Master Thesis at the Department of Economics, Lund University

A Historical Evaluation of Inflation Dynamics and the Role of Inflation Expectations

- An empirical study from 1880 to 2005

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ABSTRACT

We employ a VAR-model to study the dynamics of inflation and the role of inflation expectations and other macro economic variables to the inflation process with annual data over the period 1880-2005 in Denmark, France, Germany, Italy, Sweden, The UK and The US. We divide the period into four sub-periods following the Lucas critique (1976). The periods under examination are: 1880-1913, 1914-1939, 1950-1971 and 1972-2005 and the variables studied besides inflation expectations are long run excess money growth, short term interest rate and output-gap. This helps us interpreting the changing role of inflation expectations over the period. Because of the limitations of the VAR-model we also complement the method with correlation schemes and OLS-regressions with ad-hoc selection of lags based on the correlation schemes. We find weak evidence on rational expectations up until 1972 where the expectations to a larger extent can help explain the inflation process. The results suggest that inflation expectations are more adaptive than rational. Up until 1972 there are no signs that inflation expectations would be a leading variable to inflation.

Keywords: Inflation, Inflation Expectations, historical, correlation scheme, VAR

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1. Introduction

The purpose of the thesis is to cast further light over how the dynamics of inflation have changed from 1880 to 2005, with focus on inflation expectations. We study the inflation process and what role the inflation expectations have had historically. How have the individuals views on inflation and inflation expectations changed and are the relationship between inflation and other macro economic variables the same today as 125 years ago? The aim is to add knowledge by studying the longest period possible for the nations where data is available. The seven nations we study are Denmark, France, Germany, Italy, Sweden, The U.K. and The U.S. we examine the relationship between inflation and the following other variables: expected inflation, interest rate, long run excess money growth, output-gap and unemployment-gap. This is done by employing a VAR-model supported by correlation schemes for lag selection and OLS-regressions. By doing this we are looking for possible changes in these relationships. This first section will go through the developments regarding inflation and monetary policy. It will bring forward some of the more important theories and findings about inflation expectations and their role in monetary policy. The historic duality of adaptive or rational expectations has been evolved and more complex theories manage to explain the formation of expectations better. It is also the purpose to place this study in a theoretic context by discussing and exploring recent developments, theories and studies. We will analyze our results and search for evidence with these theories in mind.

1.1 Earlier Work

The role of inflation expectations has been widely discussed in post-war economics. The literature on how inflation expectations are formed, how they should be incorporated into forecasting models and what implications they have for monetary policy is vast and growing. Yet already before the two world wars Wicksell (1898) was foreseeing the possibilities of rapid growing inflation driven by higher inflation expectations. In 1926 Irving Fisher found a relationship between unemployment and price change (Fisher 1973). The same relationship became canonical in 1958 when Alban William Phillips presented an empirical relationship between the same variables as Fisher did back in 1926. Solow and Samuelson (1960) presented the same sort of relationship with the implication that unemployment was an indicator of future inflation. This relationship came to be known as the Phillips-curve relationship and implied a trade-off between unemployment and inflation i.e. a negative relationship between the two variables (Fisher 1973, Phillips 1958, Solow and Samuelson 1960, Lucas and Rapping 1969). The poor theoretical underpinning of the Phillips-curve was deeply criticized by Phelps (1967), Friedman (1968, 1977) and Lucas (1972, 1976) among others. According to economists the empirical relationship would not be stable over time and does not hold any foundation in economic theory (see e.g. Phelps 1967, Friedman 1968, Lucas 1972, Fischer 1977 and Taylor 1980). Lucas argued that the relationship was fading due to structural breaks; moreover, he argued that it was naïve to build models based on adaptive expectations. Lucas (1976) stressed that empirical relationships are likely to change when the policy regime does and to base policies on historical data would also be naïve. Instead they argued that the variables would change with individual's changing inflation expectations, which would happen when the economic environment changed. At the same time Friedman (1963, 1977) introduced the Natural Rate of Unemployment[1], which is determined by real factors and should explain the departure from the original Phillips relationship. The natural rate would be attained when expectations are rational[2] meaning that unanticipated change in inflation would lead to deviations from the natural rate in the spirit of Fisher (1896) and Wicksell (1898). Friedman (1977) argued that if the agents have anticipated the rise in prices, then it would be embodied in wage contracts etc., and the market would not clear in the same way when inflation is unanticipated. The Lucas critique, together with Phelps and Friedman's work, revisited the Phillips-curve by incorporating rational inflation expectations.

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[1] Based on Wicksells (1898) Natural Rate of Interest.

[2] For definition of rational expectations see Muth (1961), and for further discussion see Friedman (1977).

The work on rational expectations was mainly made by Muth (1961) and became very influential and still is to this day. Rationality in expectations implies that individuals foresee the future rate of inflation using all relevant information and the forecasts are therefore unbiased. This would mean that inflation expectations would be a leading, procyclical variable to inflation (see Lucas 1972 for full discussion). The empirical relationship suggested by Phillips (1958) was fading and from the seventies onwards the empirical relationship does not hold (see e.g. Atkeson and Ohanian 2001). During this period both prices and unemployment systematically started to increase and Lucas were to be right. Since the 90's, central banks all over the world have been adopting explicit inflation targets, which has come to be under considerable interest since the start of these monetary policy regimes[3]. Considering Wicksell's (Ibid) words about potential rapid growth in inflation, when the inflation expectation increases, hands the potential objective to the central banks to manage the expectations. Although recent work has been downplaying the importance of expectation for inflation in the long run most of the same studies shows that over high frequencies the expectations might have a role in the inflation dynamics (Estrella and Mishkin 1997, Neumann and Greiber 2004, De Grauwe and Polan 2005, Assenmacher-Wesche and Gerlach 2007, Andersson 2008, Benati 2009, Jörgensen 2009). Moreover, recent studies have shown that forecasting inflation has become harder and different forecast models have been performing with large forecast errors in tests (Cecchetti 1995, Atkeson and Ohanian 2001, Stock and Watson 2006). Tests employed by Atkeson and Ohanian (Ibid) even show that a naïve model, that employs adaptive expectations, perform as well as more sophisticated forecast models. Ball (1991) discusses how and why inflation rises and what the costs of disinflation are. Noteworthy, in this context, are two issues that he raises. First he notes that Sargent (1983) argues that the cost of disinflation is raised by weak political strength, which would affect the credibility of the policy negatively, i.e. the policy that is implemented to reduce inflation becomes weak as well. Moreover, he argues that the difference between adaptive and rational expectations is small which gives individuals little

[3] See e.g. Svensson (1997) and Bernanke and Woodford (1997).

incentive to form rational expectations and rather rely on adaptive expectations. Ball and Croushore (2003) discusses the same subject where they point out that expectations are not fully rational even though they are not to reject the null. The theory they base their result on is, that agents are not likely to form their expectations on nothing but rules of thumb to reduce the costs of gathering and processing information[4]. Mankiw, Reis and Wolfers (2003) also describe a potential problem that the public updates their expectations more seldom than professional economists i.e. people do not have the same forecasts. Another example against rational forecasters is Lamont's (1995) study where he finds that forecasters incentives lay in making a reputation and not minimizing forecast errors. The forecasts are essential for what policy that should be used and Svensson (1997) presents a theory, in the spirit of inflation targeting, where Inflation expectations are central to price stability. They affect future inflation itself and because they constitute a variable that central banks can use in forecasts, upon which the central banks to a varying extent makes their policy decisions. He suggests that the central banks inflation forecast is the ideal intermediate target. Svensson's theories are being criticised by Bernanke and Woodford (1997) by showing that inflation forecast targeting are inconsistent with rational expectations equilibrium and using private forecasts as long run indicators on future inflation might be dangerous. Bernanke and Woodford (ibid) recommends a structural model where information is gathered from many different sources which assumes that private-sector forecasts can hold some information about future inflation. Following Friedman (1977), the private sector forecasts cannot hold all the information that the central bank holds. Still, the authors suggest that the public inflation expectations may hold some information about future inflation. The source of the problem argued by Bernanke and Woodford (1997) is that the public may adopt the particular central banks inflation target as their inflation expectation. Hence, this would lead to non-informative expectations. If the expectations are fully forward-looking the central bank is in a position where the policies are of no effect because the public has already foreseen the central bank's next move (Clarida et.

[4] See also Ball (1991) and Roberts (1997).

al., 1999). Cecchetti (1995) argues that the implementation of an inflation target might be hard and raises two potential problems. Firstly, he argues, it is hard to forecast inflation and secondly, when the inflation rate is forecasted, the policymakers stands before the task of making up their minds what the policy should be.

1.2 Recent studies

The seventies and early eighties was a very eventful and interesting time concerning the big changes in politics and political economy. Most important for this thesis was of course the effects that these events had on the macroeconomic environment in general and inflation in particular. The collapse of the Bretton-Woods system in 1971 and the two oil price-shocks of 1973 and 1979 had been accompanied by a period of low levels of GDP-growth at the same time as a high inflation rate. This was characteristic for many industrial nations in the seventies. The evidence that the Phillips-curve was not a permanent trade-off between inflation and employment opened up for a change in monetary policy. The criticism of the Phillips-curve gained recognition in the U.S. when Paul Volcker was appointed chairman of the Federal Reserve (Bootle 1997). The monetary policy in the U.S. now became more focused on fighting inflation by raising interest rates rather than stimulating demand in a Keynesian style which would have been a more standard response in the beginning of this decade (Ibid 1997).

Inflation was persistent and did not decline until mid-eighties, after a period of struggling economies in many industrial nations. The fact that inflation seems to be persistent and costly to reduce led to a desire of keeping inflation low (Clarida et. al 1999). Credibility and anchoring inflation and expectations became important for central banks around the developed world (Svensson 1999). When expectations have been brought down, central banks tends to be able to keep inflation low with smaller measures than before, although this can be lost if policies are not continuously directed at keeping inflation low and stable also in the future (Clarida et. al 1999). The importance of changes in monetary policy for reducing the inflation volatility is confirmed by Roberts (2006). Credibility, anchored inflation expectations are thus central when it comes to maintaining price stability (Mishkin 2007). An important part in central banks ways of achieving high credibility and anchored expectations is through being transparent and communicative about their decisions. This means communicating policies to the market actors and to the public through media (Bernanke and Woodford 1997). Credibility is naturally interconnected with transparency. Lyziak, Mackiewicz and Stanislawska (2007) study this relationship in the recent history of the national bank of Poland. They study this by examining analysts and the public's expectations in relation to the inflation target set by the national bank. The results show a clear difference with respect to taking the inflation target into account when forming expectations, forecasters/analysts do but consumers do not.

The importance of inflation expectation should hopefully be quite clear by now. The rest of this section will focus more on theories of how individuals, both in the public and in the markets, form their expectations on inflation. Mankiw, Reis and Wolfers outline a theory of the disagreement in a number of papers (Mankiw and Reis 2001 and 2002, Mankiw, et. al. 2003). This is called the sticky-information model and allows for the assumption of homogenous expectation to be relaxed. The differing expectations of individuals are explained by the costs of gathering information about inflation and optimizing actions according to the new information. Since individuals update their information only once in a while, this means that only some people will have the latest information and hence act on it. This leads to a few quite intuitive but nonetheless interesting implications for the disagreement about expectations: disagreement rises with inflation, and with sharp changes in inflation, it also rises when inflation differs across groups of different goods. Economists and people for whom inflation are especially important will naturally keep up to date to a larger extent than people in general. This means that the sticky-information generated expectations resemble the distribution of survey data better than rational or adaptive expectations (Ibid 2001, 2002, 2003). Carroll (2003) provides micro foundations for the sticky-information model. Epidemiological disease models inspire the model although information is what's being spread around in this case. Forecasts about future inflation made by professionals are provided to the public through the media.

Carroll uses an absorption parameter that depends on news coverage intensity and indirectly on the magnitude of change in forecasts or unexpected change in actual inflation. The basic idea is that the public only pays attention to news about inflation every now and then. On average, expectations about inflation are being updated once a year (Carroll 2003).

A recurring question on the nature of expectations is of course to what extent expectations can be said to be rational. Roberts (1998) findings imply that the answer lies somewhere between perfect rationality and purely adaptive expectations, this result is thus consistent with the theories of sticky-information. Roberts describe this as representing an intermediate degree of rationality.

Mishkin (2007) studies changes in inflation dynamics in recent years. He finds that when inflation increases it tends to return to the normal rate quickly. Inflation has thus become less persistent and more anchored (se also Stock and Watson 2006, Cogley and Sargent 2005, Cechetti et al, 2007). Mishkin also concludes that the Phillips-curve now has a flatter slope than before, because inflation has become more insensitive to the unemployment gap. This indicates that inflation will not increase as much as before from a reduction in unemployment but it also means it will be more costly to return to the original rate of inflation. The effect of price-shocks such as surges in the price of oil seems to have decreased in later years, as opposed to the price shocks of the seventies (Hooker 2002). Mishkin puts great emphasis on the importance of expectations in inflation dynamics; it really has a central role. These findings are interpreted as signs of the re-anchoring of inflation that has been going on since the seventies period of stagflation. Empirical studies supports this; expectations have been brought down to a more stable rate. The flatter slope of the Phillips-curve and the decreased sensitivity to price-shocks are of course also supporting the theory of anchored expectations.

It is clear that depending on what relationship inflation expectations have with inflation they matter for the policy makers. When looking through the protocols from the meeting of the board of the Swedish Riksbank from February 2009 and

May 2009, the word Inflation Expectations is mentioned 28 and 27 times and 11 times in the Federal Reserve protocol from July 2009: which, show that these are taken into great consideration. Some empirical relationships have changed during the years as well as the available information about the economy and these relationships following Lucas (1976). This raises the question about how the inflation dynamics have changed over the years when the available information has been expanding. At the same time, the world has experienced periods with different levels, volatility and persistence of inflation. Bernanke (2007) points out that we need more understanding of how inflation expectations are formed and how they affect actual inflation. Furthermore the models that are being used for projecting inflation assume that the public uses historical relationships between inflation and other key variables. This thesis will help sort out how the relationships between variables have changed during 1880-2005 and this way make a contribution to the research on the inflation process.

2. Model and selection of variables

Earlier work shows what variables might be important in explaining inflation process; we will test the inflation expectations (π^e)[5], nominal interest rate (i), long-run excess money growth (μ) and two productivity gaps (GDP-gap, *y-gap* and unemployment-gap, *u-gap*) to inflation (the different sources time series will be described more closely in chapter 3.1 The Data, as well as in chapter "8. Data Appendix"). We employ a VAR-model similar to Mehra and Herrington (2008). Mehra and Herrington employ a structural VAR-model to derive how different variables affect the formation of inflation expectations. The study made by Mehra and Herrington is based on Leduc, Sill and Stark (2007) who use the same type of structural VAR-model to explain the persistent inflation in the 1970's. We are taking the analysis one step further by deriving inflation expectations back to 1880.

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[5] For calculations of these and other variables see chapter 3.2 Data Transformations.

We construct inflation expectations[6] back to 1880 using the Fisher equation (1930) and the golden rule theory (Taylor 1993). Contrary to Mehra and Harrington's (2008) and Leduc et. al. (2007) study that uses survey expectations[7]. Lucas (1976) pointed out that different empirical relationship were not likely to be the same when the economic environment shifts and therefore we divide the period 1880-2005 into sub-periods[8]. We select the periods with foundation in economic theory and by testing for structural breaks; this helps us to interpret how the relationships between different macro variables have changed during time with respect to different economic structures. As a complement to the VAR-model we construct a correlation scheme and an OLS-model to analyze the impact of each variable on inflation during different periods. Merits and issues of such an OLS-model will be discussed further in chapter 4. We use the correlation schemes to select lags for the model, ad-hoc. This will cast additional light over how the inflation process has changed over time and give us a view on how the inflation expectations affect inflation.

A measure of excess money growth is important as well since recent studies have shown that the single most important indicator of future inflation is excess money growth (see: Estrella and Mishkin 1997, Neumann and Greiber 2004, Dewald and Haug 2004, De Grauwe and Polan 2005, Assenmacher-Wesche and Gerlach 2007, Andersson 2008, Benati 2009, Jörgensen 2009). Cagan (1956) emphasized the role of money creation as well before these studies and Friedman and Schwartz (1982) referred to money as "the sole and only source of inflation". The European Central Bank (ECB) uses a two-pillar system where long run money growth is an indicator on inflation in the long run (ECB 2003, 2004, Gerlach 2004). Gerlach (2004) specifies the equation with a measure of long run money growth in the same manner as the studies mentioned above. Therefore a measure of excess money growth is used.

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[6] See Bordo and Dewald 2001, Dewald 2003.

[7] For a discussion about different ways to record and calculate inflation expectation see chapter 3.2.1 Calculations of Inflation Expectations.

[8] More on the different periods in see chapter 3.3 The Period Under Examination.

At last, we are aware of the fact that some other variables might affect inflation during the period. Other variables are unfortunately poorly documented (e.g. oil-price, commodity prices) and thus forced us to exclude these. Moreover Mehra and Harrington (2008) find that the oil-price does not affect the inflation expectation process. We are focusing on the inflation process and the oil-price is likely to be reflected in the lagged values of inflation in our VAR-model. Another reason worth mentioning is the fact that commodity prices works directly into the inflation and should therefore be recorded in the lags of inflation.

In short the process is as follows:

First we construct correlation schemes for the whole period to see what variables have been leading or lagging inflation over the whole period. This benchmark helps us to add lags ad-hoc, to the general OLS that we use to divide the period into sub-samples with the help of CUSUM-test. These sub-samples are based on economic theory and are tested for structural breaks using Chow's-test. Different OLS-equations for the periods selected are regressed to support the VAR-model for every period. The findings in the different tests and regressions are reported in chapter "5. Results and Interpretation" but first we present the data and the calculations made.

3. Data

This section will discuss the data, the sources and the process of collecting it, as well as the transformations made to fit the purpose of this study. The first part will give an account for the data in general and the primary sources. Later on the transformations will be described and discussed. The last part will walk us through the period and figures of the variables will be presented.

3.1 The Data

For this sort of study, which goes far back in time, it is necessary to import data from a number of different sources and this may cause problems, sometimes data is even hard to find. The choice of countries and periods is made on the availability of data. In general there are equally many different ways to define e.g. the money stock as there are countries and the same definition is not available for all time periods. The latter problem can be solved by chaining the different periods together with the use of the following equation[9]:

Value in year *t* with new definition=

$$\frac{\text{Value with new definition for overlapping year}}{\text{Value with old definition for overlapping year}} * \text{ Value in year } t \text{ with old definition}$$

The same transformation is used to solve the issues of different base years for e.g. GDP and CPI where "definition" can be replaced with "base year". We base inflation on series of CPI, which we chain in this manner except for Sweden where data on inflation is available. The definition of most variables are regularly updated and since our period of examination is so long we see no other way around it than to use the mentioned method of chaining, which a common method.

The problem with different sources is somewhat harder to solve. Most often we simply use the sources used by Dewald (2003) and add some new resources made available[10], by doing so we use the most similar definitions available. More specifically, one important source is B.R. Mitchell's International Historical Statistics: Europe, 1750-2005 (2007). Mitchell (ibid) is our primary source of data on inflation (CPI), money supply and unemployment. The main source of GDP-data is Maddison's Monitoring the World Economy 1820-1992 (1995). Homer and Sylla's The History of Interest Rates (1991), has been especially useful in providing data on bond yield and interest rates and we have had great use of Thompson Financial Datastream for more recent data (1970- and onwards) on most variables. During some periods data on money stock is not available, mostly for Germany and France during the period of the two world wars. Money stock data for France from the beginning of the 20th century could not be found and is therefore excluded before that and included for the remaining time period. The yearly bond rate for Sweden in the 1880's is lacking

[9] Fregert (2000) http://www.nek.lu.se/NEKKFR/Bkurs/pmch2.pdf Chaining, 2.2
[10] For a full reference list see the Chapter 8. Data Appendix.

as well, but every other year was recorded. These "small" gaps were filled by linear interpolation to get as many observations as possible and the big gaps during the wartime were avoided by excluding (1940-1949) this period. Besides the lack of data in many countries, the rationale for excluding the time for the Second World War is that we are not likely to find any informative relationship for this period where different countries were suffering from major structural changes and high economic volatility. The solution is not ideal but the selection of periods helps solving this problem.

One way to extend the paper would be using panel data. This would help to generalise to a larger extent. I could give the opportunity to divide the sample in to smaller periods as well e.g. one can suspect that the period after the inflation targets where implemented for many countries hold a different structure than the period before (see e.g. Mehra and Herrington 2008). When using panel data would require a different set of data and splitting the different countries up by what monetary policy are implemented. We are focusing on the separate countries and this way avoiding that different structures in the various countries contaminate the others.

3.2 Data Transformations

We make use of real GDP to construct a output-gap (denoted *y*-gap from now on). Using an output-gap is intuitive and also constitutes a value of how well a country makes use of their resources, which is a matter of interest in most inflation-models (see e.g. Phillips 1958, Galí and Gertler 1999, Gerlach 2004). Where data are available we also construct an unemployment gap (denoted *u*-gap from now on) as well and where unemployment rates are not available we refer to Okun's law (see Okun 1962, Prachowny 1993). The *y*-gap (and *u*-gap as well) are constructed by subtracting a seven-year centred, moving average from the observed value in GDP using the equation:

$$\frac{1}{T}\sum_{t=1}^{T}(\Delta X_t) = \overline{X} \quad \text{(Equation 3.1)}$$

Where $\overline{X}$ denotes the trend in variable X. The use of this method instead of a Hodrick-Prescott filter is chosen following the results of Englund (1992) and

Assenmacher-Wesche and Gerlach (2006) who finds that a business cycle varies from 3 - 8 years and 5-6 years respectively. With this in mind, we choose a seven-year symmetrical average and avoid the problems and uncertainty with choosing a lambda value for the Hodrick-Prescott filter (see Leser 1961, Hodrick and Prescott 1997, Ravn and Uhlig 1997 for discussion). Furthermore, this way of choosing a trend is also used in computing g. This is in turn used to construct the measure of inflation expectations, the same method is used for computing the long run excess money growth as well. The measure of long run money growth is calculated by subtracting g from the growth trend in money supply. The last variable is the nominal short-term interest rate, typically the discount rate, *i*. This is perhaps the most appropriate measure of political interference and it is well recorded for all countries in this study. Fisher (1896) was one of the first to stress the importance of the interest rate to the exchange rate, and in addition, the importance for the money market and inflation. The variable is likely to work with long lags pointed out by Friedman (1968), meaning that the policy change (in this case an interest rate change) can take up to two years before it has come to full utilization.

3.2.1 Calculation of Inflation Expectations

Irving Fisher (1896, 1930) established that "high and low prices are directly correlated with high and rates of interest" and "rising and falling prices and wages are directly correlated with high and low rates of interest". An example given by Fisher summarizes the ideas, assume prices rise:

"Business profits (measured in money) will rise, for profits are the difference between gross income and expense, and if both these rise, their difference will also rise. Borrowers can now afford to pay higher "money interest." If, however, only a few persons see this, the interest will not be fully adjusted and borrowers will realize an extra margin of profit after deducting interest charges. This raises an expectation of a similar profit in the future and this expectation, acting on the demand for loans, will raise the rate of interest."

The nominal interest rate would embody the future real interest rate and therefore the future inflation (Fisher 1930, Dewald 2003). Fisher's ideas lead to the Fisher-equation where the nominal rate equals: the real rate, expected inflation plus a risk premium (Fisher 1930), which gives the equation:

$$i = r + \pi^e + RP \qquad \text{(Equation 3.2)}$$

The above equation combined with "The Golden Rule Theory" based on John Taylor's (1993) assumptions when formulating the "Taylor-rule"[11]. The Golden Rule Theory suggests that in the long-run equilibrium the real interest rate equals the growth-trend in GDP[12] in constant prices and yield the equation:

$$r = g \qquad \text{(Equation 3.3)}$$

This thesis employs long-term government bonds, and by this sets the risk premium to zero. The calculations are straightforward from here and by simple algebra using (1) and (2) we reach the following equation:

$$\pi^e = i - g \qquad \text{(Equation 3.4)}$$

These assumptions are used by e.g. Bordo and Dewald (2001) and Dewald (2003, 2004) for calculating the expected inflation ex-post. We use the same method and the sources of data are much of the same as Dewald (2003). Of course there are some problems with a method like this where e.g. taxes and different regulations can affect the bond rate (ibid. 2003). And although the risk premium is close to zero there is some uncertainty around this matter. Studies have been done before, focusing on how good different methods of collecting data of inflation expectation are and have come to the conclusion that the method applied here is satisfactory (see e.g. Andersson and Degrér 2001, Christensen et. al. 2004, Abildgren 2005). The studies have been made in countries where the economy has been relatively stable during time and so are the countries we are examining, with the exception of the period from the outbreak First World-War

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[11] This is a common assumption in both theoretical and empirical studies. In formulating his Taylor Rule", John Taylor (1993), for example, set the equilibrium short-term interest rate at the trend growth in real income because this value is approximately equal to potential growth, i.e. compatible with a long-term equilibrium growth path.

[12] For calculation of g see the previous chapter: 3.2 Data Transformations.

until the end of the Second World War. Moreover the different long-term bonds during the nineteenth century are somewhat different[13]. At last it should be mentioned, as in Dewald (2003), it is a "crude measure" of inflation expectations. Noticeable as well is the fact that during Irving Fishers days among us (until the 1940´s) the data did not show any systematic link between interest rates and inflation but, as mentioned, recent studies have (ibid. 2003). Other measures of inflation expectations such as surveys are not recorded as far back as long-term government bonds and have not been used for this reason. Another alternative is comparing yields on nominal and inflation-indexed Treasury securities and this way excerpt inflations expectations. Besides the problem with the lack of availability for periods back in time Bernanke (2007) points out problems with risk premiums. As in Bordo and Dewald (2001) and Dewald (2003) we interpret a close relationship between actual inflation and bond market inflation expectations as a trustworthy central bank. A larger spread would mean that the central bank is unsuccessful in their monetary policies and the uncertainty is reflected in the spread.

3.3. The Period under Examination

This section aims to examine the variables over the entire period. This helps us further on when searching for structural breaks and to divide the sample into different economic periods.

One striking feature of the inflation series (Figure 3.1 – 3.7) is that there seems to be moderate price changes until First World War (WW1), after which inflation first took off. The second general surge in inflation comes during the Second World War (WW2). Further on, prices accelerated in the 70's in the wake of the supply shocks driven by OPEC. Looking at the second set of figures (Figure 3.8-3.14), which is a plot of the interest rates, Y-gap and U-gap, it is obvious that interest rates were raised subsequent to the OPECs. Thereafter, inflation once

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13 More on the different data sets can be read in the 8. Data appendix

again declined in the 80's and is to this day moderate in the countries being examined.

These empirical findings are in line the results presented by Bordo (1993), Bordo and Dewald (2001) and Dewald (2003) and Dewald and Haug (2004) where the same patterns are described. When it comes to the beginning of the period, the exchange rates are under the stable gold standard that lasted until the First World War (WW1) (Jones 1933). However, until the outbreak of the First World War the gold standard was the prevailing monetary regime following most of the western countries left the silver standard during the last three decades of the nineteenth century (Jones 1923). As mentioned, inflation was low and stable during this period. Although some economists raised warnings about the possibility of surging prices, inflation was not considered as a threat during this period (see e.g. Wicksell 1898). Irving Fisher wrote about the difference between foreseen and unforeseen changes in the value of money already in 1896, the same difference that Phelps (1967) and Friedman (1968) emphasized later on. Fisher further wrote about the issues of a stable value of money and the interest rate to control inflation.

The period after the First World War inherited higher inflation and therefore problems with exchange rates, which played a part in the crisis in 1931 and 1933 (Brown 1934). During this time most countries had left the gold standard and no other standard system was in place. Gustav Cassel (1923) described the situation as "complete chaos in the world's monetary system". Additionally Cassel wrote about people's wish to bring back the gold standard instead of the paper standard despite the fact that gold lacked value stability in a period where the economy was shaken by WW1 and the great depression.

The WW2 period is excluded from the OLS- and VAR-models, due to missing data and very high volatility in all variables that would cause problems in the model. One is not likely to find a simple OLS-model that fits this period nearly as well as the other*s* and our aim with this study is not to find a model that explains wartime inflation. After the end of the Second World War (WW2) the Bretton-Woods was adopted the 18th of December 1946 with the hope of getting an adjustable peg and by doing this, get the advantages from the gold standard as well as the floating exchange rates (Bordo 1993). The main advantages mentioned by Bordo (1993) are the exchange rate stability and the possibility to pursue full employment policies under an adjustable peg. Moreover the world found itself in a stable price environment and the view that a commodity-based fixed exchange rate regime worked well as a nominal anchor was enforced (ibid 1993).

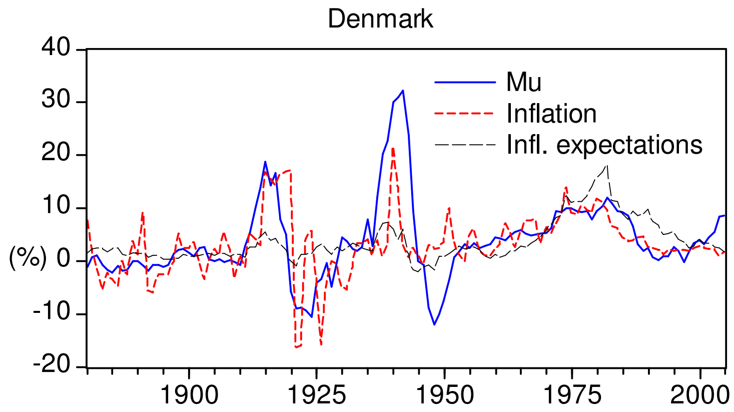


Figure 3.1

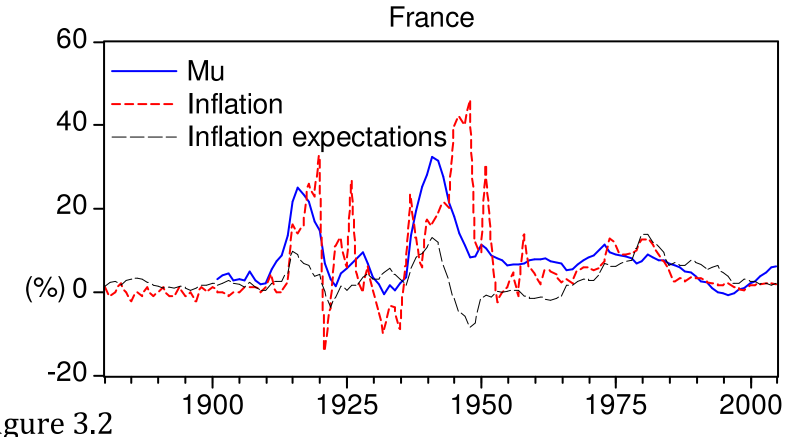


Figure 3.2

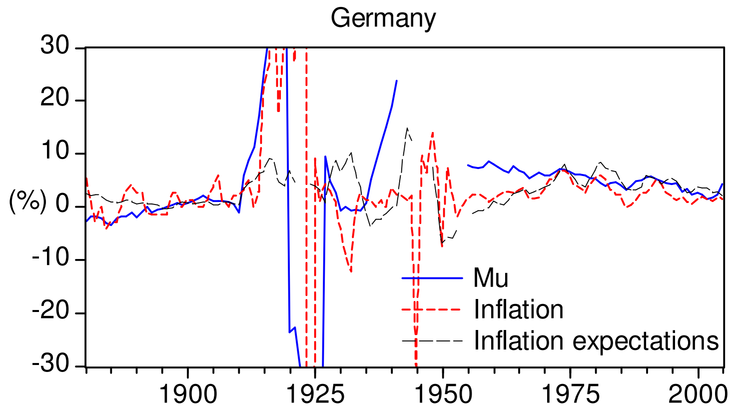


Figure 3.3

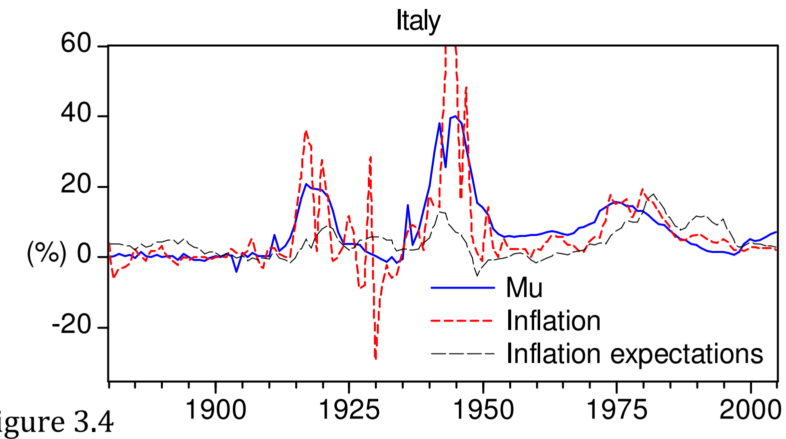


Figure 3.4

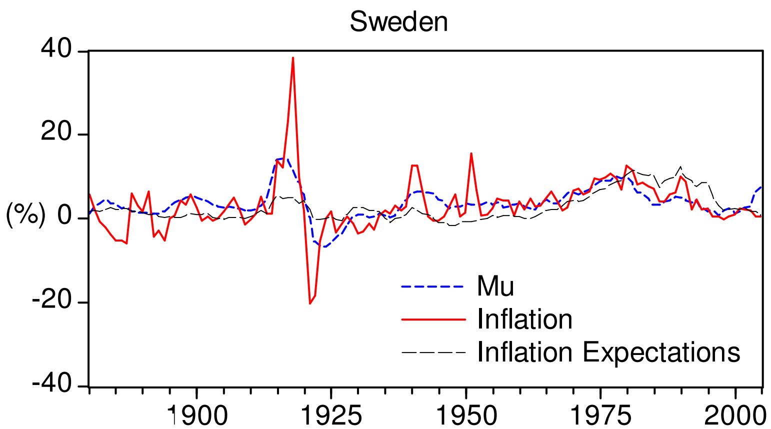


Figure 3.5

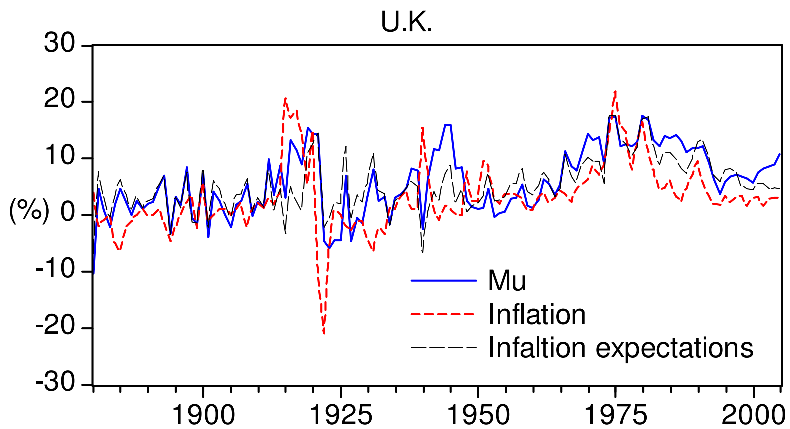


Figure 3.6

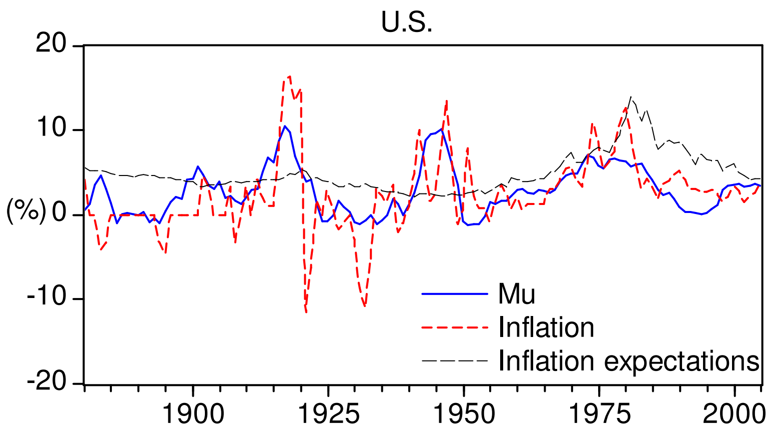


Figure 3.7

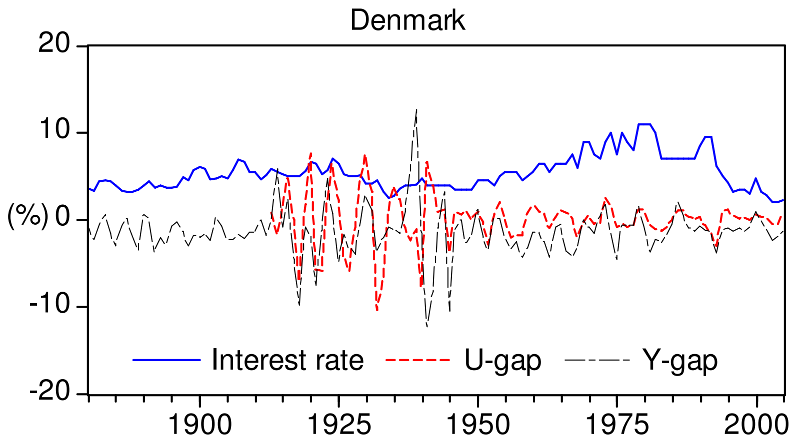


Figure 3.8

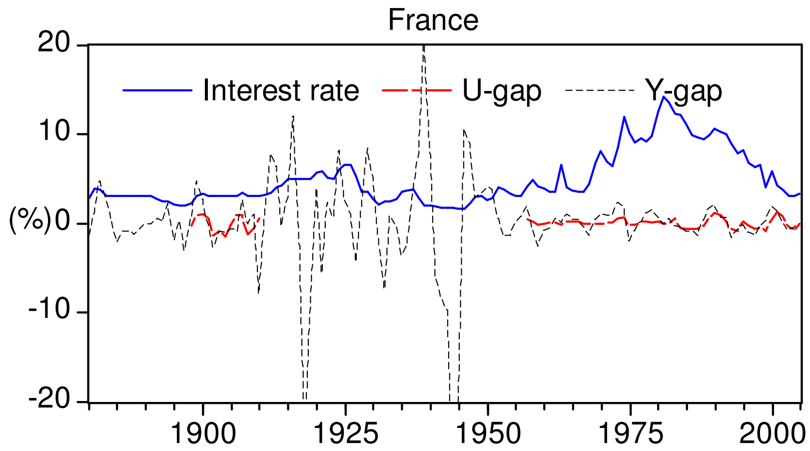


Figure 3.9

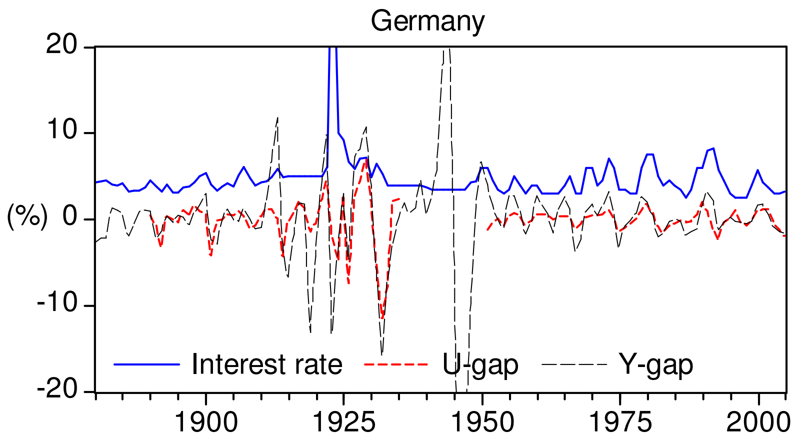


Figure 3.10

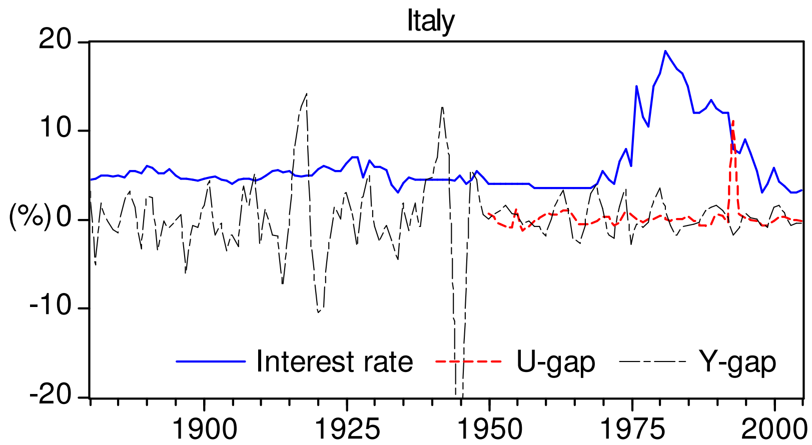
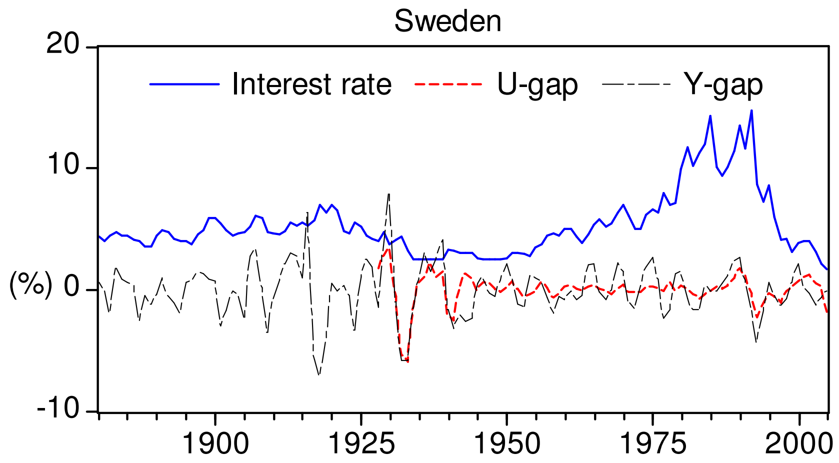


Figure 3.11



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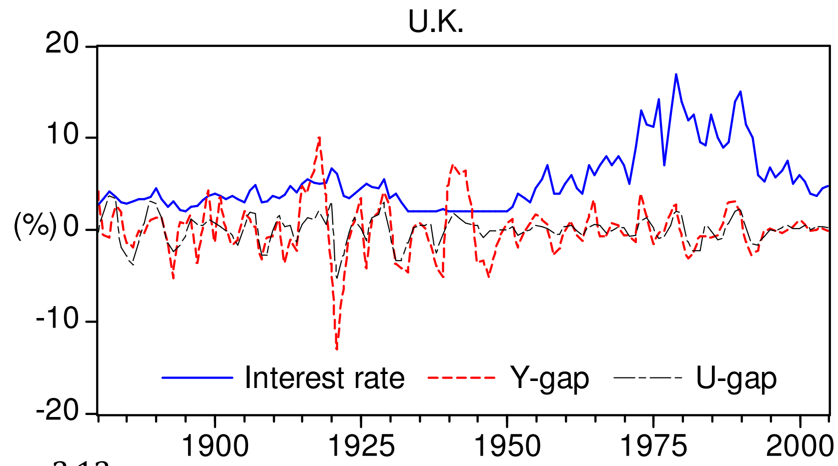


Figure 3.13

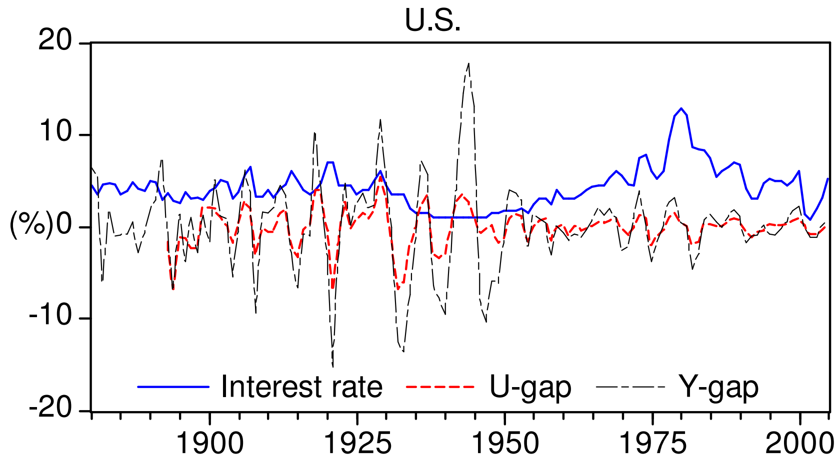
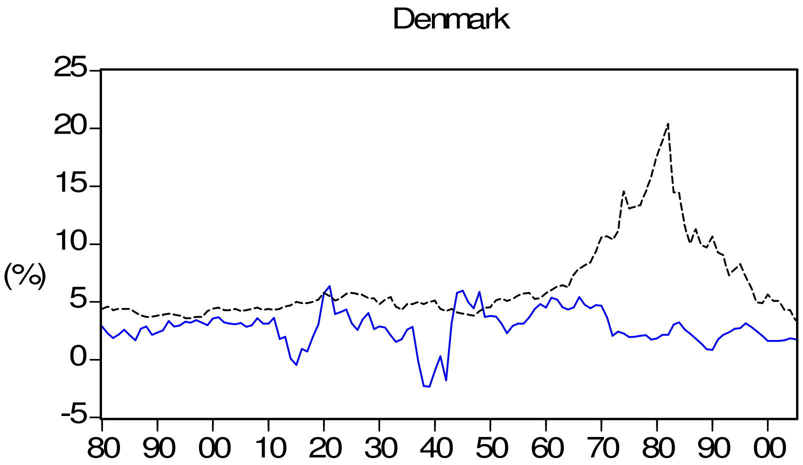


Figure 3.14



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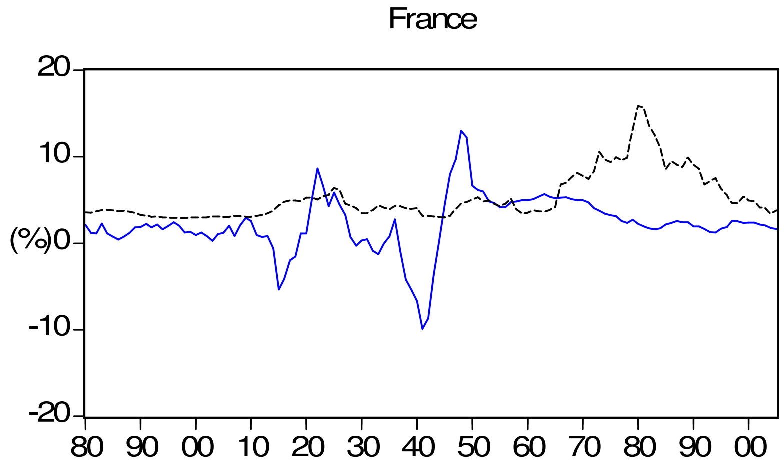


Figure 3.16

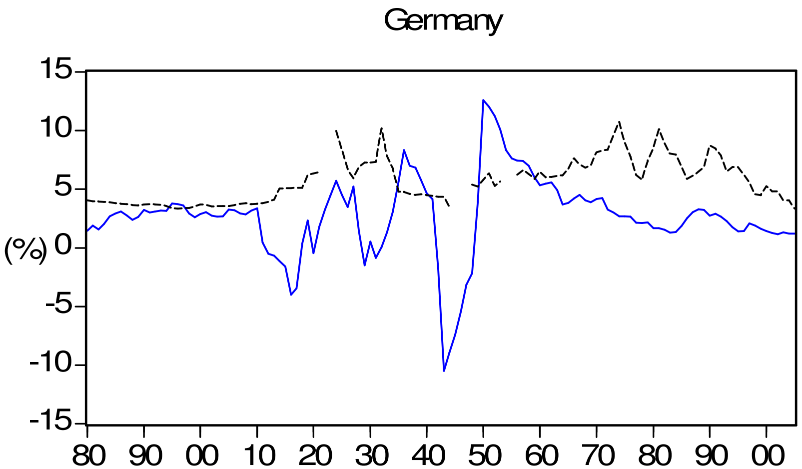


Figure 3.17

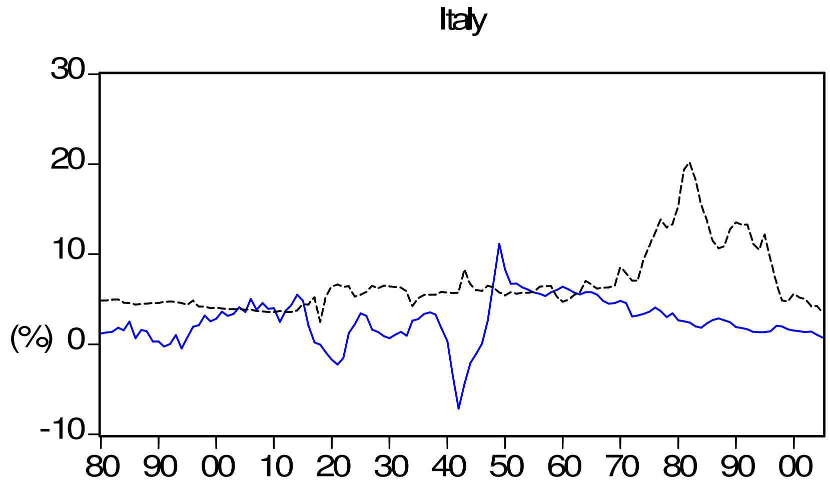


Figure 3.18

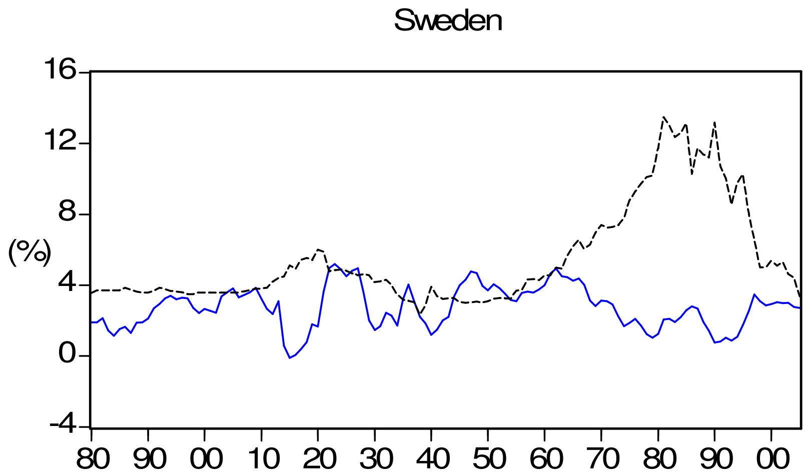


Figure 3.19

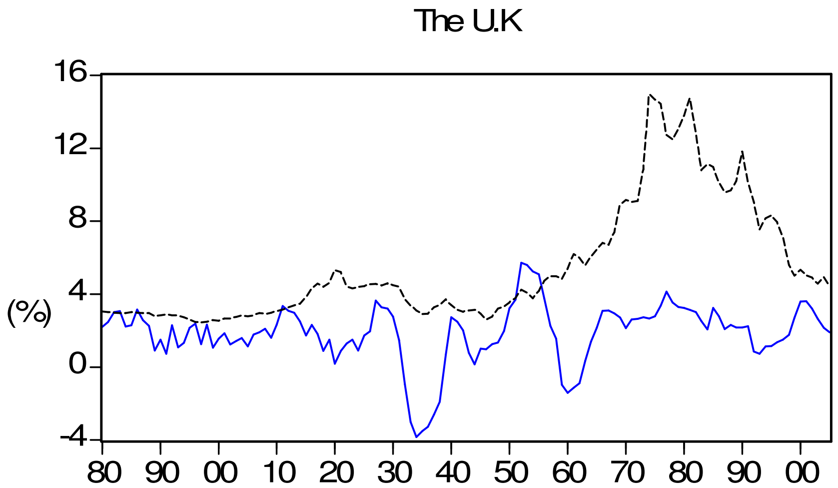


Figure 3.20

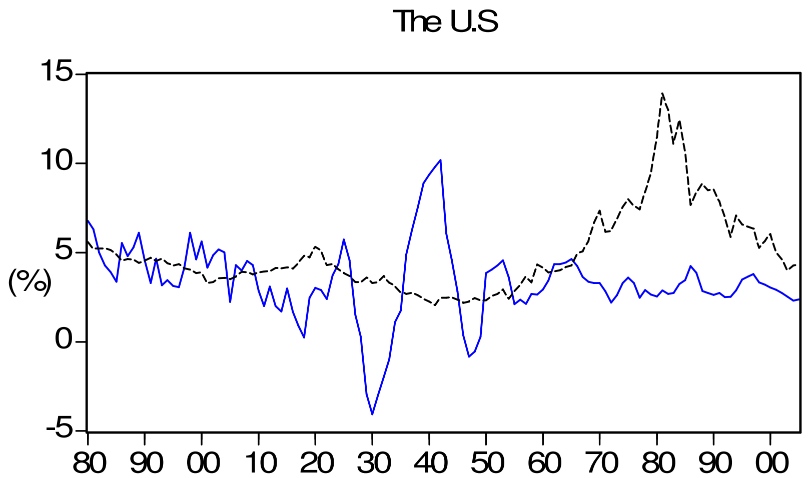


Figure 3.21

At the same time as the research on inflation expectations grew larger, the stable exchange rate regime became doubted. In 1971 U.S. President Nixon was forced to cut out the US dollar-to-gold link and this marked the breakdown of Bretton Woods[14]. The period since then has been characterized by floating exchange rates with some exceptions (ibid. 1993). A matter that Mussa (1986) emphasizes is that real exchange rate becomes more volatile when there is a change in exchange rate regime from fixed to floating this swift. Evidence in our data shows that the breakdown of Bretton Woods, by some means, marks a change in inflation volatility as well as in levels which is in line with e.g. Bordo and Dewald (2001) and Dewald (2003). During the two oil crises the world economy suffered from stagflation (see Friedman 1977) and these issues were addressed by the policy makers in different ways. The Phillips-curve was proven not to be a long term trade-off and price stability was given a high priority issue in most countries. Inflation has clearly dropped since the early eighties. More and more countries now have explicit inflation targets that the central banks are continuously working to achieve.

When it comes to the possible problems with non-stationary variables and spurious regressions due to a unit root, Beechey and Österholm (2008) finds the CPI and GDP process for US stationary. These processes are not likely to take any given value and the other series are by construction mean reverting (e.g. the gaps). The nominal interest rate, *i*, holds the same characteristic according to Österholm (2004) and is generated by a stationary process. We employ a visual inspection of the series, which shows no sign of non-mean reverting series (see figures 3.1 – 3.21 above).

[14] For a discussion around this matter we recommend Bordo (1993).

4. Analysis

The following section will walk us through the way the analysis is made; starting out with explaining how our correlation schemes and confidence intervals are constructed and presenting benchmark results for the whole period. The next step is to test the time series for structural breaks using a general form of OLS. To round up with we present our VAR-model and a benchmark result for this as well.

4.1 Correlation schemes

Since the purpose of this study is to explore the dynamics of inflation and expected inflation, it is relevant to take a closer look at how the variables (π^e, μ, *i* *u-gap* and *y-gap*) relate to inflation with respect to timing. Do the variables proceed, coincide or succeed inflation, and if so, by how long time? A basic prediction would for example be that expected inflation succeeds inflation in the earlier periods as expectations tended to be more adaptive in that time. Moreover this scheme helps us with the selection of lags in the VAR-model as well as in and in the complementary OLS-model.

To do this we calculate the correlation between inflation and the variables under examination, starting three years before that year and three years after (*t-3, t-2, t-1, t, t+1, t+2, t+3*). This is done as an iterative process for all years possible in our sample. The reason behind using lead/lag selection of seven years is again to approximately cover an entire business cycle, following the findings of Englund (1992) and Assenmacher-Wesche and Gerlach (2006) in this matter. We end up with seven correlations series; one per country and this is used as a benchmark. We will make the same type of schemes for the sub-periods to see whether the relationships have changed. 95 % confidence intervals are then constructed around the sample by using the Fisher transformation (Fisher 1921) correlation coefficient (r) in order to test the hypothesis that the population correlation coefficient (ρ) is different from zero.

$$z = \frac{1}{2}\log\frac{1+r}{1-r} = \text{arctanh(r)} \qquad \text{(Equation 4.1)}$$

Normally distributed variables (e.g. inflation and excess money growth) will then give an approximate normally distributed z around the mean.

$\frac{1}{2}\log\frac{1+\rho}{1-\rho}$ (Equation 4.2) with standard deviation $\frac{1}{\sqrt{N-3}}$ (Equation 4.3)

The confidence intervals are then transformed back from the z-distribution to a distribution around *r*.

The results from this examination of correlation are then used to help us specify the most appropriate VAR- and OLS-models possible. More specifically, it is especially useful when deciding what lags to use. The following tables (4.1-4.5) are our benchmark result for the whole period. The interpretation of these is somewhat hard and following Lucas (1976) they are not likely to hold any informative information. They are therefore handled with care just as a benchmark result and are used for comparison and guidance for lag selection over the whole period.

Table 4.1: 1880-2005, Correlation between Inflation and inflation expectations

	Denmark			France			Germany			Italy			Sweden			The UK			The US		
	CI^{Low}	r	CI^{High}	CI^{Low}	r	CI^{High}	CI^{Low}	r	CI^{High}	CI^{Low}	r	CI^{High}	CI^{Low}	r	CI^{High}	CI^{Low}	r	CI^{High}	CI^{Low}	r	CI^{High}
t-3	0.16	0.32	0.47	-0.01	**0.17**	0.33	-0.14	0.04	0.21	0.03	0.21	0.37	0.03	0.21	0.37	0.06	0.23	0.39	0.01	0.18	0.35
t-2	0.24	0.40	0.54	-0.09	0.09	0.26	-0.11	**0.07**	0.24	0.13	0.30	0.45	0.09	0.27	0.42	-0.06	0.12	0.29	0.03	0.21	0.37
t-1	0.28	**0.43**	0.57	-0.15	0.02	0.20	-0.09	0.09	0.26	0.17	**0.33**	0.48	0.18	0.34	0.49	0.06	0.23	0.39	0.07	0.25	0.41
t	0.27	**0.43**	0.56	-0.20	-0.03	0.15	-0.19	-0.02	0.16	0.13	0.30	0.45	0.25	0.41	0.54	0.20	0.36	0.51	0.16	0.32	0.47
t+1	0.24	0.40	0.53	-0.28	-0.11	0.06	-0.17	0.01	0.18	0.09	0.26	0.41	0.26	**0.42**	0.55	0.34	**0.49**	0.61	0.21	0.37	0.51
t+2	0.23	0.39	0.53	-0.34	-0.18	0.00	-0.16	0.02	0.19	0.03	0.20	0.36	0.27	**0.42**	0.56	0.28	0.43	0.57	0.22	0.38	0.52
t+3	0.14	0.31	0.46	-0.37	-0.21	-0.04	-0.12	0.06	0.23	-0.03	0.14	0.31	0.23	0.39	0.53	0.26	0.42	0.55	0.23	**0.39**	0.53

CI^{Low} and CI^{High} indicate the low and high confidence interval boundary at 95% significance. r shows the correlation at time t-/+ x (where x are different leads and lags) and highest correlation for every country and period are in bold.

Table 4.2: 1880-2005, Correlation between Inflation and long run excess money growth

	Denmark			France			Germany			Italy			Sweden			The UK			The US		
	CI^{Low}	r	CI^{High}	CI^{Low}	r	CI^{High}	CI^{Low}	r	CI^{High}	CI^{Low}	r	CI^{High}	CI^{Low}	r	CI^{High}	CI^{Low}	r	CI^{High}	CI^{Low}	r	CI^{High}
t-3	0.21	0.37	0.51	0.49	**0.62**	0.72	-0.09	0.09	0.26	0.37	0.51	0.63	0.17	0.34	0.48	0.19	0.35	0.50	0.31	0.46	0.59
t-2	0.32	0.47	0.60	0.49	0.61	0.71	-0.11	0.07	0.24	0.47	0.60	0.70	0.34	0.49	0.61	0.14	0.31	0.46	0.42	0.55	0.67
t-1	0.37	**0.51**	0.63	0.46	0.59	0.69	-0.10	0.07	0.25	0.48	0.61	0.71	0.49	0.61	0.71	0.24	0.40	0.54	0.45	**0.58**	0.69
t	0.36	0.50	0.62	0.43	0.56	0.67	-0.11	0.07	0.24	0.59	0.69	0.77	0.57	**0.68**	0.76	0.37	0.51	0.63	0.44	0.57	0.68
t+1	0.30	0.45	0.58	0.33	0.48	0.60	-0.13	0.05	0.23	0.60	**0.70**	0.78	0.54	0.66	0.75	0.50	**0.62**	0.72	0.39	0.53	0.65
t+2	0.24	0.40	0.54	0.22	0.38	0.52	0.02	**0.19**	0.36	0.50	0.62	0.72	0.42	0.56	0.67	0.44	0.57	0.68	0.33	0.48	0.61
t+3	0.06	0.23	0.39	0.07	0.25	0.40	-0.52	-0.37	-0.21	0.36	0.50	0.62	0.24	0.40	0.53	0.38	0.52	0.64	0.23	0.39	0.53

CI^{Low} and CI^{High} indicate the low and high confidence interval boundary at 95% significance. r shows the correlation at time t-/+ x (where x are different leads and lags) and highest correlation for every country and period are in bold.

Table 4.3: 1880-2005, Correlation between Inflation and y-gap

	Denmark			France			Germany			Italy			Sweden			The UK			The US		
	CI^{Low}	r	CI^{High}	CI^{Low}	r	CI^{High}	CI^{Low}	r	CI^{High}	CI^{Low}	r	CI^{High}	CI^{Low}	r	CI^{High}	CI^{Low}	r	CI^{High}	CI^{Low}	r	CI^{High}
t-3	-0.02	0.16	0.32	-0.33	-0.16	0.02	-0.27	-0.10	0.08	0.02	**0.19**	0.36	0.10	0.27	0.42	-0.30	-0.13	0.04	-0.32	-0.15	0.02
t-2	-0.04	0.13	0.30	-0.39	-0.23	-0.05	-0.25	-0.08	0.10	-0.05	0.13	0.29	0.11	**0.28**	0.44	-0.02	0.15	0.32	-0.25	-0.08	0.10
t-1	0.09	**0.26**	0.41	-0.37	-0.21	-0.04	0.03	**0.20**	0.37	-0.10	0.07	0.25	-0.16	0.02	0.19	0.17	0.33	0.48	-0.05	0.12	0.29
t	-0.23	-0.06	0.12	-0.24	-0.07	0.11	-0.24	-0.06	0.11	-0.37	-0.21	-0.03	-0.34	-0.17	0.01	0.20	**0.36**	0.51	0.06	**0.23**	0.39
t+1	-0.45	-0.30	-0.13	-0.21	-0.03	0.14	-0.24	-0.06	0.11	-0.61	-0.49	-0.35	-0.34	-0.18	0.00	0.04	0.21	0.37	-0.07	0.10	0.27
t+2	-0.35	-0.19	-0.01	-0.19	**-0.01**	0.16	-0.10	0.08	0.25	-0.39	-0.23	-0.06	-0.30	-0.13	0.05	-0.05	0.12	0.29	-0.14	0.03	0.21
t+3	-0.20	-0.03	0.15	-0.24	-0.06	0.11	-0.28	-0.11	0.06	-0.18	-0.01	0.17	-0.28	-0.11	0.07	-0.13	0.05	0.22	-0.22	-0.05	0.13

CI^{Low} and CI^{High} indicate the low and high confidence interval boundary at 95% significance. r shows the correlation at time t-/+ x (where x are different leads and lags) and highest correlation for every country and period are in bold.

Table 4.4: 1880-2005, Correlation between Inflation and u-gap

	Denmark, 1913-			France, 1957-			Germany, 1951-			Italy, 1950-			Sweden, 1928 -			The UK, 1880-			The US, 1892-		
	CI^{Low}	r	CI^{High}	CI^{Low}	r	CI^{High}	CI^{Low}	r	CI^{High}	CI^{Low}	r	CI^{High}	CI^{Low}	r	CI^{High}	CI^{Low}	r	CI^{High}	CI^{Low}	r	CI^{High}
t-3	-0.11	0.09	0.29	-0.11	0.18	0.44	0.08	0.34	0.56	-0.29	-0.03	0.24	-0.14	0.08	0.30	-0.31	-0.14	0.03	-0.59	-0.22	0.22
t-2	-0.45	-0.27	-0.07	-0.02	**0.26**	0.51	0.23	**0.47**	0.65	-0.25	**0.02**	0.28	-0.16	0.07	0.29	-0.22	-0.05	0.13	-0.33	-0.17	0.01
t-1	-0.34	-0.14	0.06	-0.08	0.21	0.47	0.10	0.35	0.57	-0.27	0.00	0.26	-0.12	0.11	0.33	0.06	0.23	0.39	0.00	0.17	0.34
t	-0.01	0.19	0.38	-0.18	0.11	0.38	-0.24	0.03	0.29	-0.25	**0.02**	0.28	-0.08	**0.15**	0.36	0.23	**0.39**	0.53	0.28	0.44	0.57
t+1	0.02	**0.22**	0.41	-0.28	0.01	0.29	-0.47	-0.23	0.03	-0.26	0.01	0.27	-0.09	0.14	0.35	-0.03	0.14	0.31	0.01	0.18	0.35
t+2	-0.26	-0.06	0.15	-0.31	-0.03	0.25	-0.60	-0.40	-0.15	-0.30	-0.04	0.23	-0.17	0.06	0.28	-0.16	0.02	0.19	-0.19	-0.02	0.16
t+3	-0.36	-0.17	0.03	-0.37	-0.10	0.19	-0.54	-0.32	-0.06	-0.28	-0.02	0.25	-0.34	-0.12	0.11	-0.17	0.00	0.18	-0.28	-0.12	0.06

CI^{Low} and CI^{High} indicate the low and high confidence interval boundary at 95% significance. r shows the correlation at time t-/+ x (where x are different leads and lags) and highest correlation for every country and period are in bold.

Table 4.5: 1880-2005, Correlation between Inflation and short term interest rate

	Denmark			France			Germany			Italy			Sweden			The UK			The US		
	CI^{Low}	r	CI^{High}	CI^{Low}	r	CI^{High}	CI^{Low}	r	CI^{High}	CI^{Low}	r	CI^{High}	CI^{Low}	r	CI^{High}	CI^{Low}	r	CI^{High}	CI^{Low}	r	CI^{High}
t-3	0.07	0.24	0.40	-0.26	-0.08	0.09	-0.18	0.00	0.18	-0.16	0.01	0.19	-0.09	0.08	0.25	0.13	0.30	0.45	-0.07	0.10	0.27
t-2	0.04	0.22	0.38	-0.23	-0.06	0.12	-0.20	-0.02	0.16	-0.14	0.03	0.21	-0.07	0.11	0.28	0.19	0.36	0.50	-0.05	0.13	0.30
t-1	0.11	0.28	0.43	-0.20	-0.03	0.15	-0.78	-0.70	-0.59	-0.14	0.04	0.21	0.01	0.19	0.35	0.28	0.44	0.57	0.01	0.18	0.35
t	0.20	0.36	0.51	-0.16	0.02	0.20	0.27	**0.43**	0.56	-0.09	0.08	0.26	0.13	0.30	0.45	0.35	0.50	0.62	0.10	0.27	0.43
t+1	0.21	**0.37**	0.51	-0.14	**0.03**	0.21	-0.09	0.08	0.26	-0.07	0.10	0.27	0.19	0.35	0.50	0.37	**0.51**	0.63	0.13	0.30	0.45
t+2	0.19	0.35	0.50	-0.16	0.02	0.19	-0.12	0.06	0.23	-0.07	0.10	0.27	0.21	**0.37**	0.51	0.33	0.48	0.60	0.14	0.31	0.46
t+3	0.18	0.34	0.49	-0.17	0.01	0.18	-0.12	0.06	0.23	-0.06	**0.12**	0.29	0.19	0.36	0.50	0.33	0.48	0.60	0.19	**0.35**	0.49

CI^{Low} and CI^{High} indicate the low and high confidence interval boundary at 95% significance. r shows the correlation at time t-/+ x (where x are different leads and lags) and highest correlation for every country and period are in bold.

4.2 OLS and Period Selection

The selection of periods is of great importance for this kind of study and the periods must be chosen carefully. In search of empirical relationships during different time periods, we take both economic theory and model-stability under consideration. These issues tend to go hand in hand e.g. the collapse of the Bretton-Woods is likely to hold a structural break in the sense that monetary environment changed. And as pointed out by Lucas (1976) the empirical relationships are likely to change when the economic structures change. Subsequently, these changes were taken into consideration in the choice of periods and the structural change constitutes problems in the models. As mentioned these periods are likely to be different and the changes are central to this study. In search of structural breaks we employ a number of different tests on a general type of OLS-model based on the variables under consideration suggested by economic theory and the benchmark correlation schemes. In this context it is worth noting that an OLS is a type of VAR when the lags are independent i.e. ($\varepsilon_i \varepsilon_j = 0$). The OLS described here is also used as a complement to the VAR-model because of its problems (the issues of the VAR-model are discussed in the next chapter). The general OLS-model is specified as follows:

$$\pi_t = \alpha_t + \beta_1 \pi_{t-1} + \beta_2 \pi^e_{t-1} + \beta_3 \pi^e_t + \beta_4 \pi^e_{t+1} + \beta_5 i_{t-1} + \beta_6 i_t + \beta_7 i_{t+1} + \beta_8 \mu_{t-1} + \beta_9 \mu_t + \beta_{10} \mu_{t+1} + \beta_{11} y^{gap}_{t-1} + \beta_{12} y^{gap}_t + D + \varepsilon_t$$

(Equation 4.4)

Where the variables follow the same notation as before and *D* is a matrix of dummy variables (that are dropped when testing for structural breaks to avoid exact collinearity) to account for economic turmoil like WW1 (1914-18), WW2 (1939-46), Bretton-Woods breakdown (1970-71) and the OPEC's oil crises (1973-75, 1979-81). For Germany, the reunification of Western and Eastern Germany (1990-92) has been accounted for as well with a dummy. The unemployment gap is dropped because of its similar pattern to the *y-gap* and the results are not likely to be affected by using a *u-gap* instead of a *y-gap*. Following Okun (1962). For output see" 9. Appendix", table 9.13. At last, ε denotes the error term and is adjusted for autocorrelation and heteroskedasticity by Newey-West where necessary. Although this OLS-model is mainly used in search of structural breaks, autocorrelation can in fact cause problems with the Chow test.

Using this general type of model, it is straightforward to test for structural breaks using the CUSUM test; CUSUM of squares test and Chow-test[15]. When testing for structural breaks with Chow, the dummies are dropped to avoid exact collinearity. Beside these tests, a graphical inspection is made of the residuals and the recursive residuals. The testing with CUSUM has the advantage that it can be used even under problem with autocorrelation and heteroskedasticity (see Brown et. al. 1975) and therefore it has high power even when the beta-values are unstable. The cost of this is that it has limited power compared to the Chow-test, but as a first test it is well suited. It is appropriate for time series where the structural breaks are not known and therefore gives us guidance, together with economic theory and history, on where to look for structural breaks with Chow and where to apply the dummy-variables.

By studying the CUSUM output and the plotted recursive residuals we are one step closer to finding the structural breaks and test the suspected dates with the Chow-test. Inference is also done around the dummies to test for significance in each of the dummy variables. In general, we find evidence of structural breaks during the time of the two world wars but no break in connection to the OPEC's or the collapse of the Bretton-Woods system. These are not the only structural breaks found and for better fit of the model, the other major structural breaks found are handled with dummies, e.g. the reunification of Germany. The following table summarises our findings:

[15] For discussion of the different tests see e.g. Chow (1960) and Brown et. al. (1975).

Table 4.6	Suggested break in year by:	
	CUSUM#	CHOW
Denmark	1903, 1918, 1924, 1939, 1948, 1971, 1991	1922, 1939
France°	1922, 1925, 1938, 1949, 1951, 1971, 1981, 1990	1922, 1924, 1939, 1950
Germany§	1918, 1922, 1925, 1930, 1938, 1946, 1959, 1979, 1990	1919, 1922-1930, 1938, 1959, 1990
Italy	1918, 1922, 1930, 1943, 1950, 1971, 1981	1930, 1938, 1948
Sweden	1903, 1914, 1922, 1949, 1951, 1971, 1991	1915,1922, 1949
The UK	1918, 1921, 1931, 1938, 1940, 1950, 1963, 1971, 1979, 1981	1918, 1920, 1931, 1938, 1950, 1971
The US	1900, 1910, 1918, 1921, 1929, 1935, 1938, 1971, 1981	1922, 1929, 1939, 1950

Notes: # marks approximate year, tested with Chow around t-1…t+3. And suggested breaks by Chow-test at 99% significance level. ° Money supply is not available for all times therefore the period is tested without excess money growth for the whole period and with the same for the period where the variable is available (1899-2003). § Data on Money Supply is lacking between 1942-1954 and is treated as in the case of France.

With the structural breaks theory and model instability in mind we find it applicable to structure the time-periods in the following way:

Period 1: 1880-1913 – Is not likely to hold a structural break following table 4.6.

Period 2: 1914-1939 – Is likely to hold a structural break as suggested by table 4.6. This period holds a lot of uncertainty and problems with model instability according to the CUSUM and Chow-test. By assembling these structural breaks in one period has the advantage we avoid contaminating the other periods.

Period 3: 1950-1971 – Holds structural breaks for Germany in 1959.

Period 4: 1972-2005 – Germany holds a structural break around 1990 following the reunification of Western and Eastern Germany.

This section concludes that it is acceptable to divide the time period into four subsamples making it straightforward to compare these to each other with respect to the inflation process. Even though some of these periods are likely to hold a structural break, for one or more countries, these periods cannot be divided into smaller samples because of diminishing samples. We handle this by the use of dummies and where a structural break is found it is interpreted with caution. We also make use of the correlation schemes to construct simple OLS-models (as a complement to the VAR-model) for each period and for the whole period by using the suggested leads and lags in the correlation schemes i.e. where the correlation is highest. These equations are presented below (in table 4.7) and in chapter "5. Results and Interpretation" (equation 5.1-5.4). The benchmark correlation schemes suggest the following equations (the output of these is found in table 4.1-4.6):

Table 4.7 Benchmark OLS equations for 1880-2005

Denmark	$\pi_t = \alpha_t + \pi_t^e + \mu_{t-1} + i_{t+1} + y_{t-1}^{gap} + \varepsilon_t$
France	$\pi_t = \alpha_t + \pi_{t-2}^e + \mu_{t-2} + i_{t+1} + y_{t+2}^{gap} + \varepsilon_t$
Germany	$\pi_t = \alpha_t + \pi_t^e + \mu_{t+2} + i_t + y_{t-1}^{gap} + \varepsilon_t$
Italy	$\pi_t = \alpha_t + \pi_{t-1}^e + \mu_{t+1} + i_{t+2} + y_{t-2}^{gap} + \varepsilon_t$
Sweden	$\pi_t = \alpha_t + \pi_{t+1}^e + \mu_t + i_{t+2} + y_{t-2}^{gap} + \varepsilon_t$
The UK	$\pi_t = \alpha_t + \pi_{t+1}^e + \mu_{t+1} + i_{t+1} + y_t^{gap} + \varepsilon_t$
The US	$\pi_t = \alpha_t + \pi_{t+2}^e + \mu_{t-1} + i_{t+2} + y_t^{gap} + \varepsilon_t$

The correlation between inflation and inflation expectations and long run money growth are presented in chapter 5[16] and the other schemes are found in chapter "9. Appendix"[17]. This ad-hoc creation of OLS-models is used as a complement to the VAR-model because of the critique being addressed to the model. One potential problem with the OLS-equations are the fact that it becomes a problem to select leads in term of what variables should be endogenous and exogenous. A solution for this might be that specify these the same way as the VAR-model. The

[16] Table 5.3, 5.4, 5.7, 5.8, 5.11, 5.12, 5.15 and 5.16.
[17] Table 9.1-9.12

critique will be discussed further in the next section. We are now ready to set up the general VAR-model.

4.3 The VAR-model

The economic theory and the findings of the correlation schemes lead us to build a model that fits the different periods as well as possible. The process is as follows:

1) Economic Theory – what do earlier research tell us, and where are the structural breaks likely to be, i.e. do we need a dummy somewhere in the sub-periods? This is tested by CUSUM and Chow-tests.
2) Correlation Schemes – what leads and lags are significantly different from zero? Is this compatible with economic theory and are these leads/lags reasonable in the theoretical perspective? This helps us to look for lags in correlation schemes and to specify the VAR's and OLS's ad-hoc.
3) Statistical inference – Besides tests of significance, normality is tested by a Jarque-Bera test with the null of non-normality. Test of autocorrelation with LM, Portmanteau and Whites test for heteroskedasticity are employed as well, for both the VAR and the OLS where possible.

The results of importance are of course discussed in the next chapter "5. Results and Interpretation". We start this section by describing the VAR model.

We mainly make use of a general VAR model to examine the different time periods; the VAR-model has its issues however. The VAR model as suggested by Sims (1980) was said to be forecasting better than simultaneous-equation models (see Litterman 1979, 1986, Sims 1980). The model was also criticized for simply being an overfit form of simultaneous-equation model (see Hamilton 1994). The overfitting would result from more lags than appropriate being included and the constant is likely to catch the truly relevant movement in the explained variable. These notes are worth mentioning but this type of study face the problem of what contemporary variables should be used; as a matter of fact this is the subject/purpose of study. The VAR model only has lagged values of its variables on the right-hand side and they are all assumed to be endogenous which helps us obviate the problem of deciding what variables are exogenous.

Blanchard and Galí (2007) use this type of model as well for testing the shift in inflation process, with a focus on the oil shocks, for the seventies compared to the period after 1984. Our study has a focus on explaining the structure in a more general form and therefore is constructed somewhat different to fit the purpose compared to the Blanchard and Galí (2007) or Mehra and Herrington (2008). We are not analyzing impulse propagation schemes as the mentioned authors; instead we construct correlations schemes as described above. The described variables are the base for a five-order VAR(*2*) model which, generally can be described in the following way:

$$X_t = \Gamma_1 + \Gamma_2 \Pi_{t-1} + \Gamma_3 \Pi_{t-2} + \Gamma_4 \Pi^e_{t-1} + \Gamma_5 \Pi^e_{t-2} + \Gamma_6 \mathrm{I}_{t-1} + \Gamma_7 \mathrm{I}_{t-2} + \Gamma_8 \mathrm{M}_{t-1} + \Gamma_9 \mathrm{M}_{t-2} + \Gamma_{10} \mathrm{Y}_{t-1} + \Gamma_{11} \mathrm{Y}_{t-2} + \varepsilon_t$$

(Equation 4.5)

This is the kind of model once proposed by Sims (1980) where X is a 6x1 vector of variables under consideration, i.e. $[\pi_t, \pi^e_t, i_t, \mu_t, ygap_t / ugap_t]$ where all variables follow the earlier definitions in higher case letters. Note that the *y-gap* and the *u-gap* are not tested at the same time, as they are in part measuring the same structure as mentioned earlier (see Okun 1962). In the case of doing so the model would suffer from overfitting. The beta matrices, $\Gamma_{1\text{-}11}$, is 5x5 matrices of coefficients and ε_t is a vector of, what we assume, white noise (uncorrelated and zero mean) error terms caused by shocks to the variables. This kind of model can be written out by extracting every equation, which would result in six different equations (if all variables are used) that allows for feedback among the variables, i.e. the lagged values of the variables. One problem that emerges is that of the interest rate probably takes power from the inference around inflation expectations significance in the inflation process. The interest rate has to be included though although it might hamper the model. This because of the interest rates importance in the inflation expectations process. A possible way to solve this is to do a regression with the same variables apart from the interest rate where inflation is the dependent variable. We find this a possible way to extend this paper in the future.

For the different equations we recommend Mehra and Herrington (2008) or Leduc et. al. (2007) where these equations are printed out with some differences pointed out by equation 4.5 above. Different from the above studies, we don't impose any restriction on the coefficients for tracing out which variables that are uncorrelated. Instead of the structural VAR (SVAR) we make use of the correlation schemes to find out what variables are correlated or uncorrelated. Another possible problem is the degrees of freedom (DF): if we were to estimate the VAR with all the variables the model could suffer from the number of DF. This problem is taken under consideration and we start by estimating a benchmark VAR-model with all the variables and two lags as equation 4.5 suggests. If the results seem to suffer from the number of DF we are to find which variable have significant impact on inflation. E.g. if we find the most suitable model to include five variables, then $\prod$ will be a 5x1 vector and $\Gamma_{1\text{-}11}$ will be a 5x5 matrix and so on. In those cases where the lagged values of e.g. inflation catch the majority of the movement in itself and other variables becomes insignificantly different from zero we simply build an OLS model with appropriate lags ad-hoc. The discussion about the possibility of a unit root, made above, applies for the above models as well. The next section will walk us through the results of the different periods under examination but first we present the benchmark VAR-model for the whole period. The next page presents a benchmark VAR-model (table 4.8) of the equations for inflation and inflation expectations. The justification of reporting only these two is that they are the ones of interest and the others are used for building the VAR-model. We generally see that the inflation expectations equation have higher coefficient of determination than the inflation equation. The VAR-output reports an R^2 that varies from 73-94% for inflation expectations compared to inflation that reports 48-76% (see table 4.8). Generally we find that the *y-gap* (apart from the lagged values of itself) has the highest significance in the inflation equation and inflation expectations are best forecasted by lagged values of mu (apart from the lagged values of itself). The benchmark model shows some problems with autocorrelation and heteroscedasticity and is therefore interpreted with caution. Adding additional lags does not help this problem. The output follows:

Table 4.8 1880-2005, Benchmark VAR-model: $X_t = \Gamma_1 + \Gamma_2 \Pi_{t-1} + \Gamma_3 \Pi_{t-2} + \Gamma_4 \Pi^e_{t-1} + \Gamma_5 \Pi^e_{t-2} + \Gamma_6 \mathrm{I}_{t-1} + \Gamma_7 \mathrm{I}_{t-2} + \Gamma_8 \mathrm{M}_{t-1} + \Gamma_9 \mathrm{M}_{t-2} + \Gamma_{10} \mathrm{Y}_{t-1} + \Gamma_{11} \mathrm{Y}_{t-2} + \varepsilon_t$

	Denmark		France#		Germany°		Italy		Sweden		The UK		The US	
	π_t	π^e	π_t	π^e	π_t	π^e	π_t	π^e	π_t	π^e	π_t	π^e	π_t	π^e
π_{t-1}	0.513***	-0.032	0.266**	-0.028	0.464***	0.045**	0.304***	-0.012	0.549***	0.005	0.493***	-0.008	0.515***	0.039**
	(0.095)	(0.026)	(0.106)	(0.022)	(0.098)	(0.020)	(0.103)	(0.012)	(0.097)	(0.019)	(0.094)	(0.059)	(0.094)	(0.017)
π_{t-2}	-0.271***	0.067**	-0.161	-0.006	-0.005	-0,000	-0.265**	-0.009	-0.216**	0.019	-0.064	-0.096	-0.289***	0.007
	(0.101)	(0.027)	(0.106)	(0.021)	(0.004)	(0.001)	(0.116)	(0.013)	(0.097)	(0.019)	(0.097)	(0.061)	(0.092)	(0.017)
π^e_{t-1}	0.564	0.787***	-0.798	0.862***	-0.657	1.109***	2.034**	1.018***	0.219	1.029***	0.582	1.539***	0.731	0.655***
	(0.406)	(0.109)	(0.602)	(0.124)	(0.490)	(0.099)	(0.876)	(0.099)	(0.619)	(0.120)	(0.484)	(0.301)	(0.653)	(0.118)
π^e_{t-2}	-0.403	0.027	-0.416	-0.104	0.025	-0.265***	-0.878	-0.262***	0.007	-0.173	-0.456	-0.423*	-0.096	0.122
	(0.390)	(0.105)	(0.586)	(0.120)	(0.467)	(0.095)	(0.872)	(0.099)	(0.600)	(0.117)	(0.351)	(0.219)	(0.537)	(0.097)
μ_{t-1}	0.149	0.019	0.741	0.292***	0.377***	0.051***	-0.579	0.078	0.986**	0.185**	0.422	-0.783***	0.339	0.075
	(0.152)	(0.041)	(0.444)	(0.091)	(0.055)	(0.011)	(0.458)	(0.052)	(0.403)	(0.079)	(0.336)	(0.209)	(0.260)	(0.047)
μ_{t-2}	0.130	-0.033	-0.258	-0.265***	-0.144**	-0.062***	1.242***	-0.078*	-0.446	-0.163**	-0.045	0.699***	0.199	-0.065
	(0.171)	(0.046)	(0.445)	(0.091)	(0.067)	(0.013)	(0.360)	(0.041)	(0.379)	(0.074)	(0.331)	(0.206)	(0.255)	(0.046)
i_{t-1}	-0.171	0.068	1.797**	-0.076	1.101*	0.180	-1.397	0.318***	-0.189	-0.134	-0.106	-0.131	-0.627	0.216***
	(0.513)	(0.138)	(0.887)	(0.182)	(0.687)	(0.139)	(0.923)	(0.107)	(0.495)	(0.096)	(0.309)	(0.193)	(0.312)	(0.066)
i_{t-2}	0.225	0.092	-0.377	0.207	0.064	-0.233	0.429	-0.072	0.020	0.243***	-0.072	0.116	0.026	-0.043
	(0.514)	(0.138)	(0.801)	(0.165)	(0.702)	(0.143)	(0.972)	(0.110)	(0.474)	(0.092)	(0.299)	(0.186)	(0.326)	(0.059)
y^{gap}_{t-1}	0.452***	0.035	-0.287*	0.007	-1.213***	-0.046	0.037	-0.027	-0.074	0.038	1.160***	1.360***	0.060	-0.006
	(0.165)	(0.045)	(0.146)	(0.031)	(0.189)	(0.038)	(0.318)	(0.046)	(0.207)	(0.040)	(0.424)	(0.265)	(0.070)	(0.013)
y^{gap}_{t-2}	-0.237	0.128***	-0.090	0.046	0.461**	0.142***	0.308**	0.059	0.633***	0.042	-1.516***	-0.288	-0.141**	-0.004
	(0.154)	(0.041)	(0.130)	(0.028)	(0.224)	(0.046)	(0.263)	(0.030)	(0.202)	(0.039)	(0.408)	(0.254)	(0.067)	(0.012)
α	0.557	-0.005	-3.207	0.069	-3.510	0.524	1.131	-0.609*	0.314	-0.349	-0.466	0.246	-0.712	0.254*
	(1.578)	(0.425)	(2.233)	(0.459)	(2.545)	(0.517)	(2.960)	(0.335)	(1.637)	(0.319)	(0.903)	(0.563)	(0.793)	(0.144)
d^{WW1}	2.847	-0.623	5.041	-0.043	12.99***	-0.155	6.344	0.938*	-0.458	-0.254	1.509	0.167	2.182	-0.499*
	(1.910)	(0.514)	(3.445)	(0.716)	(3.444)	(0.697)	(4.857)	(0.550)	(1.832)	(0.357)	(1.885)	(1.175)	(1.425)	(0.258)
d^{WW2}	-1.507	-0.712	19.38***	-0.344	-3.241	-0.173	16.17**	1.587**	0.501	-0.246	-0.027	-0.293	1.282	-0.203
	(2.097)	(0.565)	(4.886)	(1.004)	(3.468)	(0.704)	(6.921)	(0.784)	(1.579)	(0.308)	(1.763)	(1.099)	(1.345)	(0.244)
d^{B-W}	1.331	1.005	-3.507	-0.411	2.154	0.403	-1.927	0.369	0.555	-0.102	0.410	1.972	0.782	-0.167
	(3.312)	(0.892)	(5.359)	(1.101)	(4.004)	(0.813)	(8.868)	(1.004)	(3.148)	(0.612)	(2.870)	(1.790)	(2.284)	(0.414)
d^{OPEC1}	1.816	1.419*	1.110	0.853	3.903	0.322	4.948	1.128	1.665	0.855*	4.536*	1.667	3.215	0.358
	(2.762)	(0.743)	(4.611)	(0.948)	(3.376)	(0.685)	(7.551)	(0.855)	(2.643)	(0.514)	(2.577)	(1.607)	(1.939)	(0.351)
d^{OPEC2}	1.924	2.633***	7.148***	4.033	4.663	1.429*	7.231	1.489	2.124	1.083*	5.491*	2.058	7.004***	0.960**
	(3.383)	(0.911)	(5.343)	(1.098)	(4.043)	(0.820)	(9.155)	(1.037)	(3.370)	(0.656)	(3.244)	(2.023)	(2.557)	(0.465)
$d^{RE-U.}$	n/a	n/a	n/a	n/a	1.040	0.793	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
					(3.289)	(0.668)								
R^2(%)	48	91	56	89	76	85	51	90	54	94	59	73	54	94

Notes: ***/**/* marks significance at 1, 5 and 10%-level. # Marks that France is estimated from 1903 and forward because of data missing for money supply. ° Germany is estimated with 104 observations due to data missing for Money Supply after WW2.

5. Results and Interpretation

This section will report our findings and to make it easy to follow we will use a chronological order and start with the most distant period and go through our findings and end with the latest period. We will be focusing on inflation expectations relation to but other results of importance will of course also be presented.

5.1 Period 1: 1880-1913

It is hard to draw any clear general conclusions when looking at significance in the correlation scheme in the first period (1880-1913) for the variables (see table 5.3 below). We find that some countries show significantly negative correlation at some times and positive correlation other times. E.g. the correlation schemes (see table 5.3) show no significance over the first period while the VAR show negative relationship between inflation and the two-year lag of inflation expectations at 5%- level. Moreover the OLS shows negative significance for the one year-lag of inflation expectations. As a matter of fact it is hard to interpret the first period at all. We find it hard to generalize from the correlation schemes due to insignificance but it gives us some guidance for what leads/lags to apply for the different models.

The fit of the different models are practically the same, scoring an R-square around 19-55% where no variable stands out as a good predictor of inflation. Notably, the expectations are negatively correlated with inflation at all lags suggesting countercyclical behaviour. The VAR shows only negative correlation where it is significant, with large standard errors and the null of a coefficient significantly different from zero is rejected. Another interesting result is that the long run excess money-growth shows no significance, neither in the VAR nor the OLS but the correlation scheme show significantly leading and procyclical behaviour in t-2 for Germany and The US. The VAR and the OLS are probably misspecified and we suspect that the VAR suffers from overfitting following Hamilton (1994). When looking to the adjusted coefficient of determination we can see that this is generally lower than the non-adjusted R-square.

Table 5.1 1880-1913 VAR-model: $\Pi_t = \Gamma_1 + \Gamma_2\Pi_{t-1} + \Gamma_3\Pi_{t-2} + \Gamma_4\Pi^e_{t-1} + \Gamma_5\Pi^e_{t-2} + \Gamma_6 I_{t-1} + \Gamma_7 I_{t-2} + \Gamma_8 M_{t-1} + \Gamma_9 M_{t-2} + \Gamma_{10} Y_{t-1} + \Gamma_{11} Y_{t-2} + \varepsilon_t$

	Denmark		France#		Germany		Italy		Sweden		The UK		The US	
	π_t	π^e_t	π_t	π^e_t	π_t	π^e_t	π_t	π^e_t	π_t	π^e_t	π_t	π^e_t	π_t	π^e_t
π_{t-1}	0.066	-0.030	-0.192	0.130	0.494**	0.061	0.203	0.024	0.395*	-0.003	0.224	-0.039	0.060	0.013
	(0.226)	(0.028)	(0.210)	(0.116)	(0.221)	(0.071)	(0.241)	(0.102)	(0.205)	(0.032)	(0.281)	(0.194)	(0.235)	(0.022)
π_{t-2}	-0.011	0.022	-0.165	0.093	-0.112	-0.012	-0.243	-0.011	0.046	-0.006	0.064	0.188	-0.110	0.024
	(0.191)	(0.024)	(0.200)	(0.110)	(0.242)	(0.078)	(0.161)	(0.068)	(0.208)	(0.032)	(0.232)	(0.161)	(0.193)	(0.018)
π^e_{t-1}	-0.305	0.496**	-0.564	0.824***	1.809	1.217***	-0.529	0.559*	2.510	1.024***	-0.586	5.726	-3.046	0.738***
	(1.558)	(0.196)	(0.406)	(0.224)	(1.311)	(0.424)	(0.685)	(0.290)	(1.715)	(0.266)	(5.359)	(3.709)	(2.526)	(0.241)
π^e_{t-2}	-1.447	0.341	-0.353	-0.080	-2.431**	-0.265	-0.142	0.284	-4.595**	-0.224	-0.348	0.668	1.335	0.178
	(2.040)	(0.256)	(0.434)	(0.240)	(1.166)	(0.377)	(0.626)	(0.266)	(1.886)	(0.292)	(1.505)	(1.042)	(2.245)	(0.214)
μ_{t-1}	0.960	0.274***	n/a	n/a	-0.526	0.019	0.045	-0.215	-0.835	0.047	0.304	0.704	-0.149	-0.013
	(0.682)	(0.086)			(0.570)	(0.184)	(0.302)	(0.128)	(1.228)	(0.190)	(1.430)	(0.990)	(0.316)	(0.030)
μ_{t-2}	-0.737	-0.169*	n/a	n/a	0.639	0.026	-0.245	-0.123	1.374	-0.001	0.196	-0.249	0.362	-0.017
	(0.773)	(0.097)			(0.559)	(0.181)	(0.380)	(0.161)	(1.261)	(0.195)	(1.490)	(1.031)	(0.342)	(0.033)
i_{t-1}	1.540	-0.058	2.033**	0.219	-0.514	0.334	1.128	1.281*	0.249	-0.009	0.270	-1.593*	-0.394	0.059
	(1.416)	(0.178)	(0.883)	(0.487)	(1.076)	(0.348)	(1.756)	(0.745)	(1.769)	(0.274)	(1.271)	(0.879)	(0.556)	(0.053)
i_{t-2}	-1.152	0.091	-0.093	-0.398	-0.246	-0.337	0.561	-0.602	-3.489**	-0.094	-0.196	-0.469	0.128	-0.007
	(1.239)	(0.156)	(0.949)	(0.524)	(0.947)	(0.306)	(1.481)	(0.628)	(1.500)	(0.232)	(1.043)	(0.722)	(0.484)	(0.046)
y^{gap}_{t-1}	0.796	-0.062	-0.109	-0.101*	-0.079	-0.147	-0.145	0.024	-0.779	-0.036	-0.150	7.831**	0.224**	0.014
	(0.710)	(0.089)	(0.095)	(0.052)	(0.399)	(0.129)	(0.155)	(0.066)	(0.446)	(0.069)	(4.447)	(3.078)	(0.101)	(0.010)
y^{gap}_{t-2}	-0.182	0.137*	0.025	0.067	0.206	0.008	0.077	0.061	0.092	0.013	0.185	-5.428*	-0.033	-0.014
	(0.622)	(0.078)	(0.114)	(0.063)	(0.367)	(0.119)	(0.161)	(0.068)	(0.418)	(0.065)	(4.214)	(2.917)	(0.112)	(0.011)
α	1.138	0.125	-3.865*	0.971	4.318	0.105	-6.625	-3.085	15.871	0.541	1.436	-9.149	7.875**	0.164
	(4.674)	(0.587)	(1.904)	(1.051)	(3.706)	(1.198)	(10.45)	(4.432)	(6.868)	(1.064)	(9.669)	(6.693)	(3.760)	(0.358)
R^2	40	70	33	52	48	77	33	88	54	79	19	73	55	93
Adj. R^2	7	55	10	36	24	66	1	82	33	68	0	61	34	90

Notes: ***/**/* marks significance at 1, 5 and 10%- level. # France is estimated without μ due to lack of data.

Equations 5.1.1. 1880-1913. Equations Suggested by the Correlation Schemes.

Denmark	$\pi_t = \alpha_t + \pi^e_{t+2} + \mu_t + i_t + y^{gap}_{t-1} + \varepsilon_t$
France	$\pi_t = \alpha_t + \pi^e_{t+2} + i_t + y^{gap}_t + \varepsilon_t$
Germany	$\pi_t = \alpha_t + \pi^e_{t+2} + \mu_{t-2} + i_{t+1} + y^{gap}_{t+2} + \varepsilon_t$
Italy	$\pi_t = \alpha_t + \pi^e_{t-1} + \mu_{t+1} + i_t + y^{gap}_{t+2} + \varepsilon_t$
Sweden	$\pi_t = \alpha_t + \pi^e_{t+1} + \mu_{t+1} + i_{t+1} + y^{gap}_{t+1} + \varepsilon_t$
The UK	$\pi_t = \alpha_t + \pi^e_{t+2} + \mu_t + i_t + y^{gap}_{t+1} + \varepsilon_t$
The US	$\pi_t = \alpha_t + \pi^e_{t+2} + \mu_{t-1} + i_t + y^{gap}_{t-1} + \varepsilon_t$

Table 5.2 OLS based on correlations, Period 1: 1880-1913, $\pi_t = \alpha_t + \beta\pi^e_t + \beta i_t + \beta\mu_t + \beta y^{gap}_t + \varepsilon_t$

	Denmark		France°		Germany		Italy		Sweden°		UK		US
α	-4.172 (3.461)	α	-1.099 (1.477)	α	-6.652*** (2.364)	α	-11.039** (4.404)	α	-8.443* (4.592)	α	-4.508* (2.262)	α	3.924 (3.086)
π^e_{t+2}	-0.460 (0.855)	π^e_{t+2}	-0.078 (0.110)	π^e_{t+2}	-0.029 (0.250)	π^e_{t-1}	-0.843*** (0.252)	π^e_{t+1}	-0.517 (0.830)	π^e_{t+2}	0.020 (0.193)	π^e_{t+2}	-1.708** (0.693)
μ_t	0.606 (0.402)	μ_t	n/a	μ_{t-2}	0.116 (0.229)	μ_{t+1}	-0.254 (0.228)	μ_{t+1}	-0.119 (0.432)	μ_t	0.031 (0.113)	μ_{t-1}	-0.022 (0.176)
i_t	1.301** (0.636)	i_t	0.471 (0.566)	i_{t+1}	1.797*** (0.581)	i_t	2.640** (0.966)	i_{t+1}	2.146** (0.874)	i_t	1.320** (0.640)	i_t	0.799* (0.392)
y^{gap}_{t-1}	0.945 (0.599)	y^{gap}_t	0.046 (0.093)	y^{gap}_{t+2}	0.158 (0.124)	y^{gap}_{t+2}	0.122 (0.129)	y^{gap}_t	0.616** (0.286)	y^{gap}_{t+1}	0.182 (0.293)	y^{gap}_{t-1}	0.195** (0.084)
R^2	32		4		39		32		35		16		41
Adj. R^2:	23		5		30		23		26		5		32

Note: ***/**/* marks significance at 1, 5 and 10%- level. # France is estimated without μ due to lack of data. °Estimated with Newey-West due to autocorrelation and/or heteroskedasticity at 95%-level.

Table 5.3 Period 1: 1880-1913, Correlation between Inflation and Inflation Expectations

	Denmark			France			Germany			Italy			Sweden			The UK			The US		
	CI^{Low}	r	CI^{High}	CI^{Low}	R	CI^{High}	CI^{Low}	r	CI^{High}	CI^{Low}	r	CI^{High}	CI^{Low}	r	CI^{High}	CI^{Low}	r	CI^{High}	CI^{Low}	r	CI^{High}
t-3	-0.72	-0.43	0.00	-0.49	-0.09	0.34	-0.70	-0.40	0.03	-0.64	-0.29	0.15	-0.69	-0.38	0.05	-0.42	0.01	0.43	-0.71	-0.41	0.01
t-2	-0.68	-0.36	0.07	-0.38	0.05	0.46	-0.65	-0.32	0.12	-0.62	-0.28	0.17	-0.70	-0.39	0.03	-0.58	-0.21	0.23	-0.75	-0.48	-0.08
t-1	-0.58	-0.21	0.23	-0.46	-0.05	0.38	-0.59	-0.23	0.22	-0.63	-0.29	0.15	-0.65	-0.32	0.12	-0.46	-0.05	0.38	-0.81	-0.59	-0.23
t	-0.54	-0.15	0.29	-0.55	-0.17	0.28	-0.48	-0.08	0.36	-0.57	-0.20	0.24	-0.67	-0.34	0.09	-0.27	0.17	0.55	-0.76	-0.51	-0.11
t+1	-0.56	-0.18	0.26	-0.48	-0.07	0.36	-0.25	0.19	0.56	-0.51	**-0.11**	0.33	-0.65	**-0.31**	0.13	-0.66	-0.33	0.11	-0.74	-0.45	-0.04
t+2	-0.35	**0.09**	0.49	-0.47	-0.06	0.37	-0.18	**0.26**	0.61	-0.55	-0.16	0.28	-0.65	**-0.31**	0.13	-0.26	**0.18**	0.56	-0.71	-0.42	0.01
t+3	-0.50	-0.10	0.33	-0.34	**0.09**	0.49	-0.29	0.15	0.54	-0.56	-0.18	0.27	-0.66	-0.33	0.11	-0.40	0.02	0.44	-0.65	**-0.32**	0.12

CI^{Low} and CI^{High} indicate the low and high confidence interval boundary at 95% significance. r shows the correlation at time t-/+ x (where x are different leads and lags) and highest correlation for every country and period are in bold.

Table 5.4 Period 1: 1880-1913, Correlation between Inflation and long run excess money growth

	Denmark			France			Germany			Italy			Sweden			The UK			The US		
	CI^{Low}	r	CI^{High}	CI^{Low}	R	CI^{High}	CI^{Low}	r	CI^{High}	CI^{Low}	r	CI^{High}	CI^{Low}	r	CI^{High}	CI^{Low}	r	CI^{High}	CI^{Low}	r	CI^{High}
t-3	-0.39	0.04	0.46				-0.10	0.34	0.67	-0.63	-0.29	0.15	-0.41	0.02	0.44	-0.33	0.10	0.50	-0.06	0.37	0.69
t-2	-0.24	0.21	0.58				0.01	**0.43**	0.72	-0.42	0.00	0.42	-0.40	0.02	0.44	-0.53	-0.13	0.30	-0.01	**0.41**	0.71
t-1	-0.08	0.35	0.67				-0.02	0.40	0.71	-0.45	-0.03	0.40	-0.29	0.15	0.53	-0.42	0.00	0.42	-0.17	0.27	0.62
t	-0.07	**0.36**	0.68				-0.03	0.40	0.70	-0.37	0.06	0.47	-0.28	0.16	0.55	-0.24	**0.21**	0.58	-0.25	0.20	0.57
t+1	-0.10	0.34	0.67				-0.06	0.37	0.68	-0.28	**0.16**	0.55	-0.26	**0.18**	0.56	-0.65	-0.31	0.13	-0.28	0.17	0.55
t+2	-0.22	0.22	0.59				-0.11	0.33	0.66	-0.54	-0.16	0.28	-0.34	0.10	0.50	-0.28	0.16	0.55	-0.21	0.23	0.59
t+3	-0.37	0.06	0.47				-0.19	0.25	0.61	-0.49	-0.08	0.35	-0.41	0.01	0.43	-0.44	-0.02	0.41	-0.13	0.31	0.65

CI^{Low} and CI^{High} indicate the low and high confidence interval boundary at 95% significance. r shows the correlation at time t-/+ x (where x are different leads and lags) and highest correlation for every country and period are in bold.

We find it hard to model the first period in a general model where the different countries do not hold the same structure and different variables are statistically significant for some countries but not for others and sometimes even with different signs. For Italy and France we were not able to find an appropriate model when all models tested showed a very low R-square (see table 5.1, 5.2). The adjusted R-square for the UK shows 0% and 19% for the non-adjusted.

The inflation expectations seem to be best explained by it's own lagged values. For Denmark, France and the UK the output-gap shows significance at 5 and 10%-level while all countries (except for the UK) show significance on the one-year lagged values. We find no evidence that the inflation expectations is a good predictor for inflation in the first period under examination. Neither do we find any consensus on how the expectations are formed although the VAR-model seems to explain the formation of inflation expectations better than inflation itself. This is probably because of the high significance of it's own lagged values and it can be interpreted as high persistence. The correlation schemes show no significance in the *t+1* and *t+2*, correlation between inflation and inflation expectations.

5.2 Period 2:1914-1939

The second period unfortunately suffers from some problems; a major problem is that this period is volatile with the political changes mentioned earlier. Another drawback is that the observations are few, which mostly punishes the confidence intervals for the correlations schemes[18]. The result is that we are getting few significant observations and it is harder to set the lead/lags. Even in the absence of significance we can get some guidance on how to specify our models and the results are scattered but shows one major result: the expectations does not seem to matter for this period either. We get no significance for the expectations in the VAR or the OLS and the correlation schemes do not give us any reason to believe something else. The correlation

[18] For understanding, see "4.1 Correlation Schemes" how the confidence intervals are constructed with respect to standard deviation.

between inflation and inflation expectations show a more general pattern for this period though. We find the highest significant correlation in t+1 to t+3 in the correlation schemes. Moreover the VAR-model tells us no other than that the lags of the inflation expectations do not seem to explain a lot of the variation. This suggests that inflation expectations are adaptive to inflation although the VAR-model holds no significance of the lags of inflation in explaining inflation expectations.[19] A general pattern for explaining the inflation expectations are hard to find though which, leaves us with no clear result.

When looking into the OLS suggested by the correlation scheme we find evidence for that the long run excess money growth are highly significant for the majority of the countries. Germany and the US are the exceptions while the others show of high significance and a high coefficient varying around one (except for Sweden: 2.6) as suggested by the quantity theory (see Hume 1752, Fisher 1911, Friedman 1963, 1968). We are quite surprised finding this pattern as this was a period of high volatility and as Cassel (1923) described the period: "complete chaos in the world's monetary system". On the other hand, Sweden had an explicit goal of price stability already in the thirties (Jonung 2000).

Issues of uncertainty about the exchange rate regime marked this period and available literature on this subject is larger than on the subject on inflation expectations. The inflation between the wars was seen as inheritance from the First World War (Brown 1934). In the first period we find significance among different variables for different countries but we can't find significant pattern for the period besides that excess money growth seems to be the single best predictor of inflation.

[19] See Table 5.5-5.8

Table 5.5 1913-1939 VAR-model: $\Pi_t = \Gamma_1 + \Gamma_2\Pi_{t-1} + \Gamma_3\Pi_{t-2} + \Gamma_4\Pi^e_{t-1} + \Gamma_5\Pi^e_{t-2} + \Gamma_6 \mathrm{I}_{t-1} + \Gamma_7 \mathrm{I}_{t-2} + \Gamma_8 \mathrm{M}_{t-1} + \Gamma_9 \mathrm{M}_{t-2} + \Gamma_{10} \mathrm{Y}_{t-1} + \Gamma_{11} \mathrm{Y}_{t-2} + D + \varepsilon_t$

	Denmark		France		Germany		Italy		Sweden		The UK		The US	
	π_t	π^e_t	π_t	π^e_t	π_t	π^e_t	π_t	π^e_t	π_t	π^e_t	π_t	π^e_t	π_t	π^e_t
π_{t-1}	0.278	-0.111**	-0.339	0.012	0.082	0.035	-0.308	0.007	0.575	-0.059	0.030	0.090	0.149	0.015
	(0.306)	(0.054)	(0.321)	(0.058)	(0.253)	(0.062)	(0.284)	(0.059)	(0.344)	(0.044)	(0.424)	(0.233)	(0.297)	(0.014)
π_{t-2}	-0.511**	0.042	-0.301*	-0.024	0.018	0.001	-0.487**	-0.006	-0.208	0.028	-0.414	-0.089	-0.258	-0.023
	(0.224)	(0.039)	(0.268)	(0.048)	(0.011)	(0.003)	(0.206)	(0.043)	(0.218)	(0.028)	(0.299)	(0.164)	(0.298)	(0.014)
π^e_{t-1}	3.648	0.951*	-3.715	0.117	-3.830**	0.952**	1.256	0.766**	-4.529	-0.046	-7.686	1.484	-9.560	0.416
	(2.746)	(0.482)	(1.956)	(0.354)	(1.566)	(0.380)	(1.373)	(0.284)	(3.031)	(0.385)	(7.787)	(4.277)	(5.914)	(0.277)
π^e_{t-2}	-0.738	-0.294	0.570	-0.099	0.035	-0.209	-3.860***	-0.113	1.081	-0.224	-0.147	-0.317	8.448	0.336
	(2.394)	(0.420)	(1.663)	(0.301)	(1.394)	(0.338)	(1.388)	(0.287)	(2.599)	(0.330)	(1.467)	(0.806)	(5.320)	(0.249)
μ_{t-1}	-0.445	0.007	3.356***	0.574***	0.535***	0.050	1.429**	-0.001	3.211*	0.688***	1.751	-1.841*	0.382	0.020
	(0.682)	(0.120)	(1.137)	(0.206)	(0.131)	(0.032)	(0.579)	(0.120)	(1.860)	(0.236)	(1.758)	(0.966)	(1.076)	(0.050)
μ_{t-2}	0.602	0.095	-0.244	-0.403**	0.261	-0.054	0.912*	0.044	-1.265	-0.246	-0.547	0.995*	1.395	0.061
	(0.532)	(0.093)	(1.027)	(0.186)	(0.196)	(0.048)	(0.530)	(0.110)	(1.221)	(0.155)	(1.400)	(0.769)	(1.097)	(0.051)
i_{t-1}	-1.635	0.913	7.888*	-1.670*	6.673	0.929	-8.524***	0.370	-3.338	0.788	1.440	-1.521	-1.352	-0.031
	(3.497)	(0.613)	(4.614)	(0.834)	(4.775)	(1.160)	(3.136)	(0.649)	(4.678)	(0.595)	(3.518)	(1.933)	(1.581)	(0.074)
i_{t-2}	-0.441	-0.918	-8.065	0.444	9.873**	-0.324	4.958	-0.055	6.142**	0.327	1.383	-0.296	-1.303	0.014
	(3.576)	(0.627)	(5.708)	(1.032)	(4.272)	(1.037)	(3.634)	(0.752)	(2.999)	(0.381)	(3.728)	(2.048)	(1.745)	(0.082)
y^{gap}_{t-1}	0.169	0.069	-0.568	-0.048	-1.382***	-0.056	0.527	-0.022	-0.640**	-0.049	-5.525	0.350	0.125	-0.004
	(0.456)	(0.080)	(0.319)	(0.058)	(0.431)	(0.105)	(0.525)	(0.109)	(0.486)	(0.062)	(9.074)	(4.985)	(0.267)	(0.013)
y^{gap}_{t-2}	-0.591	0.064	-0.182*	0.040	-0.704	0.122	-0.260	0.075	1.071	0.056	5.996	1.101	-0.113	0.028***
	(0.479)	(0.084)	(0.317)	(0.057)	(0.685)	(0.166)	(0.421)	(0.087)	(0.490)	(0.062)	(9.015)	(4.952)	(0.235)	(0.011)
α	0.996	1.476	2.946	7.083**	-73.56***	-2.642	22.90	-0.699	-6.792	-2.649**	17.605	8.059	10.37	0.729
	(11.77)	(2.064)	(16.95)	(3.065)	(26.88)	(6.529)	(13.80)	(2.855)	(11.40)	(1.444)	(17.79)	(9.773)	(11.35)	(0.532)
d^{WW1}	11.15	-0.845	-20.94*	0.838	18.853**	0.339	-3.083	0.381	-8.768	-2.969	2.066	6.696	3.916	0.061
	(10.10)	(1.772)	(11.58)	(2.094)	(8.812)	(2.141)	(7.543)	(1.561)	(14.89)	(1.892)	(11.68)	(6.414)	(7.964)	(0.373)
d^{WW2}	-8.800	-1.160	-5.629	-0.269	-7.751	0.500	-6.491	1.522	-5.286	-0.826	0.630	6.804	-6.745	-0.531
	(10.11)	(1.773)	(15.10)	(2.730)	(12.48)	(3.030)	(10.41)	(2.154)	(8.494)	(1.080)	(8.564)	(4.705)	(7.491)	(0.351)
R^2	77	81	66	84	91	84	81	71	80	89	78	75	76	95
Adj. R^2	55	63	35	70	78	63	63	44	62	80	58	52	55	91

Notes: ***/**/* marks significance at 1, 5 and 10%- level. The values in parenthesis are standard errors.

Equations 5.2. 1914-1939. Equations Suggested by the Correlation Schemes.

Denmark	$\pi_t = \alpha_t + \pi^e_{t-1} + \mu_{t-2} + i_{t+1} + y^{gap}_{t-2} + \varepsilon_t$
France	$\pi_t = \alpha_t + \pi^e_t + \mu_t + i_t + y^{gap}_{t-2} + \varepsilon_t$
Germany	$\pi_t = \alpha_t + \pi^e_{t-2} + \mu_{t+2} + i_t + y^{gap}_{t-1} + \varepsilon_t$
Italy	$\pi_t = \alpha_t + \pi^e_{t+2} + \mu_{t+1} + i_{t+2} + y^{gap}_t + \varepsilon_t$
Sweden	$\pi_t = \alpha_t + \pi^e_{t+2} + \mu_{t+1} + i_{t+2} + y^{gap}_{t-2} + \varepsilon_t$
The UK	$\pi_t = \alpha_t + \pi^e_{t+1} + \mu_{t+1} + i_{t-1} + y^{gap}_{t+1} + \varepsilon_t$
The US	$\pi_t = \alpha_t + \pi^e_{t+2} + \mu_{t+2} + i_{t+2} + y^{gap}_t + \varepsilon_t$

Table 5.6 OLS based on correlations, Period 2: 1914-1939, $\pi_t = \alpha_t + \beta\pi^e_t + \beta i_t + \beta\mu_t + \beta y^{gap}_t + \varepsilon_t$

	Denmark°		France		Germany		Italy°		Sweden°		UK		US
α	-24.80***	α	-16.56*	α	-206.1***	α	-6.803	α	-18.768***	α	2.407	α	-2.233
	(8.208)		(9.501)		(28.29)		(6.780)		(5.613)		(5.157)		(11.24)
π^e_{t-1}	2.690	π^e_t	-0.029	π^e_{t-2}	-1.911	π^e_{t+2}	0.493	π^e_{t+2}	-6.061**	π^e_{t+1}	-0.898**	π^e_{t+2}	0.370
	(1.618)		(1.247)		(4.105)		(0.901)		(2.184)		(0.421)		(4.552)
μ_{t-2}	0.934***	μ_t	1.273**	μ_{t-2}	-0.555	μ_{t-1}	0.802*	μ_{t-1}	2.536***	μ_{t+1}	1.324***	μ_{t+2}	0.829
	(0.262)		(0.566)		(0.493)		(0.414)		(0.487)		(0.439)		(0.540)
i_{t+1}	4.250**	i_t	3.788*	i_t	42.10***	i_{t+2}	0.502	i_{t+2}	7.364***	i_{t-1}	-0.644	i_{t+2}	-0.094
	(1.830)		(2.092)		(2.098)		(1.117)		(2.134)		(1.427)		(1.510)
y^{gap}_{t-2}	-0.328	y^{gap}_{t-2}	-0.273	y^{gap}_{t-1}	-2.447	y^{gap}_t	0.818	y^{gap}_{t-2}	0.939	y^{gap}_{t-1}	0.469	y^{gap}_t	0.562**
	(0.431)		(0.247)		(1.868)		(0.500)		(0.683)		(0.338)		(0.200)
d^{WW1}	-8.076*	d^{WW1}	-11.13*	d^{WW1}	57.60**	d^{WW1}	4.752	d^{WW1}	-16.789***	d^{WW1}	1.383	d^{WW1}	3.399
	(4.298)		(5.457)		(25.53)		(4.285)		(3.806)		(4.808)		(5.961)
d^{WW2}	-22.75***	d^{WW2}	-16.02	d^{WW2}	49.58	d^{WW2}	-17.783**	d^{WW2}	-6.834***	d^{WW2}	-0.900	d^{WW2}	2.756
	(5.431)		(12.11)		(65.00)		(6.339)		(2.054)		(6.264)		(6.851)
R^2	74		61		97		51		69		75		55
Adj. R^2:	66		49		96		36		59		67		41

Note: ***/**/* marks significance at 1, 5 and 10%- level. # France is estimated without μ due to lack of data. °Estimated with Newey-West due to autocorrelation and/or heteroskedasticity at 95%-level.

Table 5.7 Period 2: 1914-1939, Correlation between Inflation and Inflation Expectations

	Denmark			France			Germany			Italy			Sweden			The UK			The US		
	CI^{Low}	r	CI^{High}	CI^{Low}	r	CI^{High}	CI^{Low}	r	CI^{High}	CI^{Low}	R	CI^{High}	CI^{Low}	r	CI^{High}	CI^{Low}	r	CI^{High}	CI^{Low}	r	CI^{High}
t-3	0.07	0.48	0.75	-0.26	0.18	0.56	-0.29	**0.15**	0.53	-0.74	-0.46	-0.05	-0.20	0.24	0.60	-0.62	-0.26	0.18	-0.31	0.13	0.52
t-2	0.22	0.58	0.81	-0.25	0.19	0.57	-0.51	-0.11	0.33	-0.69	-0.38	0.05	-0.13	0.31	0.65	-0.80	-0.58	-0.21	-0.23	0.21	0.58
t-1	0.24	**0.60**	0.82	-0.36	0.07	0.48	-0.48	-0.08	0.35	-0.50	-0.09	0.34	-0.04	0.39	0.70	-0.63	-0.29	0.15	-0.24	0.20	0.57
t	-0.22	0.23	0.59	-0.21	**0.23**	0.59	-0.39	0.04	0.46	-0.38	0.05	0.46	0.19	0.57	0.80	-0.34	0.09	0.50	-0.02	0.40	0.70
t+1	-0.57	-0.19	0.25	-0.36	0.08	0.48	-0.41	0.02	0.43	-0.24	0.20	0.58	0.30	0.64	0.84	0.09	**0.49**	0.76	0.16	0.55	0.79
t+2	-0.54	-0.16	0.28	-0.62	-0.27	0.18	-0.39	0.04	0.45	0.00	0.42	0.72	0.32	**0.66**	0.84	-0.01	0.41	0.71	0.18	0.56	0.79
t+3	-0.59	-0.23	0.21	-0.71	-0.41	0.01	-0.31	0.13	0.52	0.09	**0.49**	0.76	0.02	0.43	0.72	-0.11	0.33	0.66	0.29	**0.63**	0.83

CI^{Low} and CI^{High} indicate the low and high confidence interval boundary at 95% significance. R shows the correlation at time t-/+ x (where x are different leads and lags) and highest correlation for every country and period are in bold.

Table 5.8 Period 2: 1914-1939, Correlation between Inflation and long run excess money growth

	Denmark			France			Germany			Italy			Sweden			The UK			The US		
	CI^{Low}	r	CI^{High}	CI^{Low}	r	CI^{High}	CI^{Low}	r	CI^{High}	CI^{Low}	r	CI^{High}	CI^{Low}	r	CI^{High}	CI^{Low}	r	CI^{High}	CI^{Low}	r	CI^{High}
t-3	0.20	0.58	0.80	-0.03	0.39	0.70	-0.35	0.09	0.49	-0.12	0.31	0.65	-0.16	0.28	0.63	-0.40	0.02	0.44	0.00	0.42	0.71
t-2	0.32	**0.65**	0.84	0.11	0.50	0.76	-0.36	0.07	0.48	0.01	0.43	0.72	0.02	0.44	0.73	-0.48	-0.08	0.36	0.23	0.59	0.81
t-1	0.30	0.64	0.84	0.17	0.55	0.79	-0.36	0.08	0.48	0.18	0.56	0.79	0.21	0.58	0.81	-0.25	0.19	0.57	0.38	0.69	0.86
t	0.04	0.46	0.74	0.36	**0.68**	0.86	-0.36	0.07	0.48	0.31	0.64	0.84	0.46	0.74	0.89	0.07	0.48	0.75	0.36	0.68	0.85
t+1	-0.26	0.18	0.56	0.29	0.63	0.83	-0.38	0.05	0.47	0.31	**0.65**	0.84	0.63	**0.83**	0.93	0.50	**0.76**	0.89	0.34	0.67	0.85
t+2	-0.36	0.07	0.48	-0.06	0.37	0.69	-0.21	**0.23**	0.60	0.23	0.59	0.81	0.49	0.76	0.89	0.25	0.61	0.82	0.63	0.83	0.93
t+3	-0.52	-0.13	0.31	-0.46	-0.04	0.38	-0.80	-0.58	-0.21	0.07	0.48	0.75	0.00	0.42	0.71	0.03	0.45	0.73	0.66	**0.84**	0.93

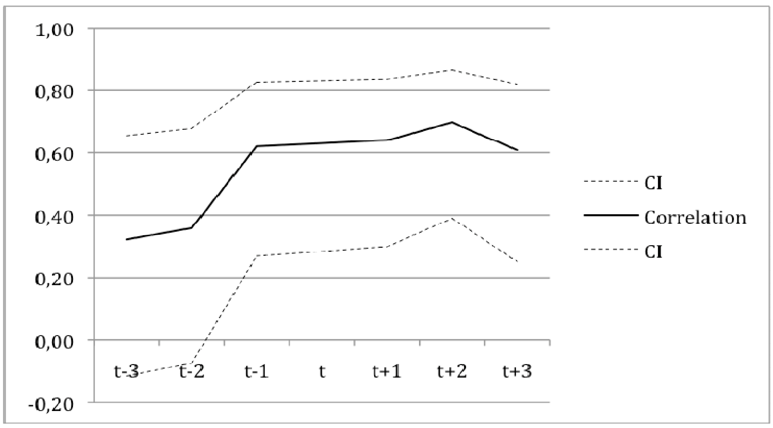
CI^{Low} and CI^{High} indicate the low and high confidence interval boundary at 95% significance. R shows the correlation at time t-/+ x (where x are different leads and lags) and highest correlation for every country and period are in bold.

The output shows no signs of significant correlation between inflation and inflation expectations. Looking at the correlation schemes we can see some signs of inflation expectations lagging inflation but the VAR and OLS show no sign of significant relationship. It is possible that the observations are too few and unfortunately this can't be helped without merging the periods and that would result in structural breaks (see chapter 4.2 for period selection and search for structural breaks). In the first period we find significance among different variables for different countries but we can't find significant pattern for the period. The most important observation is that the expectations show no significance in any country for the period.

5.3 Period 3: 1950-1971

The correlation output varies a lot when it comes to whether expectations is a lagging or leading indicator of inflation. It is difficult to see any distinct patterns for this period in the correlations schemes or in the OLS- and VAR-models. Still, there are some examples: lagged inflation is significant in the VAR-model for Germany and The U.K., Expectations is only significant for the U.S. in the OLS-model (lagged two periods, compare with figure 5.1), with a coefficient close to one. Y-gap is significant for Denmark, France, Germany and Sweden with coefficients ranging from 0.39 to 1.93. Long run excess money growth is significant for France, leading both one and two periods.

Figure 5.1 – Correlation Between Inflation and Inflation Expectations 1950-1971 in the US.



The testing of the model follows the same pattern as earlier with tests of serial correlation by a LM-test, Portmanteau and Whites heteroscedasticity test. The output gives evidence against expectations holding relevant information about future inflation. We find very little significance among inflation expectations and where we do, it has got the wrong sign i.e. a negative relationship. The coefficient of determination varies somewhat among the OLS and VAR-models where the VAR-model generally seems to explain more in the variability of inflation than a simple OLS. The adjusted R-square for the OLS scores in a wide range, 16-66%. The VAR scores 79% for Italy, 72% for Germany, but only 29% for Sweden. There is no other visible pattern for this period but the fact that the inflation expectations does not seem to hold any information about the future inflation. This can be explained by the fact that the inflation was not a target for economic adjustment during this period and was not considered a serious threat until the stagflation in the seventies (Bootle 1997). At this point (1950-1971) the society did not suffer from a high inflation rate and therefore did not need to pay for the costs of forecasts of inflation in the way the economy does today (see Ball 1991). Worth mentioning is that Dewald (2003) comes to the conclusion that the method of constructing inflation expectations in long-term bond yields is more accurate in a stable and low inflation environment. Econometrically we cannot find any evidence of this even though this is a period of relatively low inflation. Dewalds result (ibid.) may come from the fact that he uses a ten-year moving average inflation measure and the calculation of the inflation expectations are made in same fashion in this study.

Table 5.9 1950-1971 VAR-model: $\Pi_t = \Gamma_1 + \Gamma_2\Pi_{t-1} + \Gamma_3\Pi_{t-2} + \Gamma_4\Pi^e_{t-1} + \Gamma_5\Pi^e_{t-2} + \Gamma_6 I_{t-1} + \Gamma_7 I_{t-2} + \Gamma_8 M_{t-1} + \Gamma_9 M_{t-2} + \Gamma_{10} Y_{t-1} + \Gamma_{11} Y_{t-2} + D + \varepsilon_t$

	Denmark		France		Germany#		Italy		Sweden		The UK		The US	
	π_t	π^e_t	π_t	π^e_t	π_t	π^e_t	π_t	π^e_t	π_t	π^e_t	π_t	π^e_t	π_t	π^e_t
π_{t-1}	-0.041	0.087	-0.089	0.020	1.036***	0.940***	-0.465	-0.015	-0.302	0.075*	0.471*	0.331	0.147	0.124
	(0.267)	(0.117)	(0.219)	(0.057)	(0.463)	(0.320)	(0.195)	(0.117)	(0.305)	(0.037)	(0.246)	(0.144)	(0.255)	(0.078)
π_{t-2}	-0.116	-0.040	-0.150	0.058	0.855	0.961***	-0.025	0.065	-0.316	0.075**	-0.582**	-0.284**	-0.196	0.032
	(0.229)	(0.101)	(0.167)	(0.044)	(0.667)	(0.461)	(0.188)	(0.113)	(0.263)	(0.032)	(0.216)	(0.126)	(0.178)	(0.054)
π^e_{t-1}	-0.329	0.732***	0.901	0.840***	-0.953	-0.202	1.049	0.634	-1.580	1.303***	-1.430	1.795	-0.348	-1.130*
	(0.644)	(0.283)	(1.120)	(0.294)	(0.745)	(0.516)	(0.628)	(0.377)	(1.709)	(0.209)	(1.766)	(1.034)	(1.979)	(0.605)
π^e_{t-2}	0.479	0.216	-1.129	-0.277	0.735	0.675*	-2.003	-0.044	0.718	0.214	-0.017	-0.989**	0.162	1.099*
	(0.598)	(0.263)	(1.037)	(0.273)	(0.537)	(0.372)	(0.342)	(0.205)	(2.643)	(0.323)	(0.700)	(0.410)	(1.825)	(0.558)
μ_{t-1}	-0.433	0.207	3.972***	-0.500	-0.462	-0.285	1.152	0.122	0.838	-0.172	0.532	-1.267*	-1.335**	0.021
	(0.472)	(0.207)	(1.335)	(0.351)	(0.755)	(0.523)	(0.696)	(0.417)	(1.838)	(0.225)	(1.035)	(0.606)	(0.497)	(0.152)
μ_{t-2}	-0.114	-0.248	-3.310***	-0.082	0.857	0.994	-0.564	-0.080	-1.269	0.001	0.339	1.102*	1.245**	0.047
	(0.499)	(0.219)	(1.091)	(0.287)	(0.775)	(0.536)	(0.678)	(0.407)	(1.727)	(0.211)	(0.908)	(0.531)	(0.458)	(0.140)
i_{t-1}	3.488***	0.446	0.721	-0.208	-0.661	-0.022	-0.489	-0.432	-0.838	-0.671**	-0.273	0.015	1.918	1.385***
	(0.793)	(0.348)	(1.315)	(0.346)	(0.410)	(0.284)	(1.667)	(1.001)	(1.985)	(0.242)	(0.480)	(0.281)	(1.210)	(0.370)
i_{t-2}	-0.197	-0.077	-0.872	-0.019	0.520*	0.070	-2.835	0.369	1.221	0.396	-0.308	0.752***	-0.849	-0.427
	(0.641)	(0.281)	(1.136)	(0.299)	(0.282)	(0.195)	(2.379)	(1.428)	(2.214)	(0.271)	(0.412)	(0.241)	(1.500)	(0.458)
y^{gap}_{t-1}	0.363	-0.039	1.417	-0.085	0.570	0.007	-0.522	0.115	0.901	0.301**	-0.529	1.294	0.118	-0.007
	(0.331)	(0.145)	(1.095)	(0.288)	(0.350)	(0.242)	(0.243)	(0.146)	(1.069)	(0.131)	(1.212)	(0.709)	(0.311)	(0.095)
y^{gap}_{t-2}	0.313	-0.080	0.730	0.088	-0.836	-0.835	1.036*	-0.056**	1.828	-0.257**	1.053	-0.449	0.069	0.056
	(0.318)	(0.139)	(1.147)	(0.302)	(0.468)	(0.324)	(0.286)	(0.172)	(1.158)	(0.141)	(0.998)	(0.584)	(0.283)	(0.087)
α	-10.59***	-2.262	1.340	4.692*	-3.665	-7.934	12.805	-0.010*	6.791	1.172	11.13**	-1.724	-0.399	0.763
	(5.139)	(2.255)	(10.32)	(2.713)	(6.555)	(4.536)	(6.675)	(4.005)	(11.37)	(1.389)	(3.947)	(2.310)	(2.240)	(0.685)
d^{B-W}	-9.438***	0.336	-3.083	2.227	2.835	1.402	-0.201***	1.895	2.699	-0.850*	3.991*	1.216	1.560	0.360
	(3.151)	(1.383)	(8.783)	(2.309)	(1.227)	(0.849)	(2.780)	(1.668)	(3.924)	(0.479)	(2.100)	(1.229)	(2.079)	(0.636)
R^2	85	93	84	82	94	98	90	86	67	98	80	95	79	96
Adj. R^2	69	85	66	62	72	92	79	70	29	96	58	88	57	91

Notes: ***/**/* marks significance at 1, 5 and 10%- level. The values in parenthesis are standard errors. # Germany is estimated from 1954 due to lack of data (see appendix for output without μ).

Equations 5.3. 1950-1971. Equations Suggested by the Correlation Schemes.

Denmark	$\pi_t = \alpha_t + \pi^e_{t+1} + \mu_{t-1} + i_{t-1} + y^{gap}_{t-2} + \varepsilon_t$
France	$\pi_t = \alpha_t + \pi^e_{t-2} + \mu_{t+1} + i_t + y^{gap}_{t-1} + \varepsilon_t$
Germany	$\pi_t = \alpha_t + \pi^e_{t-1} + \mu_t + i_t + y^{gap}_t + \varepsilon_t$
Italy	$\pi_t = \alpha_t + \pi^e_{t+1} + \mu_{t-1} + i_{t+2} + y^{gap}_{t-1} + \varepsilon_t$
Sweden	$\pi_t = \alpha_t + \pi^e_{t-1} + \mu_{t-1} + i_t + y^{gap}_{t-1} + \varepsilon_t$
The UK	$\pi_t = \alpha_t + \pi^e_{t+2} + \mu_{t+1} + i_{t+2} + y^{gap}_{t-1} + \varepsilon_t$
The US	$\pi_t = \alpha_t + \pi^e_{t+2} + \mu_{t+2} + i_{t-1} + y^{gap}_{t-1} + \varepsilon_t$

Table 5.10 OLS based on correlations, Period 3: 1950-1971, $\pi_t = \alpha_t + \beta\pi^e_t + \beta i_t + \beta\mu_t + \beta y^{gap}_t + \varepsilon_t$

	Denmark		France°		Germany		Italy°		Sweden		UK°		US°
α	-10.10*** (2.647)	α	-7.402 (6.847)	α	9.169** (3.409)	α	3.072 (2.799)	α	4.814 (6.897)	α	6.987** (3.021)	α	-3.022* (1.514)
π^e_{t+1}	0.151 (0.290)	π^e_{t-2}	-0.635 (0.766)	π^e_{t-1}	-0.070 (0.209)	π^e_{t+1}	0.221 (0.470)	π^e_{t-1}	-0.380 (1.381)	π^e_{t+2}	-0.386 (0.253)	π^e_{t+2}	1.108* (0.552)
μ_{t-1}	-0.533*** (0.120)	μ_{t-1}	1.105 (1.083)	μ_t	-0.776 (0.435)	μ_{t-1}	0.344 (0.381)	μ_{t-1}	-0.361 (1.219)	μ_{t+1}	0.266** (0.110)	μ_{t+2}	-1.517** (0.667)
i_{t-1}	2.964*** (0.538)	i_t	0.842 (0.836)	i_t	-0.416 (0.229)	i_{t+2}	-0.672 (0.713)	i_t	0.093 (1.229)	i_{t+2}	-0.409 (0.324)	i_{t-1}	1.296** (0.574)
y^{gap}_{t-2}	0.429** (0.214)	y^{gap}_{t-1}	1.880*** (0.552)	y^{gap}_t	0.390** (0.150)	y^{gap}_{t-1}	0.084 (0.324)	y^{gap}_{t-1}	1.928*** (0.576)	y^{gap}_{t-1}	0.364 (0.310)	y^{gap}_{t-1}	0.205 (0.120)
d^{B-W}	-8.363*** (2.076)	d^{B-W}	-3.511 (3.855)	d^{B-W}	1.614** (0.650)	d^{B-W}	1.504 (1.619)	d^{B-W}	1.702 (3.328)	d^{B-W}	4.294** (1.724)	d^{B-W}	3.191** (1.404)
R^2	74		52		73		12		52		55		57
Adj. R^2:	66		36		58		16		37		41		43

Note: ***/**/* marks significance at 1, 5 and 10%-level. # France is estimated without μ due to lack of data. °Estimated with Newey-West due to autocorrelation and/or heteroskedasticity at 95%-level.

Table 5.11 Period 3: 1950-1971, Correlation between Inflation and Inflation Expectations

	Denmark			France			Germany			Italy			Sweden			The UK			The US		
	CI^{Low}	r	CI^{High}	CI^{Low}	R	CI^{High}	CI^{Low}	r	CI^{High}	CI^{Low}	R	CI^{High}	CI^{Low}	r	CI^{High}	CI^{Low}	r	CI^{High}	CI^{Low}	r	CI^{High}
t-3	-0.36	0.08	0.48	-0.04	**0.39**	0.70	0.29	0.63	0.83	-0.57	-0.20	0.24	-0.23	0.21	0.58	-0.28	0.16	0.54	-0.12	0.32	0.65
t-2	-0.31	0.13	0.52	-0.14	0.30	0.64	0.42	0.71	0.87	-0.67	-0.35	0.08	-0.11	0.33	0.66	-0.57	-0.20	0.24	-0.07	0.36	0.68
t-1	-0.23	0.21	0.58	-0.36	0.07	0.48	0.54	**0.78**	0.91	-0.40	0.03	0.45	-0.02	**0.41**	0.71	-0.63	-0.28	0.16	0.27	0.62	0.83
t	0.12	0.52	0.77	-0.61	-0.25	0.19	0.40	0.70	0.87	-0.16	0.28	0.63	-0.10	0.33	0.66	-0.16	0.28	0.63	0.28	0.63	0.83
t+1	0.32	**0.65**	0.84	-0.60	-0.24	0.20	-0.12	0.32	0.65	0.01	**0.43**	0.72	-0.25	0.19	0.57	0.35	**0.67**	0.85	0.30	0.64	0.84
t+2	0.27	0.62	0.83	-0.58	-0.21	0.23	-0.55	-0.16	0.28	-0.14	0.30	0.64	-0.14	0.30	0.64	-0.33	0.11	0.51	0.39	**0.70**	0.86
t+3	0.26	0.62	0.82	-0.54	-0.16	0.28	-0.46	-0.05	0.38	-0.20	0.24	0.60	-0.04	0.38	0.69	-0.52	-0.12	0.32	0.25	0.61	0.82

CI^{Low} and CI^{High} indicate the low and high confidence interval boundary at 95% significance. r shows the correlation at time t-/+ x (where x are different leads and lags) and highest correlation for every country and period are in bold.

Table 5.12 Period 3: 1950-1971, Correlation between Inflation and long run excess money growth

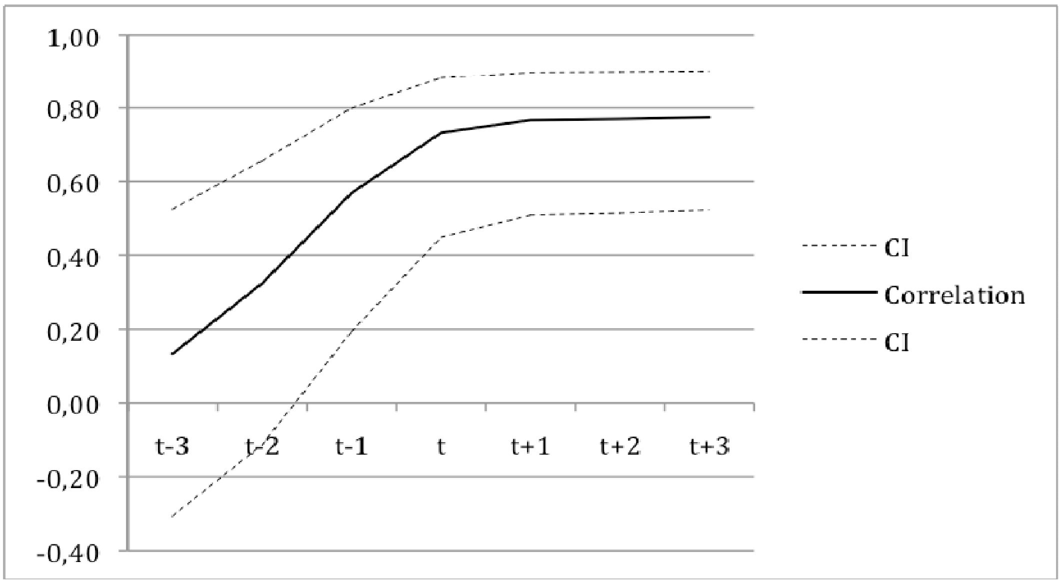
	Denmark			France			Germany			Italy			Sweden			The UK			The US		
	CI^{Low}	r	CI^{High}	CI^{Low}	R	CI^{High}	CI^{Low}	r	CI^{High}	CI^{Low}	R	CI^{High}	CI^{Low}	r	CI^{High}	CI^{Low}	r	CI^{High}	CI^{Low}	r	CI^{High}
t-3	0.22	0.59	0.81	-0.84	-0.65	-0.31	0.15	0.54	0.78	-0.51	-0.12	0.32	-0.78	-0.53	-0.14	-0.13	0.30	0.64	0.00	0.42	0.72
t-2	0.37	**0.69**	0.86	-0.76	-0.50	-0.10	0.29	0.63	0.83	-0.53	-0.13	0.30	-0.33	0.11	0.51	-0.41	0.02	0.44	0.10	0.50	0.76
t-1	0.38	**0.69**	0.86	-0.65	-0.32	0.12	0.47	0.74	0.89	-0.20	**0.25**	0.60	-0.18	0.26	0.61	-0.42	0.00	0.42	0.03	0.45	0.73
t	0.12	0.52	0.77	-0.44	-0.03	0.40	0.51	**0.77**	0.90	-0.26	0.18	0.56	-0.48	-0.08	0.36	-0.06	0.37	0.69	-0.03	0.39	0.70
t+1	0.08	0.48	0.75	-0.22	0.22	0.59	0.34	0.67	0.85	-0.32	0.12	0.52	-0.60	-0.24	0.20	0.28	**0.63**	0.83	0.15	0.54	0.78
t+2	0.07	0.48	0.75	-0.08	**0.35**	0.67	-0.71	-0.41	0.01	-0.47	-0.06	0.37	-0.32	0.11	0.51	-0.17	0.27	0.62	0.37	0.68	0.86
t+3	0.20	0.57	0.80	-0.27	0.17	0.55	-0.59	-0.23	0.21	-0.43	-0.01	0.42	-0.02	**0.40**	0.70	-0.35	0.08	0.49	0.46	**0.74**	0.88

CI^{Low} and CI^{High} indicate the low and high confidence interval boundary at 95% significance. r shows the correlation at time t-/+ x (where x are different leads and lags) and highest correlation for every country and period are in bold.

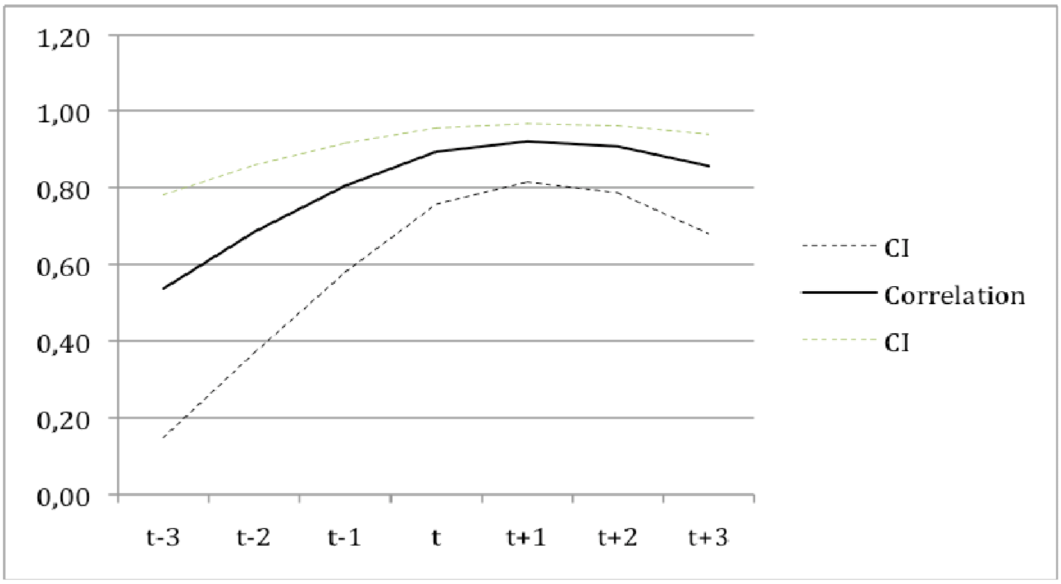
5.4 Period 4: 1972-2005

Overall, period 4 shows a lot more significant relationships than the other periods, especially concerning expected inflation and inflation. The correlation schemes show high positive significant correlation for *t* up to *t+3* for all countries. Denmark shows the highest correlation of 0.92 in *t+1* (see figure 5.3 below). There are of course a number of reasons for this; one might be that the fourth period is a bit longer than the second and third. Another reason might be that the financial markets have become more effective which would make our way of constructing inflation expectations more accurate since it is based on bond yield. Moreover, the economy is overall more stable, at least in terms of the variables that are used in this study, Dewald (2003) comes to this conclusion. A general feature of the analysis of this period is that the coefficient of determination is higher on average, between 80 and 98%, both in the OLS and VAR-models. The models are estimated and tested in the same fashion as before.

Figure 5.2 and 5.3 Correlation between Inflation and Inflation Expectations 1972-2005 Sweden



Denmark



Just by examining the correlation schemes it is obvious that the relationships are stronger in period 4 than in the other periods. This is also confirmed by the results from the OLS-models. Basic relationships with rigorous support in theory are found to be significant. For example μ is a highly significant indicator of future inflation and a coefficient around 0.5 i.e. not as high as the quantity theory suggests, except for Sweden with a coefficient of 0.96 significant at the 1% level.

The VAR-model shows, surprisingly, no significance in the lagged values of excess money growth except for Germany, that show of a coefficient of 0.67 at 5%-significance level. Once again we suspect that the VAR-model is overfit when the OLS perform equally well in explaining inflation. Keep in mind that the selection of lags is made ad-hoc and following Lucas (1976) this relationship is likely to change.

When it comes to expected inflation these is also found to be significantly related to inflation, there is support for π^e being an indicator of future inflation. Evidence for rational expectations is found in the models for France (in the VAR-model), The UK and The US. There are significant relationships with simultaneous or lagged expectations in the rest of the countries. The correlation scheme displays this very well with high significance as mentioned earlier. Compared to the sporadically significant relationships between expectations and inflation in the other periods, the expectations now seems to be rational or nearly rational in the cases of France, The U.K. and The U.S. The closer relationship may come from the fact that this period is characterized by a stabilization of both inflation and expected inflation, which might make future inflation more predictable (Mishkin 2007, Stock and Watson 2006, Levin et. al. 2004). Svensson stress the importance of central banks being predictable and having roughly the same expectations as the markets (Svensson 1999).

To sum up we find no support for the possibility to forecast future inflation based on inflation expectations for the periods up to 1972. In other words: the inflation expectations are not a significant leading variable to inflation and therefore were not likely to hold any information relevant to future inflation up to 1972. The latter period is different; we find evidence for a closer relationship between inflation expectations and inflation.

5.13 1972-2005 VAR-model: $\Pi_t = \Gamma_1 + \Gamma_2\Pi_{t-1} + \Gamma_3\Pi_{t-2} + \Gamma_4\Pi^e_{t-1} + \Gamma_5\Pi^e_{t-2} + \Gamma_6 I_{t-1} + \Gamma_7 I_{t-2} + \Gamma_8 M_{t-1} + \Gamma_9 M_{t-2} + \Gamma_{10} Y_{t-1} + \Gamma_{11} Y_{t-2} + \varepsilon_t$

	Denmark		France		Germany		Italy		Sweden		The UK		The US	
	π_t	π^e_t	π_t	π^e_t	π_t	π^e_t	π_t	π^e_t	π_t	π^e_t	π_t	π^e_t	π_t	π^e_t
π_{t-1}	0.610**	0.441	0.595***	0.090	0.600***	0.036	0.608***	0.360*	-0.121	0.066	0.523***	0.290**	0.693***	0.287
	(0.272)	(0.278)	(0.207)	(0.279	(0.216)	(0.260)	(0.213)	(0.174)	(0.262)	(0.190)	(0.147)	(0.128)	(0.220)	(0.209)
π_{t-2}	0.459	0.096	0.254	-0.075	0.167	0.306	-0.048	-0.228	-0.220	-0.148	0.050	-0.142	0.156	-0.121
	(0.289)	(0.296)	(0.220)	(0.297)	(0.237)	(0.286)	(0.236)	(0.193)	(0.242)	(0.176)	(0.140)	(0.122)	(0.179)	(0.170)
π^e_{t-1}	-0.476*	0.100	0.663***	0.895***	0.235	0.770***	0.057	0.819***	0.164	0.541	1.010***	0.877***	-0.468	0.233
	(0.278)	(0.284)	(0.122)	(0.165)	(0.203)	(0.245)	(0.310)	(0.253)	(0.505)	(0.367)	(0.353)	(0.307)	(0.298)	(0.284)
π^e_{t-2}	0.104	0.264	-0.617***	-0.440**	-0.363*	-0.450*	-0.055	-0.454**	-0.300	-0.032	-0.649	-0.442	0.460*	0.269
	(0.246)	(0.251)	(0.150)	(0.203)	(0.203)	(0.244)	(0.298)	(0.243)	(0.386)	(0.281)	(0.413)	(0.359)	(0.246)	(0.234)
μ_{t-1}	0.172	0.069	0.098	0.259	0.674**	0.339	-0.062	0.241	0.359	0.304	-0.467	-0.247	0.141	0.068
	(0.239)	(0.244)	(0.244)	(0.329)	(0.251)	(0.303)	(0.560)	(0.457)	(0.340)	(0.247)	(0.346)	(0.300)	(0.354)	(0.337)
μ_{t-2}	-0.137	-0.073	-0.089	-0.121	-0.418	-0.286	0.210	-0.397	1.120**	0.234	0.603	0.180	-0.050	-0.097
	(0.251)	(0.257)	(0.241)	(0.325)	(0.268)	(0.323)	(0.528)	(0.431)	(0.504)	(0.366)	(0.384)	(0.334)	(0.346)	(0.329)
i_{t-1}	0.366	0.282	0.070	0.292	0.198	0.376*	0.599**	0.440**	0.273	0.024	-0.199	0.159	0.331	0.403*
	(0.328)	(0.335)	(0.214)	(0.289)	(0.174)	(0.209)	(0.237)	(0.194)	(0.315)	(0.229)	(0.201)	(0.175)	(0.236)	(0.225)
i_{t-2}	0.009	0.133	-0.164	0.098	-0.364*	-0.213	-0.508**	0.055	0.146	0.364*	-0.124	0.341**	-0.452*	-0.002
	(0.294)	(0.300)	(0.243)	(0.328)	(0.199)	(0.239)	(0.188)	(0.153)	(0.258)	(0.187)	(0.161)	(0.140)	(0.254)	(0.242)
y^{gap}_{t-1}	0.539*	0.310	0.353*	0.016	0.040	-0.187	-0.508	-0.320	0.636**	0.300	1.069**	1.220***	0.419**	-0.060
	(0.304)	(0.311)	(0.177)	(0.238)	(0.155)	(0.187)	(0.375)	(0.307)	(0.287)	(0.209)	(0.425)	(0.369)	(0.181)	(0.173)
y^{gap}_{t-2}	-0.038	0.240	-0.201	-0.084	0.280	0.075	0.312	0.202	0.054	-0.289	-0.570	-0.994***	-0.205	-0.177
	(0.218)	(0.223)	(0.155)	(0.209)	(0.179)	(0.216)	(0.281)	(0.230)	(0.340)	(0.247)	(0.397)	(0.345)	(0.179)	(0.170)
α	0.113	-0.060	0.910	-0.960	0.840	1.196	0.621	0.541	-2.526*	-1.912*	-0.005	0.309	0.789	0.711
	(0.962)	(0.984)	(0.893)	(1.204)	(0.841)	(1.014)	(1.329)	(1.085)	(1.373)	(0.998)	(1.367)	(1.189)	(0.894)	(0.851)
d^{opec1}	1.216	-1.056	2.081***	-0.773	-0.480	-0.234	5.011***	-0.295	1.923	-0.144	4.879***	0.755	1.828**	-0.232
	(1.359)	(1.390)	(0.719)	(0.969)	(0.760)	(0.917)	(1.720)	(1.405)	(1.283)	(0.932)	(1.336)	(1.161)	(0.838)	(0.797)
d^{opec2}	1.039	1.726	1.430**	3.389***	0.376	1.085	5.284***	2.355*	-0.336	-0.551	5.272***	1.288	2.454**	0.053
	(1.358)	(1.389)	(0.698)	(0.942)	(0.697)	(0.841)	(1.580)	(1.290)	(1.695)	(1.232)	(1.712)	(1.488)	(1.003)	(0.955)
$d^{RE-U.}$	n/a	n/a	n/a	n/a	0.112	0.097	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
					(0.686)	(0.826)								
R^2	90	93	98	94	92	84	95	94	88	92	94	92	93	91
Adj. R^2	84	89	97	91	86	74	92	91	81	88	90	88	87	86

Notes: ***/**/* marks significance at 1, 5 and 10%- level. The values in parenthesis are standard errors.

Equations 5.4. 1972-2005. Equations Suggested by the Correlation Schemes.

Denmark	$\pi_t = \alpha_t + \pi^e_{t+1} + \mu_{t+1} + i_{t+1} + y^{gap}_{t-2} + \varepsilon_t$
France	$\pi_t = \alpha_t + \pi^e_{t+1} + \mu_{t+1} + i_{t+2} + y^{gap}_{t-2} + \varepsilon_t$
Germany	$\pi_t = \alpha_t + \pi^e_t + \mu_{t-1} + i_{t-1} + y^{gap}_{t-2} + \varepsilon_t$
Italy	$\pi_t = \alpha_t + \pi^e_{t+1} + \mu_{t-1} + i_{t+1} + y^{gap}_{t-2} + \varepsilon_t$
Sweden	$\pi_t = \alpha_t + \pi^e_{t+1} + \mu_{t-1} + i_{t+2} + y^{gap}_{t-1} + \varepsilon_t$
The UK	$\pi_t = \alpha_t + \pi^e_t + \mu_t + i_t + y^{gap}_{t-2} + \varepsilon_t$
The US	$\pi_t = \alpha_t + \pi^e_{t+2} + \mu_{t-1} + i_t + y^{gap}_{t-1} + \varepsilon_t$

5.14 OLS based on correlations, Period 4: 1972-2005, $\pi_t = \alpha_t + \beta\pi^e_t + \beta i_t + \beta\mu_t + \beta y^{gap}_t + \varepsilon_t$

	Denmark		France°		Germany°		Italy°		Sweden		UK°		US
α	-0.362 (0.719)	α	-0.235 (0.802)	α	-1.906** (0.722)	α	-1.873* (0.993)	α	-1.357** (0.620)	α	-2.237* (1.213)	α	-0.154 (0.669)
π^e_{t+1}	0.664*** (0.157)	π^e_t	1.313*** (0.400)	π^e_t	0.304** (0.130)	π^e_{t+1}	0.931*** (0.143)	π^e_{t+1}	0.210 (0.196)	π^e_t	0.696** (0.292)	π^e_{t+2}	0.219 (0.199)
μ_{t+1}	0.230** (0.095)	μ_t	0.411*** (0.125)	μ_{t-1}	0.510*** (0.136)	μ_{t-1}	0.758*** (0.093)	μ_{t-1}	0.931*** (0.143)	μ_t	0.068 (0.234)	μ_{t-1}	0.195 (0.148)
i_{t+1}	-0.208 (0.203)	i_t	-0.584 (0.364)	i_{t-1}	0.195 (0.126)	i_{t+1}	-0.412*** (0.135)	i_{t+2}	0.108 (0.154)	i_t	0.073 (0.109)	i_t	0.320*** (0.194)
y^{gap}_{t-2}	-0.017 (0.168)	y^{gap}_t	0.120 (0.261)	y^{gap}_{t-2}	0.231 (0.151)	y^{gap}_{t-2}	-0.118 (0.128)	y^{gap}_{t-1}	0.552*** (0.153)	y^{gap}_{t-2}	0.281 (0.326)	y^{gap}_{t-1}	0.230 (0.181)
d^{OPEC1}	3.021*** (0.936)	d^{OPEC1}	3.936*** (0.748)	d^{OPEC1}	1.172** (0.534)	d^{OPEC1}	2.633*** (0.779)	d^{OPEC1}	1.019 (0.897)	d^{OPEC1}	5.857*** (1.289)	d^{OPEC1}	3.018*** (1.080)
d^{OPEC2}	-0.014 (1.115)	d^{OPEC2}	-1.726 (1.393)	d^{OPEC2}	0.900** (0.350)	d^{OPEC2}	1.404 (1.024)	d^{OPEC2}	-1.360 (1.133)	d^{OPEC2}	4.262*** (1.480)	d^{OPEC2}	2.966 (1.293)
				d^{UNIF}	0.069 (0.527)						-		
R^2	90		87		84		94		90		80		83
Adj. R^2:	87		84		80		93		87		76		79

Note: ***/**/* marks significance at 1, 5 and 10%-level. # France is estimated without μ due to lack of data. °Estimated with Newey-West due to autocorrelation and/or heteroskedasticity at 95%-level.

5.15 Period 4: 1972-2005, Correlation between Inflation and Inflation Expectations

	Denmark			France			Germany			Italy			Sweden			The UK			The US		
	CI^{Low}	r	CI^{High}	CI^{Low}	R	CI^{High}	CI^{Low}	r	CI^{High}	CI^{Low}	r	CI^{High}	CI^{Low}	r	CI^{High}	CI^{Low}	r	CI^{High}	CI^{Low}	r	CI^{High}
t-3	0.15	0.54	0.78	-0.08	0.36	0.68	-0.51	-0.11	0.33	-0.46	-0.04	0.39	-0.31	0.13	0.53	-0.25	0.19	0.56	-0.47	-0.06	0.37
t-2	0.37	0.68	0.86	0.24	0.60	0.82	-0.17	0.27	0.62	-0.25	0.20	0.57	-0.11	0.32	0.66	-0.16	0.28	0.63	-0.37	0.06	0.47
t-1	0.58	0.80	0.92	0.49	0.75	0.89	0.27	0.62	0.83	0.04	0.45	0.73	0.19	0.57	0.80	0.39	0.70	0.86	-0.13	0.31	0.65
t	0.76	0.89	0.96	0.63	0.83	0.93	0.48	**0.75**	0.89	0.33	0.66	0.85	0.45	0.73	0.88	0.66	**0.84**	0.93	0.24	0.60	0.81
t+1	0.81	**0.92**	0.97	0.66	**0.85**	0.93	0.43	0.72	0.88	0.51	**0.77**	0.90	0.51	**0.77**	0.90	0.53	0.78	0.90	0.46	0.74	0.88
t+2	0.79	0.91	0.96	0.62	0.82	0.92	0.25	0.60	0.82	0.51	**0.77**	0.90	0.51	**0.77**	0.90	0.26	0.62	0.82	0.51	0.77	0.90
t+3	0.68	0.86	0.94	0.59	0.81	0.92	0.14	0.53	0.78	0.46	0.74	0.88	0.52	**0.77**	0.90	0.19	0.56	0.80	0.57	**0.80**	0.91

CI^{Low} and CI^{High} indicate the low and high confidence interval boundary at 95% significance. r shows the correlation at time t-/+ x (where x are different leads and lags) and highest correlation for every country and period are in bold.

5.16 Period 4: 1972-2005, Correlation between Inflation and long run excess money growth

	Denmark			France			Germany			Italy			Sweden			The UK			The US		
	CI^{Low}	r	CI^{High}	CI^{Low}	r	CI^{High}	CI^{Low}	r	CI^{High}	CI^{Low}	r	CI^{High}	CI^{Low}	r	CI^{High}	CI^{Low}	r	CI^{High}	CI^{Low}	r	CI^{High}
t-3	0.43	0.72	0.88	0.55	0.79	0.91	0.25	0.61	0.82	0.81	0.92	0.97	0.53	0.78	0.90	-0.06	0.37	0.69	0.25	0.61	0.82
t-2	0.51	0.77	0.90	0.60	0.81	0.92	0.41	0.71	0.87	0.83	**0.93**	0.97	0.69	0.86	0.94	-0.02	0.41	0.71	0.34	0.66	0.85
t-1	0.58	0.80	0.91	0.65	0.84	0.93	0.42	**0.72**	0.87	0.81	0.92	0.97	0.74	**0.88**	0.95	0.31	0.65	0.84	0.34	**0.67**	0.85
t	0.66	0.84	0.93	0.70	0.86	0.94	0.24	0.60	0.82	0.76	0.89	0.96	0.70	0.87	0.94	0.43	**0.72**	0.88	0.29	0.64	0.83
t+1	0.71	**0.87**	0.95	0.71	**0.87**	0.94	0.09	0.49	0.76	0.68	0.85	0.94	0.56	0.79	0.91	0.30	0.64	0.84	0.25	0.61	0.82
t+2	0.64	0.84	0.93	0.64	0.83	0.93	0.00	0.42	0.72	0.55	0.79	0.91	0.37	0.68	0.86	0.17	0.55	0.79	0.24	0.60	0.82
t+3	0.51	0.77	0.90	0.48	0.75	0.89	-0.17	0.27	0.62	0.40	0.70	0.87	0.16	0.55	0.79	0.16	0.55	0.79	0.17	0.55	0.79

CI^{Low} and CI^{High} indicate the low and high confidence interval boundary at 95% significance. r shows the correlation at time t-/+ x (where x are different leads and lags) and highest correlation for every country and period are in bold.

6. Conclusion

Previous studies have downplayed the role of expectations in forecasting inflation (see e.g. Cecchetti 1995, Bernanke and Woodford 1997, Croushore 2003 among others) while some have advocatied the advantages of using expectations as an intermediate target (e.g. Svensson 1997). Other studies have shown that the assumption of rationality originally suggested by Muth (1961) and Lucas (1976) is not as clear as most economic models suggests (see e.g. Cecchetti 1995 and Croushore 2003). These studies show that models with adaptive inflation expectations perform equally good or better than models with an assumption of rational expectations. Our results for the last period are somewhat ambiguous but we clearly find that inflation expectations are more closely related to the future course of inflation. The ambiguity comes from the fact that we cannot find any consensus in what way the inflation expectations affect inflation, the same question is raised by Bernanke (2007). For almost half (Denmark, France and the UK) the countries the inflation expectations seem to preced inflation and are significantly different from zero in period 4. Mishkin (2007) finds evidence that the inflation expectations have become more anchored in recent years. If one compares the volatility in inflation expectations for the most recent period in the UK with previous periods there is a tendency that these are less volatile than before[20] (from the mid eighties to 2005 and the other countries show similar patterns, see chapter 3.3).

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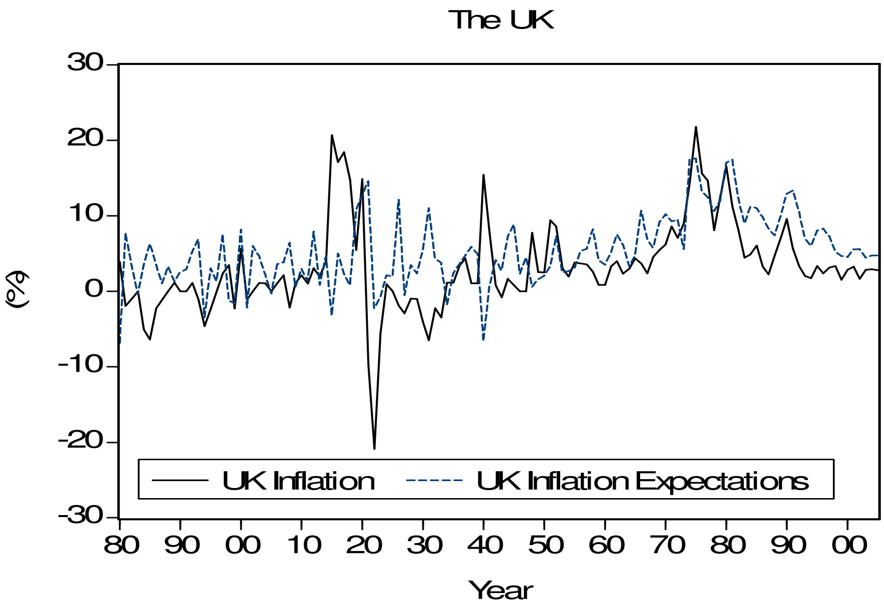
[20] See also Roberts (2006).

Figure 6.1



When this being just a small part of the period under investigation we recommend other studies as Mishkin (2007), Mehra and Herrington (2008) among others, for a discussion about the last periods. Our aim was to see how the structures have changed over more than hundred years and with respect to different periods with different economic structures. The results are quite straightforward: we find no support for that expected inflation is a procyclical variable to inflation before 1972. During these years the inflation expectations seem to be lagging inflation although quite a few of the correlation schemes have broad confidence intervals. The results of the OLS and VAR-models confirmed this thesis. No significance is found for inflation expectations and in some cases we find evidence of a negative correlation, which does not go with theory. Dewald (2003) comes to the conclusion that under periods that are characterized by low and stable inflation the inflation expectations retrieved from long-term bond yields were more accurate, in the sense that the relationship between the variables is closer. We find, compared to Dewald (2003), when we look into higher frequencies that the results in our study are somewhat alike Dewald's. There is support for Lucas's (1972) theories about changing structures and changing economic relationships, which is no big surprise. Another possible explanation of why the inflation expectations have become more accurate in recent periods is the fact that central banks have become more transparent (Batini and Haldane 1998). The simple fact that the institutions have become more open vouch for people to become more enlightened when it comes to monetary and fiscal policies conducted by the central banks and governments (Svensson 1999). Some studies, e.g. Bernanke and Woodford (1997), show that this might become a problem with the risk of sunspot equilibrium. The authors show that gathering information from the public might be risky when the information might be just a mirror of the central banks forecasts and therefore not holding any additional information[21]. Other researchers find evidence or warn for similar problems e.g. Lamont (1995) argues that professional forecasters are sometime more eager to build a reputation than minimizing the forecast errors. This would mean that the information available for the public is biased. In the same spirit Mankiw et. al. (2003) suggests that the public is likely to update their expectations less frequently than economists. These arguments and results are not in favour for the assumption of rational expectations and ibid. (2003) criticises the assumption of homogeneity among expectations i.e. different people have different expectations. To sum up: there was not much use of inflation expectations as a variable to forecast inflation up to 1972 as it was of no significance up till then. During the last period we find inflation expectations procyclical and sometimes leading and coinciding. For the latter periods we find inflation expectations sometimes countercyclical, acyclical and lagging inflation. There is a change since the OPEC's and we conclude and agree with Bernanke and Woodford (1997) that the inflation expectations should be used to forecast future inflation but not solely, rather as a part in a bigger structural model.

The view on inflation has definitely changed over the period examined. At first, inflation was not considered a problem although it was seen a risk (Wicksell 1898). In the second period this risk became a real problem as inflation accelerated in many of the countries in this study, especially Germany of course. Following the empirical findings of Fisher (1973) and Phillips (1958), inflation was used as a means of keeping unemployment low in the third period. This trade-off proved not to hold in the long run as individuals started expecting

[21] For full discussion see Svensson (1997), Bernanke and Woodford (1997).

inflation and act according to rising prices. We find evidence of expectations being more informative in the fourth and last period, which is consistent with the views of Lucas (1972), Friedman (1968 and 1977) and Phelps (1967). Since the trade-off with unemployment no longer prevails, price stability has become the reigning ideal for central banks.

7. References

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8. Data Appendix

Denmark

Inflation, CPI, 1880-1949: B.R. Mitchell, International Historical Statistics: Europe, 1750-2005 (2007). 1950-2008: Thompson financial Datastream.

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Italy

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9. Appendix

Table 9.1 Period 1: 1880-1913, Correlation between Inflation and *y-gap*

	Denmark			France			Germany			Italy			Sweden			The UK			The US		
	CI^{Low}	r	CI^{High}	CI^{Low}	r	CI^{High}	CI^{Low}	r	CI^{High}	CI^{Low}	r	CI^{High}	CI^{Low}	r	CI^{High}	CI^{Low}	r	CI^{High}	CI^{Low}	r	CI^{High}
t-3	-0.41	0.01	0.43	-0.77	-0.51	-0.11	-0.42	0.00	0.42	-0.23	0.21	0.58	-0.54	-0.15	0.29	-0.56	-0.19	0.26	-0.72	-0.43	0.00
t-2	-0.60	-0.24	0.21	-0.40	0.02	0.44	-0.27	0.17	0.55	-0.32	0.11	0.51	-0.52	-0.13	0.31	-0.35	0.09	0.49	-0.64	-0.30	0.14
t-1	-0.33	**0.10**	0.50	-0.20	0.24	0.60	-0.33	0.11	0.51	-0.57	-0.20	0.24	-0.42	0.00	0.42	-0.31	0.13	0.52	0.00	**0.42**	0.71
t	-0.47	-0.06	0.37	-0.16	**0.28**	0.63	-0.39	0.03	0.45	-0.47	-0.06	0.37	-0.02	**0.40**	0.70	-0.53	-0.15	0.29	-0.12	0.32	0.65
t+1	-0.55	-0.16	0.28	-0.29	0.15	0.53	-0.31	0.12	0.52	-0.26	0.18	0.56	-0.27	0.17	0.55	-0.12	**0.31**	0.65	-0.51	-0.11	0.33
t+2	-0.45	-0.03	0.40	-0.49	-0.09	0.35	-0.24	**0.20**	0.57	-0.21	**0.23**	0.59	-0.47	-0.06	0.37	-0.39	0.04	0.46	-0.41	0.01	0.43
t+3	-0.55	-0.16	0.28	-0.48	-0.07	0.36	-0.39	0.04	0.45	-0.53	-0.14	0.30	-0.58	-0.21	0.23	-0.40	0.02	0.44	-0.26	0.18	0.56

CI^{Low} and CI^{High} indicate the low and high confidence interval boundary at 95% significance. r shows the correlation at time t-/+ x (where x are different leads and lags) and highest correlation for every country and period are in bold.

Table 9.2 Period 2: 1914-1939, Correlation between Inflation and *y-gap*

	Denmark			France			Germany			Italy			Sweden			The UK			The US		
	CI^{Low}	r	CI^{High}	CI^{Low}	r	CI^{High}	CI^{Low}	r	CI^{High}	CI^{Low}	r	CI^{High}	CI^{Low}	r	CI^{High}	CI^{Low}	r	CI^{High}	CI^{Low}	r	CI^{High}
t-3	-0.25	**0.19**	0.57	-0.08	**0.35**	0.67	-0.59	-0.23	0.21	-0.30	0.14	0.53	-0.09	**0.34**	0.67	-0.49	-0.09	0.34	-0.75	-0.49	-0.08
t-2	-0.63	-0.28	0.16	-0.52	-0.12	0.32	-0.56	-0.17	0.27	-0.28	0.16	0.54	-0.17	0.27	0.62	0.03	0.44	0.73	-0.59	-0.22	0.22
t-1	-0.38	0.05	0.46	-0.62	-0.27	0.17	0.08	**0.49**	0.75	-0.22	0.22	0.59	-0.57	-0.20	0.24	0.40	**0.70**	0.87	-0.24	0.20	0.57
t	-0.48	-0.08	0.36	-0.53	-0.14	0.30	-0.53	-0.13	0.31	-0.04	**0.38**	0.69	-0.76	-0.50	-0.10	0.28	0.63	0.83	0.05	**0.46**	0.74
t+1	-0.74	-0.46	-0.04	-0.62	-0.27	0.17	-0.55	-0.16	0.28	-0.34	0.09	0.49	-0.64	-0.30	0.14	-0.26	0.18	0.56	-0.21	0.23	0.59
t+2	-0.65	-0.31	0.12	-0.49	-0.08	0.35	-0.28	0.16	0.54	-0.70	-0.39	0.04	-0.38	0.05	0.46	-0.60	-0.24	0.21	-0.44	-0.02	0.40
t+3	-0.41	0.01	0.43	-0.49	-0.09	0.35	-0.63	-0.28	0.16	-0.63	-0.29	0.16	-0.37	0.06	0.47	-0.80	-0.57	-0.19	-0.54	-0.15	0.29

CI^{Low} and CI^{High} indicate the low and high confidence interval boundary at 95% significance. r shows the correlation at time t-/+ x (where x are different leads and lags) and highest correlation for every country and period are in bold.

Table 9.3Period 3: 1950-1971, Correlation between Inflation and *y-gap*

	Denmark			France			Germany			Italy			Sweden			The UK			The US		
	CI^{Low}	r	CI^{High}	CI^{Low}	r	CI^{High}	CI^{Low}	r	CI^{High}	CI^{Low}	r	CI^{High}	CI^{Low}	r	CI^{High}	CI^{Low}	r	CI^{High}	CI^{Low}	r	CI^{High}
t-3	-0.49	-0.08	0.35	-0.68	-0.36	0.07	-0.92	-0.81	-0.58	-0.33	0.11	0.51	-0.67	-0.35	0.08	-0.62	-0.26	0.18	-0.63	-0.28	0.16
t-2	0.05	**0.46**	0.74	-0.50	-0.11	0.33	-0.70	-0.40	0.03	-0.09	0.35	0.67	-0.03	0.39	0.70	-0.34	0.10	0.50	-0.52	-0.13	0.31
t-1	-0.35	0.09	0.49	-0.17	**0.27**	0.62	-0.22	0.22	0.59	0.08	**0.48**	0.75	0.56	**0.79**	0.91	0.33	**0.66**	0.85	-0.06	**0.37**	0.68
t	-0.76	-0.50	-0.10	-0.50	-0.10	0.34	-0.20	**0.24**	0.60	-0.32	0.11	0.51	-0.38	0.05	0.46	0.16	0.54	0.78	-0.29	0.14	0.53
t+1	-0.62	-0.26	0.18	-0.62	-0.26	0.18	-0.58	-0.21	0.23	-0.49	-0.09	0.34	-0.74	-0.46	-0.04	-0.62	-0.26	0.18	-0.43	-0.01	0.42
t+2	-0.17	0.27	0.62	-0.42	0.00	0.42	-0.81	-0.59	-0.22	-0.67	-0.34	0.09	-0.60	-0.24	0.20	-0.64	-0.30	0.14	-0.54	-0.15	0.29
t+3	-0.09	0.35	0.67	-0.58	-0.21	0.23	-0.62	-0.27	0.17	-0.52	-0.13	0.31	-0.08	0.36	0.68	-0.29	0.15	0.54	-0.56	-0.18	0.26

CI^{Low} and CI^{High} indicate the low and high confidence interval boundary at 95% significance. r shows the correlation at time t-/+ x (where x are different leads and lags) and highest correlation for every country and period are in bold.

Table 9.4 Period 4: 1972-2005, Correlation between Inflation and *y-gap*

	Denmark			France			Germany			Italy			Sweden			The UK			The US		
	CI^{Low}	r	CI^{High}	CI^{Low}	r	CI^{High}	CI^{Low}	r	CI^{High}	CI^{Low}	r	CI^{High}	CI^{Low}	r	CI^{High}	CI^{Low}	r	CI^{High}	CI^{Low}	r	CI^{High}
t-3	-0.28	**0.16**	0.55	-0.11	**0.33**	0.66	-0.10	0.33	0.66	-0.24	**0.21**	0.58	-0.27	0.17	0.55	-0.22	0.22	0.59	-0.33	0.11	0.51
t-2	-0.34	0.09	0.49	-0.11	**0.33**	0.66	0.08	**0.48**	0.75	-0.23	**0.21**	0.58	-0.19	0.25	0.61	0.11	**0.51**	0.77	-0.15	0.29	0.63
t-1	-0.47	-0.06	0.37	-0.22	0.22	0.59	-0.06	0.37	0.69	-0.26	0.18	0.56	-0.11	**0.33**	0.66	-0.10	0.34	0.66	-0.11	**0.32**	0.66
t	-0.55	-0.16	0.28	-0.41	0.02	0.44	-0.39	0.04	0.45	-0.42	0.01	0.43	-0.31	0.13	0.52	-0.45	-0.04	0.39	-0.36	0.08	0.48
t+1	-0.50	-0.10	0.33	-0.40	0.03	0.44	-0.47	-0.06	0.37	-0.46	-0.05	0.38	-0.49	-0.08	0.35	-0.58	-0.22	0.23	-0.57	-0.19	0.25
t+2	-0.45	-0.04	0.39	-0.45	-0.03	0.40	-0.51	-0.12	0.32	-0.53	-0.14	0.30	-0.62	-0.27	0.17	-0.58	-0.21	0.23	-0.72	-0.43	-0.01
t+3	-0.47	-0.07	0.37	-0.53	-0.14	0.30	-0.51	-0.11	0.32	-0.45	-0.04	0.39	-0.59	-0.22	0.22	-0.59	-0.23	0.22	-0.75	-0.47	-0.06

CI^{Low} and CI^{High} indicate the low and high confidence interval boundary at 95% significance. r shows the correlation at time t-/+ x (where x are different leads and lags) and highest correlation for every country and period are in bold.

Table 9.5 Period 1: 1880-1913, Correlation between Inflation and u-gap

	Denmark			France			Germany			Italy			Sweden			The UK			The US		
	CI^{Low}	r	CI^{High}	CI^{Low}	r	CI^{High}	CI^{Low}	r	CI^{High}	CI^{Low}	r	CI^{High}	CI^{Low}	r	CI^{High}	CI^{Low}	r	CI^{High}	CI^{Low}	r	CI^{High}
t-3																-0.68	-0.36	0.07			
t-2																-0.56	-0.18	0.26			
t-1																-0.27	0.17	0.55			
t																0.05	**0.46**	0.74			
t+1																-0.02	0.40	0.70			
t+2																-0.32	0.12	0.51			
t+3																-0.52	-0.13	0.31			

CI^{Low} and CI^{High} indicate the low and high confidence interval boundary at 95% significance. r shows the correlation at time t-/+ x (where x are different leads and lags) and highest correlation for every country and period are in bold.

Table 9.6 Period 2: 1914-1939, Correlation between Inflation and u-gap

	Denmark			France			Germany			Italy			Sweden			The UK			The US		
	CI^{Low}	r	CI^{High}	CI^{Low}	r	CI^{High}	CI^{Low}	r	CI^{High}	CI^{Low}	r	CI^{High}	CI^{Low}	r	CI^{High}	CI^{Low}	r	CI^{High}	CI^{Low}	r	CI^{High}
t-3																-0.60	-0.23	0.21	-0.76	-0.49	-0.09
t-2																-0.43	-0.01	0.41	-0.63	-0.28	0.16
t-1																0.01	0.43	0.72	-0.19	0.25	0.61
t																0.32	**0.65**	0.84	0.19	**0.56**	0.80
t+1																-0.33	0.11	0.51	-0.16	0.28	0.63
t+2																-0.49	-0.09	0.35	-0.41	0.01	0.43
t+3																-0.52	-0.13	0.31	-0.51	-0.11	0.32

CI^{Low} and CI^{High} indicate the low and high confidence interval boundary at 95% significance. r shows the correlation at time t-/+ x (where x are different leads and lags) and highest correlation for every country and period are in bold.

Table 9.7 Period 3: 1950-1971, Correlation between Inflation and u-gap

	Denmark			France			Germany			Italy			Sweden			The UK			The US		
	CI^{Low}	r	CI^{High}	CI^{Low}	r	CI^{High}	CI^{Low}	r	CI^{High}	CI^{Low}	r	CI^{High}	CI^{Low}	r	CI^{High}	CI^{Low}	r	CI^{High}	CI^{Low}	r	CI^{High}
t-3	-0.27	0.17	0.55				-0.16	0.28	0.63	0.00	**0.42**	0.72	-0.81	-0.59	-0.22	-0.72	-0.43	-0.01	-0.64	-0.31	0.13
t-2	0.49	**0.75**	0.89				0.26	**0.61**	0.82	0.00	**0.42**	0.72	-0.55	-0.17	0.27	-0.31	0.13	0.52	-0.59	-0.23	0.22
t-1	0.17	0.55	0.79				0.16	0.55	0.79	-0.01	0.41	0.71	0.23	**0.59**	0.81	0.02	**0.44**	0.73	0.03	**0.45**	0.73
t	-0.63	-0.28	0.16				-0.11	0.33	0.66	-0.09	0.35	0.67	0.15	0.54	0.78	-0.02	0.40	0.71	-0.16	0.28	0.63
t+1	-0.79	-0.56	-0.18				-0.41	0.02	0.43	-0.09	0.34	0.67	-0.55	-0.17	0.27	-0.61	-0.26	0.19	-0.42	0.00	0.42
t+2	-0.60	-0.23	0.21				-0.78	-0.54	-0.16	-0.78	-0.53	-0.14	-0.80	-0.58	-0.20	-0.67	-0.34	0.09	-0.41	0.02	0.44
t+3	-0.28	0.16	0.55				-0.66	-0.33	0.10	-0.69	-0.38	0.05	-0.54	-0.15	0.29	-0.38	0.04	0.46	-0.46	-0.05	0.38

CI^{Low} and CI^{High} indicate the low and high confidence interval boundary at 95% significance. r shows the correlation at time t-/+ x (where x are different leads and lags) and highest correlation for every country and period are in bold.

Table 9.8 Period 4: 1972-2005, Correlation between Inflation and u-gap

	Denmark			France			Germany			Italy			Sweden			The UK			The US		
	CI^{Low}	r	CI^{High}	CI^{Low}	r	CI^{High}	CI^{Low}	r	CI^{High}	CI^{Low}	r	CI^{High}	CI^{Low}	r	CI^{High}	CI^{Low}	r	CI^{High}	CI^{Low}	r	CI^{High}
t-3	-0.31	0.13	0.52	-0.19	0.25	0.61	0.01	0.43	0.72	-0.52	-0.12	0.31	-0.13	**0.31**	0.65	-0.43	-0.01	0.41	-0.44	-0.02	0.41
t-2	-0.28	**0.17**	0.55	-0.15	**0.29**	0.64	0.08	**0.49**	0.75	-0.46	**-0.04**	0.38	-0.13	0.30	0.64	-0.15	0.29	0.63	-0.25	0.19	0.57
t-1	-0.36	0.07	0.48	-0.24	0.20	0.57	-0.18	0.27	0.62	-0.48	-0.07	0.36	-0.16	0.28	0.63	-0.01	**0.41**	0.71	-0.11	**0.33**	0.66
t	-0.51	-0.11	0.32	-0.37	0.06	0.47	-0.54	-0.16	0.28	-0.48	-0.08	0.36	-0.23	0.21	0.58	-0.21	0.23	0.59	-0.33	0.11	0.51
t+1	-0.57	-0.19	0.25	-0.40	0.03	0.45	-0.67	-0.34	0.10	-0.48	-0.08	0.35	-0.37	0.06	0.47	-0.55	-0.17	0.27	-0.54	-0.15	0.29
t+2	-0.55	-0.17	0.27	-0.44	-0.03	0.40	-0.68	-0.36	0.07	-0.46	-0.05	0.38	-0.62	-0.26	0.18	-0.62	-0.28	0.16	-0.71	-0.41	0.01
t+3	-0.53	-0.14	0.30	-0.54	-0.16	0.28	-0.62	-0.26	0.18	-0.45	**-0.04**	0.39	-0.66	-0.34	0.10	-0.58	-0.22	0.23	-0.75	-0.47	-0.07

CI^{Low} and CI^{High} indicate the low and high confidence interval boundary at 95% significance. r shows the correlation at time t-/+ x (where x are different leads and lags) and highest correlation for every country and period are in bold.

Table 9.9 Period 1: 1880-1913, Correlation between Inflation and i

	Denmark			France			Germany			Italy			Sweden			The UK			The US		
	CI^{Low}	r	CI^{High}	CI^{Low}	r	CI^{High}	CI^{Low}	r	CI^{High}	CI^{Low}	r	CI^{High}	CI^{Low}	r	CI^{High}	CI^{Low}	r	CI^{High}	CI^{Low}	r	CI^{High}
t-3	-0.45	-0.04	0.39	-0.56	-0.19	0.26	-0.59	-0.23	0.21	-0.48	-0.08	0.36	-0.58	-0.20	0.24	-0.56	-0.18	0.26	-0.38	0.05	0.46
t-2	-0.41	0.01	0.43	-0.28	0.16	0.54	-0.51	-0.11	0.32	-0.59	-0.22	0.22	-0.62	-0.27	0.17	-0.51	-0.12	0.32	-0.46	-0.05	0.38
t-1	-0.20	0.24	0.60	-0.13	0.31	0.64	-0.38	0.04	0.46	-0.54	-0.15	0.29	-0.43	-0.01	0.41	-0.37	0.06	0.47	-0.40	0.03	0.44
t	0.04	**0.46**	0.74	-0.09	**0.35**	0.67	-0.14	0.30	0.64	-0.38	**0.05**	0.46	-0.07	0.37	0.68	0.01	**0.43**	0.72	0.01	**0.43**	0.72
t+1	0.02	0.44	0.73	-0.11	0.32	0.66	0.17	0.55	0.79	-0.41	0.01	0.43	0.24	0.60	0.81	-0.03	0.40	0.70	-0.38	0.05	0.46
t+2	0.06	0.47	0.75	-0.30	0.14	0.53	0.23	**0.60**	0.81	-0.40	0.03	0.44	0.35	**0.67**	0.85	-0.25	0.19	0.57	-0.41	0.02	0.44
t+3	-0.15	0.29	0.63	-0.27	0.17	0.55	-0.21	0.23	0.59	-0.41	0.01	0.43	0.00	0.42	0.71	-0.19	0.25	0.61	-0.17	0.27	0.62

CI^{Low} and CI^{High} indicate the low and high confidence interval boundary at 95% significance. r shows the correlation at time t-/+ x (where x are different leads and lags) and highest correlation for every country and period are in bold.

Table 9.10 Period 2: 1914-1939, Correlation between Inflation and i

	Denmark			France			Germany			Italy			Sweden			The UK			The US		
	CI^{Low}	r	CI^{High}	CI^{Low}	r	CI^{High}	CI^{Low}	r	CI^{High}	CI^{Low}	r	CI^{High}	CI^{Low}	r	CI^{High}	CI^{Low}	r	CI^{High}	CI^{Low}	r	CI^{High}
t-3	-0.49	-0.09	0.34	-0.10	0.34	0.67	-0.42	0.00	0.42	-0.61	-0.26	0.19	-0.55	-0.17	0.27	-0.52	-0.12	0.32	-0.46	-0.05	0.38
t-2	-0.69	-0.38	0.05	0.01	0.43	0.72	-0.44	-0.02	0.40	-0.50	-0.11	0.33	-0.53	-0.14	0.30	-0.58	-0.21	0.24	-0.61	-0.26	0.18
t-1	-0.67	-0.34	0.09	0.05	0.46	0.74	-0.91	-0.80	-0.57	-0.71	-0.41	0.02	-0.44	-0.03	0.40	-0.48	-0.08	0.35	-0.64	-0.30	0.13
t	-0.40	0.02	0.44	0.18	**0.56**	0.79	0.08	**0.49**	0.75	-0.35	0.08	0.49	-0.15	0.29	0.63	-0.16	0.28	0.63	-0.42	0.00	0.42
t+1	-0.22	**0.22**	0.59	0.18	**0.56**	0.79	-0.34	0.10	0.50	-0.31	0.13	0.52	0.00	0.42	0.72	-0.02	**0.41**	0.71	-0.08	0.36	0.68
t+2	-0.32	0.12	0.51	-0.03	0.40	0.70	-0.37	0.06	0.47	-0.29	0.15	0.54	0.01	**0.43**	0.72	-0.10	0.34	0.66	0.03	0.45	0.73
t+3	-0.33	0.11	0.50	-0.16	0.28	0.63	-0.36	0.07	0.48	-0.08	**0.36**	0.68	-0.04	0.38	0.69	-0.13	0.31	0.65	0.17	**0.55**	0.79

CI^{Low} and CI^{High} indicate the low and high confidence interval boundary at 95% significance. r shows the correlation at time t-/+ x (where x are different leads and lags) and highest correlation for every country and period are in bold.

Table 9.11 Period 3: 1950-1971, Correlation between Inflation and i

	Denmark			France			Germany			Italy			Sweden			The UK			The US		
	CI^{Low}	r	CI^{High}	CI^{Low}	r	CI^{High}	CI^{Low}	r	CI^{High}	CI^{Low}	r	CI^{High}	CI^{Low}	r	CI^{High}	CI^{Low}	r	CI^{High}	CI^{Low}	r	CI^{High}
t-3	-0.12	0.32	0.65	-0.42	0.01	0.43	-0.92	-0.82	-0.61	-0.78	-0.53	-0.14	-0.33	0.11	0.51	-0.66	-0.33	0.11	0.04	0.45	0.74
t-2	0.13	0.52	0.77	-0.46	-0.05	0.38	-0.89	-0.76	-0.50	-0.75	-0.48	-0.07	-0.32	0.12	0.52	-0.51	-0.12	0.32	0.14	0.53	0.78
t-1	0.68	**0.86**	0.94	-0.24	0.20	0.57	-0.61	-0.25	0.19	-0.62	-0.27	0.17	-0.02	0.40	0.70	0.04	**0.46**	0.74	0.46	**0.74**	0.88
t	0.38	0.69	0.86	-0.03	**0.39**	0.70	-0.22	**0.23**	0.59	-0.59	-0.22	0.22	0.19	**0.56**	0.80	-0.03	0.40	0.70	0.13	0.53	0.78
t+1	0.18	0.56	0.79	-0.19	0.25	0.61	-0.39	0.04	0.46	-0.63	-0.28	0.16	-0.05	0.38	0.69	-0.23	0.22	0.58	0.18	0.56	0.79
t+2	0.12	0.52	0.77	-0.38	0.05	0.47	-0.56	-0.18	0.26	-0.60	-0.24	0.20	-0.17	0.27	0.62	-0.17	0.27	0.62	0.25	0.61	0.82
t+3	0.07	0.48	0.75	-0.46	-0.04	0.38	-0.45	-0.04	0.39	-0.48	**-0.08**	0.36	0.04	0.46	0.74	-0.31	0.13	0.52	0.00	0.42	0.72

CI^{Low} and CI^{High} indicate the low and high confidence interval boundary at 95% significance. r shows the correlation at time t-/+ x (where x are different leads and lags) and highest correlation for every country and period are in bold.

Table 9.12 Period 4: 1972-2005, Correlation between Inflation and i

	Denmark			France			Germany			Italy			Sweden			The UK			The US		
	CI^{Low}	r	CI^{High}	CI^{Low}	r	CI^{High}	CI^{Low}	r	CI^{High}	CI^{Low}	r	CI^{High}	CI^{Low}	r	CI^{High}	CI^{Low}	r	CI^{High}	CI^{Low}	r	CI^{High}
t-3	0.13	0.53	0.78	-0.25	0.19	0.57	-0.30	0.14	0.53	-0.30	0.14	0.53	-0.48	-0.08	0.35	-0.24	0.21	0.58	-0.33	0.10	0.50
t-2	0.27	0.62	0.83	0.01	0.43	0.72	0.05	0.46	0.74	-0.13	0.31	0.65	-0.38	0.05	0.46	-0.01	0.41	0.71	-0.02	0.40	0.71
t-1	0.41	0.71	0.87	0.29	0.63	0.83	0.36	**0.68**	0.86	0.21	0.58	0.80	-0.11	0.33	0.66	0.27	0.62	0.83	0.41	0.71	0.87
t	0.45	0.73	0.88	0.43	0.72	0.88	0.23	0.59	0.81	0.43	0.72	0.88	0.13	0.52	0.77	0.30	**0.64**	0.84	0.57	**0.80**	0.91
t+1	0.47	**0.75**	0.89	0.49	0.76	0.89	-0.13	0.31	0.65	0.61	0.82	0.92	0.32	0.65	0.84	0.23	0.60	0.81	0.44	0.72	0.88
t+2	0.47	0.74	0.89	0.53	0.78	0.90	-0.40	0.03	0.44	0.60	0.81	0.92	0.37	**0.68**	0.86	0.05	0.46	0.74	0.27	0.62	0.83
t+3	0.44	0.73	0.88	0.56	**0.79**	0.91	-0.50	-0.10	0.34	0.65	**0.84**	0.93	0.35	0.67	0.85	0.19	0.57	0.80	0.20	0.58	0.80

CI^{Low} and CI^{High} indicate the low and high confidence interval boundary at 95% significance. r shows the correlation at time t-/+ x (where x are different leads and lags) and highest correlation for every country and period are in bold.

Table 9.13 OLS Benchmark for Structural Breaks 1880-2005:

$$\pi_t = \alpha_t + \beta_1\pi_{t-1} + \beta_2\pi^e_{t-1} + \beta_3\pi^e_t + \beta_4\pi^e_{t+1} + \beta_5 i_{t-1} + \beta_6 i_t + \beta_7 i_{t+1} + \beta_8\mu_{t-1} + \beta_9\mu_t + \beta_{10}\mu_{t+1} + \beta_{11}y^{gap}_{t-1} + \beta_{12}y^{gap}_t + \varepsilon_t$$

	Denmark	France	France#	Germany	Italy	Sweden	UK	US
α	-0.668 (1.312)	-4.416*** 1.273	2.162* (1.220)	-12.92** (5.971)	-5.283* (2.722)	-1.619 (1.510)	-1.127 (0.787)	-0.774* (0.432)
β_1	0.411*** (0.125)	0.339** (0.139)	0.675*** (0.113)	-0.002 (0.008)	0.018 (0.146)	0.399*** (0.083)	0.443*** (0.107)	0.381*** (0.110)
β_2	-0.066 (0.269)	-0.399 (0.662)	-0.330 (0.570)	0.000 (0.000)	2.626 (1.658)	-0.002 (0.491)	-0.750*** (0.278)	-1.057** (0.488)
β_3	0.721 (0.497)	0.277 (0.754)	0.850 (0.663)	0.000* (0.000)	-0.351 (1.033)	0.551 (0.589)	1.751*** (0.623)	0.432 (0.610)
β_4	-0.622 (0.491)	-0.864* (0.811)	-0.361 (0.810)	0.000** (0.000)	-1.869 (1.138)	-0.576 (0.415)	-0.870* (0.470)	1.514*** (0.497)
β_5	-0.810 (0.568)	-0.679 (0.405)	-1.287*** (0.432)	2.767** (1.285)	-1.906* (1.138)	-0.910 (0.611)	-0.227 (0.330)	-0.445* (0.246)
β_6	0.345 (0.454)	0.986 (0.832)	0.581 (0.864)	-1.070 (0.769)	1.312 (0.790)	0.226 (0.525)	0.021 (0.282)	0.002 (0.534)
β_7	0.923 (0.627)	0.722 (0.885)	0.581 (0.802)	1.677 (0.949)	0.763 (0.833)	0.968** (0.383)	0.217 (0.214)	-0.439 (0.346)
β_8	0.118 (0.154)	-0.078 (0.575)	n/a	0.570 (0.274)	-0.987 (0.768)	-0.787* (0.413)	0.657** (0.259)	0.512** (0.213)
β_9	0.109 (0.173(	0.590 (1.053)	n/a	-0.031 (0.107)	1.214 (0.751)	1.088* (0.563)	-1.180* (0.603)	-0.098 (0.351)
β_{10}	-0.046 (0.141)	0.358 (0.557)	n/a	-0.060 (0.168)	1.034*** (0.350)	0.261 (0.504)	0.874 (0.543)	0.150 (0.263)
β_{11}	0.647*** (0.170)	-0.338* (0.177)	-0.325 (0.217)	-1.301** (0.579)	0.675* (0.385)	0.209 (0.196)	-0.635 (0.393)	-0.110 (0.086)
β_{12}	-0.084 (0.211)	0.089 (0.146)	0.044 (0.133)	0.484 (0.372)	-0.533 (0.525)	-0.603* (0.333)	1.001* (0.554)	0.176 (0.128)
R^2	54	61	52	61	65	62	62	60
Adj. R^2	49	55	48	55	61	58	58	55

Note: ***/**/* marks significance at 1, 5 and 10%-level. # France is estimated without μ due to lack of data. Estimated with Newey-West when tests show of autocorrelation and heteroskedasticity at 95%-level.

Table 9.14 OLS based on correlations, Benchmark: 1880-2005, $\pi_t = \alpha_t + \beta\pi_t^e + \beta i_t + \beta\mu_t + \beta y_t^{gap} + \varepsilon_t$

	Denmark		France		Germany°		Italy°		Sweden°		UK°		US°
α	-1.876	α	-4.158*	α	156.6*	α	-2.056	α	-2.989*	α	-1.184	α	-2.438***
	(1.465)		(2.116)		(86.99)		(1.922)		(1.515)		(0.829)		(0.843)
π_t^e	0.114	π_{t-2}^e	-0.912***	π_t^e	3.349	π_{t-1}^e	1.252**	π_{t+1}^e	-0.128	π_{t+1}^e	-0.477*	π_{t+2}^e	0.671***
	(0.174)		(0.231)		(4.082)		(0.620)		(0.256)		(0.262)		(0.200)
μ_{t-1}	0.335***	μ_{t-2}	0.637**	μ_{t-2}	5.591	μ_{t-1}	1.426***	μ_t	1.145***	μ_{t-1}	0.582**	μ_{t-1}	0.536**
	(0.080)		(0.199)		(4.289)		(0.376)		(0.322)		(0.256)		(0.215)
i_{t+1}	0.699**	i_{t+1}	1.361***	i_t	-46.05**	i_{t+2}	-0.963*	i_{t+2}	0.463	i_{t+1}	0.560***	i_{t+2}	-0.143
	(0.303)		(0.361)		(23.05)		(0.806)		(0.304)		(0.184)		(0.179)
y_{t-1}^{gap}	0.503***	y_{t+2}^{gap}	0.284**	y_{t-1}^{gap}	10.34	y_{t-2}^{gap}	0.128	y_{t-2}^{gap}	0.531*	y_t^{gap}	0.399**	y_t^{gap}	0.201
	(0.153)		(0.130)		(6.438)		(0.372)		(0.314)		(0.182)		(0.146)
d^{WW1}	3.550**	d^{WW1}	4.159	d^{WW1}	55.83	d^{WW1}	-3.631	d^{WW1}	-1.603	d^{WW1}	2.957	d^{WW1}	2.553
	(1.738)		(3.500)		(134.7)		(5.152)		(4.019)		(3.497)		(2.778)
d^{WW2}	-0.684	d^{WW2}	20.22***	d^{WW2}	-115.3	d^{WW2}	-6.328	d^{WW2}	0.617	d^{WW2}	-0.144	d^{WW2}	3.319***
	(2.037)		(4.576)		(90.47)		(11.85)		(1.623)		(2.378)		(1.255)
d^{BW}	0.426	d^{BW}	-1.828	d^{BW}	12.30	d^{BW}	-8.041	d^{BW}	0.658	d^{BW}	1.609	d^{BW}	1.663***
	(3.388)		(5.325)		(28.67)		(3.511)		(1.242)		(1.395)		(0.618)
d^{OPEC1}	1.573	d^{OPEC1}	-1.507	d^{OPEC1}	25.96	d^{OPEC1}	-0.657	d^{OPEC1}	0.463	d^{OPEC1}	7.472***	d^{OPEC2}	3.028***
	(2.959)		(4.707)		(38.90)		(2.300)		(1.376)		(2.322)		(1.162)
d^{OPEC2}	-0.221	d^{OPEC2}	-1.459	d^{OPEC2}	98.07*	d^{OPEC2}	6.128	d^{OPEC2}	-0.862	d^{OPEC2}	6.217***	d^{OPEC2}	2.735**
	(3.749)		(5.820)		(54.53)		(4.137)		(1.727)		(2.122)		(1.298)
				d^{UNIF}	109.7*								
					(59.29)						-		
R^2	43		57		46		55		51		52		47
Adj. R^2:	39		52		40		51		47		48		43

Note: ***/**/* marks significance at 1, 5 and 10%-level. # France is estimated from 1903 to 2003 due to lack of data.of μ °Estimated with Newey-West due to autocorrelation and/or heteroskedasticity at 95%-level.

Table 9.15 1880-2005 VAR-model:

$$\Pi_t = \Gamma_1 + \Gamma_2\Pi_{t-1} + \Gamma_3\Pi_{t-2} + \Gamma_4\Pi^e_{t-1} + \Gamma_5\Pi^e_{t-2} + \Gamma_6 I_{t-1} + \Gamma_7 I_{t-2} + \Gamma_8 M_{t-1} + \Gamma_9 M_{t-2} + \Gamma_{10} Y_{t-1} + \Gamma_{11} Y_{t-2} + \varepsilon_t$$

	Denmark			France			Germany			Italy		
	μ_t	i_t	y_t^{gap}	μ_t	i_t	y_t^{gap}	μ_t	i_t	y_t^{gap}	μ_t	i_t	y_t^{gap}
π_{t-1}	-0.066	0.030	-0.106	-0.011	0.016	-0.046	-0.557***	0.026*	0.181***	0.057**	0.009	-0.175***
	(-0.060)	(-0.020)	(-0.052)	(-0.028)	(-0.014)	(-0.063)	(-0.143)	(-0.015)	(-0.045)	(-0.025)	(-0.010)	(-0.028)
π_{t-2}	0.158**	0.009	-0.040	-0.015	-0.009	0.094	0.043***	0.000	0.006***	-0.015	-0.008	0.044
	(-0.064)	(-0.021)	(-0.055)	(-0.028)	(-0.014)	(-0.063)	(-0.005)	(-0.001)	(-0.002)	(-0.028)	(-0.012)	(-0.032)
π^e_{t-1}	0.485*	-0.050	0.500	-0.216	0.213***	0.722**	-0.423	0.015	0.776***	0.225	0.135	0.136
	(-0.257)	(-0.084)	(-0.221)	(-0.157)	(-0.078)	(-0.358)	(-0.717)	(-0.077)	(-0.225)	(-0.212)	(-0.089)	(-0.240)
π^e_{t-2}	-0.494**	0.012	-0.204	0.088	-0.163**	-1.219***	0.844	0.006	-0.943***	-0.396*	-0.142	-0.402*
	(-0.247)	(-0.080)	(-0.212)	(-0.152)	(-0.076)	(-0.348)	(-0.685)	(-0.074)	(-0.214)	(-0.211)	(-0.089)	(-0.239)
μ_{t-1}	1.089***	0.000	0.168	1.609***	-0.124**	0.434	0.024	0.006	0.010	0.441***	0.027	0.256**
	(-0.096)	(-0.031)	(-0.083)	(-0.116)	(-0.057)	(-0.264)	(-0.081)	(-0.009)	(-0.025)	(-0.111)	(-0.047)	(-0.126)
μ_{t-2}	-0.169	0.010	-0.225	-0.792***	0.108*	-0.873***	0.080	-0.027**	-0.112***	0.198**	0.008	-0.170*
	(-0.109)	(-0.035)	(-0.094)	(-0.116)	(-0.058)	(-0.264)	(-0.098)	(-0.011)	(-0.031)	(-0.087)	(-0.037)	(-0.099)
i_{t-1}	-0.229	0.742***	-0.382	0.127	0.851***	0.067	-1.117	0.704***	-0.414	0.014	0.636***	0.100
	(-0.325)	(-0.106)	(-0.279)	(-0.231)	(-0.115)	(-0.527)	(-1.006)	(-0.108)	(-0.315)	(-0.228)	(-0.096)	(-0.259)
i_{t-2}	0.087	0.106	0.031	-0.050	0.015	0.516	1.082	-0.230**	0.238	0.129	0.265***	0.221
	(-0.326)	(-0.106)	(-0.280)	(-0.209)	(-0.104)	(-0.476)	(-1.029)	(-0.111)	(-0.322)	(-0.235)	(-0.099)	(-0.267)
y^{gap}_{t-1}	0.149	0.056	0.182	-0.063	0.014	0.306***	1.005***	0.009	0.446***	-0.060	-0.009	0.505***
	(-0.105)	(-0.034)	(-0.090)	(-0.038)	(-0.019)	(-0.087)	(-0.277)	(-0.030)	(-0.087)	(-0.077)	(-0.032)	(-0.087)
y^{gap}_{t-2}	0.411***	-0.055*	-0.377	0.105***	-0.016	-0.391**	-0.458	0.017	-0.263**	0.136**	-0.002	-0.309***
	(-0.097)	(-0.032)	(-0.084)	(-0.036)	(-0.018)	(-0.082)	(-0.328)	(-0.035)	(-0.103)	(-0.064)	(-0.027)	(-0.072)
α	2.103**	0.815**	-0.450	1.215**	0.547	0.426	2.344	2.122***	1.307	0.957	0.384	-0.864
	(-0.999)	(-0.326)	(-0.860)	(-0.581)	(-0.289)	(-1.327)	(-3.728)	(-0.402)	(-1.168)	(-0.716)	(-0.301)	(-0.812)
d^{WW1}	-2.742**	-0.373	1.827	1.831**	0.246	4.495**	30.98***	0.204	-3.787**	4.303***	-0.451	0.547
	(-1.209)	(-0.394)	(-1.040)	(-0.907)	(-0.451)	(-2.070)	(-5.030)	(-0.542)	(-1.576)	(-1.175)	(-0.494)	(-1.334)
d^{WW2}	-2.591*	-0.535	0.931	3.196**	-0.185	8.764***	16.49***	-0.067	1.535	10.24***	-0.845	2.968
	(-1.328)	(-0.433)	(-1.143)	(-1.272)	(-0.632)	(-2.903)	(-5.080)	(-0.548)	(-1.592)	(-1.675)	(-0.704)	(-1.900)
d^{B-W}	-0.018	-0.143	1.184	0.150	0.532	0.685	3.427	-0.324	0.716	2.147	0.198	-0.977
	(-2.097)	(-0.684)	(-1.804)	(-1.395)	(-0.694)	(-3.184)	(-5.865)	(-0.632)	(-1.838)	(-2.146)	(-0.902)	(-2.435)
d^{OPEC1}	-1.445	0.707	0.526	0.353	1.551**	1.565	5.339	0.251	-0.913	4.601**	0.602	0.113
	(-1.749)	(-0.570)	(-1.505)	(-1.200)	(-0.597)	(-2.739)	(-4.945)	(-0.533)	(-1.550)	(-1.827)	(-0.768)	(-2.073)
d^{OPEC2}	-1.198	2.234***	1.756	1.201	1.636**	1.071	3.062	2.077***	1.676	3.029	3.965***	2.475
	(2.142)	(0.699)	(1.843)	(1.391)	(0.691)	(3.174)	(5.922)	(0.638)	(1.855)	(2.215)	(0.931)	(2.514)
$d^{RE-U.}$	n/a	n/a	n/a	n/a	n/a	n/a	3.838	1.805***	0.789	n/a	n/a	n/a
							(-4.818)	(-0.519)	(-1.509)			
R^2	89	82	40	94	93	60	70	63	70	90	91	60
Adj. R^2	87	80	31	93	91	52	65	56	52	89	88	54

Notes:

Table 9.16 1880-2005 VAR-model: $\Pi_t = \Gamma_1 + \Gamma_2\Pi_{t-1} + \Gamma_3\Pi_{t-2} + \Gamma_4\Pi^e_{t-1} + \Gamma_5\Pi^e_{t-2} + \Gamma_6 I_{t-1} + \Gamma_7 I_{t-2} + \Gamma_8 M_{t-1} + \Gamma_9 M_{t-2} + \Gamma_{10} Y_{t-1} + \Gamma_{11} Y_{t-2} + \varepsilon_t$

	Sweden			The UK			The US		
	μ_t	i_t	y_t^{gap}	μ_t	i_t	y_t^{gap}	μ_t	i_t	y_t^{gap}
π_{t-1}	0.004	0.043*	-0.047	0.028	-0.002	0.016	0.009	-0.002	0.007
	(-0.022)	(-0.023)	(-0.040)	(-0.061)	(-0.033)	(-0.057)	(-0.032)	(-0.031)	(-0.126)
π_{t-2}	0.007	-0.005	0.018	-0.107*	-0.055	0.082	0.010	0.009	0.179
	(-0.022)	(-0.023)	(-0.040)	(-0.063)	(-0.034)	(-0.059)	(-0.032)	(-0.030)	(-0.124)
π^e_{t-1}	-0.106	0.314**	0.343	0.234	0.622***	-0.661**	0.279	-0.120	-0.889
	(-0.140)	(-0.145)	(-0.254)	(-0.313)	(-0.168)	(-0.292)	(-0.224)	(-0.214)	(-0.878)
π^e_{t-2}	0.106	-0.210	-0.408	0.189	-0.023	0.389*	-0.167	0.295*	0.493
	(-0.135)	(-0.141)	(-0.247)	(-0.227)	(-0.122)	(-0.212)	(-0.185)	(-0.176)	(-0.723)
μ_{t-1}	1.563***	-0.124	0.402**	0.728***	0.140	0.818***	1.229***	0.106	0.751**
	(-0.091)	(-0.095)	(-0.166)	(-0.217)	(-0.117)	(-0.202)	(-0.089)	(-0.085)	(-0.350)
μ_{t-2}	-0.689***	0.147	-0.526***	0.046	-0.007	-0.688***	-0.469***	-0.022	-0.707**
	(-0.085)	(-0.089)	(-0.156)	(-0.214)	(-0.115)	(-0.199)	(-0.087)	(-0.083)	(-0.342)
i_{t-1}	0.049	0.531***	0.107	-0.146	0.261**	0.174	-0.124	0.847***	-0.053
	(-0.112)	(-0.116)	(-0.203)	(-0.200)	(-0.107)	(-0.186)	(-0.124)	(-0.118)	(-0.487)
i_{t-2}	-0.068	0.224**	0.020	0.000	-0.100	-0.113	0.045	-0.284***	0.306
	(-0.107)	(-0.111)	(-0.195)	(-0.193)	(-0.104)	(-0.180)	(-0.112)	(-0.107)	(-0.439)
y^{gap}_{t-1}	-0.012	0.126**	0.392***	1.526***	0.802***	0.584**	0.007	0.017	0.569***
	(-0.047)	(-0.049)	(-0.085)	(-0.274)	(-0.147)	(-0.256)	(-0.024)	(-0.023)	(-0.094)
y^{gap}_{t-2}	0.086*	-0.001	-0.410***	-0.487*	-0.701***	-0.655***	0.008	-0.016	-0.398***
	(-0.046)	(-0.047)	(-0.083)	(-0.264)	(-0.142)	(-0.246)	(-0.023)	(-0.022)	(-0.090)
α	0.529	0.842**	-0.085	0.047	0.701**	0.079	0.257	0.768***	0.534
	(-0.369)	(-0.385)	(-0.673)	(-0.584)	(-0.314)	(-0.545)	(-0.272)	(-0.259)	(-1.066)
d^{WW1}	-0.266	-0.373	0.494	0.406	0.212	-0.264	1.006**	-0.017	-2.689
	(-0.413)	(-0.431)	(-0.753)	(-1.219)	(-0.655)	(-1.137)	(-0.490)	(-0.466)	(-1.917)
d^{WW2}	-0.024	-0.351	-0.173	0.134	-1.921***	-0.018	0.989**	-1.173***	-0.198
	(-0.356)	(-0.371)	(-0.650)	(-1.140)	(-0.612)	(-1.063)	(-0.462)	(-0.440)	(-1.810)
d^{B-W}	-0.323	-0.186	-0.122	2.044	-2.730***	-1.702	0.217	-0.335	-1.489
	(-0.709)	(-0.739)	(-1.293)	(-1.857)	(-0.997)	(-1.731)	(-0.784)	(-0.747)	(-3.072)
d^{OPEC1}	0.885	-0.023	1.420	0.562	0.646	0.423	0.530	0.643	-0.983
	(0.596)	(0.621)	(-1.087)	(-1.667)	(-0.895)	(-1.555)	(-0.666)	(-0.635)	(-2.609)
d^{OPEC2}	0.603	0.737	1.421	0.636	2.902**	-1.051	0.790	2.882***	0.871
	(0.760)	(0.792)	(1.386)	(2.099)	(1.127)	(1.957)	(0.882)	(0.840)	(3.453)
$d^{RE-U.}$	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
R^2	93	87	44	83	86	46	88	83	37
Adj. R^2	93	85	37	81	84	39	86	80	27

Notes:

Table 9.17 1880-1913 VAR-model: $\Pi_t = \Gamma_1 + \Gamma_2\Pi_{t-1} + \Gamma_3\Pi_{t-2} + \Gamma_4\Pi^e_{t-1} + \Gamma_5\Pi^e_{t-2} + \Gamma_6 I_{t-1} + \Gamma_7 I_{t-2} + \Gamma_8 M_{t-1} + \Gamma_9 M_{t-2} + \Gamma_{10} Y_{t-1} + \Gamma_{11} Y_{t-2} + \varepsilon_t$

	Denmark			France#			Germany			Italy		
	μ_t	i_t	y_t^{gap}	μ_t	i_t	y_t^{gap}	μ_t	i_t	y_t^{gap}	μ_t	i_t	y_t^{gap}
π_{t-1}	0.006	-0.003	0.020	n/a	0.080*	0.545	0.047	0.080	-0.042	-0.026	0.006	0.294
	(0.084)	(0.036)	(0.063)		(0.046)	(0.489)	(0.170)	(0.056)	(0.133)	(0.194)	(0.042)	(0.335)
π_{t-2}	-0.058	0.036	-0.004	n/a	0.102**	0.262	-0.015	0.063	0.077	-0.122	0.020	0.359
	(0.071)	(0.031)	(0.053)		(0.044)	(0.465)	(0.187)	(0.061)	(0.145)	(0.129)	(0.028)	(0.223)
π^e_{t-1}	0.638	0.029	0.643	n/a	-0.017	0.899	1.570	-0.144	3.035***	-0.172	0.172	0.746
	(0.581)	(0.250)	(0.432)		(0.088)	(0.943)	(1.011)	(0.333)	(0.788)	(0.552)	(0.120)	(0.953)
π^e_{t-2}	-1.260	-0.219	0.129	n/a	0.164*	-0.753	-1.153	0.194	-1.668**	-0.268	-0.059	0.371
	(0.761)	(0.327)	(0.566)		(0.094)	(1.008)	(0.899)	(0.296)	(0.700)	(0.505)	(0.109)	(0.871)
μ_{t-1}	1.271***	0.126	0.173	n/a	n/a	n/a	0.652	0.121	-0.213	0.059	0.078	-0.018
	(0.254)	(0.110)	(0.189)				(0.439)	(0.145)	(0.342)	(0.243)	(0.053)	(0.420)
μ_{t-2}	-0.571*	0.024	0.089	n/a	n/a	n/a	0.375	-0.024	0.678**	0.020	0.072	0.198
	(0.288)	(0.124)	(0.214)				(0.431)	(0.142)	(0.336)	(0.306)	(0.066)	(0.528)
i_{t-1}	-0.009	0.784***	-0.732*	n/a	0.898***	1.116	0.145	0.414	-0.936	2.189	0.463	0.181
	(0.528)	(0.227)	(0.393)		(0.192)	(2.051)	(0.830)	(0.273)	(0.646)	(1.415)	(0.307)	(2.442)
i_{t-2}	0.454	-0.196	0.356	n/a	-0.409*	-1.268	-0.619	-0.206	-0.940	-1.208	-0.211	-5.272**
	(0.462)	(0.199)	(0.344)		(0.207)	(2.206)	(0.731)	(0.240)	(0.569)	(1.193)	(0.259)	(2.059)
y^{gap}_{t-1}	0.096	-0.050	-0.121	n/a	-0.019	0.199	-0.181	0.039	0.367	-0.129	-0.001	0.052
	(0.265)	(0.114)	(0.197)		(0.021)	(0.221)	(0.308)	(0.101)	(0.240)	(0.125)	(0.027)	(0.215)
y^{gap}_{t-2}	0.564**	-0.003	-0.527***	n/a	-0.024	-0.235	0.266	-0.055	0.034	0.128	-0.006	0.177
	(0.232)	(0.100)	(0.172)		(0.025)	(0.266)	(0.283)	(0.093)	(0.220)	(0.130)	(0.028)	(0.224)
α	-0.071	2.092***	-1.617	n/a	1.222***	0.352	2.055	3.108***	7.000***	-3.542	3.425*	22.32
	(1.743)	(0.750)	(1.296)		(0.415)	(4.425)	(2.857)	(0.940)	(2.226)	(8.423)	(1.826)	(14.54)
R^2	80	77	52	n/a	75	33	81	66	85	37	68	28
Adj. R^2	70	66	29	n/a	66	10	72	50	78	1	53	0

Notes: ***/**/* marks significance at 1, 5 and 10%-level. # France is estimated without μ due to lack of data.

Table 9.18 1880-1913 VAR-model:

$$\Pi_t = \Gamma_1 + \Gamma_2\Pi_{t-1} + \Gamma_3\Pi_{t-2} + \Gamma_4\Pi^e_{t-1} + \Gamma_5\Pi^e_{t-2} + \Gamma_6 I_{t-1} + \Gamma_7 I_{t-2} + \Gamma_8 M_{t-1} + \Gamma_9 M_{t-2} + \Gamma_{10} Y_{t-1} + \Gamma_{11} Y_{t-2} + \varepsilon_t$$

	Sweden			The UK			The US		
	μ_t	i_t	y_t^{gap}	μ_t	i_t	y_t^{gap}	μ_t	i_t	y_t^{gap}
π_{t-1}	0.052	0.031	0.012	0.011	0.108*	0.056	-0.001	-0.062	-0.098
	(0.034)	(0.023)	(0.102)	(0.209)	(0.062)	(0.195)	(0.141)	(0.102)	(0.554)
π_{t-2}	-0.039	0.060**	-0.036	0.210	0.035	-0.185	0.240**	0.168*	0.103
	(0.035)	(0.023)	(0.104)	(0.173)	(0.052)	(0.161)	(0.115)	(0.084)	(0.455)
π^e_{t-1}	-0.057	0.271	1.335	6.529	0.452	-4.648	-0.320	-1.743*	1.475
	(0.286)	(0.192)	(0.858)	(3.996)	(1.188)	(3.723)	(1.513)	(1.098)	(5.964)
π^e_{t-2}	-0.141	-0.493**	-1.860*	0.994	0.253	-0.665	0.287	1.799*	-1.917
	(0.315)	(0.211)	(0.943)	(1.123)	(0.334)	(1.046)	(1.345)	(0.976)	(5.302)
μ_{t-1}	1.479***	-0.101	0.102	1.941*	0.187	-0.706	0.817***	-0.068	-0.290
	(0.205)	(0.137)	(0.614)	(1.066)	(0.317)	(0.993)	(0.189)	(0.137)	(0.746)
μ_{t-2}	-0.616***	0.216	0.033	-0.530	-0.280	0.250	-0.009	0.165	0.635
	(0.211)	(0.141)	(0.630)	(1.111)	(0.330)	(1.035)	(0.205)	(0.148)	(0.807)
i_{t-1}	-0.362	0.427**	0.897	-1.867*	0.278	1.586*	-0.157	0.693***	0.102
	(0.295)	(0.198)	(0.884)	(0.948)	(0.282)	(0.883)	(0.333)	(0.242)	(1.313)
i_{t-2}	0.102	-0.306*	-1.851**	-0.686	-0.314	0.467	-0.790***	-0.461	-1.103
	(0.250)	(0.168)	(0.750)	(0.778)	(0.231)	(0.725)	(0.290)	(0.210)	(1.143)
y^{gap}_{t-1}	-0.029	0.052	-0.025	9.941***	0.717	-5.751*	-0.010	0.025	-0.140
	(0.074)	(0.050)	(0.223)	(3.316)	(0.986)	(3.089)	(0.060)	(0.044)	(0.237)
y^{gap}_{t-2}	0.108	-0.005	-0.208	-7.394**	-0.616	4.365	0.059	-0.063	-0.194
	(0.070)	(0.047)	(0.209)	(3.143)	(0.934)	(2.928)	(0.067)	(0.049)	(0.266)
α	1.837	3.987***	4.557	-13.298*	1.664	8.968	4.370*	2.603	5.603
	(1.147)	(0.769)	(3.434)	(7.211)	(2.144)	(6.718)	(2.253)	(1.634)	(8.879)
R^2	89	83	51	73	48	44	79	52	16
Adj. R^2	84	75	28	61	23	17	70	29	0

Notes: ***/**/* marks significance at 1, 5 and 10%-level.

Table 9.19 1913-1939 VAR-model: $\Pi_t = \Gamma_1 + \Gamma_2\Pi_{t-1} + \Gamma_3\Pi_{t-2} + \Gamma_4\Pi^e_{t-1} + \Gamma_5\Pi^e_{t-2} + \Gamma_6 I_{t-1} + \Gamma_7 I_{t-2} + \Gamma_8 M_{t-1} + \Gamma_9 M_{t-2} + \Gamma_{10} Y_{t-1} + \Gamma_{11} Y_{t-2} + D + \varepsilon_t$

	Denmark			France			Germany°			Italy		
	μ_t	i_t	y^{gap}_t	μ_t	i_t	y^{gap}_t	μ_t	i_t	y^{gap}_t	μ_t	i_t	y^{gap}_t
π_{t-1}	-0.427*	0.035	-0.002	0.005	-0.006	-0.374**	-0.758	0.033*	0.092	-0.135	0.000	0.015
	(0.219)	(0.028)	(0.166	(0.103)	(0.022)	(0.174)	(0.521)	(0.018)	(0.122)	(0.082)	(0.030)	(0.141)
π_{t-2}	0.256	-0.035*	-0.134	-0.048	-0.021	0.093	0.045*	0.000	0.009	-0.002	-0.006	-0.042
	(0.160)	(0.020)	(0.122	(0.086)	(0.018)	(0.146)	(0.022)	(0.001)	(0.005)	(0.060)	(0.022)	(0.103)
π^e_{t-1}	3.702*	-0.274	0.441	-1.016	-0.028	1.028	-0.938	0.026	0.532	0.928**	-0.105	0.229
	(1.965)	(0.248)	(1.495	(0.629)	(0.135)	(1.064)	(3.223)	(0.112)	(0.755)	(0.397)	(0.146)	(0.683)
π^e_{t-2}	0.070	-0.053	-1.520	0.317	-0.064	-2.427**	0.988	0.021	-1.504**	-1.360***	0.057	-0.871
	(1.713)	(0.216)	(1.304	(0.534)	(0.115)	(0.904)	(2.868)	(0.100)	(0.672)	(0.401)	(0.148)	(0.690)
μ_{t-1}	0.182	0.027	0.297	1.916***	-0.017	0.596	-0.065	0.011	0.039	0.183	0.003	0.486
	(0.488)	(0.062)	(0.371	(0.365)	(0.078)	(0.618)	(0.269)	(0.009)	(0.063)	(0.167)	(0.062)	(0.288)
μ_{t-2}	0.289	0.027	-0.176	-1.057***	0.044	-0.261	0.111	-0.020	-0.036	0.440***	0.040	-0.184
	(0.380)	(0.048)	(0.289	(0.330)	(0.071)	(0.558)	(0.404)	(0.014)	(0.095)	(0.153)	(0.056)	(0.263)
i_{t-1}	1.949	0.953***	0.190	-0.128	1.233***	0.183	-1.743	0.234	-1.260	0.664	0.625*	-1.627
	(2.503)	(0.316)	(1.904	(1.482)	(0.319)	(2.510)	(9.825)	(0.341)	(2.303)	(0.906)	(0.334)	(1.559)
i_{t-2}	-3.538	-0.033	-0.782	-0.608	-0.416	-0.176	2.200	0.134	2.956	-3.257***	0.052	2.417
	(2.559)	(0.323)	(1.947	(1.834)	(0.394)	(3.105)	(8.791)	(0.305)	(2.060)	(1.050)	(0.387)	(1.806)
y^{gap}_{t-1}	0.518	0.047	-0.016	-0.123	0.000	0.210	1.168	0.017	0.451**	0.425**	-0.009	0.713**
	(0.326)	(0.041)	(0.248	(0.102)	(0.022)	(0.173)	(0.886)	(0.031)	(0.208)	(0.152)	(0.056)	(0.261)
y^{gap}_{t-2}	0.092	-0.077*	-0.365	0.083	-0.017	-0.582***	-0.862	0.056	-0.478	-0.286**	0.018	-0.561**
	(0.343)	(0.043)	(0.261	(0.102)	(0.022)	(0.172)	(1.410)	(0.049)	(0.330)	(0.122)	(0.045)	(0.209)
α	1.617	0.989	3.291	6.198	0.809	3.632	-0.406	2.760	-5.404	16.878***	1.664	-2.630
	(8.422)	(1.063)	(6.408	(5.446)	(1.170)	(9.222)	(55.32)	(1.921)	(12.97)	(3.986)	(1.469)	(6.858)
d^{WW1}	0.067	-0.088	1.923	3.086	0.514	-0.219	40.963**	-0.544	-2.230	6.585***	-0.185	-4.006
	(7.230)	(0.913)	(5.500	(3.721)	(0.800)	(6.300)	(18.15)	(0.630)	(4.253)	(2.179)	(0.803)	(3.749)
d^{WW2}	-9.833	0.682	13.53	7.385	0.299	16.351	13.653	-0.186	0.252	7.762**	-0.229	3.422
	(7.233)	(0.913)	(5.503	(4.851)	(1.042)	(8.214)	(25.67)	(0.892)	(6.017)	(3.006)	(1.108)	(5.173)
R^2	88	86	67	93	88	77	75	77	75	94	45	69
Adj. R^2	76	73	37	86	76	56	42	46	42	88	0	40

Notes: ***/**/* marks significance at 1, 5 and 10%-level. The values in parenthesis are standard errors. ° The estimations results for Germany suffer from serial correlation and heteroscedasticity.

Table 9.20 1913-1939 VAR-model: $\Pi_t = \Gamma_1 + \Gamma_2\Pi_{t-1} + \Gamma_3\Pi_{t-2} + \Gamma_4\Pi^e_{t-1} + \Gamma_5\Pi^e_{t-2} + \Gamma_6 I_{t-1} + \Gamma_7 I_{t-2} + \Gamma_8 M_{t-1} + \Gamma_9 M_{t-2} + \Gamma_{10} Y_{t-1} + \Gamma_{11} Y_{t-2} + D + \varepsilon_t$

	Sweden			The UK			The US		
	μ_t	i_t	y_t^{gap}	μ_t	i_t	y_t^{gap}	μ_t	i_t	y_t^{gap}
π_{t-1}	-0.054	0.054*	-0.223	0.096	0.060	-0.057	0.009	0.021	0.099
	(0.060)	(0.029)	(0.171)	(0.238)	(0.049)	(0.230)	(0.065)	(0.059)	(0.353)
π_{t-2}	-0.016	0.005	0.043	-0.135	-0.032	0.087	-0.019	-0.060	0.610*
	(0.038)	(0.019)	(0.109)	(0.168)	(0.035)	(0.163)	(0.066)	(0.060)	(0.355)
π^e_{t-1}	-1.520***	0.252	-0.553	-0.161	-0.093	-1.366	0.273	0.177	-9.583
	(0.529)	(0.259)	(1.508)	(4.372)	(0.902)	(4.230)	(1.302)	(1.180)	(7.033)
π^e_{t-2}	0.065	-0.309	-1.123	0.546	-0.195	0.145	-0.618	0.929	2.864
	(0.454)	(0.222)	(1.293)	(0.824)	(0.170)	(0.797)	(1.172)	(1.061)	(6.326)
μ_{t-1}	2.291***	-0.185	0.932	-0.109	-0.340	1.641*	0.732***	0.016	1.272
	(0.325)	(0.159)	(0.925)	(0.987)	(0.204)	(0.955)	(0.237)	(0.215)	(1.280)
μ_{t-2}	-0.913***	0.136	-0.404	0.121	0.149	-0.840	-0.425*	0.016	0.109
	(0.213)	(0.104)	(0.608)	(0.786)	(0.162)	(0.760)	(0.242)	(0.219)	(1.304)
i_{t-1}	0.570	0.216	2.220	-1.174	0.166	1.682	-0.553	0.734**	1.217
	(0.816)	(0.399)	(2.327)	(1.975)	(0.408)	(1.911)	(0.348)	(0.315)	(1.880)
i_{t-2}	0.267	0.569**	-1.343	-1.075	0.694	0.683	0.451	-0.352	1.626
	(0.523)	(0.256)	(1.492)	(2.093)	(0.432)	(2.025)	(0.384)	(0.348)	(2.075)
y^{gap}_{t-1}	-0.083	0.004	0.268	0.360	-0.357	0.585	0.034	0.035	0.411
	(0.085)	(0.041)	(0.242)	(5.095)	(1.051)	(4.929)	(0.059)	(0.053)	(0.317)
y^{gap}_{t-2}	0.053	0.102**	-0.489*	1.056	0.466	-1.009	-0.008	0.064	-0.559*
	(0.086)	(0.042)	(0.244)	(5.061)	(1.044)	(4.897)	(0.052)	(0.047)	(0.279)
α	-1.212	0.668	-0.612	9.211	1.719	-5.768	1.485	-1.934	12.95
	(1.982)	(0.969)	(5.650)	(9.989)	(2.061)	(9.664)	(2.500)	(2.265)	(13.50)
d^{WW1}	-1.717	0.737	-2.261	8.077	1.712	-7.015	5.500***	0.187	-12.45
	(2.598)	(1.271)	(7.406)	(6.556)	(1.353)	(6.343)	(1.754)	(1.589)	(9.470)
d^{WW2}	-2.041	-0.012	0.520	5.195	1.687	-5.604	-0.493	-0.215	-5.096
	(1.482)	(0.725)	(4.226)	(4.809)	(0.992)	(4.652)	(1.650)	(1.494)	(8.908)
R^2	98	91	56	86	88	77	95	82	62
Adj. R^2	96	83	15	74	77	55	91	65	26

Notes: ***/**/* marks significance at 1, 5 and 10%-level. The values in parenthesis are standard errors.

Table 9.21 1950-1971 VAR-model: $\Pi_t = \Gamma_1 + \Gamma_2\Pi_{t-1} + \Gamma_3\Pi_{t-2} + \Gamma_4\Pi^e_{t-1} + \Gamma_5\Pi^e_{t-2} + \Gamma_6\mathrm{I}_{t-1} + \Gamma_7\mathrm{I}_{t-2} + \Gamma_8\mathrm{M}_{t-1} + \Gamma_9\mathrm{M}_{t-2} + \Gamma_{10}\mathrm{Y}_{t-1} + \Gamma_{11}\mathrm{Y}_{t-2} + D + \varepsilon_t$

	Denmark			France			Germany[#]			Germany Without μ			
	μ_t	i_t	y_t^{gap}	μ_t	i_t	y_t^{gap}	μ_t	i_t	y_t^{gap}	π_t	π_t^e	i_t	y_t^{gap}
π_{t-1}	0.329***	0.206	-0.205	0.038	0.024	-0.004	0.597	0.591	1.446	-0.654***	-0.446***	-0.013	0.031
	(0.139)	(0.200)	(0.208)	(0.038)	(0.054)	(0.061)	(0.363)	(0.647)	(1.093)	(0.170)	(0.123)	(0.115)	(0.175)
π_{t-2}	-0.054	-0.038	0.020	0.075	0.039	0.015	0.040***	0.086	0.803	-0.423**	0.010	-0.133	-0.206
	(0.119)	(0.171)	(0.178)	(0.029)	(0.041)	(0.047)	(0.523)	(0.932)	(1.574)	(0.161)	(0.117)	(0.109)	(0.166)
π^e_{t-1}	-0.654	0.033	0.977*	0.025	0.049	0.137	-0.056	-1.398	-0.693	0.266	1.382***	-0.232	-0.331
	(0.335)	(0.481)	(0.501)	(0.194)	(0.277)	(0.315)	(0.585)	(1.043)	(1.760)	(0.315)	(0.228)	(0.213)	(0.324)
π^e_{t-2}	0.382	-0.007	-0.795	-0.035	0.439*	-0.443	-0.288	1.117	0.719	0.332	-0.423*	0.211	0.067
	(0.311)	(0.447)	(0.465)	(0.180)	(0.256)	(0.292)	(0.422)	(0.751)	(1.268)	(0.311)	(0.225)	(0.210)	(0.320)
μ_{t-1}	1.005***	-0.013	0.496	0.875***	0.599*	0.146	0.518'***	-0.267	1.114	n/a	n/a	n/a	n/a
	(0.246)	(0.352)	(0.367)	(0.231)	(0.330)	(0.375)	(0.593)	(1.057)	(1.784)				
μ_{t-2}	-0.184	0.147	-0.470	-0.539***	-0.611**	-0.222	0.577***	-0.125	1.628	n/a	n/a	n/a	n/a
	(0.260)	(0.373)	(0.388)	(0.189)	(0.270)	(0.307)	(0.608)	(1.084)	(1.830)				
i_{t-1}	-0.466	-0.036	-0.461	0.175	0.357	0.095	-0.107	0.433	-1.046	-0.542	-0.064	0.412	-0.670
	(0.413)	(0.592)	(0.616)	(0.228)	(0.325)	(0.370)	(0.322)	(0.574)	(0.969)	(0.689)	(0.499)	(0.466)	(0.710)
i_{t-2}	0.143	0.069	0.256	-0.074	-0.184	-0.198	0.198	-0.022	0.524	0.343	-0.091	-0.037	0.464
	(0.334)	(0.479)	(0.499)	(0.197)	(0.281)	(0.320)	(0.221)	(0.394)	(0.665)	(0.485)	(0.351)	(0.328)	(0.499)
y^{gap}_{t-1}	0.215	0.197	0.074	0.069	0.288	0.513	-0.349	0.269	0.078	0.444*	-0.131	-0.025	0.608**
	(0.173)	(0.248)	(0.258)	(0.189)	(0.271)	(0.308)	(0.275)	(0.490)	(0.827)	(0.255)	(0.185)	(0.173)	(0.263)
y^{gap}_{t-2}	-0.253	-0.288	-0.438*	-0.167	-0.235	-0.418	-0.288	-0.775	-1.530	0.334	0.283**	-0.234	-0.767***
	(0.165)	(0.237)	(0.247)	(0.199)	(0.284)	(0.323)	(0.367)	(0.655)	(1.105)	(0.209)	(0.151)	(0.141)	(0.215)
α	2.113	4.423	-1.931	3.851**	3.625	0.669	-2.038**	4.595	-21.67	4.601*	1.835	3.062*	2.094
	(2.675)	(3.839)	(3.996)	(1.786)	(2.550)	(2.902)	(5.145)	(9.169)	(15.48)	(2.569)	(1.862)	(1.739)	(2.647)
d^{B-W}	2.579	1.636	1.253	-0.046	-0.233	1.397	0.697	-0.684	3.913	1.514	0.850	-0.048	0.878
	(1.641)	(2.354)	(2.450)	(1.520)	(2.171)	(2.470)	(0.963)	(1.717)	(2.898)	(1.958)	(1.419)	(1.326)	(2.018)
R^2	97	70	76	89	80	76	93	83	84	88	96	64	79
Adj. R^2	94	37	50	78	57	50	65	21	26	76	92	29	59

Notes: ***/**/* marks significance at 1, 5 and 10%-level. The values in parenthesis are standard errors. [#] Germany is estimated from 1954 with μ and without μ from 1950.

Table 9.22 1950-1971 VAR-model: $\Pi_t = \Gamma_1 + \Gamma_2\Pi_{t-1} + \Gamma_3\Pi_{t-2} + \Gamma_4\Pi^e_{t-1} + \Gamma_5\Pi^e_{t-2} + \Gamma_6 I_{t-1} + \Gamma_7 I_{t-2} + \Gamma_8 M_{t-1} + \Gamma_9 M_{t-2} + \Gamma_{10} Y_{t-1} + \Gamma_{11} Y_{t-2} + D + \varepsilon_t$

	Italy			Sweden			The UK			The US		
	μ_t	i_t	y_t^{gap}	μ_t	i_t	y_t^{gap}	μ_t	i_t	y_t^{gap}	μ_t	i_t	y_t^{gap}
π_{t-1}	-0.080	-0.019	0.006	0.066	0.024	-0.048	0.200	-0.185	-0.257	0.027	0.110	0.036
	(0.105)	(0.037)	(0.163)	(0.055)	(0.039)	(0.096)	(0.133)	(0.230)	(0.161)	(0.064)	(0.096)	(0.257)
π_{t-2}	0.028	-0.031	-0.031	0.057	0.016	-0.058	-0.198*	-0.093	0.169	-0.175***	0.037	0.320*
	(0.101)	(0.036)	(0.157)	(0.047)	(0.034)	(0.083)	(0.116)	(0.202)	(0.141)	(0.044)	(0.067)	(0.179)
π^e_{t-1}	-0.347	0.135	-0.122	1.157***	0.335	1.581***	2.460**	0.930	-1.253	0.468	-1.987**	-6.073***
	(0.338)	(0.120)	(0.526)	(0.309)	(0.220)	(0.539)	(0.953)	(1.652)	(1.153)	(0.492)	(0.742)	(1.987)
π^e_{t-2}	0.444***	-0.080	0.081	0.024	0.412	-1.035	-1.201***	0.046	0.977	0.543	1.561**	4.472**
	(0.184)	(0.065)	(0.286)	(0.477)	(0.340)	(0.834)	(0.378)	(0.655)	(0.457)	(0.454)	(0.684)	(1.832)
μ_{t-1}	1.251***	-0.240*	-0.124	0.176	-0.082	0.049	-0.924*	-0.026	1.437	0.505***	0.059	-1.347**
	(0.374)	(0.132)	(0.582)	(0.332)	(0.236)	(0.580)	(0.558)	(0.968)	(0.676)	(0.124)	(0.186)	(0.499)
μ_{t-2}	-0.386	0.197	0.226	-0.172	-0.378*	-0.555	1.450***	0.169	-1.104*	-0.389***	-0.069	-0.256
	(0.365)	(0.129)	(0.567)	(0.312)	(0.222)	(0.545)	(0.490)	(0.849)	(0.593)	(0.114)	(0.172)	(0.460)
i_{t-1}	0.120	-0.428	0.344	-0.706*	0.821***	-1.025	-0.144	0.079	0.114	0.670**	1.846***	3.180**
	(0.897)	(0.317)	(1.396)	(0.358)	(0.255)	(0.626)	(0.259)	(0.449)	(0.313)	(0.301)	(0.454)	(1.215)
i_{t-2}	0.302	0.407	-0.197	-0.139	-0.464	0.472	0.563**	-0.327	-0.695**	-0.415	-0.341	0.614
	(1.280)	(0.453)	(1.991)	(0.400)	(0.284)	(0.698)	(0.222)	(0.385)	(0.269)	(0.373)	(0.563)	(1.506)
y^{gap}_{t-1}	0.016	0.091*	0.982***	0.039	0.162	0.200	2.398***	1.111	0.398	-0.262***	-0.055	0.310
	(0.131)	(0.046)	(0.204)	(0.193)	(0.137)	(0.337)	(0.654)	(1.134)	(0.791)	(0.077)	(0.117)	(0.312)
y^{gap}_{t-2}	-0.096	-0.038	-0.916***	-0.229	-0.190	-0.213	-1.295**	-0.449	-0.430	0.116	0.026	-0.690**
	(0.154)	(0.054)	(0.240)	(0.209)	(0.149)	(0.365)	(0.538)	(0.933)	(0.651)	(0.070)	(0.106)	(0.284)
α	-0.374	4.119***	-0.934	5.828***	3.806**	4.023	-6.026***	1.816	3.020	-2.508**	0.191	-2.632
	(3.591)	(1.271)	(5.587)	(2.054)	(1.461)	(3.587)	(2.129)	(3.692)	(2.576)	(0.557)	(0.840)	(2.249)
d^{B-W}	0.920	1.662***	-0.202	0.354	-0.630	0.376	0.339	-2.708	-1.420	-1.191	-0.354	0.532
	(1.495)	(0.529)	(2.327)	(0.709)	(0.504)	(1.238)	(1.133)	(1.965)	(1.371)	(0.517)	(0.780)	(2.088)
R^2	94	85	78	91	96	79	98	69	76	99	93	78
Adj. R^2	87	67	54	81	92	55	97	36	49	97	86	53

Notes: ***/**/* marks significance at 1, 5 and 10%-level. The values in parenthesis are standard errors.

Table 9.23 1972-2005 VAR-model: $\Pi_t = \Gamma_1 + \Gamma_2\Pi_{t-1} + \Gamma_3\Pi_{t-2} + \Gamma_4\Pi^e_{t-1} + \Gamma_5\Pi^e_{t-2} + \Gamma_6 I_{t-1} + \Gamma_7 I_{t-2} + \Gamma_8 M_{t-1} + \Gamma_9 M_{t-2} + \Gamma_{10} Y_{t-1} + \Gamma_{11} Y_{t-2} + D + \varepsilon_t$

	Denmark			France			Germany			Italy		
	μ_t	i_t	y_t^{gap}	μ_t	i_t	y_t^{gap}	μ_t	i_t	y_t^{gap}	μ_t	i_t	y_t^{gap}
π_{t-1}	0.453	-0.341	-0.364	0.251	-0.087	0.329	0.297	-0.034	0.199	0.235**	0.065	-0.148
	(0.276)	(0.248)	(0.229)	(0.214)	(0.224)	(0.230)	(0.199)	(0.326)	(0.385)	(0.090)	(0.284)	(0.169)
π_{t-2}	-0.020	0.553**	0.437	-0.085	-0.034	-0.448*	-0.271	0.216	0.140	-0.274**	0.072	-0.083
	(0.293)	(0.264)	(0.244)	(0.228)	(0.238)	(0.245)	(0.219)	(0.358)	(0.424)	(0.100)	(0.315)	(0.187)
π^e_{t-1}	-0.352	0.009	-0.012	0.118	0.756***	0.301**	-0.097	-0.073	-0.312	-0.109	0.048	0.145
	(0.282)	(0.254)	(0.234)	(0.126)	(0.132)	(0.136)	(0.187)	(0.307)	(0.363)	(0.132)	(0.414)	(0.246)
π^e_{t-2}	-0.061	0.040	-0.217	-0.073	-0.339**	-0.394**	-0.128	-0.102	-0.236	0.011	-0.278	-0.206
	(0.249)	(0.224)	(0.207)	(0.156)	(0.163)	(0.167)	(0.187)	(0.306)	(0.362)	(0.126)	(0.397)	(0.236)
μ_{t-1}	1.062***	-0.118	-0.026	1.061***	0.031	0.676	0.606**	0.694*	0.280	0.968***	1.086	0.609
	(0.243)	(0.218)	(0.201)	(0.252)	(0.264)	(0.271)	(0.232)	(0.379)	(0.448)	(0.237)	(0.748)	(0.444)
μ_{t-2}	-0.182	0.010	0.117	-0.152	0.037	-0.561**	0.235	-0.598	-0.081	0.011	-1.097	-0.497
	(0.255)	(0.229)	(0.211)	(0.249)	(0.261)	(0.268)	(0.247)	(0.405)	(0.478)	(0.224)	(0.706)	(0.419)
i_{t-1}	0.255	0.660**	-0.364	-0.412	0.406	-0.404	-0.022	0.732***	-0.071	0.008	0.821**	0.075
	(0.333)	(0.299)	(0.276)	(0.221)	(0.232)	(0.238)	(0.160)	(0.262)	(0.310)	(0.101)	(0.317)	(0.188)
i_{t-2}	-0.088	0.016	0.442	0.142	0.256	0.705**	0.250	-0.327	0.108	-0.025	0.321	0.149
	(0.298)	(0.268)	(0.247)	(0.251)	(0.263)	(0.270)	(0.183)	(0.300)	(0.355)	(0.080)	(0.250)	(0.149)
y^{gap}_{t-1}	-0.207	0.232	0.650**	-0.023	0.150	0.654***	-0.179	0.114	0.710**	-0.471***	-0.428	0.297
	(0.309)	(0.277)	(0.256)	(0.183)	(0.191)	(0.196)	(0.143)	(0.234)	(0.277)	(0.159)	(0.501)	(0.298)
y^{gap}_{t-2}	-0.142	0.130	-0.334*	0.093	-0.145	-0.425**	-0.339**	0.140	-0.515	0.206*	0.363	-0.268
	(0.221)	(0.199)	(0.184)	(0.160)	(0.168)	(0.172)	(0.166)	(0.271)	(0.320)	(0.119)	(0.376)	(0.223)
α	0.517	1.197	-0.453	1.684*	0.314	-1.867*	0.591	2.404*	0.658	1.332**	-0.622	-0.632
	(0.976)	(0.878)	(0.811)	(0.924)	(0.967)	(0.993)	(0.776)	(1.270)	(1.501)	(0.564)	(1.775)	(1.054)
d^{opec1}	-1.286	1.816	0.318	-0.549	1.767**	-0.778	1.361*	-0.799	-1.113	0.284	-0.644	-0.438
	(1.379)	(1.241)	(1.145)	(0.743)	(0.778)	(0.798)	(0.701)	(1.148)	(1.357)	(0.729)	(2.297)	(1.364)
d^{opec2}	0.278	1.375	0.962	-0.931	0.755	0.268	0.510	1.618	0.710	0.808	4.247**	2.777**
	(1.378)	(1.239)	(1.144)	(0.722)	(0.756)	(0.776)	(0.643)	(1.053)	(1.245)	(0.670)	(2.110)	(1.253)
$d^{RE-U.}$	n/a	n/a	n/a	n/a	n/a	n/a	(0.174	1.633	0.444	n/a	n/a	n/a
							(0.632)	(1.035)	(1.223)			
R^2	90	86	54	97	96	70	89	77	61	99	89	55
Adj. R^2	85	78	28	95	94	48	81	62	36	98	83	29

Notes: ***/**/* marks significance at 1, 5 and 10%-level. The values in parenthesis are standard errors.

Table 9.24 1972-2005 VAR-model: $\Pi_t = \Gamma_1 + \Gamma_2\Pi_{t-1} + \Gamma_3\Pi_{t-2} + \Gamma_4\Pi^e_{t-1} + \Gamma_5\Pi^e_{t-2} + \Gamma_6 I_{t-1} + \Gamma_7 I_{t-2} + \Gamma_8 M_{t-1} + \Gamma_9 M_{t-2} + \Gamma_{10} Y_{t-1} + \Gamma_{11} Y_{t-2} + \varepsilon_t$

	Sweden			The UK			The US		
	μ_t	i_t	y_t^{gap}	μ_t	i_t	y_t^{gap}	μ_t	i_t	y_t^{gap}
π_{t-1}	-0.005	0.390	0.317**	0.231	-0.219	-0.152	-0.210*	0.314	0.220
	(0.167)	(0.244)	(0.153)	(0.143)	(0.181)	(0.114)	(0.122)	(0.316)	(0.293)
π_{t-2}	0.071	0.035	-0.068	0.019	-0.205	0.055	0.133	-0.064	-0.368
	(0.154)	(0.225)	(0.141)	(0.136)	(0.172)	(0.108)	(0.099)	(0.257)	(0.238)
π^e_{t-1}	-0.208	-0.017	0.131	0.003	0.685	-0.188	-0.022	0.008	-0.436
	(0.322)	(0.470)	(0.294)	(0.342)	(0.435)	(0.273)	(0.165)	(0.428)	(0.397)
π^e_{t-2}	0.021	0.356	-0.164	-0.552	0.696	0.481	-0.354**	0.352	0.243
	(0.246)	(0.360)	(0.225)	(0.401)	(0.509)	(0.319)	(0.136)	(0.353)	(0.328)
μ_{t-1}	1.030***	-0.068	0.163	0.861**	0.447	0.375	1.052***	0.910*	0.612
	(0.217)	(0.316)	(0.198)	(0.335)	(0.426)	(0.267)	(0.196)	(0.508)	(0.472)
μ_{t-2}	-0.136	-0.085	-0.511*	-0.014	-0.009	-0.203	-0.144	-0.813	-0.463
	(0.321)	(0.469)	(0.293)	(0.372)	(0.473)	(0.297)	(0.191)	(0.496)	(0.460)
i_{t-1}	0.121	0.205	-0.156	0.194	-0.275	-0.190	0.099	0.719**	-0.027
	(0.201)	(0.293)	(0.183)	(0.195)	(0.248)	(0.156)	(0.131)	(0.339)	(0.314)
i_{t-2}	-0.124	0.254	0.167	0.196	-0.203	-0.225	0.204	-0.413	0.211
	(0.164)	(0.240)	(0.150)	(0.156)	(0.199)	(0.125)	(0.141)	(0.365)	(0.338)
y^{gap}_{t-1}	-0.030	0.723**	0.695***	0.930**	1.724	0.959	-0.088	0.020	0.487**
	(0.183)	(0.267)	(0.167)	(0.412)	(0.523)	(0.329)	(0.100)	(0.260)	(0.241)
y^{gap}_{t-2}	0.074	-0.525	-0.616***	-1.189***	-0.131	-0.096	-0.134	-0.247	-0.627**
	(0.217)	(0.316)	(0.198)	(0.385)	(0.489)	(0.307)	(0.099)	(0.257)	(0.238)
α	1.461	0.238	0.332	1.713	-2.034	-0.329	1.665***	-0.212	0.650
	(0.876)	(1.278)	(0.800)	(1.326)	(1.686)	(1.058)	(0.495)	(1.283)	(1.191)
d^{opec1}	0.685	-0.894	0.901	-1.022	1.509	1.168	0.460	-0.251	-1.493
	(0.818)	(1.194)	(0.747)	(1.296)	(1.647)	(1.033)	(0.464)	(1.202)	(1.116)
d^{opec2}	0.611	-0.941	1.324	0.722	3.037	-0.319	0.562	2.553*	0.840
	(1.081)	(1.577)	(0.987)	(1.661)	(2.110)	(1.324)	(0.555)	(1.440)	(1.336)
R^2	91	88	76	88	81	64	96	85	67
Adj. R^2	86	82	62	82	70	43	94	76	48

Notes: ***/**/* marks significance at 1, 5 and 10%-level. The values in parenthesis are standard errors.