue of the Bank of England and the level of the Pound premium over gold (or premium over metal-anchored currencies) contemporary observers focused also on the specific problem of the increase of the level of prices. Unfamiliarity with the concept of inflation as well as with the idea of index number⁶, made the contemporary authors devote their analyses only to the increasing price of some basic items, in particular wheat and, more

⁶ See Arnon (1990).

generally, food. Among others, Boyd (1801)⁷ and Thornton (1802), studied this relation. These two authors reached opposite conclusions about the role of money supply (in particular paper money issued by the Bank of England) in effecting the level of price during the early 1800s. According to Boyd, who represented of the orthodox bullionist position, the over issue of paper money was the cause of the increase of the price of wheat during the years 1800-1802. In his famous *Inquiry*, Thornton challenged Boyd conclusion by arguing that the inflation of the period of the early 1800s was mainly due to problems of deficit in the balance of payment.

Apart from Thornton's position in the *Inquiry*, most of contemporary observers were sympathetic with Boyd. In the official final conclusions of the bullion committee, eventually shared by Thornton too, money issue was considered the cause of inflation, and the Bank of England was recognised as the ultimate responsible.

The dominance of the orthodox bullionist position, however, was short-lived. Some decades after the conclusion of the debate Tooke, in his *History of prices and the State of Circulation from 1793 to 1837* (1838) started challenging the committee conclusions. According to Tooke, augmenting cost of import, generated by the increase of transport costs and, to a lower extent, by "bottlenecks" in international markets, was the main cause of British inflation. This was already enough to free money supply and consequently the Bank of England, from any responsibilities. The author, however, went as far as to explicitly denied that currency issue could have played any influence on prices, arguing that periods of inflation were not preceded by increases of money supply. On the contrary, the Bank of England seemed to have ex-post accommodated the level of currency to the needs of the economy.

Since the 1920s other analyses by Simberling (1923), Angell (1926), and Morgan (1939 and 1943) supported Tooke points and definitely turned the bullionist position into a minority one.⁸ Two ideas were the main pillars of this

⁷ See Clapham (1944) pp.17-20 and Fetter (1965), p. 32

⁸ Simberling, however, did not share Tooke's idea of the fundamental impact of increasing transport costs on the variation of imported goods. As Simberling pointed out, "Increased costs of transportation were by no means so

revisionist view. First, very few evidence supported the presence of a strong relation between paper money issue by the Bank of England and variations of price levels. Second, the influence between these two variables, if any, run from price to money and not vice versa. Simberling, using quarterly data and a graphic analysis, underlined that the note-issue of the Bank of England “move[ed] in far less regular correspondence with the cyclical variation of prices than the loans.”⁹ Angell rejected the hypothesis of a causal relation running from note issue to price level, supporting the opposite direction of causality. Morgan, who distinguished between the price of wheat and the general level of price, shared Simberling’s idea of a scant correlation between prices and the volume of the Bank of England notes. According to these authors, not only was the link between money and price weak but, furthermore, the causal relation, if any, seemed to go from prices to money, and not vice versa. As a matter on fact, Morgan noted “while there are several instances of the indices moving in the opposite directions, and of movements in the note index following movements in the price index, there is only one single instance of a movement in the note index preceding a similar movement in the price index.”¹⁰

In the 1940s and 1950s, further studies supported the non-bullionist view. Clapham, in his *The Bank of England. A History* (1944), reached the drastic conclusion that “the general price rise of these years cannot be connected at all closely with the mere quantity of notes in circulation”.¹¹ The author pushed the argument one step further by arguing that the increase of paper notes could simply have substituted gold coins, thus the augment of money supply was only apparent. Because of the absence of reliable estimation of gold coins circulation, such an hypothesis remains a matter of speculation, but it is still one of the best argument provided to justify the absence of a strict correlation

important a factor in creating the high war-time price level as Thomas Tooke, in his classic study of the subject, seems to have believed.” (1923, p. 22).

⁹ Simberling (1923), p. 240. Concerning Simberling’s interpretation of the role of credit loans in affecting the level of price, see section four of the present paper.

¹⁰ Morgan (1939), p. 209.

¹¹ Clapham (1944), p. 9.

between notes outstanding and the level of price. Gayer, Rostow and Schwartz (1953), again, went in the same direction, pointing out that variations of the level of price during period 1790-1811 were correlated to good and bad harvests and obstacles in the international trade.¹² Mhyrman (1976) backed these conclusions as he found little relation between money and price.¹³

By the 1980s, the literature consistently denied that money supply created inflation during the Napoleonic wars period. All these researches, however, shared the same inner weakness, having been based on qualitative studies or on graphic analyses. The advent of more sophisticated econometric-based studies, only moderated the outstanding results, but provided no evidence able to support the original bullionist view. In 1990 Arnon provided the first quantitative measurement of the relation between Bank of England notes and price level during the Suspension period. Aron suggested that price levels were influenced by both money supply and real factors, reaching a marriage between the bullionist and the anti bullionist positions. Aron, however, used only linear regressions, a methodology found insufficient by the author himself.¹⁴ More recently, NH and Officier tested the relation between currency issue and price levels within wider quantitative studies of the bullionist debate, and using more sophisticated econometric techniques. NH, analysis, based on yearly data for the period 1802-1838, explicitly supports the anti-bullionist way, suggesting that money supply must be considered as the effect of exogenous price changes. Officier reached more prudent conclusions: using quarterly data for the period 1897-1821 discovered “granger causality” running from both directions. This means that past values of money changes influenced current variation of price but the opposite relation stands too.

¹² See also Kindleberger (1993), pp. 64-65.

¹³ Officier (2000) p. 201.

¹⁴ Arnon (1990), p. 17.

III Money and prices: quantitative analysis

Two problems surface from the analysis of the debate on price and currency during the suspension period. First the presence itself of a strong relation between the Bank of England paper issue and the level of prices is doubtful. As a matter of facts, Scholars such as Clapham, Simberling and Morgan denied the presence of such a link. Second, even when such a relation is accepted, there is a wide disagreement on the direction of the causal link: did money change provoked price growth or the other way round?

In this section the relation between paper issue of the bank of England and prices is studied by reference to the period 1897-1815 using quarterly data provided by Simberling (paper issue) and GRS (general price index).

To test for the presence of a relation between the two variables, we must first check for stationarity of both series, which have been transformed into natural logarithms. Augmented Dickey-Fuller test indicates that both the two series (named “lprice” and “lcurrency”) are clearly integrated of order one and consequently non-stationary (**table A1 and A2**). The non-stationary nature of the two series implies that values of coefficients and of the R2 of Ols regressions could be misleading. This problem can be solved using cointegration analysis. In case of co integration between the two series results from Ols regression can be interpreted as correct. However, also residuals of the regression appeared to be non-stationary, indicating that the two series are not co-integrated (**table A3**). The absence of co-integration in turns means that no long-run steady-state relation can be established between the two variables. If we assume that theoretically a long-run relation between money and price must exist, the absence of co-integration is rather puzzling. Te solution of the puzzle, however can be quite easy: paper money issued by the Bank of England is simply a poor and misleading proxy for money supply. In fact the level of Bank of England outstanding notes is only a very broad indication of currency supply. As stressed above, the increase of notes could reflect, totally or partially, the reduction of coins so that the actual level of total currency is unknown. As we do not have reliable figures of gold circulation, every conclusion on this point relies upon speculations. The amount of notes issued

by country banks represents another relevant measurement problem. Also in this case data are very unreliable and it is very hard to infer some reasonable conclusions out of them. Before 1806 it is simply impossible to know the level of circulation of country banks, as they were not obliged to publish their balance sheets. After 1806 we have an estimation of the level of printed notes. This variable could diverge very much from the level of outstanding notes, as the banks could print the notes in advances and put them in the market only in period of actual demand. Because of this lack in the data, it is very hard to judge whether the increase in notes issue by the bank of England represented an actual augment of the currency supply or just a compensation (may be partial) for the diminishing of other components.

Even if our proxy for money issue is a quite poor one, it is nonetheless useful to test whether any causality relation with the level of price exists. This can be investigated using Granger tests. Strictly speaking Granger tests indicates only whether lagged values of a variable have an impact on current values of another variable and therefore it cannot be interpreted as causality in economic sense. However, once two alternatives theoretical explanations are provided, Granger test allow to discriminate between on of the two. In this sense Granger procedure is suitable to choose between the hypotheses of an influence running from past level of paper money supply to current level of price vs. the opposite mechanism. Because of the non-stationary nature of the two series, test is conducted using first difference of natural logarithm. Such variables approximate the rate of change of levels. Outcomes of Granger test for causality running from paper money to price are presented in **table A4**. Akaike test (values are not provided) indicates 3lags as the best model length. The “bullionist” hypothesis that currency “granger caused” price is clearly rejected, as no one of the coefficient of lagged rate of variation of paper money (fdlcur) appears to be significant. However also the presence of the opposite link is not backed by our outcome (see **table A5**). One-period lag of price variation (fdlprice) has a significant coefficient, but the model on the whole seems to suffer of misspecification because of the high probability of residual covariance.

IV Advances, discounts and prices: theoretical relations

The difficulty of inferring any evidence from above tests, combined with historical evidence, supports the hypothesis that outstanding paper money is probably the wrong variable to measure the impact, if any, of the Bank of England policy on price levels.

However, good alternatives exist, in particular using the amount of advances and discount by the Bank of England avoids most of the problem one faces using the amount of outstanding paper money.

The use of the former variable is in line with a number of past studies which put the blame for inflation on credit supply rather than on money issue. Clapham (1944), for example, pointed out “In relation to the country’s needs the issue was reasonable; but the free discounting probably quickened the circulation of the notes.”¹⁵ He stressed the presence of a relation between prices level and credit policy of the Bank of England mainly based on increasing volumes of private discounts¹⁶ Vilar (1991) shared this opinion suggesting that the boom of 1808-1810 “was credit inflation rather than monetary inflation”.¹⁷

Saying that a relation between credit supply and prices exists, however, it is very different from saying that inflation was caused by an endogenous increase of discounts and advances supply. In Fact, the relation between credit policy of the Bank of England and the level of prices has been interpreted in different, sometimes opposite, ways and three main approaches emerged. Some scholars, such as Clapham and Vilar, identified the growing level of credit supply (in terms of discount to private sector and advances to government) as the cause of the rising price. Other authors simply stress the parallelism between the two variables, without providing any explicit suggestions about the direction of the causal nexus. This more prudent position is chosen by Kindleberger (1993),

¹⁵ Clapham (1944), p. 16

¹⁶ Clapham (1944) talks of “liberal advances to government and [...] very liberal discounts.” (p. 16)

¹⁷ Vilar (1991), p. 313

who pointed out that the growth of discounts and advances paralleled the increase of the *agio*.

Finally some other scholars suggested that the rising level of credit supply was the consequence, and not the cause of inflation. Simberling (1923) and Morgan (1939) shared the latter position. Simberling recognised the presence of a relation between the variation of credit and the level of prices, but argued that the increase of advances followed the increase of price, thus representing evidence against the causal link from credit to prices. “The two series - Simberling suggested - [...] do not move simultaneously; it will be noticed that the major variations in prices *precede* those of the Bank advances almost without exception.”¹⁸ Morgan shared Simberling’s conclusions suggesting that, “the correlation between total advances and prices is somewhat closer than that of prices and note issue, and [...] the tendency for the price movement to precede the other is more marked.”¹⁹

V Credit and prices: econometric tests

Similarly to what we have presented in section III, we start with a basic analysis of the relation between price levels and credit supply. The first preliminary step consists in testing for the order of integration of the series representing the sum of discount and advances, expressed in natural logarithm. Such a series appears to be integrated of order one and non stationary, with the already known consequences in terms of misleading value of Ols regression (**table A6 and A6.1**).

In this case, however, residual from the price-credit regression appear to be stationary, suggesting the presence of cointegration between the two variables (**table A7**). Outcomes of the Ols regression (**table A8**) can thus be interpreted as correct indication of the long-term relation between price levels and money supply, proxied by credit policy of the Bank of England. These findings,

¹⁸ Simberling (1923), p. 240

¹⁹ Morgan (1939), p. 210

however, are not completely satisfying: both the value of R squared (0.59) and of residual autocorrelation suggests the possibility of model misspecification. Direction of causality between price and credit is investigated again using Granger tests. It is interesting to note that the use of Granger is the perfect translation in formal terms of Simberling assumption that the anticipated movement of price in respect of movement of credit supply furnished “presumptive evidence that the credit operations of the bank were not in any great degree, if at all, responsible for the price fluctuations.”²⁰ Our findings, however, stand at odd with Simberling conclusions, as our test did not reject the hypothesis of non-Granger causality running from price to money (**Table A9**). Because of cointegration between the two variables, test includes the one-period lagged level of residual of the ols regression, in order to account for long-term relation between the two variables. Akaike test (values again are not provided) indicates 4 lags as the better model length.

The opposite direction is less clear (**Table 10**). The test indicates that the hypothesis of non-Granger causality can be rejected when expanding the interval of confidence from 5% to 10%. In this case one-period lagged value of credit variation has significant coefficient, suggesting that credit could have played a role in price changes.

VI Concluding remarks

Inflation during the Napoleonic wars is a widely investigated and interesting case study; it generated a fantastic contemporary theoretical debate, which *per se* is a stimulating subject, and provides a revealing perspective on more generic topics such as the gold standard, the Bank of England behaviour and the level of price.

The bullionist position had a short-living initial victory, but since Tooke’s study, the anti-bullionist perspective dominated the scene and remained relatively unchallenged. Such findings are very interesting especially when considering that they are not consistent with long run studies on money-price

²⁰ Simberling (1923), pp. 240-241

relation conducted by Bordo and Schwatz (1981) in response to previous works by Lewis (1978) and Rostow (1978).²¹

Although still provisional, our findings are in contrast with the outcome of the two centuries-long debate and provide a possible solution to this puzzle. Granger tests show very little about the causal relation between paper issue of the Bank of England and price levels and no definitive answer can be inferred by these measurements. The structure of monetary payments of the time, however, suggests that the use of the Bank of England issue could be a poor and misleading proxy of the amount of monetary means. Problems with the estimations of both gold coins and country bank issue do not allow providing a better proxy. The solution we found is to use, instead, the level of advances and discounts. This variable shows a higher level of long-term correlation with prices as well as better results when used to run Granger test with price changes. Granger causality from price to currency does not emerge, but the opposite relation stands, at least with broader interval of confidence.

This paper, however, is far from saying the last word in the debate about inflation and money during the Napoleonic wars. The limited number of observations used in the paper, the deficiencies of the Granger test, as well as the necessity of expanding the interval of confidence in order to have a clear causality direction, all cast doubts about the results. However, this can be a good starting point and other more sophisticated analyses could confirm or reject these results.

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²¹ Although Bordo and Schwartz (1981) treated the Napoleonic war period only in qualitative terms, the two authors sympathise with the monetarist (bullionist) view.

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Appendix 1: calculations

Table A1: Unit root test for lprice

The Dickey-Fuller regressions include an intercept and a linear trend

	Test Statistic	LL	AIC	SBC	HQC
DF	-2.2601	128.3674	125.3674	121.9734	124.0177
ADF(1)	-3.4643	134.4970	130.4970	125.9716	128.6974
ADF(2)	-2.8948	134.6459	129.6459	123.9892	127.3964
ADF(3)	-3.2665	135.8321	129.8321	123.0441	127.1327
ADF(4)	-3.3357	136.2310	129.2310	121.3116	126.0817

95% critical value for the augmented Dickey-Fuller statistic = -3.4730
 LL = Maximized log-likelihood AIC = Akaike Information Criterion
 SBC = Schwarz Bayesian Criterion HQC = Hannan-Quinn Criterion

Table A2: Unit root test for lcurrency

The Dickey-Fuller regressions include an intercept and a linear trend

	Test Statistic	LL	AIC	SBC	HQC
DF	-1.9351	-73.7010	-76.7010	-80.0950	-78.0506
ADF(1)	-2.1296	-73.1307	-77.1307	-81.6560	-78.9303
ADF(2)	-1.9007	-72.9708	-77.9708	-83.6275	-80.2203
ADF(3)	-1.8660	-72.9571	-78.9571	-85.7451	-81.6565
ADF(4)	-2.2268	-71.7091	-78.7091	-86.6285	-81.8584

95% critical value for the augmented Dickey-Fuller statistic = -3.4730
 LL = Maximized log-likelihood AIC = Akaike Information Criterion
 SBC = Schwarz Bayesian Criterion HQC = Hannan-Quinn Criterion

Table A3: Unit root tests for residuals

	Test Statistic	LL	AIC	SBC	HQC
DF	-2.1667	124.3163	123.3163	122.1850	122.8664
ADF(1)	-3.2097	130.0862	128.0862	125.8235	127.1864
ADF(2)	-2.6016	130.6593	127.6593	124.2653	126.3096
ADF(3)	-2.8607	131.4399	127.4399	122.9146	125.6403
ADF(4)	-3.0301	131.9727	126.9727	121.3160	124.7232

95% critical value for the Dickey-Fuller statistic = -3.4235
 LL = Maximized log-likelihood AIC = Akaike Information Criterion
 SBC = Schwarz Bayesian Criterion HQC = Hannan-Quinn Criterion

Table A4: Granger test (causality running from money to price)

Regressor	Coefficient	Standard Error	T-Ratio [Prob]
CONST	.0047645	.0056678	.84063 [.404]
FDLPRICE(-1)	.34603	.12587	2.7491 [.008]
FDLPRICE(-2)	-.25628	.13052	-1.9635 [.054]
FDLPRICE(-3)	.049458	.12728	.38857 [.699]
FDLCUR(-1)	-.060888	.14733	-.41327 [.681]
FDLCUR(-2)	-.17942	.12749	-1.4073 [.164]
FDLCUR(-3)	-.021911	.13354	-.16408 [.870]

Diagnostic Tests: serial correlation:

	LM Version	F Version
CHSQ(1) =	.40049[.527]	F(1, 62)= .35676[.552]

Table A5: Granger test (causality running from price to money)

Regressor	Coefficient	Standard Error	T-Ratio[Prob]
CONST	.011286	.0051538	2.1898[.032]
DLCUR(-1)	.12296	.12189	1.0087[.317]
DLCUR(-2)	-.28153	.11289	-2.4938[.015]
DLCUR(-3)	.10408	.10424	.99844[.322]
DLPRICE(-1)	-.097633	.11042	-.88417[.380]
DLPRICE(-2)	.22251	.11400	1.9519[.055]
DLPRICE(-3)	.0074732	.11313	.066056[.948]

Diagnostic Tests: serial correlation

LM Version	F Version
CHSQ(4)= 14.0571[.007]	*F(4, 61)= 3.6997[.009]

Table A6: Unit root test for “credit”

The Dickey-Fuller regressions include an intercept but not a trend

	Test Statistic	LL	AIC	SBC	HQC
DF	-1.8510	72.0892	70.0892	67.8265	69.1894
ADF(1)	-1.7949	72.3805	69.3805	65.9864	68.0308
ADF(2)	-1.7059	75.1486	71.1486	66.6232	69.3490
ADF(3)	-1.6845	77.2489	72.2489	66.5922	69.9994
ADF(4)	-1.6729	77.2510	71.2510	64.4630	68.5517

95% critical value for the augmented Dickey-Fuller statistic = -2.9023

Table A6.1: Unit root test for “credit”

The Dickey-Fuller regressions include an intercept and a linear trend

	Test Statistic	LL	AIC	SBC	HQC
DF	-3.8857	77.7821	74.7821	71.3881	73.4325
ADF(1)	-3.7876	77.9673	73.9673	69.4419	72.1677
ADF(2)	-3.0131	78.7119	73.7119	68.0552	71.4624
ADF(3)	-2.4226	79.4991	73.4991	66.7111	70.7997
ADF(4)	-2.4596	79.6440	72.6440	64.7247	69.4947

95% critical value for the augmented Dickey-Fuller statistic = -3.4730

LL = Maximized log-likelihood AIC = Akaike Information Criterion
SBC = Schwarz Bayesian Criterion HQC = Hannan-Quinn Criterion

Table A7: Unit root test for residual

	Test Statistic	LL	AIC	SBC	HQC
ADF(1)	-3.7052	114.8747	112.8747	110.7003	112.0168
ADF(2)	-3.1370	115.0653	112.0653	108.8038	110.7784
ADF(3)	-3.3229	115.6848	111.6848	107.3360	109.9689
ADF(4)	-3.5243	116.3975	111.3975	105.9615	109.2526

95% critical value for the Dickey-Fuller statistic = -3.4316
LL = Maximized log-likelihood AIC = Akaike Information Criterion
SBC = Schwarz Bayesian Criterion HQC = Hannan-Quinn Criterion

Table A8: Price-credit Ols regression

Regressor	Coefficient	Standard Error	T-Ratio[Prob]
CONST	4.1077	.078019	52.6505[.000]
LCRED	.22583	.021722	10.3966[.000]
R-Squared	.59360	R-Bar-Squared	.58811
S.E. of Regression	.070959	F-stat. F(1, 74)	108.0883[.000]
DW-statistic	.40299		

Diagnostic Tests

Lagrange multiplier *CHSQ(4)= 51.6230[.000]*F(4, 70)= 37.0596[.000]
Heteroscedasticity*CHSQ(1)= .27073[.603]*F(1, 74)= .26455[.609]

Table A9 Granger test: (causality running from price to money)

Regressor	Coefficient	Standard Error	T-Ratio[Prob]
CONST	.027809	.011394	2.4407[.018]
FDLPRICE(-1)	.12811	.28991	.44188[.660]
FDLPRICE(-2)	.12225	.30297	.40352[.688]
FDLPRICE(-3)	.025857	.28398	.091053[.928]
FDLPRICE(-4)	-.018823	.29325	-.064189[.949]
FDLCRED(-1)	-.24507	.12551	-1.9526[.055]
FDLCRED(-2)	-.31711	.12811	-2.4753[.016]
FDLCRED(-3)	-.23987	.12705	-1.8881[.064]
FDLCRED(-4)	-.0065838	.12193	-.053997[.957]
RES(-1)	.0026522	.0014406	1.8411[.070]

Diagnostic Tests: Serial Correlation

LM Version	F Version
CHSQ(1)= 3.8596[.049]	F(1, 60)= 3.4491[.068]

Table A10 Granger test: (causality running from money to price)

Regressor	Coefficient	Standard Error	T-Ratio[Prob]
CONST	.0053147	.0053033	1.0022[.320]
FDLPRICE(-1)	.46007	.13494	3.4095[.001]
FDLPRICE(-2)	-.046438	.14102	-.32931[.743]
FDLPRICE(-3)	.17739	.13218	1.3420[.185]

FDLPRICE(-4)	.11001	.13650	.80599[.423]
FDLCRED(-1)	-.10255	.058419	-1.7555[.084]
FDLCRED(-2)	-.085430	.059631	-1.4326[.157]
FDLCRED(-3)	-.043011	.059134	-.72735[.470]
FDLCRED(-4)	-.045656	.056753	-.80446[.424]
RES(-1)	-.0016254	.6705E-3	-2.4241[.018]

Diagnostic Tests: serial correlation

	LM Version	F Version
CHSQ(1)=	.0054095[.941]	F(1, 60)=.0045718[.946]

Appendix 2: Data set

	Quarterly price index Average for 1821-5 = 100	Note Outstanding <i>(Million of £, quarterly average)</i>	<i>Bank of England</i> Total Advances		Commercial paper under discount	discounts And Advances
1797(01)	113.93	9.80	12.60	4.1	16.70	
1797(02)	112.93	11.70	13.60	5.5	19.10	
1797(03)	110.93	11.00	12.30	5.6	17.90	
1797(04)	119.10	11.40	11.10	6.1	17.20	
1798(01)	120.73	12.90	13.30	4.4	17.70	
1798(02)	122.20	13.00	14.20	4.2	18.40	
1798(03)	121.83	12.20	13.20	4.2	17.40	
1798(04)	128.70	12.20	13.50	4.7	18.20	
1799(01)	129.67	13.00	14.40	4.5	18.90	
1799(02)	133.90	13.80	15.30	4.2	19.50	
1799(03)	135.10	13.40	15.40	5.9	21.30	
1799(04)	120.67	13.80	16.30	7.4	23.70	
1800(01)	119.03	15.00	18.80	6.5	25.30	
1800(02)	120.03	15.00	19.40	6.1	25.50	
1800(03)	124.37	15.10	18.70	6.1	24.80	
1800(04)	126.60	15.50	19.00	6.6	25.60	
1801(01)	134.50	16.40	22.10	8	30.10	
1801(02)	131.30	15.80	21.60	8.8	30.40	
1801(03)	123.77	15.30	19.40	7.5	26.90	
1801(04)	119.63	15.70	19.40	7.6	27.00	
1802(01)	116.27	15.60	21.00	6.9	27.90	
1802(02)	113.67	16.80	22.80	7.7	30.50	
1802(03)	110.40	17.00	20.80	7.4	28.20	
1802(04)	112.63	17.40	17.30	8.2	25.50	
1803(01)	121.57	15.70	9.50	10.3	19.80	
1803(02)	125.63	16.20	23.10	10.7	33.80	
1803(03)	128.40	16.80	24.60	10.9	35.50	
1803(04)	127.97	17.30	23.50	11.3	34.80	
1804(01)	131.83	17.60	24.90	11.1	36.00	
1804(02)	132.33	17.60	25.80	9.8	35.60	
1804(03)	132.73	17.10	24.00	9.1	33.10	
1804(04)	134.23	17.20	23.10	9.4	32.50	
1805(01)	141.27	17.60	26.20	10.4	36.60	
1805(02)	140.40	16.90	26.10	11.2	37.30	
1805(03)	136.87	16.50	23.30	11.6	34.90	
1805(04)	135.90	16.50	22.50	11.9	34.40	
1806(01)	135.30	16.80	24.50	11.8	36.30	
1806(02)	138.80	17.00	28.20	12.2	40.40	
1806(03)	138.40	16.70	26.00	11.9	37.90	
1806(04)	137.47	16.60	23.30	12.5	35.80	
1807(01)	139.03	16.60	25.30	13.1	38.40	
1807(02)	137.30	16.80	27.70	13.4	41.10	
1807(03)	137.17	17.00	27.50	13.4	40.90	

1807(04)	134.53	16.40	26.00	13.1	39.10
1808(01)	138.40	16.6	26.70	12.9	39.60
1808(02)	148.43	17.2	27.00	12.1	39.10
1808(03)	155.53	17.2	28.00	13.2	41.20
1808(04)	166.13	17.4	27.60	13.5	41.10
1809(01)	172.17	17.80	29.20	14.4	43.60
1809(02)	152.80	18.50	30.80	14.8	45.60
1809(03)	148.40	19.30	31.10	15.6	46.70
1809(04)	154.93	19.90	30.10	16.5	46.60
1810(01)	163.00	20.40	32.40	19.1	51.50
1810(02)	155.07	21.30	35.40	19.8	55.20
1810(03)	147.43	24.20	37.80	20.8	58.60
1810(04)	140.27	24.20	35.20	18.3	53.50
1811(01)	137.23	23.30	32.60	15.8	48.40
1811(02)	132.87	23.60	34.20	13.7	47.90
1811(03)	128.03	23.30	35.00	12.4	47.40
1811(04)	135.50	22.90	33.80	12.9	46.70
1812(01)	140.97	23.30	35.40	13.6	49.00
1812(02)	140.13	22.90	36.80	13.4	50.20
1812(03)	139.97	23.50	37.00	14.9	51.90
1812(04)	143.30	23.30	36.20	14.2	50.40
1813(01)	152.47	23.90	37.30	11.6	48.90
1813(02)	154.07	23.90	39.20	11	50.20
1813(03)	153.60	24.00	38.40	12.3	50.70
1813(04)	162.87	24.20	39.10	14.1	53.20
1814(01)	177.47	25.20	38.70	14.5	53.20
1814(02)	169.03	25.90	43.00	14.9	57.90
1814(03)	159.57	28.60	46.40	12.1	58.50
1814(04)	161.73	28.00	43.60	14.6	58.20
1815(01)	149.07	27.30	42.00	14.8	56.80
1815(02)	145.23	27.00	45.60	14.8	60.40
1815(03)	142.97	27.20	43.70	18	61.70
1815(04)	139.97	26.10	38.60	17	55.60

Source:*Price index: Gayer, Rostow, Schwartz (1953)**Bank of England figures: Simberling (1923)*

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