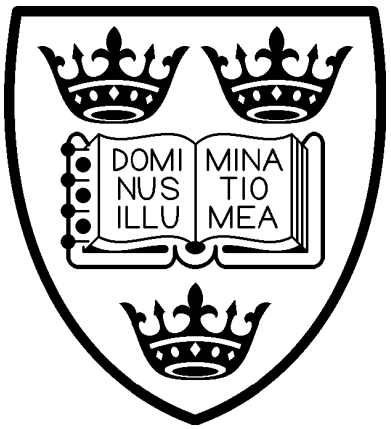

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THE BANK OF ENGLAND AND THE BRITISH ECONOMY, 1890-1913

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The Bank of England and the British Economy 1890-1913

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Abstract

The paper examines the behavior of the British economy 1890-1913 by using a newly assembled quarterly data set. This provides a basis for estimating a small macroeconomic model, which can be used to explore the relationship between the policy responses of the Bank of England and the course of the economy .It is one of the few papers to make use of UK quarterly data and seeks to extend the earlier work of Goodhart (1972). The paper goes on to look into the determinants of external and internal gold flows and relates these to an extensive historical literature. The outcome is compared with the traditional representation of the working of the gold standard, as set out in the well- known Interim Report of the Cunliffe Committee (1918).It is found that operation of the model accords in general with the views of the Committee. The views of the Committee were applicable to the pre 1914 gold standard, but less so to the restored interwar gold standard.

The next question to be considered is how far the Bank observed 'The Rules of the Game' in the sense of relating the reserves of the commercial banks to the gold reserves held at the Bank. It is shown that the relationship between the Bank's reserves and the reserves of the commercial banks was severely distorted by the massive gold movements of 1895-6. These flows were associated with US political conflicts over the monetization of silver. With the exception of this episode, the Bank is shown to have had a limited measure of discretion in operating the gold standard. The final question to be considered is whether a similar model can be estimated from US data and related to the views of Friedman and Schwartz.

Introduction

Economists and economic historians have long discussed the role of the Bank of England and the working of the pre 1914 Gold Standard. The classic works are those of Sayers (1936)(1976), Hawtrey (1938), Bloomfield (1959) and Clapham (1944). A quantitative approach to the study of Bank of England behaviour was pioneered by Goodhart (1972) and unsettled issues were further explored by Dutton, Pippenger and Goodhart in Bordo and Schwartz (1984). Much of the literature on the classical gold standard has been surveyed in a masterly fashion by Eichengreen (1992). In addition there an extensive theoretical literature which too extensive to be discussed here.

The aim of this paper is to link the actions of the Bank of England to some of the main variables of the British economy. A basic macroeconomic model is estimated and is used to evaluate the views of the Cunliffe Committee on how the mechanism of the gold standard operated before 1914 as set out in the Interim Report of the Committee (1918). Secondly the question of how far the Bank observed the conventional 'Rules of the Game', Keynes (1931), is explored. This aims to extend the work of Bloomfield

(1959) who raised the question of how far domestic credit was adjusted to external gold flows. An examination of the data indicates that special consideration needs to be given to the response of the Bank to the major gold movements of 1895-6, which were noted by Sayers (1936) and Hawtrey (1938)(1962).

Thirdly the impact of gold movements on the internal transmission mechanism is examined with particular reference to the boom of the late 1890s. A brief mention is made to the effects of varying internal demand for gold on the money demand function and the effects of cheap money on the economy. Finally some consideration is given to the question of the application of the model to the United States. This is motivated by the claims of Friedman and Schwartz (1963)(1982) for a close financial connection between the US and the UK at this time.

The Basic Model

The paper uses an empirical approach drawing on quarterly data for the British economy, which has not been analysed previously. The main macroeconomic time series were assembled by Thomas (1926) and extended in the NBER Macro data set. The main sources of the monetary data are Capie and Webber (1985), Beach (1935) and Goodhart (1972).It must be borne in mind that the quarterly data on the real economy is of variable quality, whereas the financial series are more reliable.

The basic model which is estimated is closely related to the small models of Rudebusch and Svensson (1999) and Cecchetti et al (2006). Both groups of authors were looking for minimal macro models which would enable them to explore the effects of monetary policy measures. Rudebusch and Svensson and Cecchetti proposed minimal macro model ,which were close to being VARs (Vector Autoregessions), but were viewed in a structural way. The models consisted of an aggregate demand equation and an aggregate supply equation, determining output and prices, and an exogenously determined interest rate, acting as the monetary policy variable. Rudebush and Svensson could have estimated a more detailed model from post war US data, but chose not to do so. This was because they did not wish to make assumptions about the channels of the monetary transmission mechanism. Cecchetti et al were seeking to assess the efficacy of monetary policy in a sample of 24 economies, where little data was available for some countries, since the sample included both large industrial economies and small developing ones. In this paper a similar model is used because of the limited availability of quarterly data before 1914. However the main series which are used would have been available to the Bank of England when making decisions on the setting of interest rates and use of other financial instruments.

The model consists of equations for aggregate demand and aggregate supply, where the endogenous variables are a measure of the output gap and the rate of change of prices. The short term interest rate is not assumed to be exogenous, as in the previously cited models, but is determined by a reaction function of the central bank in operating the gold standard. This follows in the tradition set by Goodhart (1972) and Dutton (1984). Aggregate demand pressure is taken to be the unemployment rate and prices are measured by the Sauerbeck index of wholesale prices. The short term interest rate is Bank Rate. In addition the volume of exports is included as an exogenous variable in the AD equation. In the aggregate

supply equation the rate of change of prices depends on unemployment, the rate of interest and international prices, as measured by US wholesale prices. The third equation is the reaction function of the Bank, which depends on unemployment, the rate of change of prices and the state of the reserves. The reserve position is indicated by the Proportion, which is the ratio of the reserve of notes and coin held by the Banking Department to its liabilities. In addition the reaction function includes the US short term interest rate as a measure of international interest rates.

Table 1 Basic Macro Equations for UK	Signs of Coefficients	
AD Unemp=F1 (Prices, Bank Rate, Exports)	(+/-, +, -)	EQN 1
AS Prices = F2 (Unemp, Bank Rate, US prices)	(-,-,+)	EQN 2
Reaction Function of the Bank		EQN3
Bank Rate =F3 (Unemp, Prices, Reserve Ratio [Proportion], US Interest Rate.) (-,+,-,+)		
External Variables : Exports, US Prices, US Interest Rate		

The basic UK macroeconomic series entering the model are the unemployment rate, wholesale prices and the volume of UK exports shown in Chart 1.Some justification is needed for the use of the Trade Union unemployment rate as a measure of economic activity, in view of the limited coverage of the labour force due to the low rate of trade union density. Using annual data the employment rate derived from the unemployment rate is compared with a measure of the output gap. This series is computed from GDP output in Feinstein (1972) by applying a Hodrick Prescott filter to the data. It will be seen from Chart 2 that there is a close coincidence in the timing of cyclical peaks and troughs of the employment rate and the output gap computed from the annual GDP series. This provides some justification for using quarterly unemployment as a measure of the output gap.

A similar comparison is also made in Chart 2 between the annual Sauerbeck wholesale price index and the TFE deflator from Feinstein. It will be seen that while the timing of cycles is similar in the series, there is greater flexibility for wholesale prices than for the TFE deflator. This is not surprising since the Sauberbeck index like other measure of wholesale prices included largely food, raw materials and intermediate manufactured products. It included few if any non traded goods, Sauerbeck (1886) (1962).While data on the value of UK exports is readily available, there are no official data for the volume of exports. Fortunately Silverman (1930) computed monthly indexes for UK export and import prices 1880-1913. The series for exports prices can be used to deflate the official trade data on export values to obtain a quarterly volume index for exports.

The equations are estimated as ADLs (Autoregressive Distributed Lag) with up to 6 lags on each variable and estimation is by OLS. Each equation is simplified to a parsimonious form following the general to

specific methodology of Hendry and associates. The residuals are tested for stationarity. The results are reported as Equations 1-3 at the end of the paper.

The Estimates of the Model

The estimated aggregate demand equation (AD) is shown in Equation (1). In this equation the change in unemployment is negatively related to the level of unemployment. It is negatively related to the change in wholesale prices and positively related to lagged Bank Rate. Unemployment is negatively related to the change and level of exports. The sign of the coefficient on prices requires some explanation. There was a strong association between the cyclical recovery of activity and rising prices in the British economy before 1914. Rising wholesale prices were a bullish indicator for the business cycle and were therefore associated with falling unemployment. In the downturn falling prices were a strong bearish indicator and associated with rising unemployment. Bank Rate had a positive effect on unemployment as might be expected and exports volume had a negative effect. These effects are summarized in the mid run solution which solves out the lagged dependent variable and simplifies the dynamics of the equation. The medium term solution for AD Equation 1 is shown below:

LUN=C – 57.3 DLP + 1.18 Bkr -2.71 DLExp-2.7LExp EQN1a

In the equation unemployment is negatively related to the change in wholesale prices. It is positively related to Bank Rate and negatively to exports.

The aggregate supply equation (AS) is estimated in Equation 2. The change in wholesale prices is negatively related to the lagged level of prices in the error correction term. It is negatively related to unemployment and Bank Rate as might be expected. The inclusion Bank rate in the AS equation requires some justification. It may be noted that neither Ceccheti nor Rudebusch and Svenson include the short term interest in the AS curve. In their models the impact of the interest rate comes via the AD schedule. The interest rate affects economic activity and only the variable measuring the level of activity enters into the price equation. This is the conventional view of the transmission process, but it does not reflect the view of Hawtrey (1938), who argued that a rise in the interest rate would have a direct effect on prices as traders adjusted their holdings of inventories. When the interest rate is included in the AS schedule, it is statistically significant so supporting the Hawtrey hypothesis. Hawtrey's view is also consistent with the views of the Macmillan Committee (1931) Para 215 on the effects of changes in Bank rate on the price of commodities.

UK wholesale prices are positively related to both the change and level of US prices. The AS curve emerges as a type of Phillips curve in which the change in prices is negatively related to unemployment and Bank Rate and is positively related to US prices. The simplified medium term solution for the change in prices is shown below. The coefficient on the change in US prices of more than unity may be due to

the higher variance of UK than US wholesale prices. The long run solution for the price level is also shown. It has a coefficient of 0.76 on US prices, which provides evidence for PPP (Purchasing Power Parity) in this period.

DLP=C- 0.41LP-0.026LUN -0.012 BKR+ 1.12 DLUSP+0.31LUSP EQN2a

LP=C-0.07LUN-0.03BKR +0.76LUSP EQN 2b

The estimated reaction function is shown in Equation 3. Bank Rate is positively related to the change in prices and negatively to the change and level of unemployment. Bank Rate is as expected negatively related to the reserve ratio (Proportion) and is positively related to the US time rate. These results are summarized in the equation for the medium term solution. The medium term solution for the Bank's reaction function is given by:

BKR=4.0+13.8DLP-0.84 LUN – 0.041Prop + 0.58 USTR EQN3a

This shows that Bank Rate was positively related to the change in prices, negatively to unemployment. As expected, it was negatively related to the Proportion and positively to the US time rate. If the US time rate is omitted the coefficient on the Proportion becomes -0.084, indicating a larger effect, but the standard error of the equation increases by 23%.By combining the solution for unemployment with the Bank's reaction function, we get the final form for unemployment:

LUN=C -20.7DLP – 1.4 LEXP -7.3 DLEXP-0.02 PROP+0.34 USTR. EQN1c

This equation shows that unemployment was negatively related to the change in prices, exports and the Proportion and positively related to the US interest rate.

The Determinants of Gold Flows

Having looked at the impact of Bank rate on unemployment and prices and also the determinants of the Bank's reaction function, we turn to the determinants of gold flows. This is necessary as changes in the Bank's reserves affect the Proportion and Bank Rate, which in turn affect unemployment and prices. We seek to explain external gold flows to the Bank and internal flows due to changes in the domestic circulation of gold coin. The modelling of external gold flows is a complex issue. It is not the main concern of this paper and will be dealt with in a simplified way. Some reference to the historical literature may be helpful. The pioneer work on gold flows was carried out by Beach (1935).Factors influencing external gold flows were discussed by Sayers (1936) and examined by Goodhart (1972). Both authors argued that market rate, that is the yield on first class commercial bills rather than Bank Rate affected external flows. Internal gold flows were examined by Beach and also by Hawtrey (1938).

The basic hypothesis used here is that external gold inflows are positively related to UK interest rates, either Bank Rate or market rate, and negatively to the level of overseas interest rates, measured by the US time rate. The result of estimating this equation with Bank Rate as the domestic interest rate is reported in Equation 4 and is summarized in the medium term as:

NGOLDBE=3.1 +1.07 BKR – 0.80 USTR £Mn EQN4a

It is found that gold inflows to the Bank are positively related to the level of Bank Rate and negatively related to the US time rate. The coefficient on Bank Rate is 1.0 and that on the US time rate -0.80. This implies that a rise of one percentage point in Bank Rate increases the gold inflow by £1m per quarter and a rise in US time rate has an effect of similar size but with opposite sign. The US time rate performs better than Continental rates because it is more flexible. The positive constant of the equation indicates that there is an average net inflow to the Bank of £3.1m per quarter excluding interest rate effects.

The equation for the internal flow of gold is reported as Equation 5 and is summarized in the medium term as:

GOLDINT=-1.68+0.094 UN-0.016 TIM £Mn EQN5a

The equation has a negative constant indicating that there was an outflow of gold from the Bank into the internal circulation. This is reinforced by a negative time trend due to a rising internal demand for gold. The outflow of gold from the Bank is reduced by a fall in the level of activity, indicated by a rise in unemployment. Lower activity implies a reduced demand for gold coin, checking the outflow of gold from the Bank or even reversing it. This equation supports Hawtrey's argument about the positive relationship between economic activity and the internal demand for gold.[1]

Comparison of the Results of the Model with the Views of the Cunliffe Committee

The results from estimating the small macro model extended by the inclusion of gold flows can be compared with the views of the Cunliffe Committee on the working of the gold standard. The Committee took as its model of the international monetary system the experience of the Bank in the early years of the 20th century.[2]The Interim Report considers first the response of the Bank to an external shock, which reduces its reserves, and secondly the response to a domestic boom.

Let us assume that the external shock takes the form of a sudden loss of reserves and hence a fall in the Proportion or a rise in US interest rates. In both cases in our model the Bank would respond by raising Bank Rate according to the reaction function Equation 3. The rise in Bank Rate has two effects: first, it induces an external gold inflow from Equation 4 and secondly it has a domestic impact, raising unemployment and curbing the price level via Equations 1 and 2.[3] A fall in activity and a rise in

[1] Hawtrey (1938)(1962) Ch3 discusses the interior demand for gold from 1858 to 1914 .

[2] First Interim Report of the Cunliffe Committee on Currency and Foreign Exchanges (1918), reprinted in Gregory (1929).

[3] The Report Para.5 refers to 'The consequent slackening of employment' diminishing 'the demand for consumable goods' as a result of a rise in Bank Rate .Thus the adverse effect of a rise in Bank Rate on unemployment was more readily recognized than by Governor Montagu Norman in his evidence to the Macmillan Committee (1931).

unemployment reduces the internal demand for gold, according to Equation 5. This will lead to some gold returning to the Bank, increasing the Proportion and reducing Bank Rate through the reaction function Equation 3.

The process recounted here follows the steps in the argument of the Cunliffe Committee .The Committee accepted that a rise in Bank Rate will raise unemployment, but does not refer to the effect on the internal demand for currency.[4]In the case of a domestic boom the Committee noted unemployment would fall and wholesale prices would rise as in Equation 2. The rise in activity and prices would prompt the Bank to raise Bank Rate in agreement with the reaction function Equation 3. This would be reinforced by a decline in the Proportion due to an increase in the internal demand for gold as indicated by Equation 5.

There is a large measure of agreement between the macro model and the analysis of the Cunliffe Committee. The Interim Report states that a rise in Bank Rate raises the cost of credit, so increasing the cost of holding stocks of goods. The response of importers and wholesalers is to reduce their stocks. The reduction in demand for stocks results in a fall in prices of commodities.[5] This is the effect which Hawtrey observed and is supported by the AS equation estimated here. In the macro model the AS curve is a form of Phillips curve in which an increase in unemployment checks rising prices. This effect was also noted by the Cunliffe Committee.

An Evaluation of Views Expressed in the Earlier Literature

The results reported here can be compared with the views of previous writers. Sayers (1936) claimed that external gold flows responded to market rate rather than Bank Rate. According to our equation for external gold flows, the results for both interest rates are similar[6]. In the interest of simplicity the emphasis is placed on Bank Rate here.

Sayers (1976) states that the setting of Bank Rate depended on the need to maintain the gold standard and that it was not intended to affect the domestic economy. Sayers (1936) was more cautious, allowing that the Bank showed 'an occasional tendency' to take domestic activity into account in setting Bank Rate. Bloomfield (1959) expressed a generally similar view that movements in discount rates were directed towards influencing gold flows rather than economic activity. [7] This is in contrast to Dutton (1984) who argued that the Bank operated a deliberate counter cyclical policy on the basis of his

[4] The Report Para.5 refers to 'The consequent slackening of employment' diminishing 'the demand for consumable goods' as a result of a rise in Bank Rate. Thus the impact of a rise in Bank Rate on unemployment was more readily recognized than by Governor Montagu Norman in his evidence to the Macmillan Committee (1931).

[5] See Interim Report Para.5.

[6] Sayers (1936) p70 contrasts the internal effects of Bank Rate with the external impact of market rate.

[7] Sayers (1976) pp29-30,43-44,Sayers (1936) p125, Bloomfield (1959) p24,37.See also pp 40-44 on the working of the discount rate.

estimated reaction functions. Sayers (1976) found no evidence within Bank of discussions about stabilisation policies. The Bank may have responded to rising unemployment by reducing Bank Rate because of the reduced internal demand for gold coin in these conditions. This explanation was proposed by Hawtrey (1938) and is supported by the results reported here for internal gold flows[8].

According to the reaction function Equation 3, the US time rate had a stronger impact on Bank Rate than the Proportion. However in view of the response of external gold flows to interest rates, the Bank may have been anticipating the effect of a change in relative interest rates on its reserves. Bloomfield (1959) discusses the importance of the reserve level and relative interest rates in the setting of discount rates by central banks, but does not resolve this issue. Since relative interest rates had powerful effects on gold flows, it is hardly surprising that central banks responded promptly to movements in international rates.

Pippenger (1984) adopts a different explanation for the relationship between Bank Rate and the state of the domestic economy. He explains the reduction of Bank rate when activity was slack by a desire of the Bank to keep its lending rate in line with market rates, which were low at such times. In his view the Bank was concerned about its competitive position in the market for short term lending, which meant that it set Bank Rate in line with market rate. However this assumes that the Bank had little appreciation of its responsibility as a central bank and lender of last resort. Other writers such as Sayers (1976) do not accept this view of the Bank's behaviour in the late 19th century. However, there could be circumstances in which the Bank would consider that its own need for income was more pressing than the strict requirements of central banking, but such behaviour was unusual.[9] There remains an issue in determining whether Bank Rate led market rate as the Bank intended or whether on occasion Bank Rate responded to market rate.[10]

Price Flexibility under the Gold Standard

Both the macro model and the Cunliffe Committee used the Sauerbeck index of wholesale prices as a measure of the price level. Wider measures such as the GDP deflator were not available to policy makers before 1914. It is notable that the annual TFE deflator, Feinstein (1972), shows less flexibility than the wholesale price index in Chart 2. The impact of changes in Bank Rate on the wholesale price index would be stronger and faster than on broader measure of prices derived from national income statistics. This may well have misled the Committee in its recommendation about restoring the gold standard after the First World War. The proponents of the return to gold in 1925 argued that the price adjustment required to make sterling competitive against the US Dollar could be assessed using the relative UK/US wholesale prices. As a result they understated the problem of adjusting the British economy to the pre war parity of $4.86, Moggridge (1969).

[8] Hawtrey (1938) pp 105-111 and Appendix I.

[9] Sayers (1976) p 11 and pp 17-18.

[10] Sayers (1936) Ch 2.

Was the Gold Standard Automatic or Discretionary?

The next issue to be considered is the extent of discretionary powers of the Bank of England under the gold standard. The question to be addressed is: was the Bank's behaviour automatic or discretionary? Of particular relevance to this question is the relationship between the Bank's reserves and the balances held by the commercial banks at the Bank. The general issue of the scope for independent action by central banks under the pre 1914 gold standard was considered by Bloomfield (1959). It follows on from Keynes's comments on the observance by central banks of 'The Rules of the Game' in *The Economic Consequences of Mr Churchill* (1931). Empirical work on the relationship between the Bank's gold reserves and the balances held at the Bank by the commercial banks was pioneered by Goodhart (1972), following the publication of data on bankers' balances, BEQB 1968. A further discussion of the relationship took places in the exchanges between Pippenger and Goodhart in Bordo and Schwartz (1984).Goodhart (1972) found that in his sample period of 1891-1914 the relationship between gold reserves and bankers' balances broke down. He concluded that a crucial relationship in the classical adjustment mechanism was flawed.[11] Goodhart's interpretation was disputed by Pippenger (1984).

It is instructive to plot the series for gold reserves and bankers' balances.Both series follow a rising trend 1880-1913, but there is a massive spike in gold reserves in 1895-6, which is not reflected in the series for bankers' balances or M0 in Chart 3.It is hardly surprising that Goodhart was unable to find a relationship between reserves and balances in his sample starting in the early 1890s.

The massive inflow and outflow of gold in the mid 1890s is discussed by Sayers (1936) and was familiar to such writers as Clapham (1944) and Hawtrey (1938).[12]Sayers attributed the rise in the Bank's reserves to the outflow of gold from the United States as a result of the Sherman Act and silver politics. These raised fears that the US might abandon the gold standard. The issue remained in doubt until the presidential election of 1896, which resulted in a victory for the gold party. Once American adherence to gold was beyond doubt, there was a massive return of gold to the US. The Bank was the main recipient of US gold and suffered the largest outflow in late 1896. US monetary experience in this episode is discussed in Friedman and Schwartz (1963)[13]. The uncertainty about US remaining on the gold standard created expectations of a possible devaluation of the Dollar. Fears of devaluation should be reflected in the differential between US and UK interest rates .There was weakness in the dollar/sterling exchange

[11] Goodhart (1972) p207 states 'The strongest link in the causal chain of the classical analysis of the working of the gold standard mechanism is generally considered to be that connecting changes in the reserve base of the commercial banks with fluctuations in the gold reserve, or liquidity position of the central bank. Yet in this study of the working of the system in the UK this is the link which shatters.'

[12] Sayers (1936) pp14-18 ,Hawtrey (1938) pp110-112, Clapham (1944) p349.

[13] Friedman and Schwartz (1963) pp113-119.

rate within the gold points. In 1895 the average annual exchange rate for sterling rose to $4.89 reverting to $4.86 after 1896, when US adherence to the gold standard was no longer in doubt.[14]

This issue of the US/UK interest differential is explored by Hallwood et al (1996), who adopt a target zone approach to the pre 1914 and interwar gold standards. They find that a target zone model from Krugman (1988) does not perform well in explaining US/UK interest differential in the 1890s. They conclude that political fears over the Dollar exchange rate accounts for the large interest differential during this period. The interest differential between the US commercial paper rate and Bank Rate is shown in Chart 4. For the period 1890.4 to 1913.4 the mean differential was 2.34%, but was only 1.87% from 1897.1 to 1913.4. The differential just fails a test for stationarity over the full sample, ADF= - 2.629 (5% CV= -2.89), but is stationary for 1897.1 to 1913.4, where ADF =-5.18 (CV=-2.90). The narrower differential and evidence for stationarity point to confidence in the maintenance of the gold standard after 1896.An additional source of the gold inflow to the Bank was the output of newly developed gold production, particularly in South Africa. This source continued to expand the Bank's reserves until the end of the period. Beach (1935), Ford (1962). Sayers concluded that the Bank's response at the time of the gold influx showed that the gold standard did not operate in an automatic way but allowed a substantial measure of discretion to the Bank.

Goodhart's conclusion that the relationship between the Bank's reserves and bankers' deposits broke down could have resulted from the inclusion of 1895-6 in his sample. This issue is examined by omitting the period of massive inflows and outflows and looking at the long term relationship between the Bank's reserves and bankers' balances. An Engle Granger analysis of cointegration between reserves and balances is reported in EQN 6a.

The Engle Granger First Stage Regression of Bankers' Balances held at the Bank (BB) on Bank of England's Reserves in the Banking Department (RES) is shown in Equation 6A below:

LBB=0.88+ 1.09 LRES Rsq= 0.845 ADF= -8.77

Sample 1880.1-1914.2, excl 1894.1- 1896.4.

The 5% CV is -3.40, supporting the hypothesis of cointegration. The second stage dynamic regression is reported as Equation 6B.It has an error correction coefficient of -0.246 (t=-4.15), which also supports the hypothesis of cointegration. The coefficient indicates that the adjustment rate of Bankers' Balances to the Bank's Reserves was 24.6% per quarter. Both Sayers (1976) and Bloomfield (1959) discussed the question of the extent of central bank discretion under the gold standard. The results reported here indicate that the adjustment of Bankers' Balances to Reserves took place over 12 months, which implies that the Bank had a useful degree of discretion in adjusting the credit base to its reserve holdings. Clearly Goodhart's conclusion on the breakdown of a crucial link in the gold standard needs to be revised.

[14] Friedman and Schwartz (1982),Table 5.

Two further topics are explored: first the demand for money under the gold standard ,where gold coins are in circulation and secondly the impact on the economy of the massive increase in gold reserves in the 1890s.

(1)The Demand for Money

The circulation of gold coins has implications for the demand for a broad monetary aggregate, such as M3.The demand for currency will depend on the level of economic activity, so that a rise in GDP increases the demand for currency ,which will reduce the reserves of the central bank. The central bank may respond to the loss of reserves by raising its discount rate. This means that the short term rate can no longer be taken to be exogenous when estimating the demand for M3. This point does not seem to have been appreciated by previous researchers who have estimated conventional money demand functions during the pre 1914 period. They may have believed that they were estimating a structural equation. In fact the estimated relationship is a reduced form, which includes components of the money supply as well as of money demand. This criticism would need to be qualified, if there were perfect international capital mobility. In that case there would be an inflow of short terms funds which would ensure that the domestic interest rate was determined exogenously as in the Mundell Fleming model with perfect capital mobility. A rise in the internal circulation of gold coin would not then affect the rate of interest or the reserves of the central bank.

The previous analysis of gold flows may shed some light on these issues. It is necessary first to examine the demand for money and the demand for currency. An equation is estimated for the long run demand for gold coin using semi annual data for the sample 1884.1-1913.2 as shown in Equation 7a. The income elasticity of demand is found to be about 1.0. A conventional money demand function is also estimated for real M3 in Equation 7b including the yield on commercial bills as the short term interest rate. The long run income elasticity of demand is also close to unity. A rise in economic activity increased the demand for gold in circulation and for M3.

Equation 7a Demand for Gold Coin

Sample 1884.1 -1913.2 Semi Annual Data, 60 Observations,

Engle Granger Long Term Relationship

LCOIN=7.00 +0.928 LGDP Rsq =0.90 ADF= -3.49

EG Test for Cointegration 5% CV=-3.46

Equation 7b Demand for M3, sample as for Eqn 7a

L(M3/P)=4.40 + 0.979LGDP -0.019 CBR Rsq=0.93 ADF= -4.53

EG Test for Cointegration 5% CV= -3.915 , CBR is the Yield on Commercial Bills.

Equations 7a and 7b indicate that a rise in GDP raised the demand for both M3 and gold coin. The equation for internal gold flows Equation 5 confirms that a rise in the level of activity or fall in unemployment induced an outflow of gold from the Bank into the internal circulation. A reduction in the reserve of the Bank prompted a rise in Bank rate, as shown by the reaction function Equation 3. A rise in Bank Rate encouraged an inflow of gold, but the response was imperfect. The external gold flow equation Equation 4 indicates that a rise in Bank Rate of 1 percentage point raised the Bank's reserves by c £1m, which implied an immediate rise in the stock of reserves of c 3-4%. These numbers are crude, but they suggest that there was imperfect mobility of short term capital. The effect of the internal demand for gold on the Bank's reserve and hence on the money supply was noted by Hawtrey (1938), but it has not been taken into account in studies of the demand for money under the pre 1914 gold standard. The conventional estimated money demand function contains supply side elements and is therefore a reduced form rather than a structural equation. This is not recognized in the literature on the demand for money, which is summarized in Capie and Wood (1996)[15].

(2) The Impact of Cheap Money in the 1890s

During the massive inflow of funds in the mid 1890s the Bank successfully isolated the monetary base M0 and the money supply M3 from the external monetary shock. However there was a sharp reduction in short term interest rates as shown in Chart 4.Both Bank Rate and market fell away. Bank rate was held at 2% but market rate fell below 1%. The fall in short term rates was followed by a decline in the yield on Consols. There was a sustained rise in the stock market according to the Smith and Horne index (1934). The cheapening of borrowing encouraged an upsurge in domestic fixed investment as shown in Chart 5.British investors were reluctant to buy foreign securities at this time following the Baring Crisis of 1890 and the US and Australian financial difficulties of 1893. They favoured issues of debentures and shares by British companies. There was a vigorous boom in industrial investment in both building and other works. There was also a major boom in residential construction in which financial factors played an important part. The overshooting of the boom in house building was followed by a severe recession in this sector due to an excessive housing stock with rising vacancy rates. This was an example of a boom and bust in the residential property market. It is important to keep these facts in mind when assessing the apparent success of the Bank in insulating the monetary base from the massive inflow of gold in the 1890s.[16]

Application of the Basic Model to the US.

The basic macro model which has been estimated for the UK could be applied to other economies. This would give a wider view on the operation of the international monetary under the gold standard. The United States is the obvious candidate because of the greater availability of quarterly data for the US as compared with France and Germany. Also monetary ties between the UK and the US were close in the

[15] The studies include Capie and Rodrik –Bali (1985), Klovland (1987),Taylor (1993).

[16] The boom of the 1890s is discussed in Sigsworth and Blackman (1965).

period we are considering, as emphasized by Friedman and Schwartz (1963), (1982). One purpose which could be served by the inclusion of the US is the ability to test some of the conjectures of Friedman and Schwartz on the North Atlantic economy, which they argue should be viewed as a unified financial system.[17]

The operation of the gold standard in the US has a large literature, including Eichengreen (1992), Bloomfield (1959), Morgenstern (1959) and Friedman and Schwartz (1963). Dornbusch and Fischer (1986) provide a useful survey of US international monetary relations, although they are mainly concerned with the period after 1914. They distinguish international linkages for the US through goods markets, price levels and capital markets. Friedman and Schwartz emphasize the PPP (Purchasing Power Parity) relationship between UK and US prices.[18] A related issue is whether PPP operates as a result of the working of the specie flow mechanism which keeps prices in the two economies generally in line. Alternatively PPP may be achieved mainly by arbitrage in the pricing of internationally traded goods, as argued by McCloskey. This is issue has not been resolved as shown by the discussion in Bordo and Schwartz (1984). Quarterly data for the US economy comes from the NBER Macro Dataset and Balke and Gordon (1986).

The model consists of three equations for aggregate demand (AD), aggregate supply (AS) and interest rate setting. In the AD equation the output gap depends on US wholesale prices, the commercial paper rate and the volume of exports. In the AS equation US prices depend on the output gap, the commercial paper rate and UK prices, measured by the Sauerbeck wholesale price index. The US interest rate is endogenous in that it is the outcome of domestic and external financial influences in the absence of a central bank. In the interest rate equation the commercial paper rate depends on US wholesale prices, the output gap and Bank Rate. Domestic prices and activity have an impact on the US interest rates, but international interest rates as represented by Bank Rate may also be important.

A smoothed series for GNP is computed using a Hodrick Prescott filter. The output gap is computed from the ratio of the actual to the smoothed series for GNP. The series for the output gap, US wholesale prices and the commercial paper rate are shown in Chart 6.

Basic Equations for the US Macro Model:	Signs of Coefficients	
AD OP Gap = F1 (USP, CPR (com paper), Export Vol)	(+/-, -,+)	Equation 8
AS USP= F2 (OP Gap, CPR, UKP (Saub))	(+, -, +)	Equation 9
CPR= F3 (USP, OP Gap, Bank Rate)	(+,+,+)	Equation 10

CPR is the endogenous US interest rate.

[17] Friedman and Schwartz (1982) pp5, 6.

[18] Friedman and Schwartz (1982) pp 287-294.

External Variables: Export Vol , UKP, Bank Rate.

The results of estimating the AD equation are reported in Table 8. The output gap was positively related to US wholesale prices. The relationship between activity and prices was less marked than in the UK. The output gap was negatively related to the commercial paper rate and positively to the change in the volume of exports. In the AS equation Equation 9 the change in US wholesale prices was negatively related to the price level and negatively to the commercial paper rate. The output gap is found not to be statistically significant, (t= 1.1). The change in US prices was strongly and positively related to both the level and change in the UK wholesale price index. It may be noted that if UK prices are omitted from the AS equation the Rsq falls sharply, pointing to the impact of UK wholesale prices on US prices.

In the interest rate equation Equation 10 the commercial paper rate was positively related to the output gap and also to changes in the US wholesale price index. A change in Bank rate had a positive effect on the US interest rate. However the effects of UK interest rates on US rates appears weaker than the impact of UK prices on US prices. If Bank Rate is omitted from the equation for CPR, there is only a slight decline in Rsq. US interest rates were determined mainly by domestic factors, but international prices exerted a major influence on US prices. It should be noted that the Sauerbeck index is a better measure of prices of internationally traded goods than of UK domestic prices.

The results reported here do not conflict with the findings of Friedman and Schwartz on the relevance of PPP in this period. The mechanism involved seems to the arbitrage of the prices of internationally traded goods rather than the operation of the specie flow mechanism. The former process is emphasized by McCloskey and Zecher (1984) and the latter by Friedman and Schwartz.[19] The commercial paper rate plays a major role in the US equations estimated here. It affects economic activity and in turn responds to economic activity and prices. Yet it plays little part in explaining US monetary experience according to Friedman and Schwartz (1963).

Conclusions

A small macroeconomic model has been estimated for the British economy under the pre 1914 gold standard using quarterly data. The model has been combined with equations explaining external and internal flows of gold to the Bank of England. This extension of the model enables it so be compared with analysis of the gold standard contained in the Interim Report of the Cunliffe Committee (1918). The model includes a predominance of series which would have available to the Bank when taking decisions over the setting of Bank Rate. There is a strong similarity in the linkages in the model and the account of the working of the gold standard in the Cunliffe Report. It is notable that the model estimated here supports the view of the Cunliffe Committee and Hawtrey that Bank rate had a direct impact on prices.

[19] This issue was vigorously debated by these authors in Bordo and Schwartz (1984).

This effect operated via the adjustment of inventories, which would work more rapidly than the effect of Bank Rate on output and indirectly on prices. [20]

The model uses the wholesale price index as a measure of the price level. This shows a high degree of flexibility, which was not present in broader measures of prices, which were not available at the time, such as the annual GDP deflator. Reliance upon the index of wholesale prices continued into the 1920s and contributed to the view that the restoration of the gold standard at the pre war exchange rate of $4.86 could be achieved without undue difficulty. Both the model and the Cunliffe Committee appear to overstate the degree of general price flexibility before 1914.

There is a problem over the interpretation of the Bank's reaction function. The equation indicates that Bank rate was reduced when unemployment rose and was raised in response to rising prices, suggesting that a countercyclical policy was operated. This contrasts with the views of economic historians who find little evidence for a policy of this type being followed. It is suggested that Hawtrey's view that the Bank responded to variations in the internal demand for gold could explain its decisions to vary Bank Rate in accordance with the state of the economy.

The gold standard was not operated in a mechanical way by the Bank. It showed discretion in not allowing the credit base to be expanded by the large gold inflows of the mid 1890s. Apart from this episode the Bank adjusted bankers' balances to its holding of reserves over about 4 quarters. This suggests it had a useful degree of discretion in the operation of the standard.

The low level of interest rates in the 1890s, which was associated with the large gold inflows, had a large impact on the economy. It contributed to an upsurge in domestic investment, particularly investment in industrial structures and house building.

The demand for gold coin was found to be related to the level of economic activity. This implies that a rise in GDP increased the interior demand for gold, reducing the Bank's reserve and so raising interest rates. This has implications for studies of money demand under the pre 1914 standard.

Finally an attempt has been made to apply the model to the United States. There is evidence of a close connection between US and UK prices, which appears to be stronger than the connection via interest rates. There is evidence for PPP in both economies. This may well have been the result of commodity arbitrage rather than the specie flow mechanism favoured by Friedman and Schwartz. The commercial paper rate affected economic activity and the economy had feedback effects on the commercial paper rate. US interest rates seem to be explained mainly by domestic rather than international factors.

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[20] A similar effect is referred to in the Macmillan Report, Committee of Finance & Industry(1931)para 215.

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Aggregate Demand	Equation 1	
Sample 1890.1 1913.4	Obs 96	EQAD22
Dependent Variable	DLUNEMP	
Explanatory Variables	Coefficient	t-Ratio
Constant	-0.339	-1.83
LUNEMP(-1)	-0.0617	-1.68
DLP(-2)	-3.537	-4.18
BKR(-3)	0.073	3.94
DLEXP	-0.714	-2.17
DLEXP(-2)	-0.185	-3.42
LEXP(-1)	-0.169	-1.77
Q1	0.022	0.045
Q2	-0.221	-5.31
Q3	-0.003	-0.06
RSQ (Adj)	0.509	
SE	0.141	
DW	2.13	

Aggregate Supply	Equation 2	
Sample 1890.1 1913.4	Obs 96	EQAS24
Dependent Variable	DLP	
Explanatory Variables	Coefficient	t-Ratio
Constant	0.292	2.67
DLP(-1)	0.315	4.14
DLP(-3)	0.196	2.45
LP(-1)	-0.160	-3.47
LUNEMP(-1)	-0.0104	-2.32
BKR(-2)	-0.0048	-2.07
DLUSP	0.442	8.42
LUSP	0.122	3.85
D1	0.009	2.36
D2	0.012	2.62
D3	0.002	0.64
RSQ (Adj)	0.537	SE 0.013
DW	2.12	

Bank of England	Reaction Function	Equation 3
Sample 1891.3 1913.4	Obs 90	Eqint 26
Dependent Variable	BKR	
Explanatory Variables	Coefficient	t-Ratio
Constant	2.393	3.13
BKR(-1)	0.322	3.85
BKR(-3)	0.234	2.95
DLP	6.114	2.24
DLUNEMP	-0.810	-2.68
LUNEMP(-1)	-0.373	-2.84
DPROPORTION	-0.028	-1.61
PROPORTION(-2)	-0.018	-1.83
US Time Rate (USTR)	0.258	6.38
Q1	-0.589	-3.38
Q2	-0.764	-4.40
Q3	--0.880	-5.94
RSQ(Adj) 0.788	SE 0.441	SE 0.541 excl USTR
DW	1.99	

Bank of England External Gold Flow	Equation 4	Eqnngoldbeb02
Sample 1891.1 1913.4	£Mn	90 obs
Dependent Variable	NGoldBE Inflow +	Outflow -
Explanatory Variable	Coefficient	t-ratio
Constant	3.127	2.21
DBKR	2.176	3.97
BKR(-1)	1.070	2.59
USTR	-0.802	-2.94
Q1	4.790	4.75
Q2	6.790	7.03
Q3	3.120	3.58
RSQ(Adj)	0.414	
SE	2.582	With Market Rate SE=2.523
DW	2.03	
Mean Dep Var	0.826	

Bank of England Internal Gold Flow	Equation 5	Eqgoldint4
Sample 1891.4 1913.4	Obs 89	Inflow +, Outflow -
Dependent Variable	GOLDINT	£000s
Explanatory Variables	Coefficient	t-Ratio
Constant	-1683.9	-2.83
DGOLDINT(-1)	-0.276	-4.49
UNEMP(-1)	292.9	2.87
UNEMP(-3)	-199.0	-1.95
TIM	-15.92	-3.45
Q1	5467	15.10
Q2	2462	5.08
Q3	34.31	0.07
RSQ(Adj)	0.840	
SE	1096.5	
DW	1.98	
Mean Dep Var	-754.9	

Banker's Balances (BB)	BoE Reserves (RES)	Equation 6b
Sample 1881.2 1893.4,	1897.1 1914.2	Obs 121 Eqbb05
Dependent Variable	DLBB	
Explanatory Variables	Coefficient	t-Ratio
Constant	0.011	0.53
DLBB(-1)	-0.322	-3.88
DLBB(-2)	-0.171	-2.17
DLRES	0.344	4.45
DLRES(-1)	0.333	4.05
DLRES(-4)	-0.154	-2.03
RESID(Eq6a)(-1)	-0.246	-4.15
+ Seasonal Dummies		
RSQ(Adj)	0.508	
SE	0.066	
DW	1.97	

US Macro Model	Equation 8	AD Equation
Sample 1884.4-1914.1	Obs 118	Equsadgap3
Dependent Var	LOPGAP	
Variable	Coefficient	t-Ratio
Constant	0.021	1.43
LOPGAP(-1)	1.140	13.33
LOPGAP(-2)	-0.412	-4.49
DLUSWHP	0.129	1.82
CPR (Com Paper)	-0.004	-1.94
DLEXPVOL	0.068	1.81
+Seasonals		Not Sig.
Rsq (Adj)	0.763	
SE	0.018	
DW	1.99	

US Macro Model	Equation 9	AS Eqn
Sample 1884.3 1914.2	Obs 120	(Equsasgap16)
Dependent Variable	DLUSWHP	
Variable	Coefficient	t-Ratio
Constant	-0.139	-1.16
DLUSWHP(-1)	0.171	2.09
LUSWHP(-1)	-0.106	-2.80
CPR	-0.005	-2.23
DLSAUB	0.781	7.46
LSAUB(-2)	0.125	2.38
+Seasonals (Sig)		
Rsq(Adj)	0.401	0.116 Excl SAUB
SE	0.020	0.024
DW	1.97	

US Macro Model	Equation 10	Interest Eqn
Sample 1884.3 1914.2	Obs 120	Equsintgap5
Dependent Var	CPR (Com Paper R)	
Variable	Coefficient	t-Ratio
Constant	2.062	5.31
CPR(-1)	0.654	10.99
LOPGAP(-1)	6.715	4.42
DLUSWHP(-2)	4.642	2.20
DBKR	0.235	3.13
+Seasonals (NS)		
Rsq(Adj)	0.632	0.604 Excl DBKR
SE	0.576	0.598
DW	2.11	

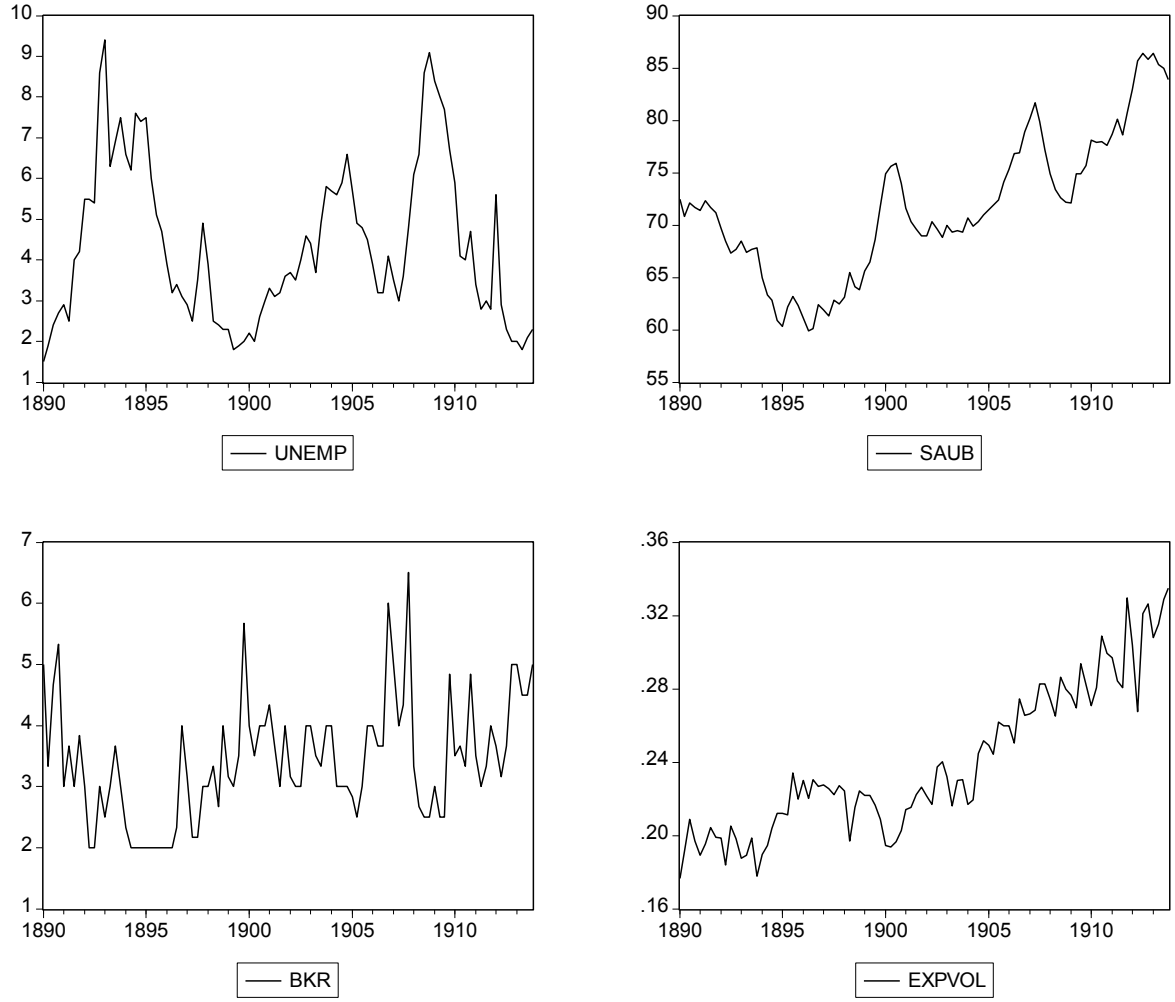

Chart 1 Basic UK Series Quarterly Data 1890.1 1913.4

Unemployment % (UNEMP), Wholesale Prices (SAUB), Bank Rate (BKR), Exports(EXPVOL).

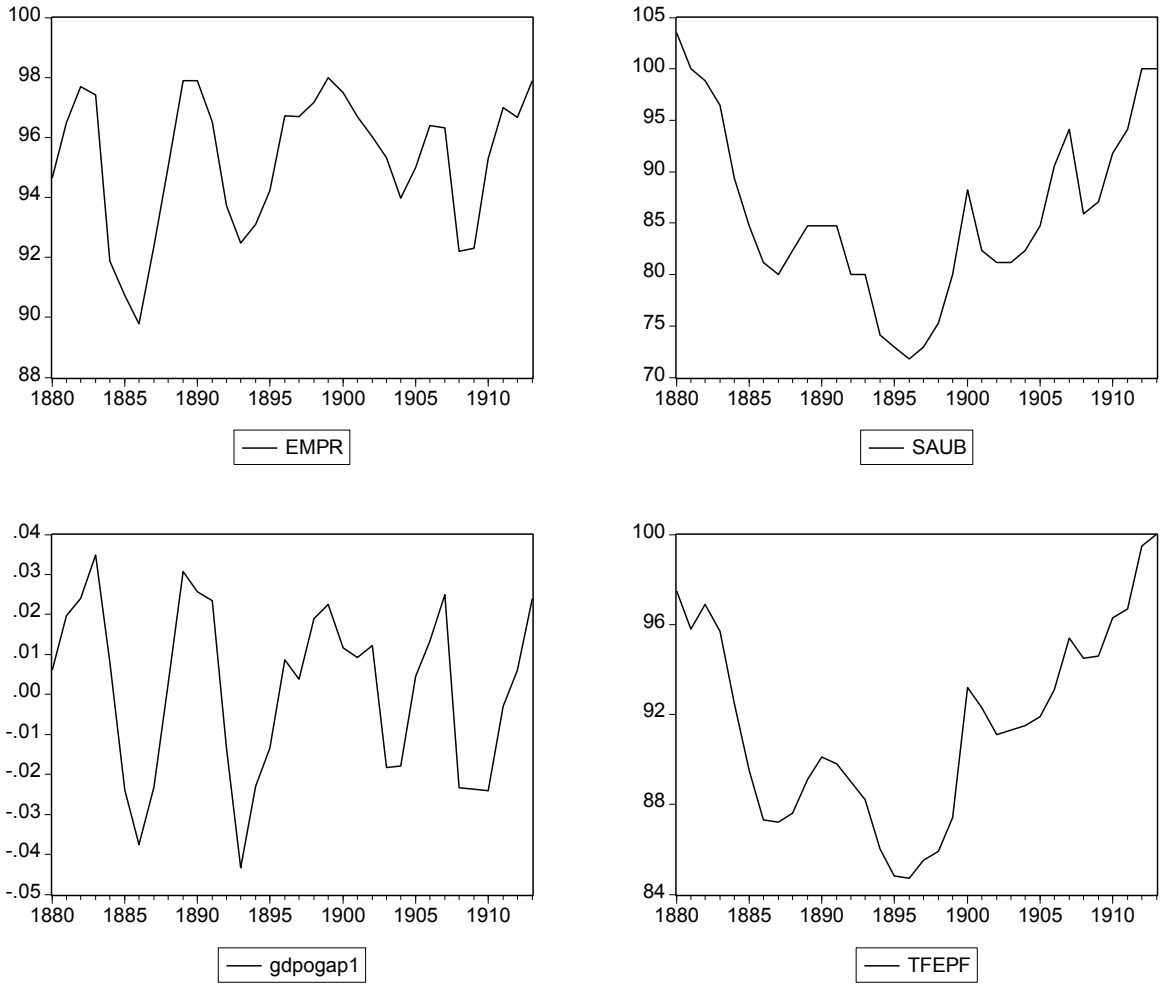

Chart 2UK Economic Activity and Prices, Annual Data 1880-1913.

Employment Rate % (EMPR), Output Gap (gdpogap1), Wholesale Prices (SAUB), Final Expenditure Deflator Feinstein (TFEPF).

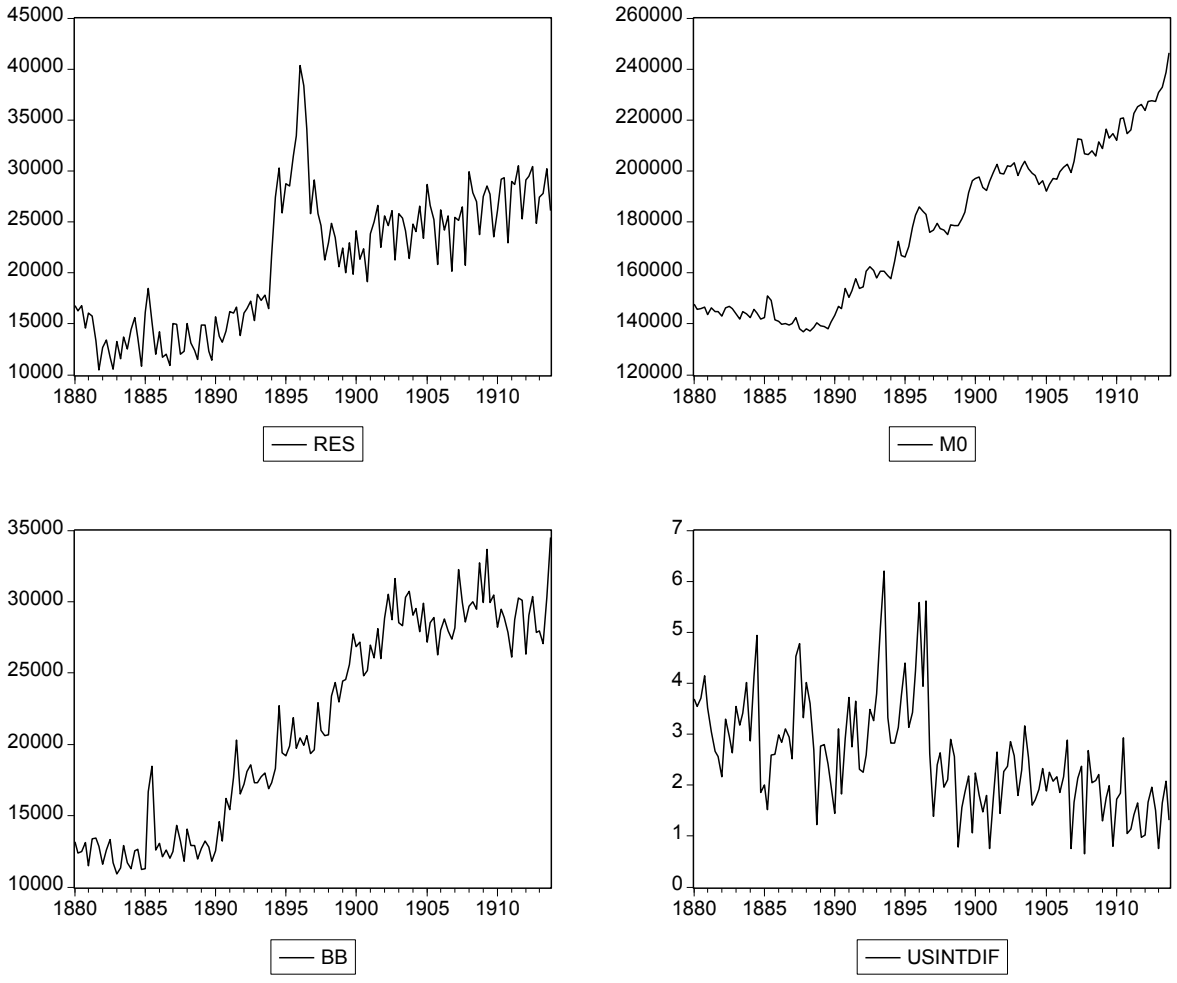

Chart 3 UK Quarterly Data 1880.1 - 1913.4, Gold Reserves, Bankers' Deposits at the Bank and US/UK Interest Differential

Bank of England Reserves (RES),Bankers' Balances (BB), M0 and US/UK Interest Differential, CPR-BKR, (USINTDIF).

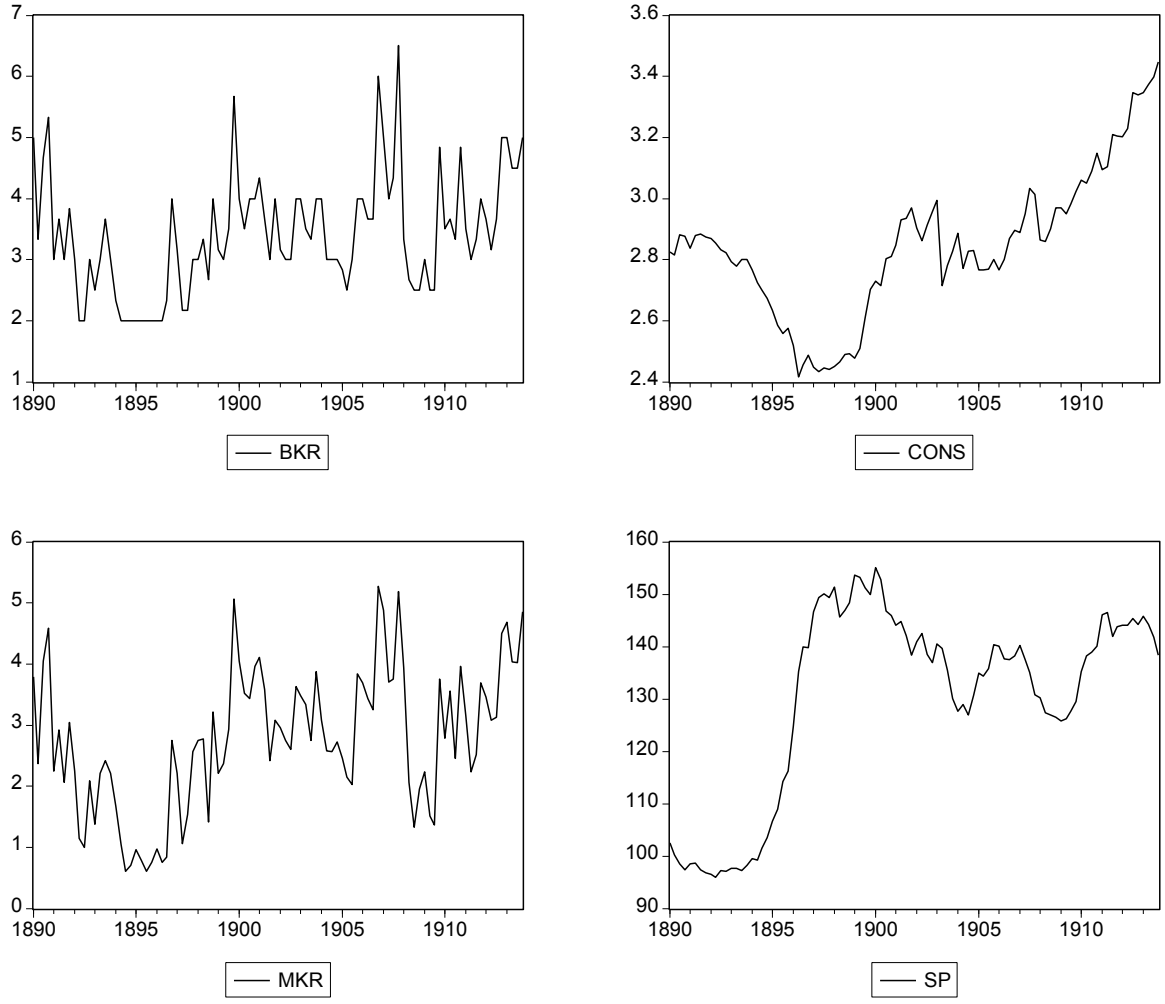

Chart 4 UK Interest Rates and Share Prices

BKR, Bank Rate, MKR, Market Rate, CONS, Yield on Consols, SP, Share Prices.

Chart 5 UK Real Share Prices, Industrial and Commercial Investment and House Building. Annual Data 1880-1913 , Feinstein.

RSP, Share Prices deflated by GDP deflator, PINVF, Investment in Plant and Machinery, OINVF, Investment in Buildings and Works, HINVF, Investment in House Building.

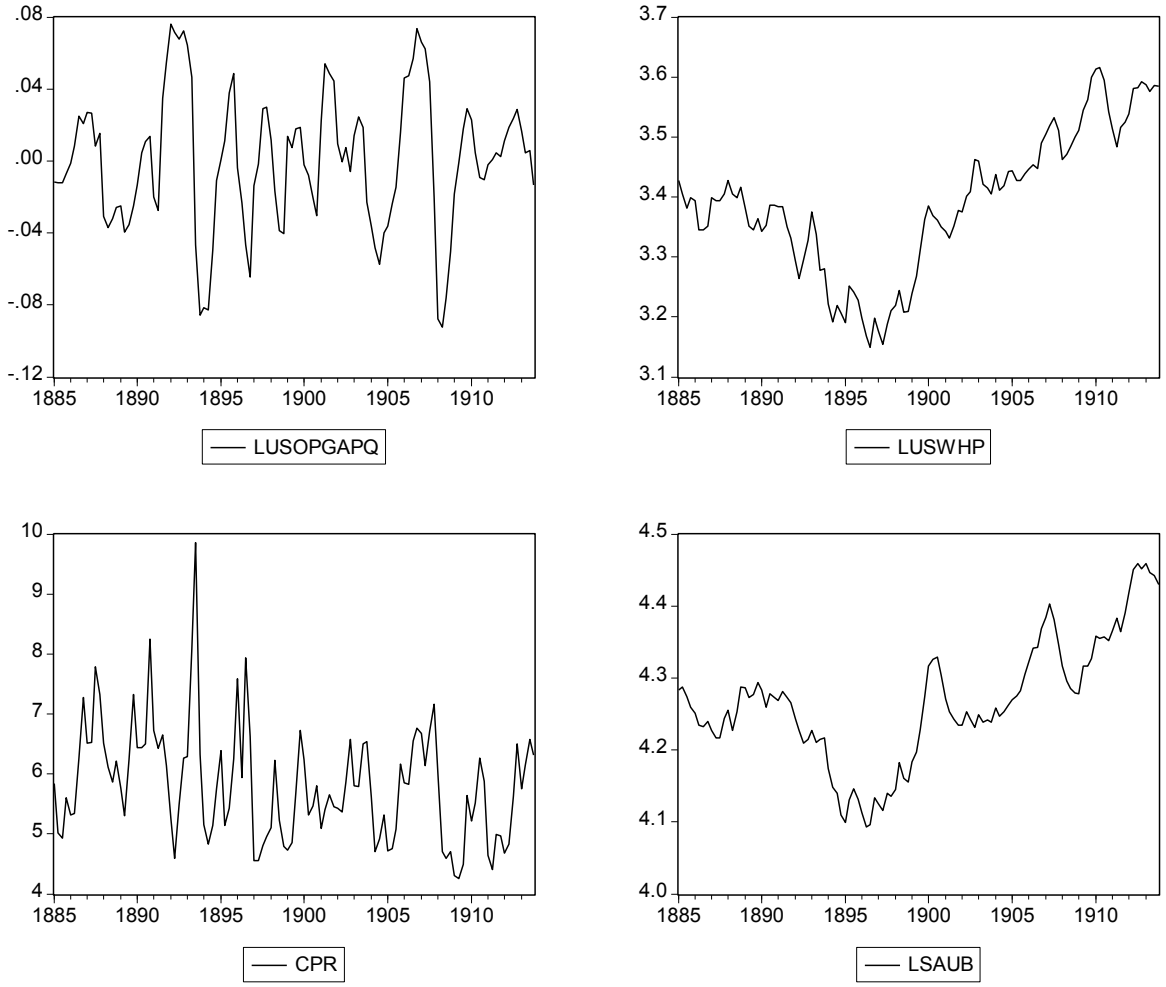

Chart 6 US Quarterly Data 1885.1 1913.4

Output Gap, US Prices, Commercial Paper Rate, UK Prices

LUSOPGAPQ, Output Gap, LUSWHP, US Wholesale Prices, CPR, Commercial Paper Rate, LSAUB, UK Wholesale Prices.