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ABSTRACT

Money, Interest Rates and Prices in Ireland, 1933-2012*

In this paper we assemble an annual data set on broad and narrow money, prices, real economic activity and interest rates in Ireland from a variety of sources for the period 1933-2012. We discuss in detail how the data set is constructed and what assumptions we have made in doing so. Furthermore, we perform a VAR analysis to provide some simple empirical evidence on the behaviour of these time series. The results suggest that aggregate supply and inflation shocks play a dominant role in Irish business cycles.

JEL Classification: E3, E4 and N14
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1. Introduction

The Irish monetary system has undergone large changes since Saorstát Éireann, the Irish Free State, was established in 1922. At that time, the Irish and British monetary and financial systems were completely integrated. While there were no changes to the monetary arrangements at independence, they started to evolve immediately afterwards. Thus, in 1927 a Currency Commission was established and Irish coins were issued and in 1928 bank notes followed. The relationship weakened further after the establishment of the Central Bank of Ireland in 1943 in response to the fact that after the start of the Second World War, or "the Emergency," it became clear that Ireland could not expect to rely on the Bank of England to serve as its central bank.[1] Nevertheless, the link with the monetary system in the UK remained close, with Sterling circulating at par with the Irish pound and the exchange rate pegged at unity until Ireland became a founding member of the European Monetary System in 1979. The Central Bank of Ireland then conducted monetary policy with an adjustable exchange rate peg until Ireland joined the Economic and Monetary Union in 1999.

Given these changes in the monetary system, it is interesting to explore how the relationships between narrow and broad money (as measured by M1 and M2), real GDP, prices and short and long interest rates have evolved over time in Ireland. In this paper we do so, focusing on the period 1933-2012. The sample period begins with the Economic War that started in 1932 and during which a policy of economic self-sufficiency based on import-substitution industrialisation was instituted. This policy was continued for many years both during and after the Second World War and was associated with slow growth.

The end of the 1950s saw a policy shift that began with the adoption of the Programme for Economic Expansion in 1959, leading the economy to be increasingly opened to international market forces, resulting in a period of relatively strong economic growth in the 1960s. However, the oil crisis in the 1973, and the deficit-

[1] See the discussion in Ó Gráda (2011).

spending that took place to promote economic activity in its immediate aftermath, prompted a period of inflation in Ireland that was very high even by the standards of western European countries. Thus, in 1975 the CPI rose by 19% and the GDP deflator rose by 22%. The impact of this deficit spending on GDP growth was largely unsuccessful, and tough fiscal measures were implemented to address a rapidly rising debt-to-GDP ratio in the mid- to late-1980s. Inflation rates subsequently declined gradually, reaching lows of 2% and 4%, respectively, in 1988, and the seeds of the 'Celtic Tiger' boom were sown.

The boom of the early-1990s saw rapid economic over a sustained period, driven largely by exceptional export performance accompanied by moderate wage and price inflation and healthy public finances. In the early-2000s, however, the boom that had been underpinned by fundamentals changed character, becoming one sustained by a credit-fuelled construction bubble. This culminated in the financial crisis that began in 2008 and that led to sharp contractions in a number of important macroeconomic variables, including money growth, inflation, real and nominal GDP that we study here.

A central part of this paper consists of the compilation of a long historical macroeconomic data set for Ireland, using data from a number of different published sources.[2] The combination of data in this way is not without problems.

First, in many cases little is known about the data. For instance, it is rarely clear whether the annual data should be interpreted as averages over the year or as capturing economic conditions at the end of the year. Moreover, breaks in the data may not be reported.

Second, economic and statistical changes may make data lack comparability over time. For instance, the increase in the relative importance of services in the economy has changed the composition of the basket for the consumer price index and has most likely reduced the volatility of consumer prices over time. This process is likely

[2] These are the same data as we use in Gerlach and Stuart (2013) to study money demand.

to have been accentuated by the increase in the number of components in the CPI, which also would have tended to reduce the volatility of the aggregate. Moreover, with the exception of interest rates and exchange rates, macroeconomic aggregates are unobserved and must be estimated. These estimates are likely to have improved in the 80 year period we study in response to the use of better statistical techniques and data. Furthermore, economies evolve over time, leading to a strong presumption that macro-economic relationships may display instability. However, such instability may be difficult to detect in estimated regressions if the equations fit poorly. It is therefore an empirical question whether structural changes are so large as to cause instability in empirical relationships.

Overall, while there are good reasons for analysts to be skeptical about data from distant historical episodes, in particular in cases in which they are constructed from a range of sources, it seems difficult to argue that these data are so poor as to be of no value for economic analysis. Furthermore, modern data are similarly subject to measurement errors and contemporary economies also experience structural change.[3] Nevertheless, we emphasize that our data set should be seen as preliminary and that we hope to find more and better data in the future.

In the paper we study the relationship between money, economic activity, interest rates and prices since 1933. The objectives are to review the availability of data; consider the evolution of some important macroeconomic aggregates in Ireland; and present tentative empirical evidence on macroeconomic fluctuations. It is structured in four Sections. In Section 2 we briefly discuss the monetary regimes in place in Ireland during the period of our study. In Section 3 we review how we compile the long time series of macroeconomic data, and in Section 4 we review the data. In Section 5 we provide some empirical evidence on the interrelationships between

[3] From an econometric perspective, these and any other data should be thought of being subject to measurement errors of unknown importance. See Greene (1990, ch. 9) for a discussion of a range of data problems.

money, prices, economic activity and interest rates in Ireland over the period 1935-2012. Section 6 concludes the paper.

2. Monetary regimes in Ireland since 1922

Collecting data on the money stock in Ireland since independence is rendered difficult by a number of changes in the monetary regime. Following independence, the monetary system was initially unchanged.[4] While it would have difficult to introduce changes rapidly, the fact that the monetary arrangements appeared to function satisfactory must have reduced any sense that it was urgent to do so. Three types of bank notes circulated: British Treasury notes; Bank of England notes; and notes issued by six Irish banks that constituted the bulk of the issue. The banks also operated in Northern Ireland and held reserves in London, where their notes were redeemable in Sterling.

In this period it is difficult to determine the money supply since the circulation of sterling notes in Ireland is not known (although it appears to have been limited), and because it is not clear how the Irish bank note issue should be divided between Northern Ireland and the Irish Free State. In any case, data on bank deposits do not appear to be readily available.

Nevertheless, it was clear that the arrangements in force were unsuitable for an independent country. In 1926 the Government established a Banking Commission under the chairmanship of Professor Henry Parker Willis of Columbia University, with the objective of reviewing what implications independence had for the monetary and financial system. The Committee recommended that the State should establish its own currency at par with Sterling and that responsibility for the issuance of bank notes should be held by a Currency Commission that was to be established. The Commission's recommendations were included in the Currency Act of 1927 that

[4] This section draws on Brennan (1931), Moynihan (1975), Honohan (1995), Ó Gráda (1995) and Kelly (2003).

introduced the Saorstát pound, which was fully backed by Sterling assets and redeemable in Sterling in London.

While these arrangements fell short of those in economies with a central bank, the Irish financial system functioned well and enjoyed access to the deep London market, implying that the absence of money and capital markets in Dublin was unproblematic. With the new currency fully backed and the Currency Commission's objectives limited to ensuring convertibility against Sterling, the credibility of the exchange rate parity was not in question. Moreover, Bank of Ireland conducted the Government's banking business satisfactorily.

Further impetus towards the establishment of a central bank came as a consequence of the Commission of Inquiry into Banking, Currency and Credit which reported in 1938. The Commission felt that the monetary authority should be given power to make advances to banks on collateral of Government securities and to conduct open market operations.

Following the introduction of a bill in the Dail in 1942, the Central Bank of Ireland was established in March 1943. Kelly (2003) notes that the close link to Sterling was not called into question and that the new central bank lacked some traditional banking functions, in particular the ability to influence credit conditions, that implied that it was not in a position to set interest rates and to conduct an active monetary policy. As Honohan (1995) notes, the functioning of the Currency Commission and the Central Bank of Ireland implied that monetary arrangements in Ireland, at least until the early 1970s, are best described as those of a currency board. As a consequence, Irish interest rates followed closely those in Britain and were thus determined with little, if any, direct reference to economic conditions in Ireland.

The close link to Sterling was broken in 1979 when the Government elected to join the European Monetary System (EMS) as a founding member. While this implied some softening of the role of the exchange rate commitment, monetary policy in Ireland continued to be geared to the requirement of exchange rate stability,

occasional devaluations of the Irish pound notwithstanding. As a consequence, there was little possibility of gearing monetary policy to domestic macroeconomic conditions and Irish interest rates were therefore largely determined from abroad.

In January 1999 Ireland became a founding member of the Eurosystem. As a consequence of this change, the Irish money supply was redenominated in euro at the fixed conversion rate of 1 euro = IR£ 0.78. Since the introduction of the euro there is no data on the use of currency in Ireland. Moreover, a distinction is made the "Irish contribution to the euro area money stock" and the money stock held by "Irish residents." Of course, interest rates in Ireland have also since the introduction of the euro been determined largely by external factors.

3. Compiling long macro economic time series for Ireland

In this section we discuss the construction of the macroeconomic time series, beginning with some general information, and then focusing on the specifics of each individual series.

We use data over a sample period of 80 years. Unfortunately, no single source provides all the data and it is therefore necessary to rely on a number of different sources, including the Central Statistics Office (CSO), the Economic and Social Research Institute (ESRI), the OECD, the IMF, the ECB, Moynihan (1975), Mitchell (2007), Homer (1963) and the website for the Maddison project.[5]

In the absence of objective criteria for constructing long time series by combining data from several sources, unless otherwise noted the current vintage of data is used as far back as possible under the assumption that it is subject to smaller measurement errors than older vintages. Older time series are then spliced in order to construct a single time series.

[5] See www.ggdc.net/maddison/maddison-project/home.htm.

In many cases there are differences in the levels of the series. Such differences can arise for a number of reasons, including changes in the number of reporting banks in the case of monetary aggregates and base-year differences in the case of real GDP. Where more than one series was available, the decision was based on a comparison of growth rates in these series during any overlapping period with the more recent vintage of data, with the series which most closely matched the recent vintage chosen. The sources and construction of the individual series are set out below, and the final series are available in Appendix 1.

3.1 Money Supply

Collecting data on the supply of money is difficult in the case of Ireland. First, at the time of independence, the monetary system was fully integrated with that of the United Kingdom and Sterling bank notes circulated freely. Second, the data are subject to a number of breaks.

Data from Moynihan (1975) for both M1 and M2 are used from 1933 to 1950. Data from Mitchell (2007) are used for M1 for over period 1950 to 1980, and for M2 over the period 1950 to 1971. Data from 1980 for M1 and from 1971 for M2 are available from the Central Bank of Ireland (Figures 1 and 2).

Monetary data are typically subject to frequent breaks and the Irish data are no exceptions. In particular, in 1982 consistent rules (including on the residency of the customer, the treatment of accrued interest and bad debts) which were compiled using international statistical and accounting standards were adopted. Prior to 1999, the data that we use for M2 were classified as M3. The current definition of M2 is M1 (currency in circulation and overnight deposits) plus deposits with agreed maturity up to 2 years, deposits redeemable at notice up to 3 months and post office savings accounts. The definition of M3 over the period 1971 to 1982 was currency outstanding and Licensed Banks' current and deposit accounts.

There is a break in both series in 1999 when data collection under Eurosystem definitions began. As the new definitions did not run concurrently with the old ones, no growth rate is available for 1999. However, monthly data for 1999 is available. We therefore annualise the 11-month growth rate (January to December) to proxy an annual rate for 1999.[6] Joining a currency union also affected how Irish money supply was defined. From 2000 onwards M1 and M2 data were collected on the basis of both "Irish contribution to the euro area" and for "Irish residents". The "Irish contribution" data include deposits in Irish resident credit institutions by other euro area private-sector residents. The "Irish resident" definition more closely represents money held by Irish citizens, and it is therefore used in our analysis.

A further break in the series occurred in 2003 when, in line with Eurosystem requirements, securities issued to non-euro area residents were excluded from M2, while holdings by credit institutions of debt securities up to two years maturity issued by euro-area MFIs are netted off debt securities issued in this category.

3.2 Inflation

The Consumer Price Index is available from the CSO from 1933 to 2012. The base year for this series is 1914.

3.3 Real and nominal GDP

For Real GDP, data from the Maddison website are used from 1933 to 1938. These data are reported on a per capita basis. To calculate the aggregate level of GDP, we use population data from the census provided by the CSO.[7] Data between 1938 and 1944 are sourced in a White Paper on National Income and Expenditure presented to the Oireachtas in March 1946, and data between 1944 and 1947 are taken from the

[6] We also seasonally adjust the series before calculating the changes using the Census X11.2 method used by the U.S. Bureau of Census. The annualised growth rate is 31.5% for M1 and 17.3% for M2.

[7] The Census was conducted every ten years between 1926 and 1946 and on a five-yearly basis thereafter. We interpolate the missing years using a cubic spline. The 1976 Census was cancelled as an "economy measure," with the result that one took place in 1979, and the 2001 Census was postponed until 2002 due to an outbreak of foot and mouth disease in Britain and Ireland.

Tables of National Income and Expenditure compiled by the CSO and presented to the Oireachtas in February 1951.[8] However, it is clear from the White Paper and the CSO's 1951 release that no data were collected in this period, and that these were estimates made in retrospect.[9] In both cases, the data are for total national income, and are reported only in nominal terms. However, a price trend is also reported in both publications, and this is used to deflate the series. Real GDP data are available from the CSO from 1947 to the 2012 (Figure 3).[10] [11]

The Maddison data are also available during the period 1938 to 1947. However, the growth rates differ dramatically between the White Paper and CSO (1951) publication and the Maddison data. In contrast to the other two sources, the Maddison data indicate that the growth rate of GDP was (almost exactly) zero throughout the Second World War (Figure 3), which suggests that no data were in fact recorded for this period. As a consequence, we prefer the data originally published by 'official' sources for the time period that they are available.

Nominal GDP is constructed in a similar manner (Figure 4). The Maddison data which are used for real GDP from 1933 to 1938 are not available in nominal terms. While these data could be deflated by CPI, it is not clear that this would be an appropriate deflator, and we instead use the Moynihan (1975), Appendix 10, pp. 528-529 series on nominal gross domestic expenditure. Data from the 1951 CSO release

[8] See White Paper (1946) and CSO (1951).

[9] The White Paper on National Income and Expenditure published in 1946, and containing data for the period 1938 - 1944, states that it *'inaugurates a series of official estimate of national income and expenditure… Heretofore the official statistical service has been unwilling to assume responsibility for statistics relating to national income through rough approximations have been made from time to time for departmental use'*.

[10] There are three breaks over this time period: in 1995 (data prior to 1995 exclude FISIM, the Financial intermediations sector indirectly measured), 1970 and 1959. Data from 1970 to 1995 are chain-linked annually and referenced to 2009; data prior to 1970 are at 1995 prices. Furthermore, there is no overlap in the two data vintages immediately before and after 1970. We therefore use growth rates of the real GDP series from the ESRI Databank for this year to splice the series. Data from 1959 to 1970 are at 1995 prices. Data prior to 1959 are estimates.

[11] Both real and nominal GDP data are also available from the OECD from 1970 onwards. The growth rates in the OECD data vary marginally from those of the CSO series (Figures 3 and 4). We do not use the OECD data as the CSO is the official statistics provider in Ireland.

and the 1946 White Paper are used for the period 1938 to 1947. CSO data are used from 1947 to 2012.

3.3 Short and long-term interest rates

With the Irish financial system before 1980 closely tied to the British after independence, we can obtain information on Irish interest rates in two ways. Most obviously, there are data on Irish interest rates that can be used. However, these appear not to be available as far back in time as data on interest rates in Great Britain. This may reflect the fact that Irish markets were much less important than British markets and that there was less demand for information about Irish interest rates. Alternatively, it may be that there were no active markets for Irish debt.[12]

We use the annual average of the open-market rate of discount in London, quoted in Homer (1963, pp. 417-420) for the period 1933 to 1962 as a proxy for Irish short-term rates. This is the rate paid in London on three months' bankers' bills or three months' bankers' acceptances. We use this rate because short-term interest rate data for Ireland is either not available, or is not appropriate to this study. Data on Irish rates available during this period appear to be official rates that may have deviated from actual market rates: there is little or no movement in any available rate over the period to 1951, which is not what would be expected of a market rate (Figure 5). The London open-market rate which we use is both lower and more volatile in the period 1933 to 1951 than the official rates reported by a number of sources. However, it moves closely with the IMF data on the discount rate in the period after 1951.[13] This rate is therefore used for the period to 1984. Irish short-term interest rates are based on OECD data from 1984 to 2012.

[12] For instance, it may be that debt issued by the Irish government was held to maturity by Irish financial institutions.

[13] Data prior are also available from the OECD from 1922 to 1949. These also move very closely with the London rate that we use over the period 1922 to 1933. A further alternative would be to use the Bank of England "Bank Rate", but that is a posted penalty rate that provided a ceiling to market rates.

Long-term interest rates prior to 1952 are proxied using UK interest rates. Homer (1963) reports a high and low bond yield for each year in the period from 1922. We take the midpoint of these yields in these years. From 1948 to 1952, IFS data are available for the UK. Data are taken from the IMF's International Financial Statistics (IFS) from 1952 to the present. Data from other sources are available over this period, including from Homer (1963), the CSO and the OECD. However, as the IMF series is available for the full period and, as it evolves over time in similar ways to the data from other sources, we use it (Figure 6).

4. Review of individual time series

As our primary interest at the current stage is to explain broad developments in the Irish economy over the sample period, we start by plotting the final series in Figures 7-10.

In Figure 7 we plot the growth rate of the money supply as measured by M2 and the inflation rate. The graph shows that money growth peaked in the early 1940s during the Emergency, following the first oil shock in the 1973 and around the establishment of the euro in 1999. Interestingly, these episodes of high money growth do not match closely with episodes of inflation. Thus, although inflation was high during the Emergence and in the 1970s, despite increasing somewhat, it was not rise particularly high in the late 1990s. The rapid money growth observed in this period must therefore be explained by other factor(s).

Figure 8 plots nominal and real GDP growth. Most of the variation in nominal GDP arises from changes in the price component rather than in real economic activity, however, the period of rapid growth in real GDP around 2000 drove strong nominal GDP growth at that time. Real GDP contracted sharply after the property bubble burst in 2008. Real GDP growth was low in other periods, in particular in the 1950s when it averaged 2.2% and in 1960-1980 when it averaged 4.2%.

Figure 9 shows M2 and nominal GDP. As one would expect, money growth and nominal income growth are closely, but not perfectly, correlated, suggesting that movements in velocity must be of some importance.

Figure 10 plots short and long nominal interest rates. These remained at low levels until 1950, subsequently rose to a peak around 1980, and then declined towards the end of the sample. There are two interesting episodes of marked divergences between short and long rates. The first took place in 1992 when pressure across a range of exchange rate pegs within the European Monetary System and forced many central banks, including the Central Bank of Ireland, to tighten monetary policy sharply.[14] The second episode occurred in 2009-2012, when concerns about the state of public finances in Ireland led to a large increase in the credit risk premium on long bond yields.

5. Empirical analysis

In this section we provide a preliminary analysis of the data. Since our main interest is to provide a broad overview of macroeconomic developments in Ireland over the 80 years that we study, we perform the analysis using a simple Vector Autoregressive (VAR) model. In subsequent work, we will focus more narrowly on specific questions of interest.[15]

Given that we have two measures of money, two measures of income and two interest rates, we need to make a number of choices regarding what precise variables to include in the VAR. The preliminary results in Gerlach and Stuart (2013) suggest that there are close relationships between real GDP, consumer prices, M2 and short-term interest rates. We therefore focus on these variables here.

5.1 Preliminaries

[14] In the event, this attempted defense of the exchange rate was unsuccessful as the Irish punt was devalued by 10% on 30 January 1993 (Kelly 2003).

[15] In Gerlach and Stuart (2013) we estimate money demand functions using these data.

For the moment we disregard the issue of cointegration and start by estimating a VAR(2) model for M2 growth, CPI inflation, real GDP growth and the change in the short-term interest rate, and perform tests for lag length.

The Akaike and Schwartz information criteria both indicate that a lag length of 1 is appropriate. Furthermore, a test that the second lag of the regressors are jointly significant does not reject the null hypothesis at five percent level ($p = 0.06$). Since inspection of the autocorrelation functions for the residuals suggest that they are serially uncorrelated, we use a VAR(1) model in what follows and estimate it over the sample 1935-2012.

Next we test for structural breaks, using Bai-Perron tests (Bai and Perron 2003).[16] The test shows no evidence of structural breaks in the regressions for real GDP growth, money growth and changes in interest rates. However, it indicates the presence of two breaks, in 1947 and 1985, in the equation for inflation.

Closer inspection of the regression for inflation shows a very large positive residual in the equations for inflation and money growth, a large negative residual in the equation for real GDP growth, in 1940. This increase is most likely due to a sharp escalation of World War 2 following the German invasion of France and the low countries and the subsequent threat of invasion of Great Britain. Since the shock to Irish economic conditions is so large, we introduce a dummy variable that takes the value of unity in 1940 and zero otherwise in the regression. Re-running the Bai Perron test, there is now no evidence of structural breaks and we therefore include the dummy variable in the VAR system.

5.2 Identification and impulse responses

Next we turn to the issue of identification. Since we are using annual data, one would expect underlying economic disturbances to have sufficient time to impact on all relevant variables within the year. Identifying restrictions that rely on temporal orderings are therefore contentious. In the present case, two pairs of residuals are highly correlated. First, the correlation between the residuals in the money and

[16] In doing so we allowed for a maximum of 3 breaks and trimmed the sample by 20%, and used a significance level of 2.5%.

output growth equations is 0.43. While this correlation could in principle arise for several reasons, given the specific monetary arrangements in force in Ireland in the sample period, it seems most likely that it reflects the impact of income growth on money demand. Second, the correlation between the residuals in the inflation and interest rate change equations is 0.33. Since it is positive, it seems likely that it reflects reactions of monetary policy to rising inflation rather than the impact of monetary policy on inflation.

Given the problem with using contemporaneous restrictions to identify the system using annual data, we do so using principal components analysis. Thus, we first compute the principal components from the correlation matrix of the estimated residuals. The first of these explains 36% percent of the variation of the four series, the second 33%, the third 17% and the fourth 14%. Their relatively even importance suggests that all the components may be of economic relevance, although, of course, the first two shocks are about twice as important as the third and fourth.

To explore this further, we next compute impulse responses, which we show in Figure 11 together with 95% confidence bands.[17] In the figure the first row shows, the responses of CPI inflation to the four shocks; the second row the responses of M2 growth; the third the responses of real GDP growth; and the forth the responses of the changes in interest rates.[18] The problem we now face is to attach an economic interpretation to the four shocks.

To do so, consider the first column that shows the responses to the first shock. Since it is given by the first principal component, which by construction explains the large fraction of the overall variation in the data, it is the most important driver of economic fluctuations in Ireland. It seems natural to think of it as an *expansionary supply shock* that raises real GDP, and therefore money growth, and puts downward pressures on inflation but leaves interest rates unaffected.

[17] Denoting the vector of VAR residuals u_t, the matrix of factor loadings F, and the vector of principal components p_t, we have that $u_t = Fp_t$. We can then compute the impulse responses by shocking the individual elements of p_t.

[18] We plot the first difference of the interest rate.

Turning to the responses to the second shock, the responses in the second column suggest that that it can be thought of as an *inflation shock* that triggers a tightening of monetary policy, which in turn depresses real GDP growth with a one-year lag. With inflation rising but growth falling and with higher interest rates, the overall effect on money growth is limited.

Similarly, we think of the third shock as an *expansionary monetary policy shock* that involves a reduction in the interest rate that in turn raises money growth, real GDP growth and inflation.

Finally, consider the fourth shock, which corresponds to the fourth principal component and is therefore by construction the least important source of macroeconomic fluctuations in Ireland. As the first shock, it raises GDP growth and reduces inflation. It is therefore natural to think also of it as an aggregate supply shock. In contrast to the first shock, however, it leads to an increase in interest rates and therefore to lower money growth. Thus, the salient difference between it and the first shock is that the former involves higher interest rates and therefore lower money growth. To distinguish it from the first shock, we think of it as a *expansionary-supply-with-tight policy shock*.

5.3 Historical decomposition

Having identified the VAR and proposed labels for the shocks, we next decompose the movements in money and real GDP growth, inflation and changes in interest rates into the four shocks. This will be helpful for assessing the identification and labeling of the shocks.

Figure 12 decomposes inflation, M2 growth, real GDP growth and changes in interest rates into the four shocks. Since the time series, in particular the changes in interest rates and real GDP growth are quite volatile, we decompose five-year moving averages of the series to clarify better the importance of the underlying shocks.

The panels show that the *expansionary supply shock* is an important source of movement in money and real GDP growth. In recent years the shock has been

contractionary, perhaps because the financial crisis has impacted on firms' ability to obtain funding and therefore on their ability to produce.

The *inflation shock* was associated with high inflation and money growth, and rising interest rates, in the 1970s. Since the global shift towards lower inflation in the mid-1980s, it has the opposite effect on the economy. Interestingly, it has had little impact on real GDP growth.

The *monetary policy shock* has been of much less importance than the two first shocks, as indicated by the principal components analysis. It tended to boost money growth, inflation and economic activity in the 1970s, and has done the opposite during the financial crisis. One interpretation of this is that interest rates in Ireland have, given the historical relationships in the last 80 years of data, been unexpectedly high in recent years. The fact that the zero lower bound limits the extent to which the ECB has been able adopt a stimulatory interest rate policy seems relevant in this context.

Finally, the *expansionary-supply-with-tight policy shock* appears to have been important in the 1970s when it tended to reduce real GDP growth and therefore interest rates, but increase inflation and money growth. It also supported growth and higher interest rates, while depressing inflation and money growth, in the 1950s.

6. Conclusion

In this paper we have two objectives. First, we compile and discuss an annual macroeconomic data base for Ireland, spanning the period 1933-2012, using published sources. The combination of data in this way is not without problems. In particular, little is known about the data and economic and statistical changes may make data lack comparability over time. But while there are good reasons to be skeptical about data, it seems difficult to argue that these data are so poor as to be of no value for economic analysis. Furthermore, modern data are similarly subject to measurement errors and contemporary economies also experience structural change.

Second, we explore the data by performing a simple VAR study. Surprisingly, testing the underlying regressions for structural break at unknown points in time, we find no evidence of one, except in the inflation equation. Introducing a dummy for 1940, also that equation is stable. Applying principal components analysis to the estimated residuals, we find that the first two, which can be interpreted as aggregate supply and inflation shocks, explain about two-thirds of the variance of the residuals.

The empirical findings raise a number of questions. For instance, are the associations between money, income, prices and interest rates such that money demand equations can be estimated? What is the best specification of the inflation process? These and other questions we hope to address in future research.

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Figure 1: Money Supply (M1)

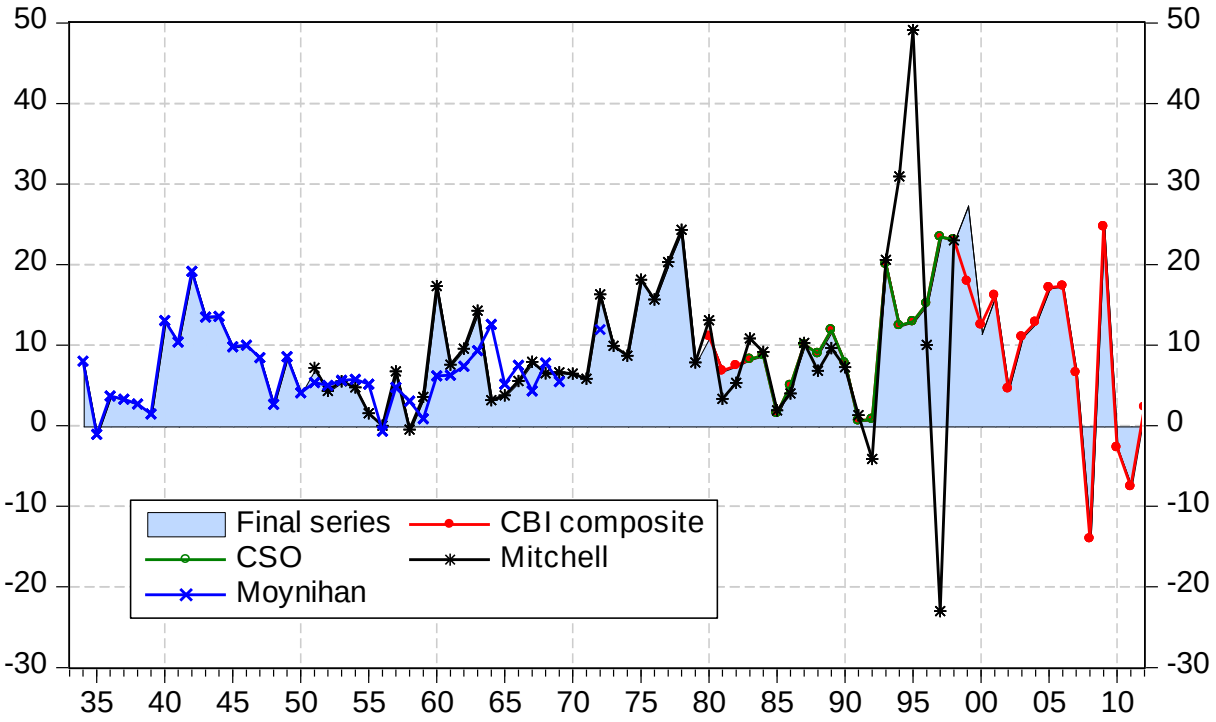


Figure 2: Money Supply (M2)

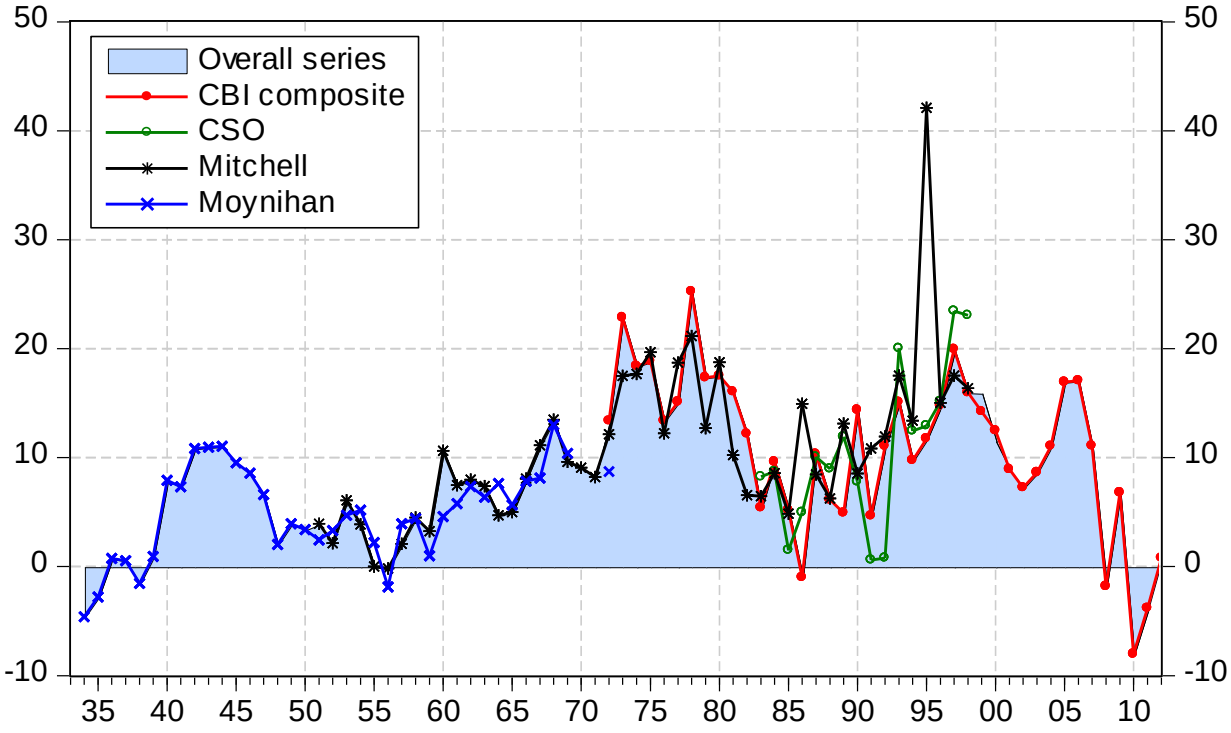


Figure 3: Real GDP

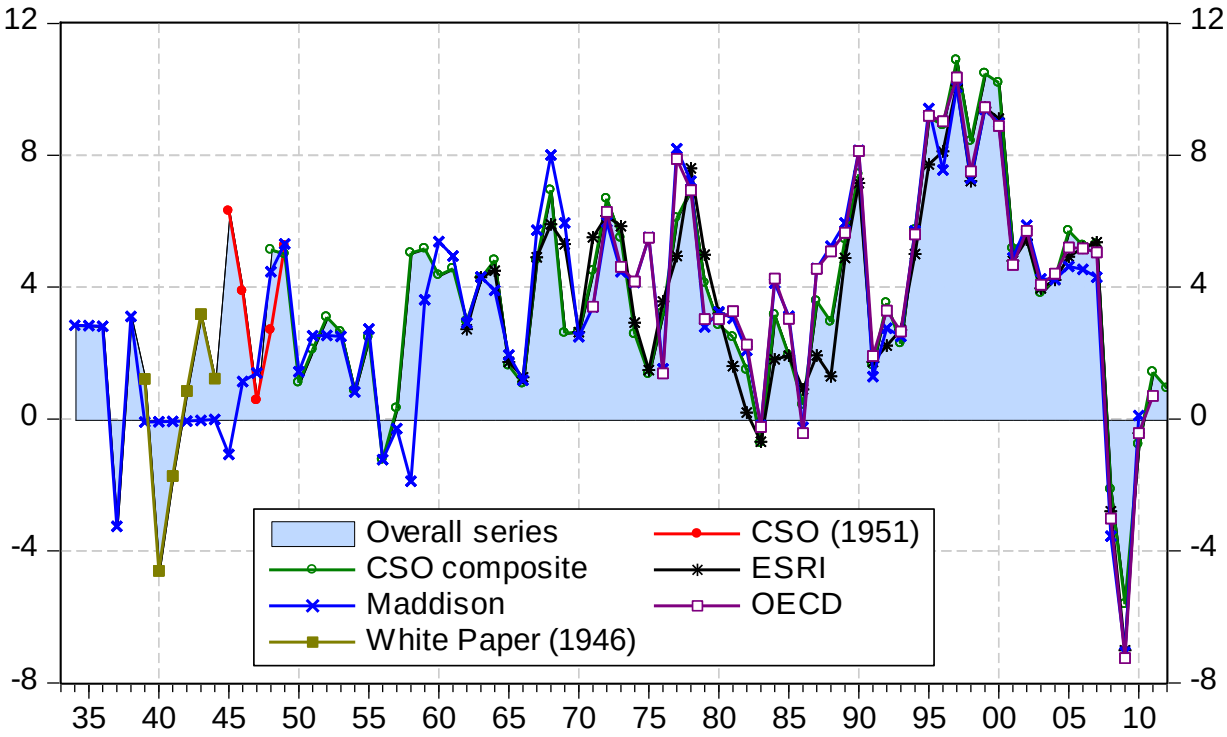


Figure 4: Nominal GDP

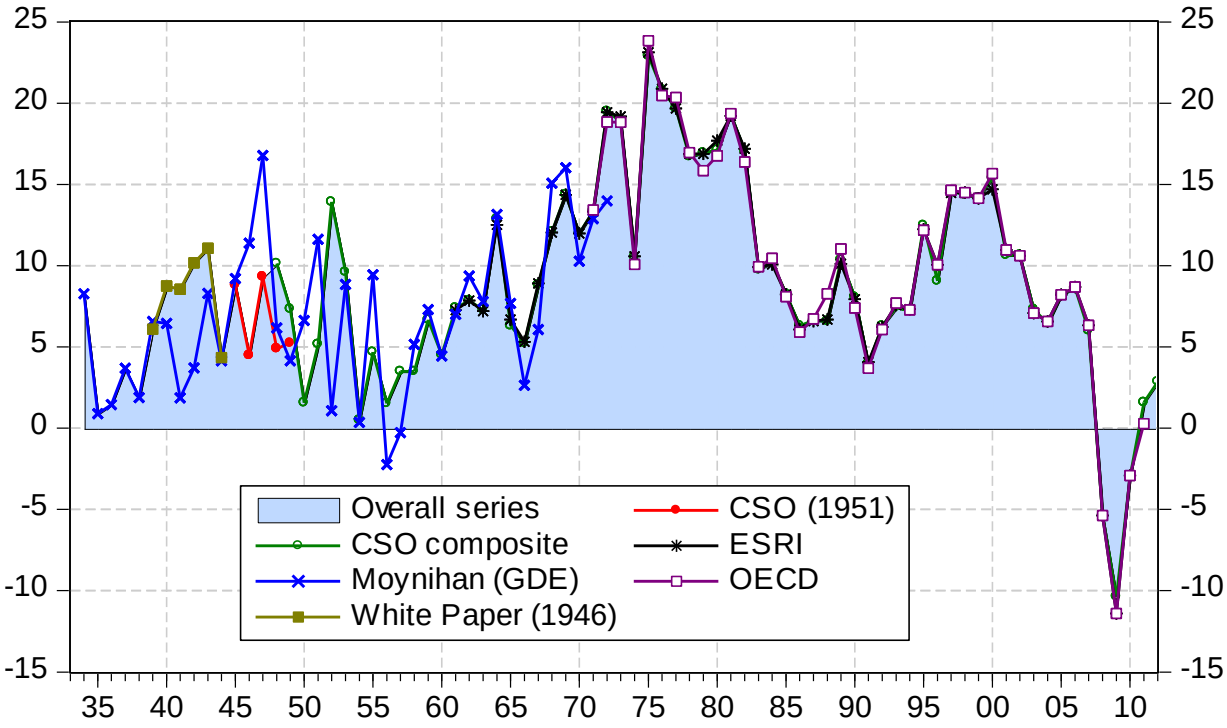


Figure 5: Short-term interest rates

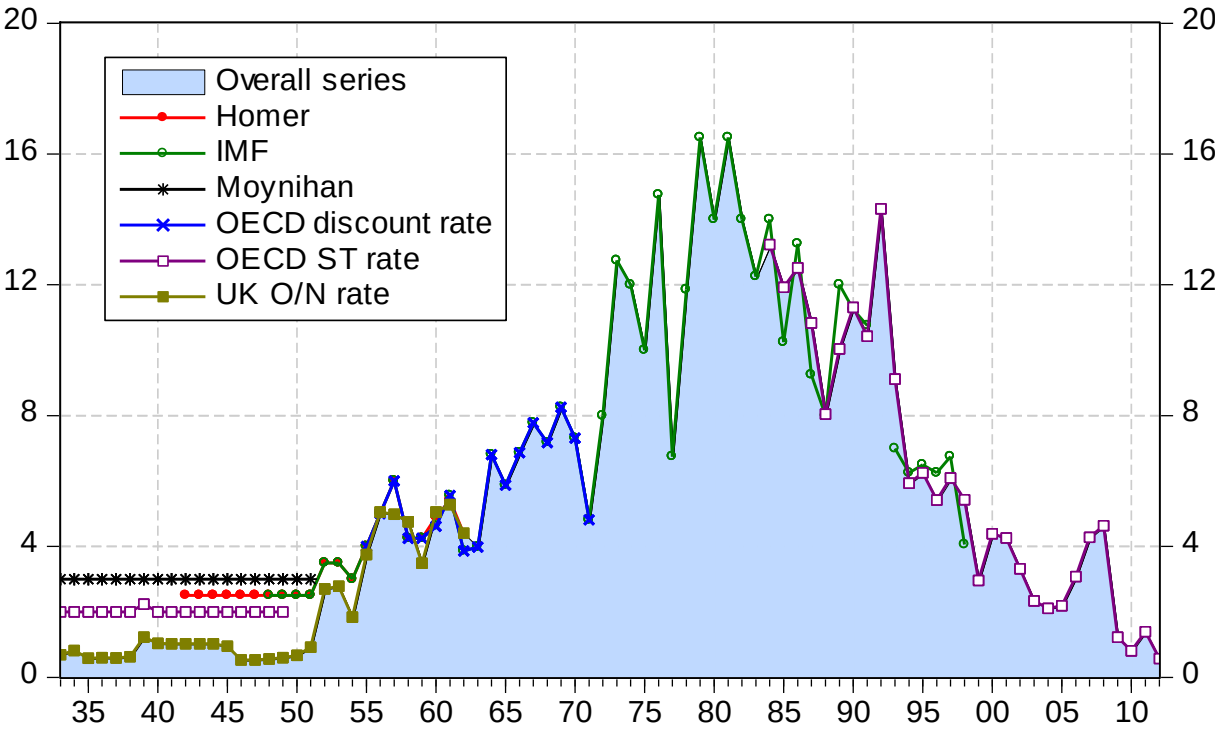


Figure 6: Long-term interest rates

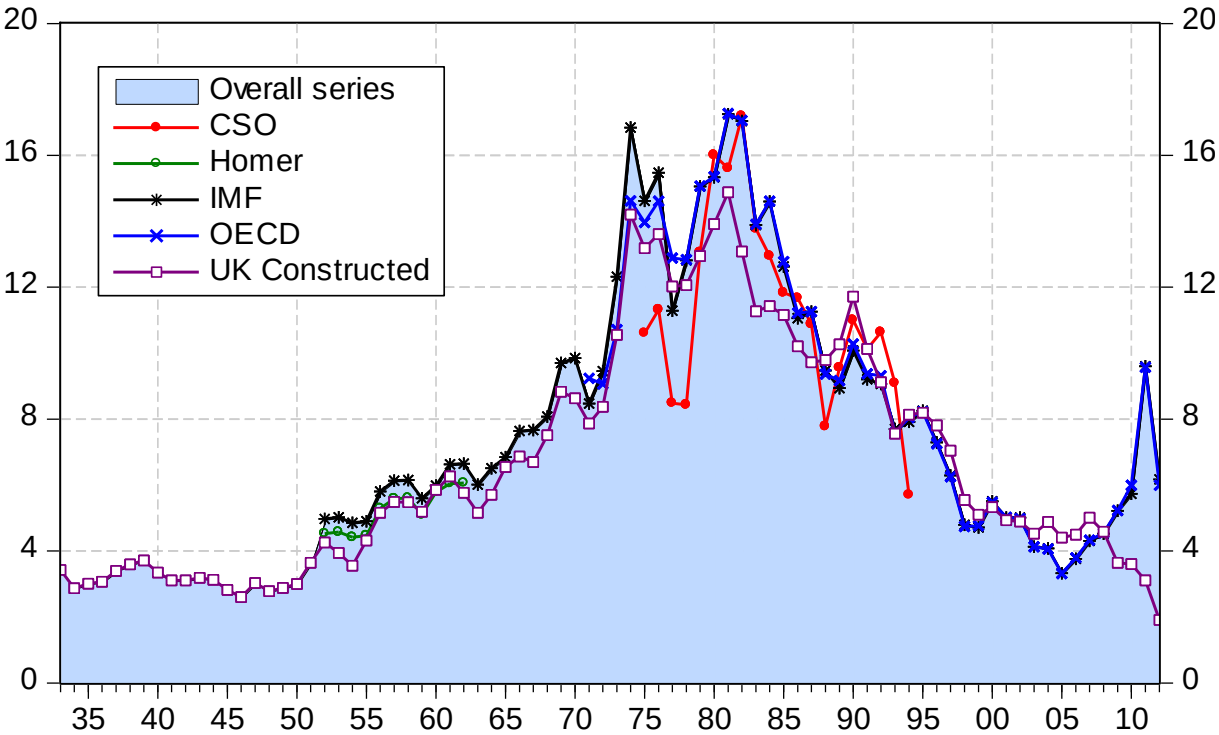


Figure 7: M2 growth and inflation

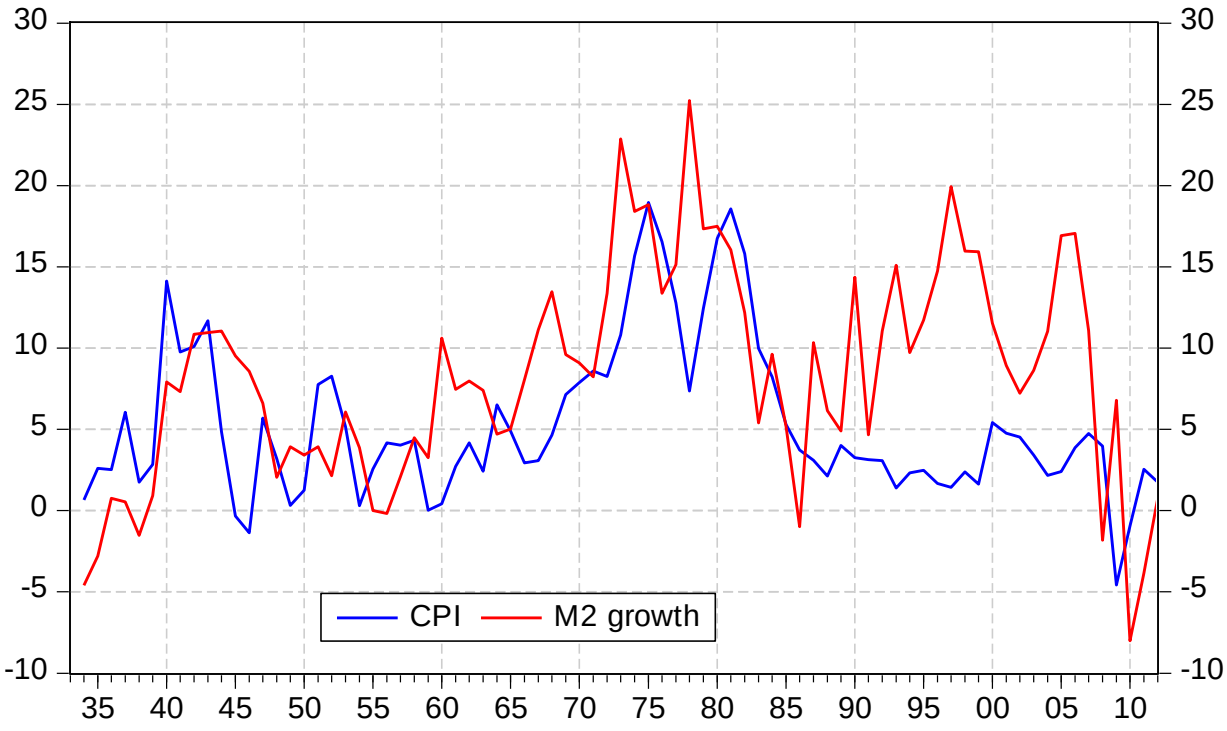


Figure 8: Real and nominal GDP growth

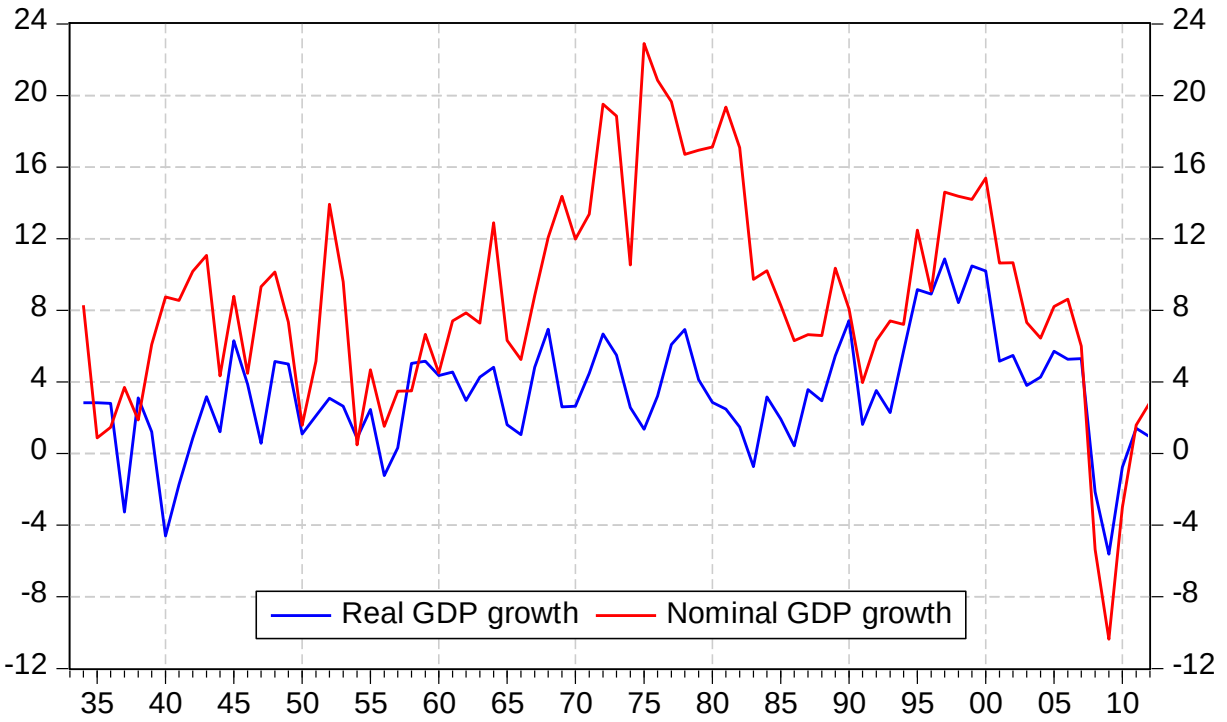


Figure 9: Nominal GDP and M2 growth

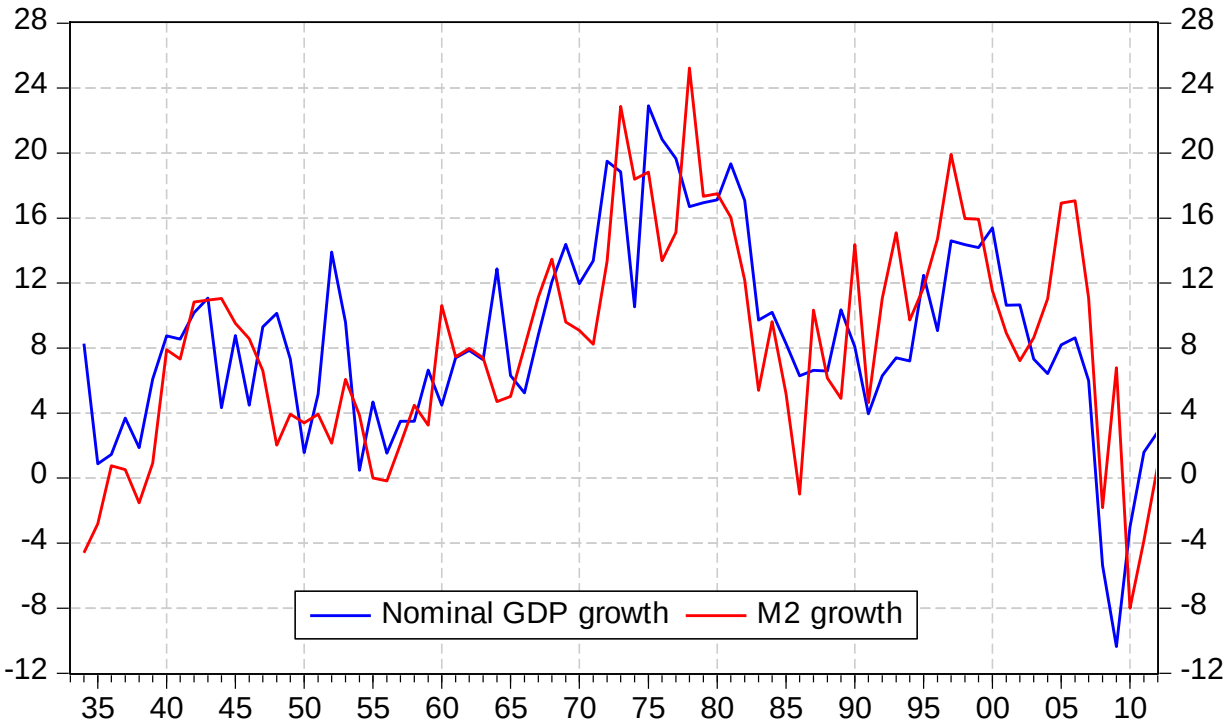


Figure 10: Short- and long-term interest rates

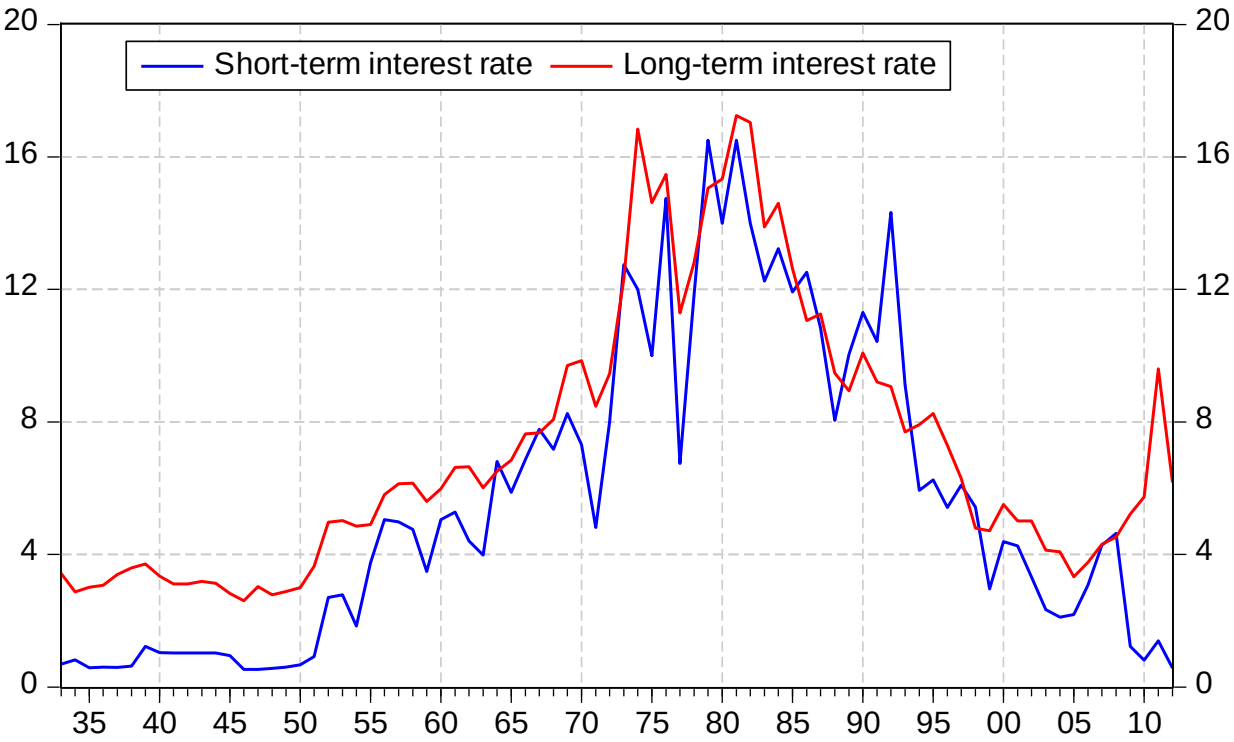


Figure 11: Impulse responses with 95% confidence interval

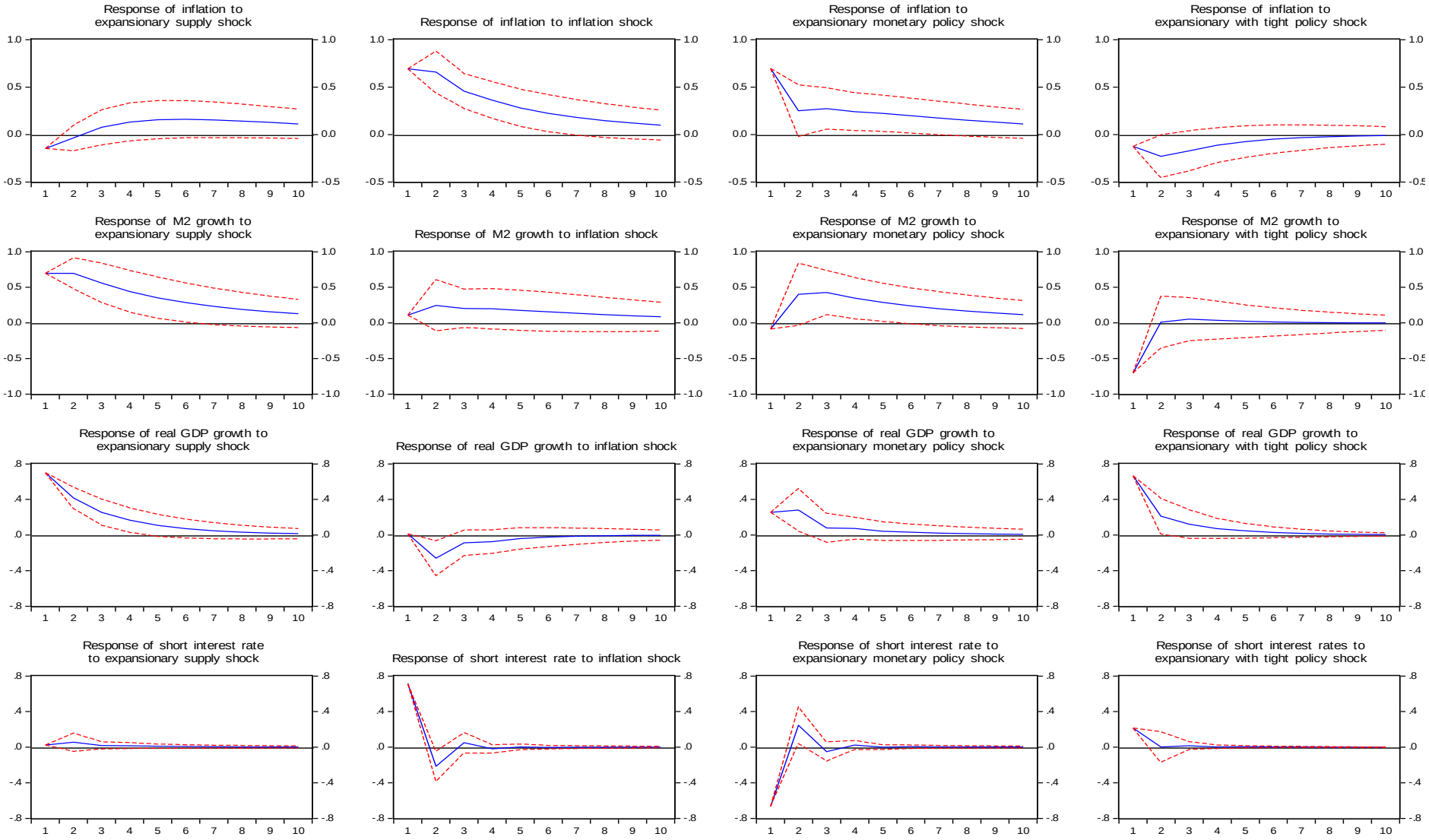
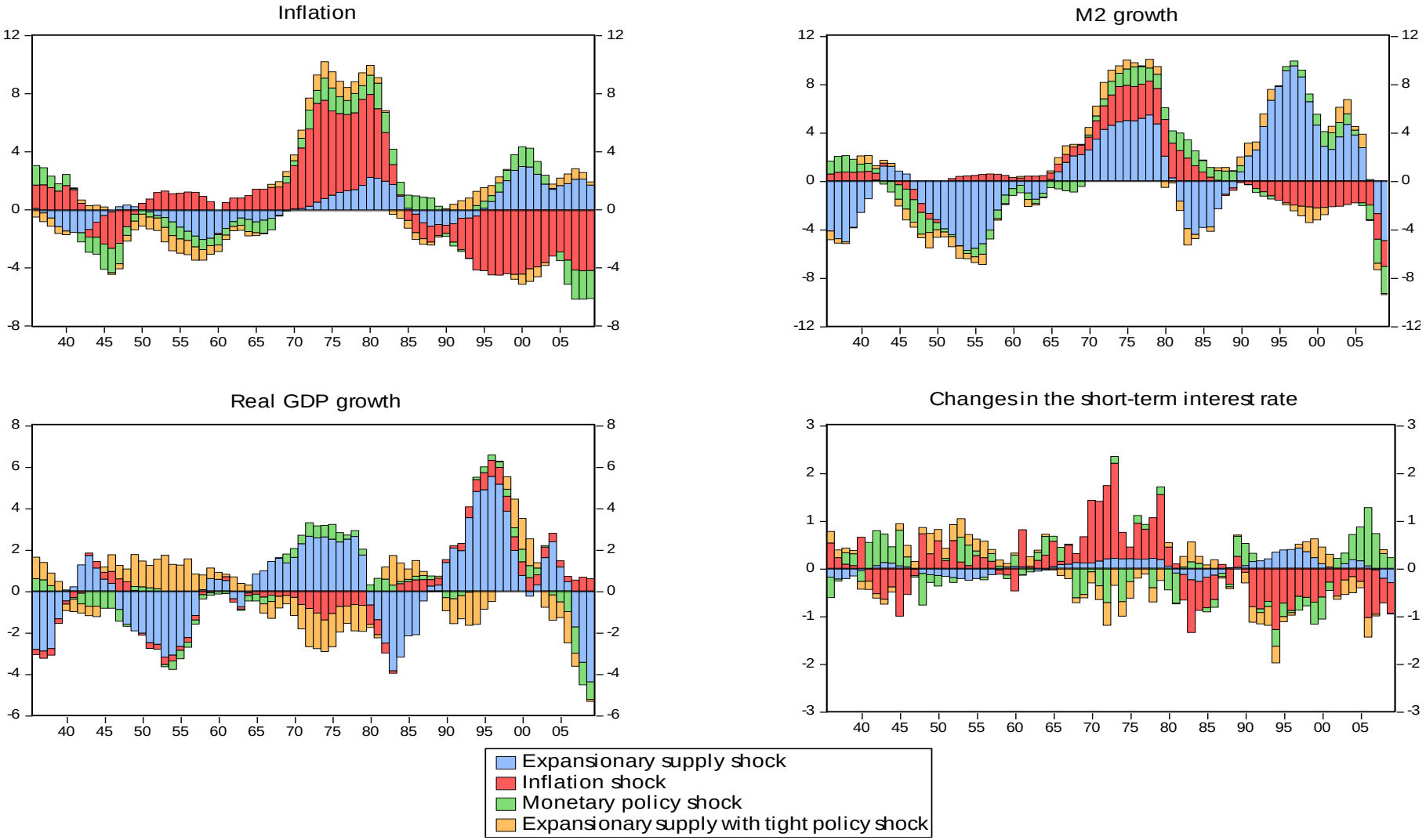


Figure 12: Role of shocks in the evolution of inflation, M2 growth, real GDP growth and changes in short rates



APPENDIX 1: Final compiled data series used in estimation

	CPI	Nominal GDP	Real GDP	M1	M2	Short-term interest rate	Long-term interest rate
1933	20.35	7.84	40.03	7.93	14.13	0.69	3.43
1934	20.49	8.52	41.19	8.59	13.50	0.82	2.87
1935	21.02	8.59	42.37	8.50	13.12	0.58	3.01
1936	21.56	8.72	43.58	8.82	13.22	0.60	3.07
1937	22.91	9.05	42.18	9.12	13.29	0.59	3.40
1938	23.32	9.22	43.52	9.37	13.09	0.63	3.59
1939	23.99	9.80	44.05	9.50	13.21	1.22	3.71
1940	27.63	10.70	42.07	10.83	14.30	1.04	3.35
1941	30.46	11.65	41.34	12.02	15.39	1.03	3.11
1942	33.69	12.90	41.70	14.55	17.15	1.03	3.11
1943	37.87	14.41	43.04	16.66	19.14	1.03	3.19
1944	39.76	15.05	43.57	19.08	21.37	1.03	3.13
1945	39.62	16.43	46.41	21.04	23.51	0.95	2.83
1946	39.08	17.19	48.24	23.26	25.61	0.53	2.60
1947	41.37	18.86	48.51	25.31	27.36	0.53	3.03
1948	42.72	20.88	51.07	26.00	27.93	0.56	2.78
1949	42.86	22.47	53.69	28.33	29.05	0.60	2.88
1950	43.40	22.82	54.28	29.52	30.05	0.67	3.00
1951	46.90	24.03	55.43	31.71	31.26	0.92	3.64
1952	50.94	27.62	57.17	33.11	31.94	2.70	4.97
1953	53.64	30.40	58.71	34.99	33.93	2.78	5.03
1954	53.80	30.55	59.21	36.70	35.27	1.84	4.85
1955	55.20	32.01	60.69	37.28	35.27	3.76	4.90
1956	57.55	32.51	59.95	37.28	35.21	5.05	5.80
1957	59.92	33.66	60.14	39.88	35.95	4.98	6.13
1958	62.57	34.86	63.25	39.69	37.60	4.75	6.16
1959	62.59	37.26	66.60	41.13	38.85	3.49	5.60
1960	62.86	38.97	69.57	48.92	43.20	5.05	5.98
1961	64.60	41.97	72.82	52.77	46.55	5.28	6.63
1962	67.35	45.40	75.01	58.07	50.42	4.41	6.65
1963	69.00	48.82	78.28	66.99	54.29	3.98	6.01
1964	73.64	55.54	82.14	69.16	56.90	6.81	6.51
1965	77.35	59.16	83.47	71.81	59.83	5.88	6.85
1966	79.65	62.35	84.37	75.90	64.85	6.87	7.64
1967	82.14	68.09	88.53	82.17	72.49	7.78	7.67
1968	86.05	76.84	94.89	87.71	82.95	7.17	8.08
1969	92.43	88.72	97.40	93.73	91.32	8.25	9.70
1970	100.00	100.00	100.00	100.00	100.00	7.31	9.85

1971	108.96	114.31	104.59	106.02	108.58	4.81	8.47
1972	118.34	138.93	111.82	124.82	124.10	8.00	9.45
1973	131.86	167.75	118.13	137.83	155.98	12.75	12.32
1974	154.23	186.40	121.21	150.36	187.49	12.00	16.84
1975	186.43	234.38	122.87	180.24	226.35	10.00	14.62
1976	219.96	288.71	126.89	210.84	258.74	14.75	15.47
1977	249.95	351.44	134.86	258.31	301.00	6.75	11.29
1978	269.03	415.33	144.55	329.40	387.37	11.85	12.82
1979	304.65	492.01	150.63	356.39	460.74	16.50	15.05
1980	360.16	583.90	154.99	398.33	548.80	14.00	15.33
1981	433.67	708.49	158.89	426.42	644.35	16.50	17.24
1982	507.92	840.48	161.26	459.52	727.79	14.00	17.04
1983	561.19	926.38	160.08	499.01	768.21	12.25	13.88
1984	609.35	1025.93	165.21	544.54	845.76	13.23	14.60
1985	642.52	1114.45	168.43	552.79	890.78	11.93	12.63
1986	666.99	1186.96	169.15	581.06	881.99	12.52	11.06
1987	687.92	1268.38	175.30	642.60	978.06	10.83	11.26
1988	702.65	1354.80	180.56	702.77	1040.09	8.05	9.48
1989	731.35	1502.65	190.70	791.56	1092.39	10.04	8.94
1990	755.61	1629.06	205.40	855.48	1261.16	11.31	10.08
1991	779.76	1694.91	208.77	861.14	1321.26	10.43	9.21
1992	804.08	1805.07	216.24	867.93	1475.74	14.32	9.07
1993	815.40	1943.96	221.25	1060.40	1716.21	9.12	7.70
1994	834.53	2089.26	234.29	1200.81	1891.60	5.93	7.92
1995	855.53	2366.77	256.76	1366.67	2126.80	6.25	8.26
1996	870.00	2591.48	280.70	1590.14	2464.35	5.42	7.29
1997	882.63	2998.97	312.97	2010.38	3007.81	6.09	6.29
1998	903.96	3462.35	340.48	2532.25	3528.72	5.43	4.80
1999	918.79	3990.29	378.11	3330.58	4137.84	2.96	4.71
2000	969.92	4654.37	418.72	3737.33	4643.17	4.39	5.51
2001	1017.17	5176.61	440.89	4393.80	5076.71	4.26	5.01
2002	1064.34	5758.97	465.75	4601.37	5457.54	3.32	5.01
2003	1101.39	6196.80	483.84	5137.36	5950.05	2.33	4.13
2004	1125.55	6608.97	504.95	5843.25	6644.59	2.11	4.08
2005	1152.92	7174.08	534.62	6934.37	7870.19	2.18	3.33
2006	1198.34	7820.58	563.52	8247.97	9334.39	3.08	3.77
2007	1256.63	8304.61	594.20	8809.86	10426.68	4.28	4.31
2008	1307.57	7871.28	581.67	7655.47	10238.91	4.63	4.53
2009	1248.99	7096.55	549.93	9800.23	10958.89	1.23	5.23
2010	1237.18	6885.85	545.72	9538.41	10115.47	0.81	5.74
2011	1269.16	6996.12	553.53	8846.84	9734.70	1.39	9.60
2012	1291.60	7198.63	558.72	9052.25	9809.86	0.57	6.17