UNIVERSITÀ DEGLI STUDI DI NAPOLI
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FINANCIAL CONDITION INDEX AND INTEREST RATE SETTINGS: A COMPARATIVE ANALYSIS

Alberto Montagnoli* **and Oreste Napolitano****

Abstract
In the last thirty years, there has been a widespread move towards financial liberalisation, both within and across national borders. This economic development brought researchers to investigate the link between asset prices, inflation and the conduct of monetary policy. Starting from the seminal work of Alchian and Klein (1973) it is often argued that the forwardlooking nature of asset prices makes them good proxies for the information left out of conventional inflation measures. It is also widely accepted that asset price inflation developments are closely associated with general inflation trends. This paper investigates the role of asset prices in the conduct of monetary policy in United States, Canada, Euro Area and United Kingdom. It has two focal points. First, we construct Financial Condition Indexes for four countries using the Kalman Filter algorithm. This methodology allows us to capture the changes of the weights associated with each financial variable in explaining the output gap over time. Second, we proceed by estimating forward-looking Taylor rules augmented for FCI. Our results suggest that the Financial Condition Index enter positively and statistically significant into the FED, Bank of England and Bank of Canada interest rate setting. This gives a positive view for the use of the FCI as an important short term indicator to guide the conduct of monetary policy in three out of four countries analyzed.

Keywords: Financial Condition Index, Optimal Monetary Policy, Taylor rule.

JEL Classification: E52, E58, G12

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Contents

1. Introduction

> *"The key aim of monetary policy for most central banks is to keep inflation low and steady. However in a market-oriented economy, central banks cannot control inflation directly. They have to use instruments such as interest rates, the effects of which on the economy are uncertain…..Decisions on monetary policy are based on a variety of indicators. Some central banks use money growth or exchange rate as the sole guide to decisions. Others take a more eclectic approach and consider a range of factors in assessing inflation conditions" (G. Hoggarth, 1996).*

In the last thirty years, there has been a widespread move towards financial liberalisation, both within and across national borders. This economic development brought researchers to investigate the link between asset prices, inflation and the conduct of monetary policy. Alchian and Klein (1973) were the first to assert that focusing only on Consumer Price Index as an indicator of inflation could be misleading because it reflects only the change in prices in the real sector. Monetary authorities should also consider inflation from the financial sector. More recently Goodhart explicitly writes: "My dictionary defines inflation as a fall in the value of money, not a rise in consumer price index. If I spend my money now on obtaining a claim on future housing services by buying a house , or on future dividends by buying an equity, and the price of that claim on housing or on dividends goes up, why is that not just as much inflation as when the price of current gods and services rises?" (Goodhart, 2001, p.3). These two views have recently received great strength by the development in capital markets and the new environment hypothesis, Borio and Lowe (2002). They argue that the presence of a credible stabilisation program, an improved supply side[1] and a credible monetary policy could create favourable ground for financial instability. High levels of monetary credibility lead to well-anchored inflation expectations. And this, in turn, has led to many economic benefits. But Borio and Lowe (2002) argue that this is a potential problem here. People can come to believe that a central bank will always be able to guard against swings in inflation or recovery the economy from a recession. At the same time investors could believe that the central bank would take decisive action to prevent the stock market from falling but not from rising Miller et al (2001).

Recently there has been an increasing interest in the role of asset prices for the conduct of monetary policy. There is however no full consensus about the conduct of monetary policy under the circumstances of shocks in the asset markets. The predominant view at the moment seems to be that

[1] They are identified as improvements in the technology, labour market reforms, and productivity gains.

central banks should only respond to asset price movements if they are expected to affect future CPI inflation and the output gap (Bernanke and Gertler, 1999). Besides the interest rate, the exchange rate is usually considered to be the most important determinant of aggregate demand and channel of monetary policy transmission in open economies. That is why several central banks adopted, in the early-mid 1990s, a Monetary Conditions Index (MCI hereafter), a weighted average of the short-term interest rate and the exchange rate as an operating target (Bank of Canada, Reserve Bank of New Zealand) or an indicator (Bank of Norway, Bank of Finland, Bank of Iceland) for monetary policy.

A more recent development is the interest in the role of housing and equity prices for the design of monetary policy. Housing and equity prices may affect demand via direct and indirect wealth effects. A change in property and equity prices affects consumer wealth, which may induce consumers to change their consumption plans (Modigliani, 1971).

Case *et al* (2001) suggests that property prices have a stronger effect on household consumption than equity prices. A more indirect wealth effect of asset price movements operates via households' and firms' balance-sheets.

Thus, from a theoretical point of view Goodhart and Hofmann (2002, page 3) assert that " there seems to be a strong case also to consider property and share prices as determinants of aggregate demand, which would imply a direct reaction of monetary policy to movements in these asset prices. This issue has proven to be highly controversial. Cecchetti, Genberg, Lipsky and Wadwhani (2000) and Goodhart (2001) argue in favour of a direct response of monetary policy to asset price movements which are not in line with perceived fundamentals, while Bernanke and Gertler (1999) and Gertler, Goodfriend, Issing and Spaventa (1998) are more sceptical".

Starting from the above considerations, in this paper we address the following issues: 1) the importance of the Financial Condition Index (FCI hereafter) in explaining a potential misalignment in asset markets; 2) the use of the FCI as an important short term indicator to guide the conduct of monetary policy.

The first step in providing answers to the questions considered above is to describe how to construct a FCI for four countries (US, UK, EU and Canada) and to prove that it can provide useful additional indicators of future changes in output and consequently inflation. Moreover, the analysis is important because it takes into account of the different channels of monetary transmission. It is evident that financial markets' responses to monetary policy actions undertaken by the Central Bank depend on a combination of domestic and foreign influences. These influences can be described in the following two ways: the first and most immediate relates to movements in the quoted prices such as exchange rates and interest rates in the international money and foreign exchange markets; the second one is due to changes in domestic real activity and prices. These channels have both direct effects and indirect effects on the economy. In particular, we focus our analysis on three asset prices: exchange rates, house prices and stock prices. For example, changes in equilibrium prices will affect both private incomes and wealth. The existence of a wealth effects associated with asset market fluctuations has been analysed among others by Morck, Shleifer and Vishny (1990), Goodhart and Hoffman (2000, 2001) and Mishkin (2001). A sharp increase in asset market prices will increase personal financial wealth, in addition, higher asset prices are associated with higher private sector investment and consumption resulting in greater expected employment level so that individuals will increment their spending. Since consumption represents a great percentage of GDP, even small changes in consumer spending could affect the expected inflation rate and economic growth.

In light of that, our contribution to the literature is referred to the attempt of solving two of the main criticisms that affect the FCIs': the parameter inconstancy problem and the non exogeneity of regressors. This study is divided in two parts. In the first one we suggest a methodology in order to account for the impact of financial markets on real output; we build a Financial Condition Index for the four countries using the Kalman Filter algorithm. This methodology allows us to capture the changes of the weights of each financial variable in explaining the output gap. In the second we analyze the interactions between FCIs and monetary policy in each single country. We estimate forward-looking Taylor rules augmented for FCI in order to analyze the Central Bank's reaction to a misalignment in the asset market. This analysis will be undertaken in the contest of a simple backward looking model of the economy described by the aggregate demand – aggregate supply framework. The standard and augmented Taylor rule will be used to define the optimal monetary policy. The concept of FCI and the way it is constructed are fundamental in the evaluation of the resulting policy rules that will emerge under different behavioral assumptions regarding the sensitivity of the monetary authorities to respond to a misalignment in the asset markets.

The structure of the paper is as follows: section 2 reviews the literature. The Roles of Monetary Conditions Index is described in section 3. The construction of the FCI and the results for the four countries are derived in section 4. Section 5 proceeds by estimating forward-looking Taylor rules augmented for FCI and present the empirical results. Section 6 concludes.

2. Monetary Policy and Asset Prices, an overview

A large body of theoretical and empirical literature has been investigating the link between asset prices and monetary policy and in particular on the response of the monetary policy to asset prices movements.
An important aspect is the role played by asset prices during the monetary transmission mechanism because they may incorporate important information regarding the current and future state of the economy. In fact, change in interest rate modifies people's expectations about future economic growth, and thus their profit expectations. This may change the set of discount factors economic agents apply to their profit expectations or to the future stream of services or revenues from the asset they hold (housing for instance).

This analysis put forward the case for a reaction of monetary authorities to asset prices movements. There are several reasons why monetary policy might wish to respond; firstly asset prices misalignments may endanger the stability of the financial system. This case is put forward by Borio and Lowe (2002), they observe that since the 1970 asset prices cycles have been growing in amplitude and size. They argue that even an environment characterised by sound and credible economic policies, financial instability could be a serious threat. According to them, "it is the unwinding of financial imbalances that is the major source of financial instability, not an unanticipated decline in inflation per se". A second potential reason why central banks would like to respond to asset prices is that they play an important role in the transmission of monetary policy. Rising asset prices may have direct impact on the aggregate demand and may, therefore, be associated with growing inflationary pressures. They also influence the collateral values and bank's willingness to lend. The final reason is that asset prices might contain important information concerning the future state of the economy; they incorporate information about financial market expectation of inflation and macroeconomic conditions.

The major debate is not on the role of asset prices in the economy, but rather if and eventually how policy makers (i.e. Central Banks) should take into consideration information deriving from the asset market. In the literature we can identify three views: the first states that assets prices should be considered but only as one of the variables used to forecast inflation. Bernanke and Gertler (1999) argue that when monetary policy operate within a logic of flexible inflation target, it should ignore movements in asset prices that do not appear to be generating inflationary or deflationary pressures. Changes in asset prices should affect monetary policy only to the extent that they affect the central bank's forecast of inflation; once the predictive content of asset prices for inflation has been accounted for, there should be no additional response of monetary policy to asset-price fluctuations. By focusing on the inflationary or deflationary pressures generated by asset price movements, a central bank effectively responds to the "*toxic*" side of asset booms and busts without getting into the business of deciding what a fundamental is and what is not. Bernanke and Gertler (1999, 2001) argue that the potential costs of responding to asset price can be quite large because asset prices can be too volatile relative to their information content. In fact, Bernanke and Gertler (2001) show that a too-aggressive response to a stock price bubble can create significant harm in the economy. Batini and Nelson (2000) find an analogous result for bubbles in the real exchange rate while Mishkin and White (2002), suggests that asset price misalignments should only be a concern when they affect financial stability.

A second view is expressed by Goodhart (1999), Goodhart and Houfmann (2000, 2001) [2]. They believe that the Central Bank should target a broader price index which includes asset prices. This measure has the potential to improve macroeconomic performance if asset prices reliably predict future consumer price inflation. The theoretical foundation of Goodhart's recommendation is based on the pioneering research on the theory of inflation measurement by Alchian and Klein (1973). They argue that since asset prices represent the current money prices of claims on future, as well as current, consumption, an accurate measure of inflation should include asset prices. They also argued that asset prices can serve as good proxies for the inflation information left out of conventional measures. Using a VAR methodology they find that the Financial Condition Index is a useful instrument to forecast in-sample future inflation[3]. If a central bank were to follow Goodhart's recommendation and use this broader measure of inflation, an increase in asset price inflation could prompt tighter monetary policy even if conventionally measured inflation were low and stable. As Filardo (2000) argued though, this policy implication depends on the strong assumption that asset price inflation accurately reflects future consumer price inflation.

The third view is that asset prices should be made an integral part of monetary policy; in this case, monetary authorities should try to act to stabilize their value around the fundamentals. Cecchetti, *et al.* (1999) argue that a central bank concerned in stabilizing inflation about a specific target level is

[2] Goodhart (2001) writes: "So long as asset price changes are not incorporated in the measure of inflation which the authorities are required to stabilize, the authorities are likely to express audible worries about 'exuberance' and 'sustainability', but in practice find themselves largely incapable of any (pre-emptive) action in response to asset price change themselves in advance of any (consequential) effects coming through onto current goods and services prices, paralysed in practice".
[3] Out-of sample results do not seem to provide satisfactory results.

likely to achieve superior performance by adjusting its policy instruments not only in response to its forecast of future inflation and the output gap as the traditional Taylor rule would suggest, but to asset prices as well. They demonstrate that monetary policymakers should react to perceived misalignments in asset prices to reduce the likelihood of asset price bubbles forming. More generally Cecchetti *et al* (2000, p.24), analyzing objectives and rule of monetary policy makers reach the conclusion that a *complex* rule is always more advisable than a *simple* Taylor rule. He states that "there is no reason to believe that information on output and inflation is always capable of adequately summarizing what policy needs to do to respond to the shocks hitting the economy". Bernanke and Gertler (2001) are very critical of Cecchetti *et al.* (1999) methodology. They argue that if Cecchetti *et al.* had accounted for stochastic, instead of deterministic, asset price bubbles, and also if they allow for the possibility that shocks other than a bubble may be driving asset prices, they would have found no useful role for asset prices beyond that that is reflected in expectations for future inflation[4]. Filardo (2001) shows that while there are benefits for the monetary authority to respond to asset price changes even when it cannot distinguish between the "bubble" and the "fundamental" part of the asset price inflation, the monetary authority's desire to respond to asset prices falls dramatically as its preference to smooth interest rates rises. He argues that even though asset prices contain useful information about inflation and output, the cost in terms of interest rate volatility can be so high as to cause the monetary authority to largely disregard the information. This result is consistent with Bernanke and Gertler's conclusion that by responding to stock prices, a central bank could worsen economic outcomes. In another paper Filardo (2000) concludes that a monetary authority generally benefits from responding to asset prices only as long as there is no uncertainty about the macroeconomic role of asset prices. If the monetary authority is uncertain about whether asset prices have an independent role in the context of a macro-model or simply reflecting other economic fundamentals, then the expected costs in terms of economic volatility of responding to asset prices may exceed the expected benefits.

Considering the above discussion, in the next paragraph we construct an indicator which capture misalignments in the asset market and it could be used by monetary authorities as part of in their information set or as a target.

3. The Roles of Monetary Conditions Index

[4] Cecchetti *et al.* "optimize" the policy rule with respect to a single scenario, a bubble shock lasting precisely five periods, rather than with respect to the entire probability distribution of shocks, including shocks other than bubble shocks. Effectively, their procedure yields a truly optimal policy only if the central bank knows with certainty that the stock market boom is driven by non-fundamentals and knows exactly when the bubble will burst, both highly unlikely conditions.

Over the past decade or so, the framework and strategy of central banks in implementing monetary policy has continually evolved along with a rapidly changing economic and financial environment at home and abroad. An increase in the volume and volatility of the international capital flows coupled with an intensified financial innovation have made financial markets and economic systems more and more interdependent. As the domestic financial market becomes more closely linked to the global financial system, the exchange rate becomes an increasingly important factor as a channel through which monetary policy may have potential impacts on the real sector.

Towards the late 1980s, central banks of many industrialized nations have turned their attention towards an inflation targeting regime as the focal point of their monetary policy. The list includes the central banks of New Zealand, Canada, England, Sweden, Finland, Australia, Spain and Israel (Green 1996, Svensson 1997, Kahn *et al* 1998).

The framework and strategy in implementing an inflation targeting-oriented monetary policy rests upon the basic assumption that monetary policy affects the economic system and in particular, the inflation rate, through two main transmission mechanisms : (i) the interest rate, which influences the level of expenditure and investment, and (ii) the exchange rate, which influences the price of imports, and ultimately the inflation level. In view of this, a continued depreciation (appreciation) in the exchange rate would require an increase (decrease) in the interest rate in order to sustain the target rate of inflation.

As interest rates and exchange rates are both important channels through which monetary policy affects economic activity and inflation, it has been argued that, combining both interest and exchange rates in a single policy indicator, a Monetary Conditions Index (MCI hereafter), may serve as a better indication of the overall policy stance (Freedman 1995, Nadal-De Simone et.al.1996). For this reason, central banks of many industrialized countries place importance on the construction and implementation of the MCI. The MCI is designed to indicate the stance (the degree of tightening or loosening) of monetary policy during a given period.

Using the MCI which encompasses movements in both interest rates and exchange rates may help the monetary authorities to gain a better assessment of the overall monetary conditions.

This is because the information content contained in the MCI would characterize the degree of pressure that monetary policy is placing on the economy and, therefore, on inflation rate. Nonetheless, the potential adopting of a MCI-oriented monetary policy, and therefore an inflation-targeting regime, calls for a more detailed analysis of whether interest rate and exchange rate variables are particularly important factors determining future inflationary pressures.

The basic definition of the Monetary Condition Index provides information about whether and to what extent the monetary framework conditions have been relaxed or tightened during a defined period.

Originally, the MCI was meant to provide a measure of the degree of ease or tightness in monetary conditions relative to a base period. In this way, the MCI should capture the effect that monetary policy has on the economy both through interest rates and the exchange rate[5]. Hence, it is defined as the weighted total of the changes in the real effective exchange rate of the domestic currency and the short-term real interest rate against a defined base period.

The MCI is then a combination of rate variables[6], which helps countries in managing liquidity within the overall framework of monetary policy. It is a weighted sum of the changes in the short-term interest rates and exchange rate relative to a base period.

The weights, which are determined by econometric models, are reflective of the importance of the respective variables in influencing the target macro (dependent) variable. More open the economy is more will be the weight age to the exchange rate.

Some of the countries where MCI is used are New Zealand (inflation target), Canada (operating target) and Sweden (leading indicator). The respective weights are determined by central banks from econometric modelling. The respective weights are determined by central banks from econometric modelling. The exchange rate is found to be half as important in New Zealand and one-third as important in Canada, compared with the domestic short-term interest rates.

3.1 From Monetary Condition Index to Financial Condition Index

In the formulation and implementation of monetary policy, the central bank needs to select an appropriate set of policy tools to implement its monetary policy. This is viewed as necessary for the attainment of ultimate targets of monetary policy. The central banks of many industrialized

[5] The Bank of Canada (1992) calculates it "as the change in the 90-day commercial paper rate since January 1987 plus one third of the percentage change in the exchange rate of the Canadian dollar against the currencies of our major trading partners, also since 1987".
The formula is:
MCI = (CP90-7.9) + (100/3) x (ln(C6)-ln(91.33))
where:

- CP90 = Canadian 90-day Commercial Paper Rate
- C6 = Canadian dollar index against C-6 currencies (1992 = 100)
- 7.9 = The average 90-day commercial paper rate for Jan. 87
- 91.33 = The average C-6 exchange rate for Jan. 87
- In Jan. 1987, the MCI = 0

[6] The developed economies are shifting from targeting quantity variables to rate variables, as the former no longer explains appropriately the changes in aggregate demand and supply. Some of the rate variables targeted are short-term interest rates, exchange rate or inflation.

countries, such as the central banks of New Zealand, Canada, Sweden, and Norway, are aware of the necessity of creating a new frame-work for conducting monetary policy so as to be a clear indicator of the central bank's policy stance and allow for a better communication with participants in the money markets. At the same time, the adoption of a MCI-oriented monetary policy is seen as an essential framework for use to follow and estimate the likely effects that monetary policy actions may have on the economy (especially in terms of the level of inflation) which is a direct responsibility of the central bank. An inflation targeting framework for monetary policy was first adopted by New Zealand's central bank in March 1990, followed by the central bank of Canada in February 1991. The framework and strategy of implementing inflation targeting-oriented monetary policy fundamentally stresses on the condition that "inflation targets" must clearly be the ultimate target of monetary policy (Kahn, et.al. 1999). Under an inflation-targeting regime, the monetary authorities normally have to make announcement of the target or a range of inflation target for the future[7].

It is interesting to note, however, that the management of monetary policy under the framework of monetary targeting primarily targets the inflation level, just as the management of monetary policy under the inflation targeting regime. Under this regime, short-term interest rates tends to be pushed upwards in the event that forecasted inflation shows a tendency of stabilizing at a higher level than the "established targeted inflation."[8].

Under an inflation targeting framework for monetary policy, there will be monetary indicators that uses the Monetary Conditions Index, which is a kind of monetary indicator that shows whether a central bank's monetary policy at any one point in time is relatively loose or tight, and to what degree. This indicator therefore acts as an indicator of operating target within an administration of monetary policy (Freedman, 1995).

Indicator of this kind reflects the degree of influence that the monetary policy has on the overall economy — especially on the level of inflation. Overall, a MCI index has a base-year equivalent to 100, as is the case of New Zealand, and serves as a benchmark indicating the direction and outlook of the future inflation. Formulating and conducting monetary policy under the MCI framework (in addition to other economic and monetary indicators) is therefore considered a policy strategy that is forward looking.

[7] If the inflation projection for the next 1-2 years is believed to fall outside the range of the official target, a series of policy actions needs to be carried out in order to bring the inflation level back into the targeted range. The monetary authorities may have to send a signal reflecting a change in the policy stance by adjusting short-term interest rates or intervening in the foreign exchange market.

[8] For more details on this matter see Svensson (1997), among others.

The use of the MCI as part of the central bank's monetary policy administration is based on the premise that both the interest rate and the exchange rate are important and influential factors of the overall economic condition especially to the inflation rate. When the interest rate rises or the exchange rate strengthens, the effect is for the economy to decelerate in the future and eventually lead to a weakening of the pressure on price levels. In contrast, when the interest rate falls or the exchange rate weakens, the effect is for expenditures, consumption and investments to rise in the future, which may eventually lead to a higher level of inflation .

Because the interest rates and the exchange rate are both important and influential channels that link the monetary policy to the real sector, the central banks of many countries tend to face with an increasing difficulty in sending a clear signal to the market about the direction and tendency of the monetary policy.

From the above statements, coupled with the fact that both the interest rate and the exchange rate are continuously changing makes it very difficult for the central bank of many nations to estimate whether the monetary conditions at a certain point in time is relatively tight or relaxing and thus may cause the inflation rate to fall or to rise. This is especially the case where the interest rate is adjusted upwards (downwards) while the exchange rate weakens (strengthens).

The assessment of liquidity conditions in the financial system and the monetary policy stance of the central banks requires a careful consideration of the behaviour of the interest rates and the exchange rate. Therefore, a MCI index can be served as an informative indicator for liquidity conditions in the financial system. It also provides useful information regarding the central bank's monetary policy stance by comparing the effects of interest rate and exchange rate on the inflation rate.

As mentioned above, it is important to evaluate monetary conditions in order to show how tight (easy) monetary policy is and thus its likelihood to lead to a lower (higher) inflation level. In order to do this effectively, it is crucial for the monetary authorities to simultaneously consider the behaviour of the movements of both the interest rates and the exchange rate.

Such an interactive movement may be expressed in equation (1) as follows:

$$MCI = w_r(r_t - r_b) + w_e(e_t - e_b) \tag{1}$$

where $w_r + w_e = 1$, r_t and e_t are interest rates and exchange rates at time t, respectively; r_b and e_b are interest rates and exchange rates during a given base year. The exchange rate variables in equation (1) are expressed in terms of logarithms.

Within an analytical framework of the CPI, the base indicator of economic activity and inflation is a variable that appears in equation (1) which in turn is the interest rate r, and the exchange rate e. The most important factor is weight w, derived from the subsequent empirical analysis. The value of this weight provides a useful information regarding the relative importance of the weight given to the interest rates (w_r) compared to the weight given to the exchange rates (w_e), which stipulates the direction of demand (economic activity) or inflation level.

Based on the theoretical discussion in the literature it is hypothesized that the model explaining the behaviour of the inflation can be formulated as follows :

$$\pi_t = \beta_0 + \beta_1 \Delta r_t + \beta_2 \Delta e_t + \beta_{i,j} Z_j + \mu_t \tag{2}$$

where, $\beta_1 \prec 0; \beta_2 \prec 0$, Δ is the difference operator, π is inflation, “r” is interest rate, “e” is nominal effective exchange rate, Z is a set of additional fundamental variables and μ is error term following a white noise process.

A formulation of inflation determining model like (2) is based on an eclectic view of different theories of inflation determination. A preference for this type of specification is not an arbitrary choice. Indeed, it is based upon a priori knowledge of the economic structure which, in many aspects, might appears to be different from country to country. It is important to note also that the weight of interest rate (w_r) together with the weight of the exchange rate (w_e) in equation (1) can be calculated from the coefficients from equation (2) which equal :

$$w_r = \frac{|\beta_1|}{(|\beta_1| + |\beta_2|)} \text{ and } w_e = \frac{|\beta_2|}{(|\beta_1| + |\beta_2|)}$$

Given all the advantages of having this indicator, the concept is criticised on its analytical foundation, as the interest rate is exogenous, while the exchange rate is endogenous, so cannot be used as a substitute. It is hard to believe that resorting to an MCI target will make the task of the central bank easier. It will also not help in removing policy uncertainties among the economic agents. MCI remains as one of the considerations of the central bank and the focus often shifts from MCI to one or more specific macro variables.

To that extent, the MCI adds to the list of confusion. Since the MCI is based on fixed coefficients and the relationship between the underlying variables need not be constant, there is a risk of policy mischance.

It would be worth noting, however, that some important factors that might have potential influence on behaviour of the inflation rate have not yet been included in equation (2). We incorporate some additional factors such as house market and stock market in the subsequent paragraph where our attempt will be focused on the construction of the Financial Condition Index (FCI) .

The FCI, on the contrary, is a wider indicator of the monetary framework conditions, to some extent also a measure of the orientation of monetary policy, combined in a single variable. Mayes and Viren (2001) assert that "the main value of the indicator is that it in turn is thought to be related to future values of economic activity or inflation. Thus it provides continuously updated information about the future, whereas traditional economic forecasts are only updated monthly or quarterly "[9].

Goodhart has long argued that central banks should lead to a broader price index which includes the prices of assets, such as houses and equities. If the prices of goods and services and those of assets move in step, then excluding the latter does not matter. But if the two types of inflation diverge, as now, a narrow price index could send central bankers astray. There are really two issues in play here. One has to do with the notion that monetary policy ought to battle deviations of asset prices from their "fundamental" value. The other is related to the presumption that asset prices give us a truer measure of the purchasing power of money. This concept was explored several years ago by Cecchetti *et al* (2001). However, the idea that asset prices should receive some consideration in the construction of aggregate price movements remained a largely dormant issue until Alchian and Klein, (1973) proposed that we focus on measuring the purchasing power of money generally, rather than on prices of current consumption specifically. Instead of looking at the cost of a particular basket of goods and services meant to measure current consumption, as is typically done by most consumer price indices, they suggest focusing on the current cost of expected life-time consumption. Asset prices provide the requisite information on the price of expected future consumption.

A key question, then, is to ask how policy would have been different if it had been based on these measures. Next sections of this work attempt to estimate this taking into account the fact that asset prices appear to be on the unusual and somewhat dramatic run-up in certain asset prices in recent years. In our approach, failure to include asset prices appears to induce a bias in the estimate of the inflation trend that may have an impact on our understanding of the broader movements in real economic variables.

4. Constructing the FCI

Constructing a Financial Condition Index is, however, a no easy task as many authors have highlighted, since this index should be able to capture the current development of financial markets

[9] Mayes and Viren (2001), page 8.

and, at the same time, it should give a good indication of the future economic activity. Moreover a correctly estimated FCI should "provide(s) continuously updated information about the future, whereas traditional economic forecasts are only updated monthly or quarterly (or half yearly in the case of the published Eurosystem forecast)" Mayes and Viren (2001, p.8)[10].

Based on the equation 1 presented in the previous section we can describe an extended MCI, or FCI comprising in addition to the exchange rate also property and share prices:

$$FCI_i = \sum w_{q,i} \left(\Gamma_{q,i} \right) \tag{3}$$

The weights $w_{q,i}$ depend on the respective effect of ($\Gamma_{q,i}$) that is, the exchange rate, the share prices and the property prices on aggregate demand.

The inclusion of the exchange rate provides additional information about the exchange rate channel, through which aggregate demand is affected by the relative price of imports and exports. Stock prices are most intuitive to describe the wealth channel while property prices are used in the FCIs of Goodhart and Hofmann (2001) and, subsequently, Mayes and Virén (2001). Both studies find that property prices have stronger explanatory and predictive power for inflation than do equity prices. The former study also finds that in country like Canada the impact of housing prices on the output gap is larger than that of the exchange rate.

In general, the FCI provides useful information about inflation and monetary policy. However, Grande (1997) stress not only the problem of how to extrapolate the relevant information from a composite index but also the problem of the additional assumptions required to implement it. In this paragraph, thus, we will construct an indicator which has the characteristics described above.

The first step of our analysis lies on the construction of an aggregate measure of a Financial Conditions Index. Following Goodhart and Hofmann (2001) we will focus our analysis on three assets[11]: the real effective exchange rate, real house prices and real share prices[12]. In this section we explain how FCIs can be derived and how FCIs can be used, especially by central banks in formulating their monetary policy. In order to construct an FCI, the first problem to face is how to

[10] It is beyond the aim of this paper to discuss why the FCIs are superiors to other financial variables, for instance Monetary Condition Indexes; for a discussion on this issue see Smets (1997) and Mayes and Viren (2001).

[11]The short-term interest rate is sometimes considered a measure of stance in itself and, since it is highly correlated with the policy instrument, we do not include it in eq. 3.

[12] Mayes and Viren (2001) present an accomplished description of the choice of different assets used in the past papers (see also Goodhart and Hofmann (2001), Goldman and Sachs (2001), Mayes and Viren (1998) and Eika et al. (1997)) and the dissimilar approaches to the FCIs based on the transmission mechanism's problems.

determine the weight of the single asset. Goodhart and Hofmann (2001) suggest three different methodologies.

The first one is based on simulation of a large scale of macro-econometric model; the second one is based on a system with reduced-form aggregate demand equations; and the third one uses a VAR impulse response methodology. They explain the difficulties related to the first way and choose the second and the third analyses.

They empirical results show that overall both approaches are very similar. However, there is a problem related with the different analyses proposed: despite the size of the sample used, the weight associated with each financial variable is fixed. In fact it is likely that firms and households portfolios change with the business cycles or in presence of particular events. In the present work, we will try to overcome this problem proposing an alternative way to calculate the weight of each single asset. We use a Kalman Filter algorithm in order to capture the changes of the weights over time.

Following the pioneering contribution of Alchian and Klein (1973) and more recently Eika et al. (1997), Mayes and Viren (1998), Goodhart (2000), Mayes and Viren (2001) and Goodhart and Hofmann (2001), we formulate a formal model of the economy in order to show the importance of financial variables in the conduct of monetary policy. In doing this, we present a simple model which is the equivalent of a conventional backward looking aggregate demand –aggregate supply augmented with the asset markets (an extender version of Redebusch and Svensson (1998) as suggested by Goodhart and Hofmann (2001)) and we apply this model to four countries, US, UK, Canada and EUM:

$$y_t = \beta_1 + \sum_{i=1}^{g_1} \beta_{1,i} y_{t-i} + \sum_{j=1}^{g_2} \beta_{2,j} ri_{t-j} + \sum_{l=1}^{g_3} \beta_{3,j} re_{t-l} \sum_{n=1}^{g_4} \beta_{4,j} rh_{t-n} \sum_{m=1}^{g_5} \beta_{5,j} rs_{t-m} + \mu_t \qquad (4)$$

$$\pi_t = \phi_1 + \sum_{i=1}^{k_1} \phi_{1,i} \pi_{t-i} \sum_{j=1}^{k_2} \phi_{2,j} y_{t-j} + \eta_t \qquad (5)$$

where π_t is equal to $100*[\ln(CPI_t/CPI_{t-12})]$, RPI for UK and HCPI for the EUM; and the output gap (y_t) is the difference between actual and potential output, is calculated as the percentage deviation of the natural logarithm of the monthly industrial production from a Hodrick-Prescott trend (HP henceforth); The financial markets are proxied by three variables: *rh, re, rs*. They are, respectively, the deviation from the long run equilibrium of the real effective exchange rate, real house price and real stock price. According to Gautier *et al* (2004) we follow Ravn and Uhlig (2002) and we calculate the long-term of the assets prices using the above HP filter methodology with a high smoothing parameter of 129,600 instead of the standard 1,600[13]. The choice of this sample is essentially based on the need of including all the main events that determine substantial changes in government and monetary policies. The choice of inflation targeting (Canada February 1991 3%; UK October 1992 5.6%) and the launch of the EMU (1999) are only a few but significant examples of these changes. In light of this, for most of the countries the sample 1985-2005 was chosen.

4.1 The methodology applied in constructing time varying FCIs

The objective of this sub-section illustrates the methodology applied using financial variables like exchange rate, stock prices and house market index, in order to circumvents the parameter inconstancy. Since it is most likely that there have been regime changes, shocks and other structural breaks within the sample period we will try to address this problem constructing FCIs[14] for the four countries using the Kalman Filter algorithm. This methodology allows us to capture the changes of the weights over time.

One of the central conditions to achieve identification when we deal with financial variables is that the structural form shocks are orthogonal to one another. That is, we assume that the error term is orthogonal to the variables on the right side of the equation (6) below. In reality, this condition may not be satisfied, in particular if asset price shocks are driven by common shocks, as indicated by past experiences. Common shocks for asset prices within a country may be news about economic fundamentals in the respective country, such as changes in the conduct of the monetary policy or announcements of releases of relevant macroeconomic data. Moreover, there may be common shocks for international asset prices, such as oil price shocks.

Following the approach commonly used in the related literature we address the issue that the three series re_{it}, rS_{it}, and rh_{it} are nearly orthogonal or uncorrelated. The correlation between them measure the extent to which each series provide "orthogonal information". The former problem is related to the possibility that financial variables are simultaneously determined. This can occur either because they cause each other as or because they have some common omitted determinants. For instance, we assume that the real stock market is nearly orthogonal to the real house market. One reason for a violation of this condition would be a contemporaneous response of monetary policy to the stock and the house market.

[13] Appendix 3 presents the sources of the variables.
[14] We construct a modified version of Goodhart – Hoffman FCI

Generally speaking, ignoring this potential correlation might reduce the efficiency of the estimates, or even produce biased estimates if these variables are correlated with other included explanatory variables. To examine the impact of controlling for this correlation, we estimate (eq.6) a system of three equations one for exchange rate (re), one for the stock market (rS) and another for the house market, while allowing for their error terms to be correlated. That is, Seemingly Unrelated Regression Estimation (SURE) are estimated for this purpose.

$$\begin{cases} re_{it} = \alpha_{1t} + \sum_{n=1}^{k_1} \beta_{1,j} rh_{it-n} + \sum_{m=1}^{k_2} \beta_{2,j} rs_{it-m} + \mu_{eit} \\ rh_{t} = \alpha_{2t} + \sum_{s=1}^{k_4} \beta_{3,j} re_{it-s} + \sum_{f=1}^{k_5} \beta_{4,j} rs_{it-f} + \mu_{hit} \\ rs_{t} = \alpha_{3t} + \sum_{v=1}^{k_7} \beta_{5,j} rh_{it-v} + \sum_{l=1}^{k_8} \beta_{6,j} re_{it-l} + \mu_{Sit} \end{cases} \tag{6}$$

The above set of equations that has contemporaneous cross-equation error correlation so that the equations seem unrelated which states that the idiosyncratic shocks of the three markets are independent. This method, also known as the multivariate regression, or Zellner's method, estimates the parameters of the system, accounting for heteroskedasticity, and contemporaneous correlation in the errors across equations. The estimates of the cross-equation covariance matrix are based upon parameter estimates of the unweighted system. In equation 6 we use impulses in a separate system so we can investigate the relationship among the impulses (re, rh and rS). The residuals from this system of equations are then our new financial market variables (μ_{eit} = Rre, μ_{Sit} = RrS and μ_{hit} = Rrh, henceforth). Figures 1 and 2 show the residuals of the estimations of eq 6 for the four countries. On these new variables (RRe, RRs and RRh) the standard two unit root tests have been employed, namely the ADF (Augmented Dickey-Fuller) and Phillips Perron test. This will both give us an opinion regarding the persistence of the series during the investigated samples and serve as a reference when interpreting the results from the estimated model with time-varying parameters. Results from the unit root tests are given in appendix 1.

4.2 The Kalman filter methodology

An additional problem in analysing FCI from the econometric point of view is related to the identification of “good” weights. A way to solve this problem is based on a typical reduced-form model consists of an IS equation relating the output gap to interest rates, exchange rates and other asset prices, and a Phillips Curve relating inflation to the output gap (eqs 4 and 5). Generally the choice of explanatory variables depends on their statistical significance in the model. The coefficient estimates then determine the weight of each variable. This methodology is perhaps the most widely used in the construction of FCIs. However, its simple assumption that all asset prices are exogenous to each other and to the real economy may lead to estimation bias.

The theoretical literature also indicates that FCIs weights are likely to be time-dependent, having both impact and subsequent effects. If weights evolve over time, there is a real problem of ensuring an adequate data set that is capable of picking up the effects.

With these considerations in mind, we then proceed to the construction of the FCIs. First we estimate eq. (5), using the new variables generate by the system in (6). In order to recover the parameter dynamics overtime, we employ the Kalman filter algorithm; our second step refers to the definition of the index using the time varying coefficients.

The Kalman filter is a popular method which can be used to estimate unobserved variable(s), provided they appear as explanatory variables in a model that can be written in a "state space form". A state space representation is one made up of *measurement* equations, expressing observed or *signal* variables as a function of unobserved or *state* variables, and some *transition* equations, governing the path of the unobserved variables. Hence the Kalman filter is a convenient way of working out the likelihood function for unobserved component models[15]. For that, the system must be written in a state space form, with a measurement equation in a matrix format:

$$y_t = Z.X_t + \gamma_t \quad \text{with} \quad \gamma_t \sim N(0, H) \qquad [7a]$$

where y_t is the value of output gap, while X_t is a matrix of dimension *(Txk)* which includes all the explanatory variables plus a constant; the state vector *Z*, a (*kx1*) vector that contains all the slope coefficients, which are now varying through time and γ_t represents residuals with variance/covariance matrix H.. The transition equation in a matrix format:

$$Z_t = T.Z_{t-1} + v_t \qquad \text{with} \quad v_t \sim N(0, Q) \qquad [7b]$$

where T is a vector of parameters and v a vector of residuals with variance/covariance matrix Q.

Such a model may be estimated by means of a Kalman filter, a recursive procedure which, combined with a maximum likelihood estimation method, gives optimal estimates of unobserved components. This method has been used for a number of applications, such as estimating expectations (Cuthberson *et al.,* 1992), estimating the underlying structural rate of unemployment

[15] See Cuthbertson, Hall and Taylor (1992), Harvey (1992) and Hamilton (1994).

(among others, Gordon, 1998, Irac, 1999,), or estimating potential output (Smets, 1999, Kichian, 1999).

In principle, with this method all the parameters of the model may be estimated. In practice, there might be a trade-off between the number of parameters being estimated and the convergence of the likelihood function. More specifically, a key variable to the estimation of such models is the relative smoothness of the unobserved variable, which is governed by the relative size of the error variances in [7a] and [7b]. The higher the ratio of the variance of the transition to the measurement equation residuals, referred to as the "signal-to-noise ratio" (Q/H), the more explanatory power is given to the unobserved variable, and the better the fit of the measurement equation. In the limit, for very large values of Q, the unobserved variable may soak up all the residual variation in the measurement equation. Alternatively if Q is zero, then it will be estimated as a constant. In practice, most studies fix the signal-to-noise ratio so that the estimated unobserved variable is relatively smooth, with fluctuations which are judged to be reasonable from one period to another, which Gordon (1997) qualifies as "the [unobserved variable] can move around as much as it likes, subject to the qualification that sharp quarter-to-quarter zigzags are ruled out" [16].

The time varying methodology allows us to recover an unobservable factor that could affect the output gap. For each single variable of the model it is therefore possible to observe how the respective coefficient has changed over time by the effect of changing in the weight attached to each single asset price.

We then apply a time varying parameters model as follow:

$$Y_{it} = \alpha_{it} + \beta_{1it} Rre_{it-n} + \beta_{2it} RrS_{it-n} + \beta_{3it} Rrh_{it-n} + \gamma_{it} \qquad (8)$$

where i is the country, γ_{it} is an independent white noise and the coefficients are assumed to be random walks. This can be written in state space form where the observation equation is given by (8) above and the state equations are given by:

$$\begin{bmatrix} \alpha_t \\ \beta_{1it} \\ \beta_{2it} \\ \beta_{3it} \end{bmatrix} = \begin{bmatrix} 1 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 \\ 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix} \begin{bmatrix} \alpha_{t-1}, \ldots \alpha_{t-n} \\ \beta_{1t-1}, \ldots \beta_{1t-n} \\ \beta_{2t-1}, \ldots \beta_{2t-n} \\ \beta_{3t-1}, \ldots \beta_{3t-n} \end{bmatrix} + \begin{bmatrix} v_{it} \\ v_{1it} \\ v_{2it} \\ v_{3it} \end{bmatrix} \qquad (9)$$

The model in equations (8) and (9) was initially estimated by maximum likelihood and the estimated variances are presented in Table 1a. However, as our attention is directed towards the

16. See Bank of England (1998) for a survey. Some exceptions are Apel and Jansson (1998, 1999) for Sweden, Kichian (1999) for Canada. These are countries specific studies, using quite sophisticated models.

issue of time-variation in the parameters, we want to establish the relevance of this modelling choice. Moreover, since we consider very important the time variation in parameters and its implication in defining a more reliable FCI index, we need to tests five hypotheses regarding the constancies of all or part of the parameters in eq.(9). Accordingly, we test five hypotheses:

1. $H_0^1 : \sigma_v^2 = \sigma_{v1}^2 = \sigma_{v2}^2 = \sigma_{v3}^2 = 0$ which implies that all parameters in eq. 8 are constant;
2. $H_0^2 : \sigma_v^2 = 0$ which implies a constant intercept but time variation in the persistence parameters;
3. $H_0^3 : \sigma_{v1}^2 = 0$ which implies a time-varying intercept but a constant Rre parameter.
4. $H_0^4 : \sigma_{v2}^2 = 0$ which implies a time-varying intercept but a constant RrS parameter.
5. $H_0^5 : \sigma_{v3}^2 = 0$ which implies a time-varying intercept but a constant Rrh parameter.

In order to test these hypotheses, we next estimate the restricted versions of the model; the hypotheses in 1), 2) 3) 4) and 5) can then be tested using likelihood ratio test (LR test) This test statistics follow a χ^2 distribution with R degrees of freedom under the null hypothesis[17]. The results from these five tests are given in Table 1b.

Table 1a Variance of the parameters from Kalman filter of equations (8) and (9).

Variance	USA	EUM	Canada	UK
σ^2_v	$4.872\text{x}10^{-8}$	$5.52\text{x}10^{-11}$	$3.57\text{x}10^{-7}$	$2.27\text{x}10^{-5}$
σ^2_{v1}	$3.931\text{x}10^{-5}$	$1.21\text{x}10^{-5}$	$2.91\text{x}10^{-4}$	$3.99\text{x}10^{-4}$
σ^2_{v2}	$2.811\text{x}10^{-3}$	$6.07\text{x}10^{-6}$	$7.03\text{x}10^{-6}$	$1.15\text{x}10^{-4}$
σ^2_{v3}	$8.153\text{x}10^{-6}$	$5.41\text{x}10^{-10}$	$5.67\text{x}10^{-4}$	$3.38\text{x}10^{-3}$
σ^2_μ	$2.259\text{x}10^{-7}$	$1.69\text{x}10^{-12}$	$6.80\text{x}10^{-3}$	$4.45\text{x}10^{-5}$

Table 1b Likelihood Ratio Test (LR test)

		USA	EUM	CANADA	UK
$H_0^1 : \sigma_v^2 = \sigma_{v1}^2 = \sigma_{v2}^2 = \sigma_{v3}^2 = 0$	$\chi^2_{LR}(4)^{\blacklozenge}$	796.72**	504.69**	996.15**	894.98**
$H_0^2 : \sigma_v^2 = 0$	$\chi^2_{LR}(1)$	670.51**	489.22**	119.26**	258.22**
$H_0^3 : \sigma_{v1}^2 = 0$	$\chi^2_{LR}(1)$	667.07**	401.37**	312.14**	297.18**
$H_0^4 : \sigma_{v2}^2 = 0$	$\chi^2_{LR}(1)$	664.93**	433.66**	310.95**	271.56**

[17] A likelihood ratio test is calculated as the ratio of the likelihood of the sample data at the hypothesised value of β to the maximum of the likelihood function (i.e. evaluated at the MLE). Hence we calculate
(for H_0: $\beta = \beta_0$ vs ≠)
$LR = \lambda = L(\beta_0)/L(\beta_{ML})$
$\lambda < 1$. If it is near to 1 we accept H_0, if not we reject. We now need the distribution of λ. In some simple problems this can be worked out, but usually not. Fortunately it can be shown that
$-2 \ln \lambda \sim \chi^2$ in large samples, with q degrees of freedom where q is the number of restrictions in H_0.
Now, large values of the test statistic (minus twice the log-likelihood ratio) reject H_0.

$H_0^5 : \sigma_{v3}^2 = 0$	$\chi_{LR}^2(1)$	667.85**	368.74**	394.15**	274.83**
Sample		1981:01 2005:04	1991:10 2005:04	1981:01 2005:04	1981:01 2005:04
♦ $\chi_{LR}^2(R)$ are the test statistics from the likelihood ratio tests of whether the variances in the equations for the parameters of the model are zero. ** significant at the 1% level;					

First, it can be noted that $H_0^1 : \sigma_v^2 = \sigma_{v1}^2 = \sigma_{v2}^2 = \sigma_{v3}^2 = 0$ is forcefully rejected for all four countries and we conclude that some kind of time-variation in coefficients seems important. The tests support also that the constant intercepts for all the countries are time-varying. Rejecting $H_0^3 : 0, H_0^4 : 0$ and $H_0^5 : 0$ it connotes that the RRe, the RRh and RRs are not constant, respectively. In conclusion, the null hypotheses are rejected for all the countries and for all the five tests. Based on the above tests, we conclude that the unrestricted models in equations (8) and (9) are preferred and we do not need to impose any restriction on them.

Having estimated the dynamic coefficients of the unrestricted model in eq. (9), we define the contribution of each asset market *(q)* at time *t* in our FCI index as:

$$w_{q,i,t} = \frac{\left|\Gamma_{q,i,t}\right|}{\left|\sum_{q=1}^{3}\left(\Gamma_{q,i,t}\right)\right|} \tag{10}$$

Finally, eq.(11) describes how we construct the Financial Index :

$$FCI_{i,t} = \sum_{q=1}^{3}\left(W_{i,q,t}\right)\left(\Gamma_{q,i,t}\right) \tag{11}$$

Before going on with the analysis we should discuss briefly about the property of the FCIs In Table 2a, we present some illustrative statistics for each of these four FCIs separately. As shown in Table 3, two out of four sample means are positive (USFCI) and (EUFCI) while the other two are negative (CNFCI) and (UKFCI). From the standard deviation of these four variables, it is observed that the US and EU FCIs are more volatile than the Canada and UK FCIs. Among the variables, the first-order autocorrelation of monthly data ranges from 0.065 (UMD) to 0.199 (S/H). Furthermore, it is observed that the first-order autocorrelation coefficients of the small stocks are slightly bigger than those of the large stocks, implying that the small stocks are slightly more persistent than the large stocks. The measures of skewness and kurtosis[18] are reported to indicate whether our FCIs are normally distributed. The signs of skewness and kurtosis vary depending on the portfolio returns, confirming that in most cases their empirical distributions have heavy tails relative to the normal distribution. Two out of four FCIs, the Jarque-Bera statistics reject normality at any conventional level of statistical significance.

Table 2a

	Sample	Mean	Std. dev.	Skewness	Kurtosis	J-B	ρ
USFCI	81-05	0.037732	0.169036	2.659852	12.00034	756.0284	0.00000
CNFCI	82-05	-0.00356	0.018761	-0.23505	2.417847	3.872637	0.144234
UKFCI	85-05	-0.00097	0.04814	0.274829	3.580777	6.500843	0.038758
EUFCI	91-05	0.0082	0.056111	0.778084	4.124192	25.49113	0.000003

Table 2b

Autocorrelation and Partial Correlation Coefficients at different lags

	UKFCI		EUFCI		USFCI		CNFCI	
	AC	***PAC***	***AC***	***PAC***	***AC***	***PAC***	***AC***	***PAC***
1	0.89	0.89	0.92	0.92	0.88	0.88	0.68	0.68
2	0.76	-0.13	0.8	-0.25	0.73	-0.15	0.46	-0.01
3	0.65	0.01	0.71	0.11	0.62	0.08	0.41	0.19
4	0.57	0.04	0.63	0	0.54	0.02	0.38	0.07
5	0.47	-0.12	0.57	0.03	0.49	0.08	0.38	0.11
6	0.39	0.03	0.5	-0.07	0.44	-0	0.34	0.01
7	0.33	0.03	0.43	-0.01	0.37	-0.14	0.31	0.05
8	0.27	-0.03	0.36	-0.13	0.31	0.07	0.28	-0
9	0.25	0.11	0.28	-0	0.27	0.03	0.24	-0.01
10	0.21	-0.09	0.22	0.03	0.23	-0.05	0.21	-0.01
11	0.16	-0.08	0.19	0.12	0.19	-0.04	0.17	-0.03
12	0.1	-0.06	0.18	-0.01	0.14	-0.06	0.14	-0.01
13	0.05	-0.02	0.16	0.01	0.09	0.02	0.11	-0.04
14	0.01	-0.01	0.15	0.02	0.06	-0.01	0.08	-0.02
15	-0.03	0.01	0.14	0.07	0.03	-0.02	0.05	-0.04
16	-0.07	-0.06	0.14	0.01	0.02	0.04	-0.01	-0.09

Table 2b shows the autocorrelation results for all of the variables examined. To identify the autocorrelation among different lags, the first step is to calculate the autocorrelation coefficients for each specified number of lags on all variables. Sixteen lags were calculated for each variable. According to the results, all observed autocorrelation of each variable falls outside the confidence limits. Therefore, all the variables are significantly autocorrelated within their time series.

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[18] Skewness is a measure of the symmetry (or deviations form symmetry) of the distribution of the data. It is the 'third moment' of the frequency distribution. Normal distribution has zero skewness. If skew is positive then the frequency distribution has a long 'right tail'. If data has negative skewness, then large negative returns are more common than large positive returns.

Kurtosis measures the degree of peakness. The normal distribution has Kurtosis = 3. If the data has more peakedness than the normal distribution then kurtosis >3 and this is known as leptokurtosis. Whereas, lower peak is called platykurtosis.

Moreover, the results of the partial autocorrelation coefficients at various lags indicate that in the FCIs for all the countries exhibit significant levels of autocorrelation at the lag 7 periods, even when lower-order effects have been removed.

Finally, figures 1 to 4 in appendix 1 show the FCI for the four countries. The FCIs present different ranges. The USFCI is the most volatile (-0.3; +0.8) and fluctuate around the value of zero during the period. The volatility for the US increases in the period 2000-2002. The UKFCI fluctuate around zero within a range of (-0.15; +0.2) as well as the CNFCI that fluctuate around zero within a range of (-0.08; +0.08). Finally, the EUFCI shows quite a strong persistence along the period 1998-2000 compared to the US, UK and CN FCIs. The range is within the band of (–0.15;+0.2) and fluctuate around the value of zero.

Given that our FCIs are a weighted sum of our chosen variables, their interpretation as a measure of stance is not clear *a priori*. Hence we argue that, because we have constructed the variables in terms of difference or simply its deviation from its stochastic trend or its equilibrium value, the higher is the FCI, the looser is the "financial stance" and the higher is expected growth. In general we can assert that the ideal value of the FCI should be close to zero. In order to better understand the interpretation of the FCI we follow Gauthier *et al* (2004) and decompose each variable in our FCI $\Gamma_{q,i,t}$, into its permanent and transitory component. From eq. 3 we obtain:

$$\Gamma_{q,i,t} = \overline{\Gamma}_{q,i,t} + \mathrm{T}c_{q,i,t} \qquad (11a)$$

where the permanent component is the equilibrium value of the variable "q" for country "I" at time "t", $\overline{\Gamma}_{q,i,t}$, and $Tc_{q,i,t}$ is its deviation from equilibrium. Taking the first difference of eq 11a we get:

$$\Delta\Gamma_{i,t} = \Delta\overline{\Gamma}_{q,i,t} + \mathrm{T}c_{q,i,t} + Tc_{q,i,t-1} \qquad (11b)$$

where $\Delta\Gamma_{i,t} = \Gamma_{q,i,t} - \Gamma_{q,i,t-1}$ and $\Delta\overline{\Gamma}_{i,t} = \overline{\Gamma}_{q,i,t} - \overline{\Gamma}_{q,i,t-1}$.

Now it is plausible to assume that the equilibrium value of the $\overline{\Gamma}_{q,i,t}$ changes very slowly, so that we can approximate the one period change, as:

$$\Delta\Gamma_{i,t} = \mathrm{T}c_{q,i,t} + Tc_{q,i,t-1} \qquad (11c)$$

This assumption can be made if the time period is not so long (e.g. monthly, quarterly, semi annual) otherwise it would be complicated to compare the value of the FCI of many years ago with its value today in terms of stance. The reason of this statement can probably be found in the change over that period of the equilibrium values of each single variable. If however the time period is not long, from one fixed policy action date to another, it seems reasonable to assume that equilibrium levels of the variables have not changed much, if they have changed at all. Hence under this assumption, an increase in housing prices, directly stimulates housing supply, and indirectly, through the credit channel, increases the borrowing capacity of consumers and firms which stimulates investment and consumption. Since housing prices enter positively in eq. 4 and consequently in the FCI, they are indicative of a looser "financial stance" and signal higher output growth. Symmetrically, a positive change in the short-term interest rate for example, means a tighter money market; Since the short-term interest rate is negatively related in the IS curve of eq 4, it will affect negatively the assets markets and decreases the FCI, which implies lower expected output growth. In general, there are three categories of asset prices besides those on debt instruments that are viewed as providing important channels through which monetary policy affects the economy: 1) stock market prices, 2) real estate prices, and 3) exchange rates. Asset price changes will affect aggregate spending via changes in consumption and investment spending but also fluctuations of the asset markets that are influenced by monetary policy, have important impacts on the aggregate economy. If the FCI is capable to capture these changes, then it can be seen as a good information tool for the monetary authority.

5. FCI and Forward-looking Taylor Rules

In this section we provide the estimates of standard forward-looking interest rate rules and of rules which allow for Financial Condition Index to be a target and an information variable for the Central Bank. There is one point that we would like to underline before moving to the estimation and it is referred to the choice of the instruments. In economic series it is easy to find instruments that fulfill the orthogonality condition between regressors and error term. In the past this assumption has been tested using a test of the validity of over identifying restrictions (*J*-stat, see Davidson and Mckinnon, 1993). Stock et al (2002) and Hahn and Hausman (2003) among others have shown that the use of weak instruments[19] can lead to biased estimations even in large sample.

Recent econometric literature discusses the problems of weak instruments in IV regressions and solves them by computing ad hoc statistics and confidence intervals directly. These test statistics pay attention to weak instruments. Most of them are constructed by using large samples properties and are efficient under weak instruments asymptotic, however some of them work well even for a small sample. Different methods are suggested and most of them are considered here:

1) Anderson-Rubin statistics (AR) (1949)
2) The Conditional-Likelihood ratio statistic, Moreira (2002)
3) The Klibergen (2002) k-statistics

For applied works and a small number of instruments the preferred statistics is the Anderson-Rubin, which has well known properties for small samples and it is shown to be totally unaffected by the presence of weak instruments, the exclusion of relevant instruments, and the error distribution in the reduced form for the endogenous explanatory variable, Dufour (2003).

To check for this effect, we amend the Anderson-Rubin procedure as follows:

$$AR = F_{\psi=0} = \frac{\left(RSS_R^* - RSS_{UR}^*\right)/K}{RSS_{UR}^* / \left((T-K\right)} \qquad (8)$$

The Anderson-Rubin statistic is pivotal and is distributed as a χ^2 with k degree of freedom as the number of instruments. This procedure provides a joint test of all endogenous variables while being robust to many problems, including weak instruments.

The AR test in its generalized form developed by Dufour and Jasiak (2001) is applicable to univariate models that use limited information, and where one or more of the right-hand-side

[19] Weak instrument describes an instrument that does not contribute much to explaining the instrumented variable.

variables are possibly endogenous. In view of this, the AR test assesses the exclusion of an explanatory variable in the regression which can be conducted using the standard F test or its chi-square asymptotic variant, under the null hypothesis of strong exogeneity.
More formally, consider a limited-information simultaneous-equations system:

$$y = Y\delta + X_1 k + u \qquad (8a)$$

where y is an $nx1$ dependent variable, Y is an nxm matrix of endogenous variables, $X1$ is an $n\ x\ k1$ matrix of exogenous variables, and u is an error term that satisfies standard regularity conditions typical of IV regressions. In this context, consider hypothesis of the form:

$$H : \delta = \delta^0$$

Define $\overline{y} = y + Y\delta^0$ so that, under the null hypothesis, (8a) implies that

$$\overline{y} = X_1 + u$$

In view of this, the AR test assesses the exclusion of X_2 (of size nxk_2) in the regression of $\overline{y}$ on X_1 and X_2, which can be conducted using the standard F-test or its chi-square asymptotic variant (see Dufour and Jasiak (2001)).

Let $X = (X_1;X_2)$, and define

$$M = 1\text{-}X(X'X)^{-1}X';$$

$$M_1 = 1\text{-}X_1(X'_1 X_1)^{-1}X'_1:$$

The statistic then takes the form

$$AR = \frac{\left[\left(y - Y\delta^0\right)' M_1 \left(y - Y\delta^0\right) - \left(y - Y\delta^0\right)' M \left(y - Y\delta^0\right)\right] / k_2}{\left(y - Y\delta^0\right)' M \left(y - Y\delta^0\right) / \left(n - k_1 - k_2\right)}$$

(8b)

Under the null hypothesis, and imposing strong exogeneity and identically, independently distributed (i.i.d.) normal errors, AR~ $F(k_2,\ n - k_1 - k_2)$; the normality and i.i.d. hypotheses can be relaxed so that, under standard regularity conditions and weakly exogenous regressors, (k_2 x AR) $\overset{\text{asy}}{\sim} X_2\ (k_2)$.

The test can be readily extended to accommodate additional constraints on the coefficients of the exogenous variables; see Maddala (1974), Dufour and Jasiak (2001), Dufour and Taamouti (2003b,c), and Dufour (2004).
Specifically, consider a hypothesis of the form

$H : \delta = \delta^0, k_1 = k_1{}^0$

where k_1 is a subset of k i.e., $k = (k'_1 = k'_2)'$. Partition the matrix X_1 (into X_{11} and X_{12} submatrices) accordingly, and let

$\breve{y} = y - Y\delta^0 + X_{11} k_1$

The restricted model then becomes

$\breve{y} = X_{12} k_{12} + u$

and the test can be carried out as above.

Table 3 Weak instruments: Anderson-Rubin statistics

Variables	*USA* K_{un}=46	*Critical value* (χ^2 / K_{un})	*EMU* K_{un}=29	*Critical value* (χ^2 /K_{un})	*Canada* K_{un}=40	*Critical value* (χ^2 K_{un} /)	*UK* (K_{un}=30)	*Critical value* (χ^2 / K_{un})
FCI	0.2724**	0.9515	0.743**	1.5094	0.2807**	1.0943	0.8287**	1.4591
Output gap ' y'	0.206**	0.9515	0.278**	1.5094	0.4027**	1.0943	0.1065**	1.4591
Inflation 'π'	0.034**	0.9515	0.695**	1.5094	0.0347**	1.0943	1.387**	1.4591
Interest rate	0.066**	0.9515	0.924**	1.5094	0.8998**	1.0943	1.105**	1.4591
World oil price	0.048**	0.9515	1.214**	1.5094	1.1040♦	1.0943	0.0180**	1.4591

*10 percent level of significance, **5 percent level of significance

While the test in its original form was derived for the case where the first-stage regression is linear, Dufour and Taamouti (2003) show that it is in fact robust to: (i) the specification of the model for Y , and (ii) excluded instruments; in other words, the test is valid regardless of whether the first-stage regression is linear, and whether the matrix X_2 includes all available instruments. As argued in Dufour (2004), since one is never sure that all instruments have been accounted for, the latter property is quite important.

Most importantly, this test (and several variants discussed in Dufour 2004) is the only truly pivotal statistic whose properties in finite samples are robust to the quality of instruments. The results of the AR tests for each country are presented in the table3.

We do not reject the null hypothesis at 5% level for all the variables except for Canada world oil price for which the null hypothesis is rejected at 10% level. .

5.1 Benchmark Taylor Rule: specification and estimation

Given the important role played by asset prices in the monetary transmission mechanism and, considering that they may contain important information regarding the current and future state of the economy, the primary objective of this sub-section is to estimate forward-looking Taylor rules augmented for the FCIs we have found above.

Generally, policy makers are aware of the growing importance of asset prices in the economy, especially after the extraordinary growth rates registered in this sector (especially in the nineties). Most leading central bankers are now wondering whether and how they can take these

developments into account in the setting up and running of their monetary strategies. A consensus seems to be emerging around the idea that, if financial assets are indeed among the leading indicators of the economy, central bankers should not worry about them and therefore take any action until price developments endanger overall price stability.
For the purposes of the analysis the most important aspect is given by value and the significance of the FCIs' coefficients. In the following part of this study we estimate two Taylor rules for each four countries. In all the cases we expect to find a positive and statistically significance value of the inclusion of contemporary Financial Condition Index that is, the inclusion of the FCI should be superior, although marginally, to a benchmark Taylor Rule specification.

Following Clarida *et al.* (1998) we assume that the Central Bank has an operating target for the nominal short term interest rate that is based upon the state of the economy. Our benchmark model is the Standart Taylor rule, where interest rate is set according to the evolution of the output gap and expected inflation. In each period, the actual interest rate partially adjusts towards the target value. Svensson (1997) justifies the partial adjustment mechanism by including the change in interest rates in the Central Bank's loss function[20]. Combining the target rule with the partial adjustment mechanism we obtain the empirical form of the monetary policy reaction function:

$$R_t = \left(1 - \sum_{i=1}^{l} \varphi_i\right)\left\{a + \beta(E_t[\pi_{t+n}] - \pi^*) + \gamma E_{t-1}[\tilde{y}_t]\right\} + \sum_{i=1}^{l} \varphi_i R_{t-i} + u_t \qquad (9)$$

where $\sum_{i=1}^{l} \varphi_i \in [0,1]$ measuring the degree of interest rate smoothing, π^* is the inflation target (implicit or explicit), and $\alpha = r^* - \beta\pi^*$, with r^* denoting the long-run equilibrium nominal interest rate. Due to the fact that monetary policymakers cannot observe $\tilde{y}_t$ when setting R_t, we replace the actual value of the output gap with its expected level, $E_{t-1}[\tilde{y}_t]$[21]; The error term, u_t, represents a white noise monetary policy shock. We consider an inflation forecast horizon of one year, therefore we set n equal to 12 in our estimation.

[20] One of the main problems when working with forward looking and current variables is that they can be correlated with the error term. This in turn can lead to biased estimates of the coefficients. GMM technique can be a valid instrument to overcome these problems.
[21] See McCallum and Nelson, 1999, and Orphanides, 2000 for a further discussion of the uncertainties faced by the policymaker with respect to output.

In order to estimate the model, unknown expected future variables are replaced with their ex-post realized values. This leads us to Equation 4:

$$R_t = \left(1-\sum_{i=1}^{l}\varphi_i\right)\left\{a+\beta(\pi_{t+n}-\pi^*)+\gamma\tilde{y}_t\right\}+\sum_{i=1}^{l}\varphi_i R_{t-i}+\omega_t \qquad (10)$$

The set of orthogonality conditions implied by Equation (10) is:

$$E_t\left[R_t-\left(1-\sum_{i=1}^{l}\varphi_i\right)\left\{a+\beta(\pi_{t+n}-\pi^*)+\gamma\tilde{y}_t\right\}+\sum_{i=1}^{l}\varphi_i R_{t-i}\middle| I_t\right]=0 \qquad (11)$$

where I_t represents all the variables in the Central Bank's information set available at time *t* when the interest rate is chosen. I_t is a vector of variables that are orthogonal to ω_t. These instruments are lagged variables that help forecasting inflation and output, and contemporaneous variables that are uncorrelated with the exogenous monetary policy shock, u_t. The benchmark reaction function given by Equation (10) is estimated using the Generalised Method of Moments (GMM). The instruments employed in the estimation include a constant and six lags of the nominal short-term interest rate, inflation, output gap, and a world commodity price index (agricultural raw materials). Since the number of instruments is greater than the number of elements of the parameter vector [φ_i, α, β, γ], we test for the validity of the over-identifying restrictions using the Hansen (1982) *J*-statistic. As pointed out by Clarida *et al.* (1998), failure to reject orthogonality implies that the Central Bank considers lagged variables in its reaction function, only to the extent that they forecast future inflation or output.

The GMM estimation results in Tables 1 to 4, column 2, indicate that the benchmark specification satisfies the dynamic stability criterion since the estimated inflation coefficient, β, is greater than one[22] The output gap coefficient, γ, is positive and statistically significant at the 1 % level in all the estimates. The sum of the interest rate smoothing parameters is close to one for all the four Central Banks under consideration, indicating a high level of persistence in short term interest rates. Finally, the *J*-statistic indicates that the over-identifying restrictions of the benchmark model are not rejected.

[22] If β was smaller than the stability threshold of one, then this would imply a positively sloped aggregated demand, with output decreasing in response to an inflation shock (Taylor, 1998).

5.2 Interest rate and FCI

As pointed out in the previous section, asset prices contain important information about future aggregate demand and consequently inflation pressures. Also, there are theoretical arguments in favour of including asset price inflation in the reaction function of the Central Bank. Cecchetti *et al*. (2000) find that, on the basis of simulations, it would be desirable to include asset inflation in the Taylor rule. Augmented Taylor rule are usually estimates including each single variable independently in the model no matter the importance of that particular market at that time. However, as described in many data[23], the composition of households and firms total assets changes over time and this is likely to be considered when monetary authority set the interest rate. The Financial Condition Index calculated in the previous paragraph should overcome this issue, since it is a weighted index.

Thus, we proceed by considering alternatives to our benchmark specification, by allowing asset prices to enter in the Taylor rule. The augmented reaction functions we consider are of the form[24]:

$$R_t = \left(1 - \sum_{i=1}^{l} \varphi_i\right)\left\{a + \beta(E_t[\pi_{t+n}] - \pi^*) + \gamma E_{t-1}[\tilde{y}_t] + \omega \chi_{t-n}\right\} + \sum_{i=1}^{l} \varphi_i R_{t-i} + \varepsilon_t \qquad (12)$$

where x_{t-n} denotes the relevant financial condition index and ω the relevant coefficient. We assume that *n* is equal to zero We use contemporaneous, and not expected, Financial Condition Index due to the well known difficulties involved in forecasting asset price movements. Also, weak form efficiency implies that the current asset price reflects all past history, thus there is no need to incorporate lags. This implies that at every disequilibria at time t, Central Banks intervene at time t+1 when $\omega > 0$.

Table 4 presents a statistics summary of the residuals from the benchmark and the augmented Taylor rules. Figure 5 shows the behaviour of the residuals from the two Taylor rules estimations for each single country.

[23] See OECD Economic Outlook.

[24] See Kontonikas and Montagnoli (2003) for a theoretical derivation of Eq. (12).

Tab. 4 Statistics of the residuals from the benchmark Taylor rule and the augmented Taylor rule								
	UKBAS	**UKFCI**	**CNBAS**	**CNFCI**	**EUBAS**	**EUFCI**	**USBAS**	**USFCI**
Mean	-0.01541	-0.01003	0.154887	0.080247	0.028237	-0.04442	0.014012	-0.02918
Median	-0.0089	-0.00829	0.141015	0.054878	0.044491	-0.02524	0.016257	-0.01519
Maximum	0.490817	0.531867	2.254068	1.691511	0.646095	0.530841	0.980333	0.62302
Minimum	-0.3669	-0.41491	-1.27722	-1.17465	-0.69513	-1.0022	-0.97741	-0.88877
Std. Dev.	0.158091	0.146212	0.500055	0.349011	0.186987	0.210785	0.302605	0.176727
Skewness	0.295066	0.222273	0.950286	1.236778	-0.11571	-0.96688	0.09431	-0.80603
Kurtosis	3.922697	4.769246	6.481201	9.245376	5.282518	6.261475	4.681332	8.703224
Jarque-Bera	5.548267	15.39132	72.75559	208.6948	24.3434	66.492	13.23885	162.4553
Probability	0.062404	0.000455	0	0	0.000005	0	0.001334	0
Sum	-1.71019	-1.11307	17.19243	8.907453	3.134351	-4.93078	1.555358	-3.23904
Sum Sq. Dev.	2.74922	2.351558	27.50606	13.39895	3.846058	4.887314	10.07269	3.435563

The visual inspection of the plots in figure 5 and the statistics presented in the above table show that the volatility of the residuals of the benchmark Taylor rules are bigger than the volatility of the augmented Taylor rules (with the FCI) for three out of four countries. The volatility of the residuals of the Europe benchmark Taylor rule is smaller than the augmented one.

Give an interpretation of the estimation results presented in tables 1 to 4 (appendix 2) is not an easy task; Except for the Euro area, all cases analysed in this work have a positive and statistically significance of the inclusion of contemporary value of Financial Condition Index in the Taylor rule[25]. Asset price parameter in the monetary policy rule is positive for three of the four countries. UK shows a non-neglectable effect of FCI in its interest rate. Central Banks always stress that they do not have any other objective than to keep the level of inflation within the target –when it exists- or at a level that is compatible with the overall economic outlook, therefore a positive FCI does not have an immediate interpretations. Gauthier *et al*. (2004) argue "that the higher the FCI, the looser the 'financial stance' and the higher the expected growth…[hence]… an increase in housing prices directly stimulates housing supply, and, indirectly, through the credit channel, it increases the borrowing capacity of consumers, which stimulates consumption. Because housing prices are positively weighted in the FCI, a higher level is indicative of a looser 'financial stance' and signals

[25] We checked whether having t-n lags in the FCI suggested by Bernake and Gertler (1999) and Chadha *et al.* (2003) made a difference. Overall the inclusion of lags do not qualitatively and quantitatively improve

higher output growth"[26].We can suggest two alternative explanations: firstly asset market might have a role in interest rate setting because they contain information about future level of asset prices and output particularly when they diverge from their fundamental value. Second, if we accept that Central Banks do not only have the objective of monetary stability but also of financial stability, then asset prices can play an important role in monetary policy. In a context characterized by asymmetric information, financial markets determine the value of the collateral, hence, fixing the cost of capital; in other words they delimit the amount of capital firms are able to borrow. In such environment, an increase in the Bank's interest rate has a more than proportional impact on the cost of capital. Given this, a monetary policy should always consider the level of the business cycles and the level of indebtedness. Failing in doing so might cause financial instability in the system.

Finally, we should try to answer the question why, for the EU, is not statistically significance of the inclusion of contemporary value of Financial Condition Index in the Taylor rule. Ehrmann *et al* (2005) found that in the euro area there is no significant relationship between equity markets and short-term interest rates. Furthermore, there is evidence for a much larger response of stock markets to changes in monetary policy in Europe. For a monetary union like the euro area, which comprises twelve individual countries, the matter is somewhat more complex. The introduction of the euro in 1999 and the conduct of the single European monetary policy for the euro area as a whole by the European Central Bank (ECB) made it necessary for the financial systems of twelve euro area countries to become more integrated. Indeed, a fully integrated money market and a sufficiently high degree of integration of other financial markets is a prerequisite "a conditio sine qua non" for the smooth and effective implementation of monetary policy and for its balanced transmission across national boundaries.

There are additional components of complexity that enter in the conduct of monetary policy when financial markets are not well integrated in the European currency area. First, central banks tend to use asset prices to extract information from asset prices about what markets expect about future states of the economy. If there is not one integrated market for the assets used but several fragmented ones, the information about the economy of the currency area as a whole may be more noisy than otherwise the case. For example, it may be difficult to control perfectly for all the local factors that influence prices in the different market segments. Second, if market prices for the same asset diverge across the area, then the overall wealth effects on area wide inflation and growth may become blurred. Finally, disintegrated asset markets may contribute to a heterogeneous transmission of monetary policy to the economy. European financial markets are still not really

[26] Gauthier *et al*., pp. 23-24, 2004.

perceived as a substitution for an investor across the countries but just inside the asset markets of each single country.

For this reason, the interrelationship between financial markets and monetary policy is particularly important in Europe but, the structural changes that took place in Europe's financial markets as a result of EMU and other developments maybe needs more and significant adjustments.

6. Conclusions

Stating from the seminal work of Alchian and Klein (1973) it is often argued that the forward-looking nature of asset prices makes them good proxies for the information left out of conventional inflation measures. It is also widely accepted that asset price inflation developments are closely associated with general inflation trends. This paper investigated the role of asset prices in the conduct of monetary policy in United States, Canada, Euro Area and United Kingdom. We constructed Financial Condition Indexes for the four countries using the Kalman Filter algorithm. This methodology allowed us to capture the changes of the weights over time. Second, we proceeded by estimating forward-looking Taylor rules augmented for FCI. The results from the Taylor rules suggest that the Financial Condition Index enter positively and statistically significant into the FED, Bank of England and Bank of Canada interest rate setting. This gives a positive view for the use of the FCI as an important short term indicator to guide the conduct of monetary policy in three out of four countries analyzed.

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Appendix 1

Table 1a Unit root test

Variables	*USA*	*EMU*	*Canada*	*UK*
RRe	ADF =-4.338** PP=-3.404*	ADF =-3.364* PP=-2.852♦	ADF =-3.197* PP=-3.076*	ADF = -3.873** PP= -3.695**
RRh	ADF =-4.225** PP=-3.979**	ADF =-3.522** PP=-3.235*	ADF =-2.113* PP=-2.159*	ADF = -14.101** PP=-2.745♦
RRs	ADF =-4.293** PP=-4.363**	ADF =-1.948* PP=-1.640♦	ADF =-3.518** PP=-3.668**	PP =-2.566* PP=-4.116**
	** significant at the 1% level; *significant at 5% level; ♦ significant at the 10% level. ADF= Augmented Dickey Fuller; PP= Phillips Perron			
Sample	1982:01 2005:04	1991:10 2005:04	1982:01 2005:04	1985:01 2005:04

Figure 1 EU and Canada residuals of the SURE

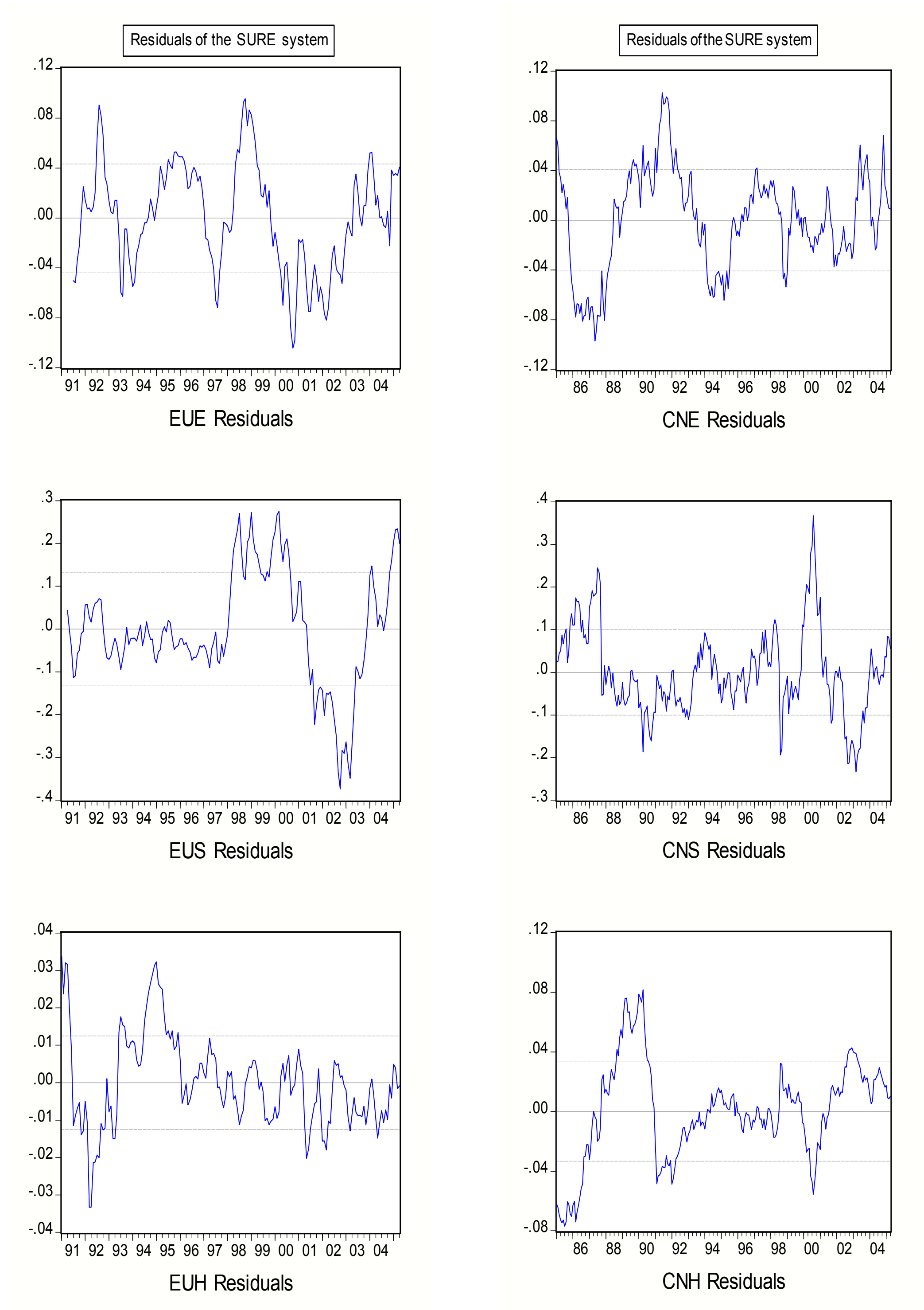


Figure 2 UK and US residuals of the SURE

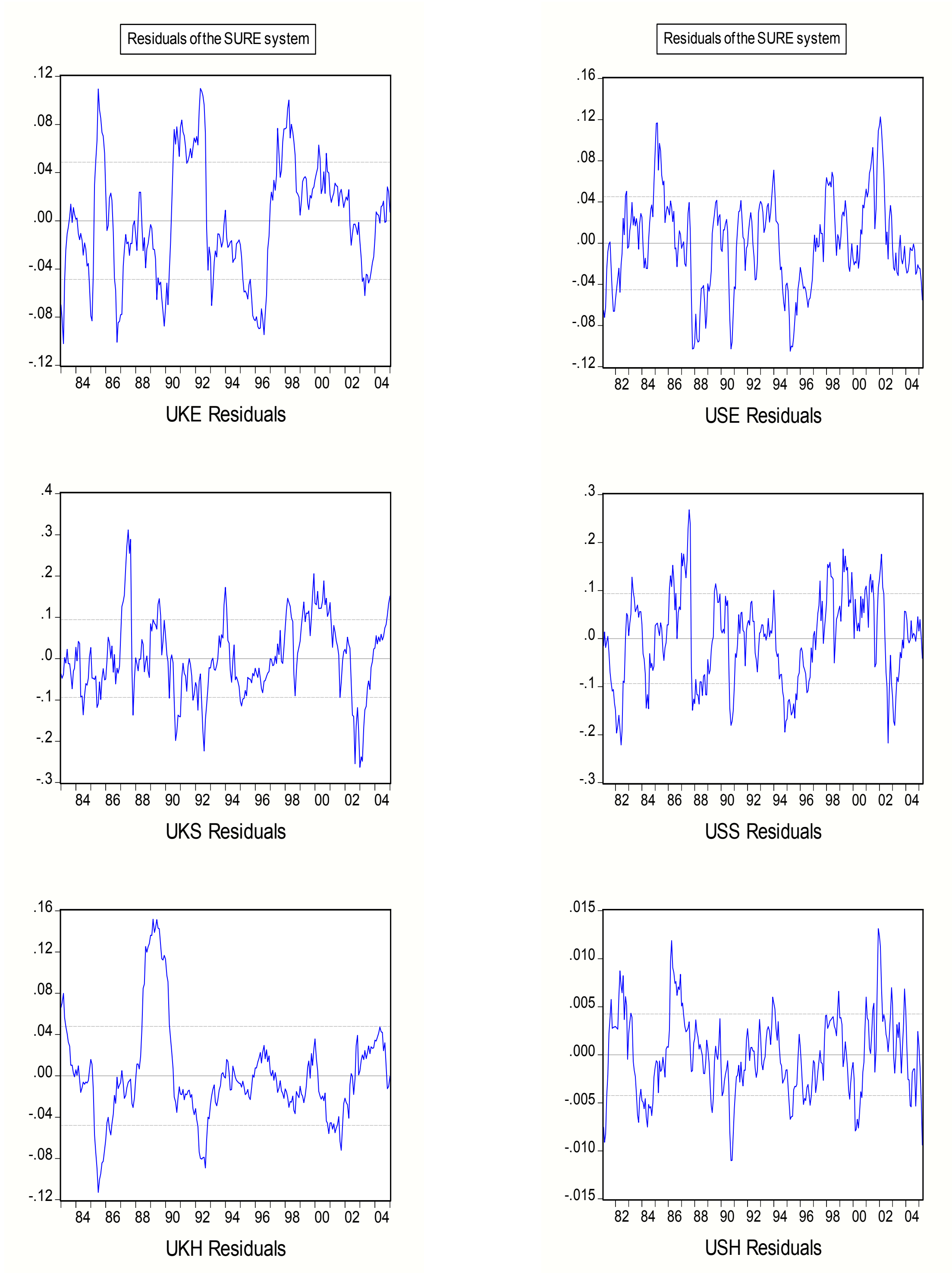


Figure 3

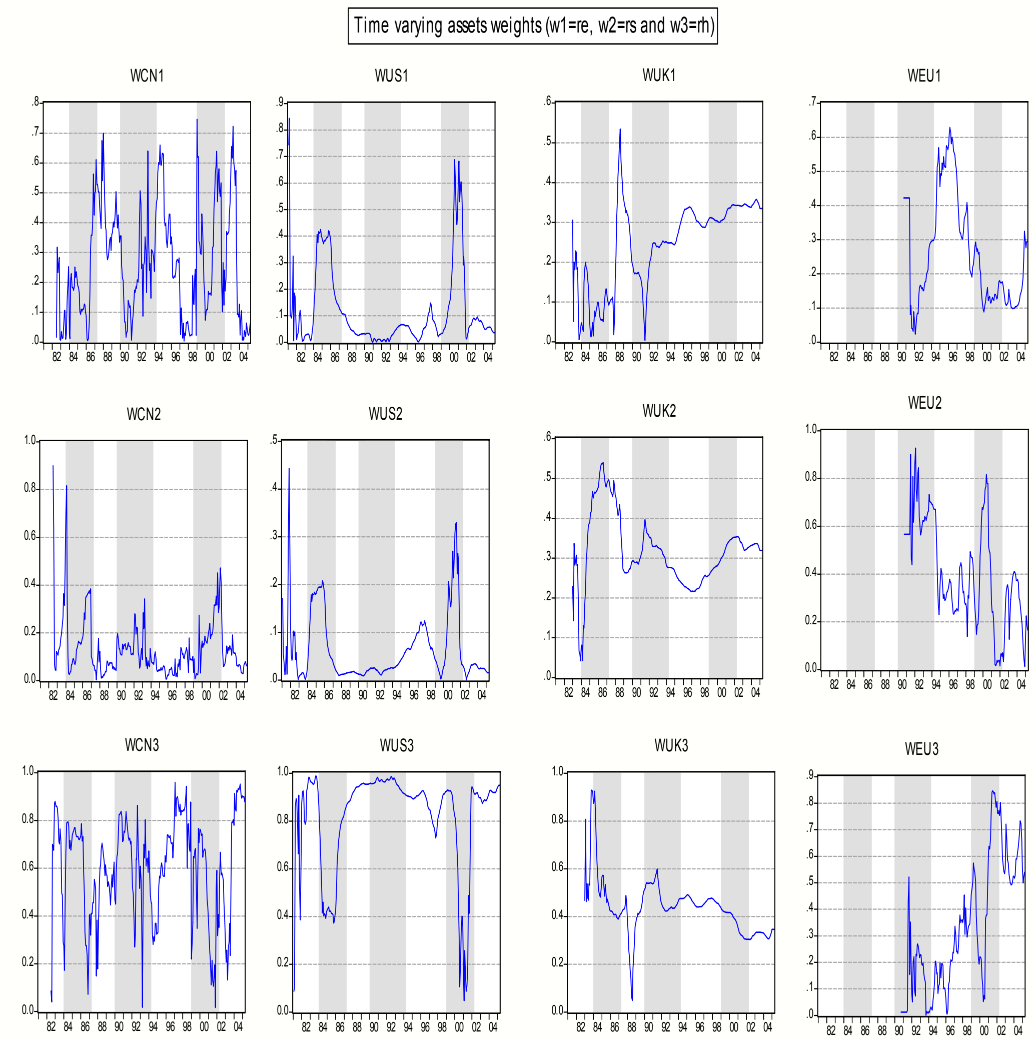

Time varying assets weights (w1=re, w2=rs and w3=rh)
WCN1
WUS1
WUK1
WEU1
WCN2
WUS2
WUK2
WEU2
WCN3
WUS3
WUK3
WEU3

Figure 4a-d FCIs

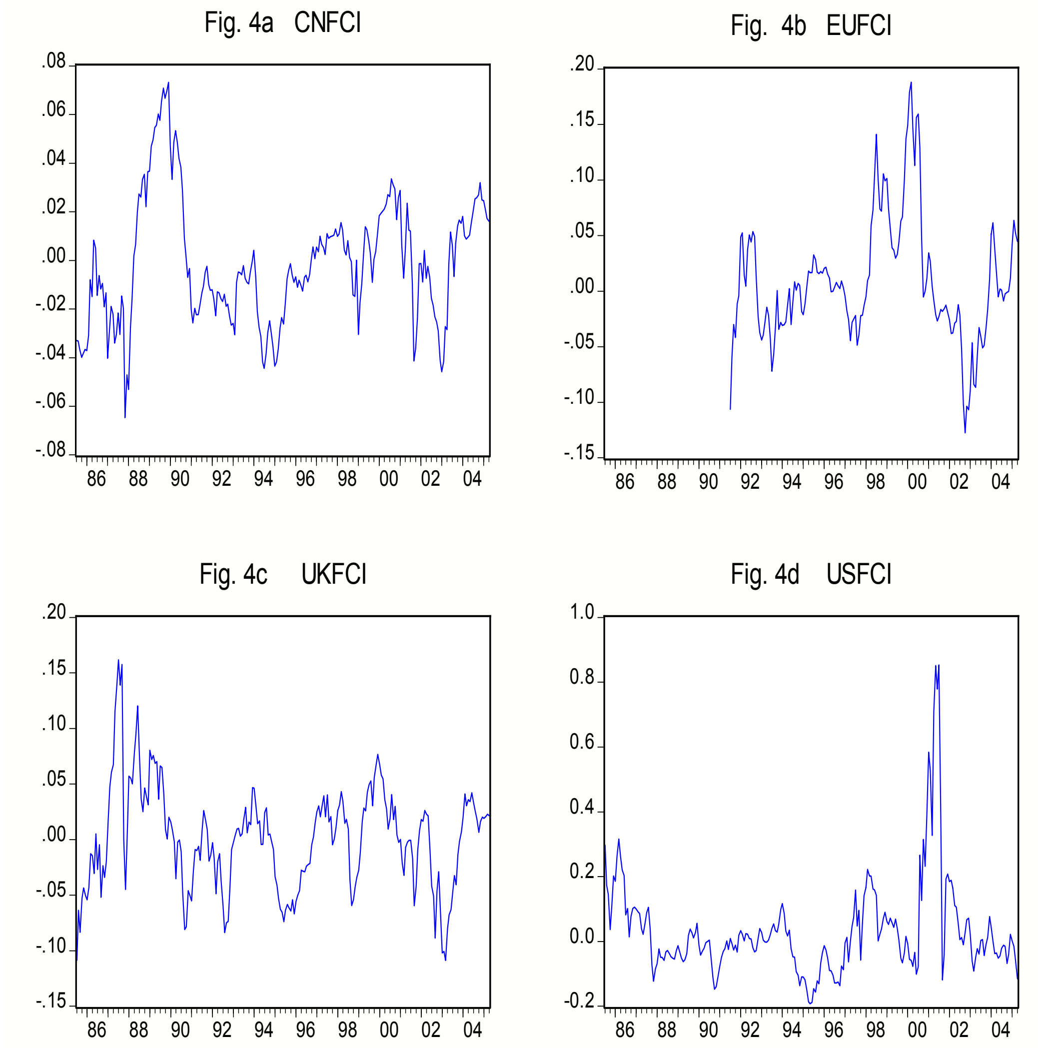


Fig. 5 Plots of the residuals from the baseline and the augmented Taylor rules

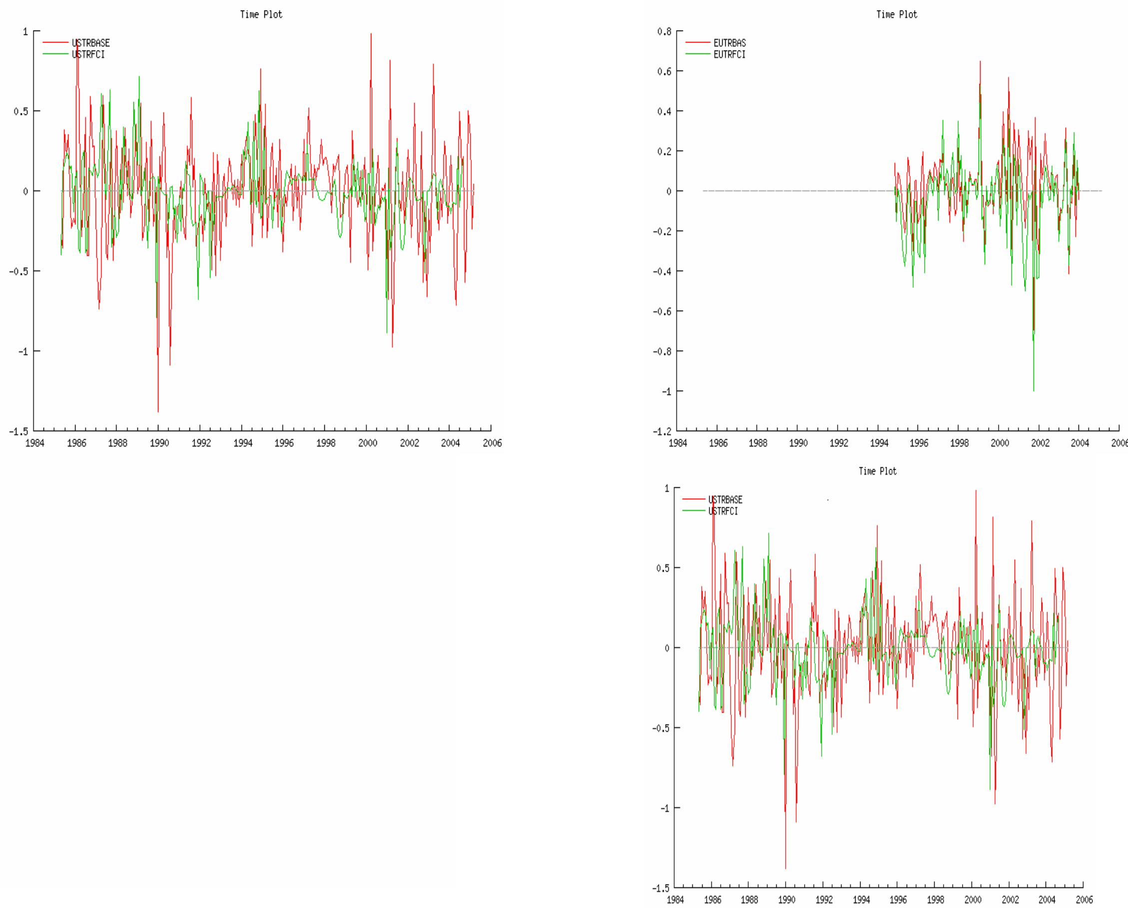


Fig. 6a EU Taylor rule residuals spectrum

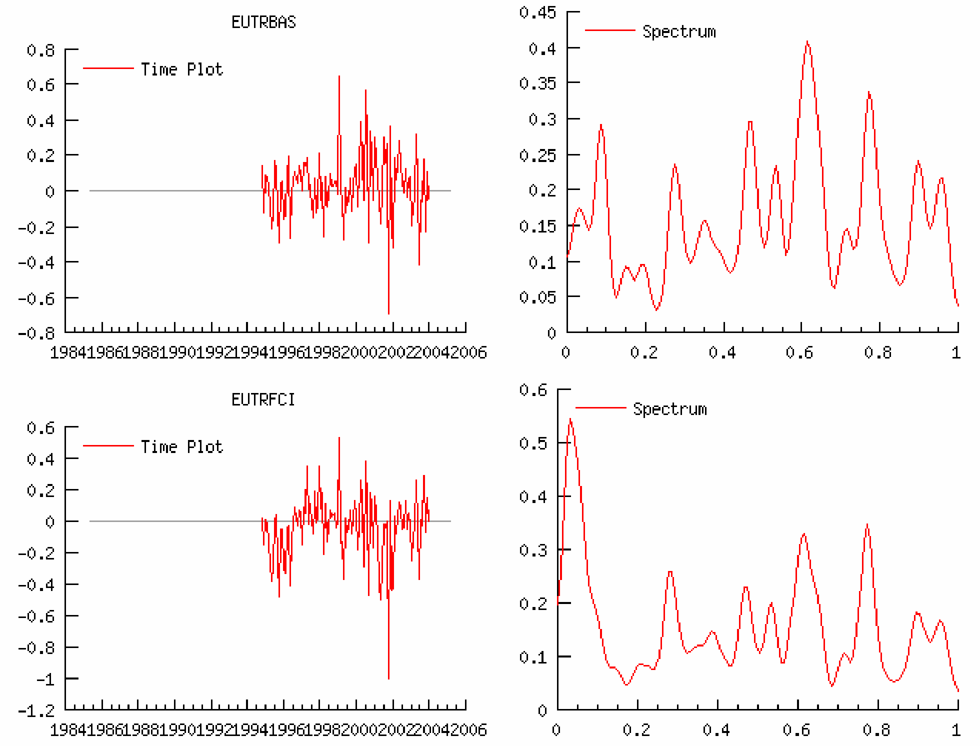


Fig. 6b US Taylor rule residuals spectrum

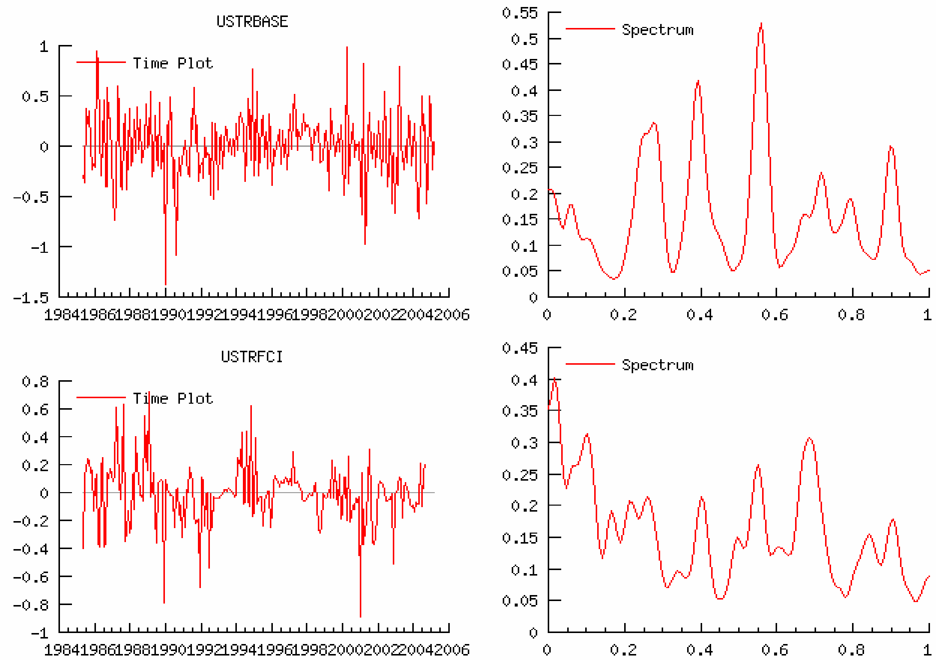


Fig. 6c UK Taylor rule residuals spctrum

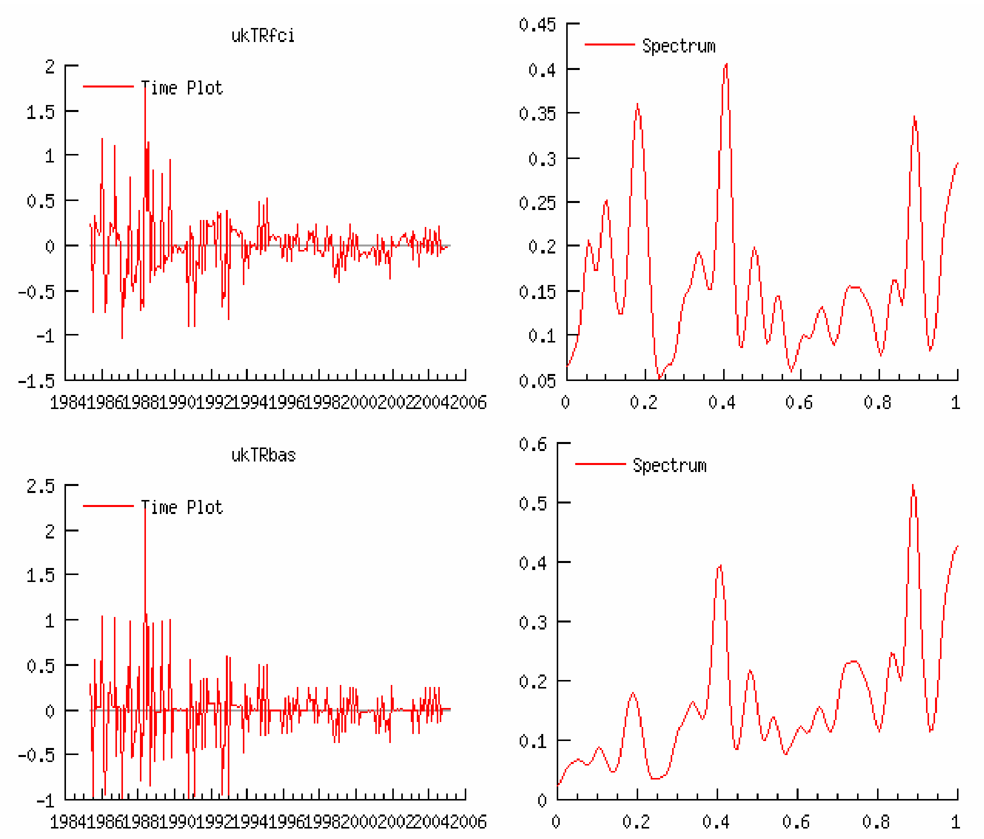
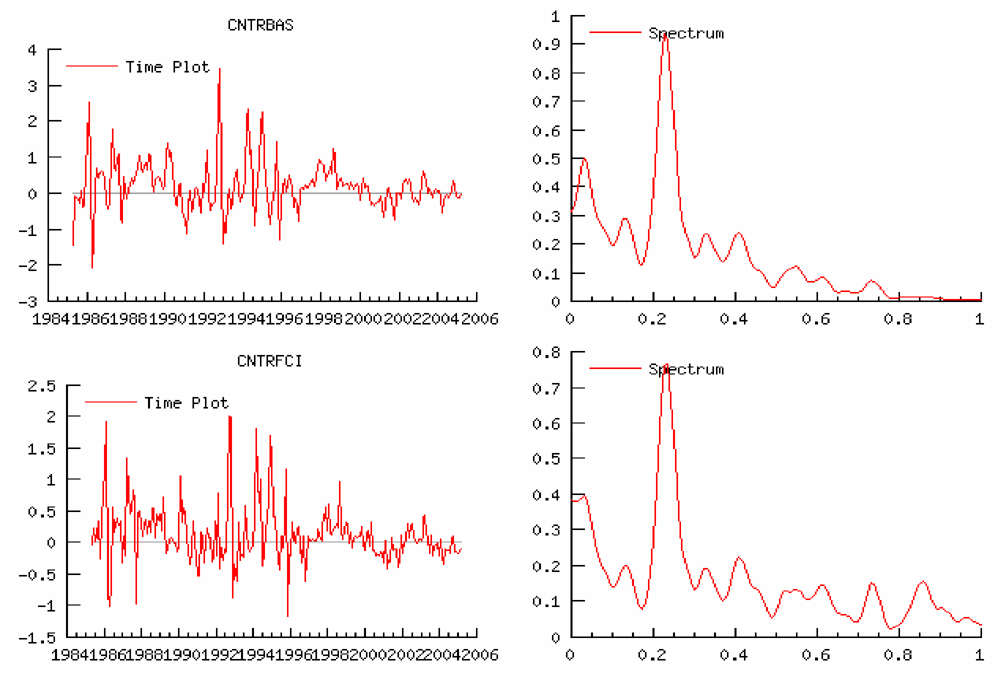


Fig. 6d Canada Taylor rule residuals spectrum



Appendix 2

Table 1: GMM Estimates of US Forward Looking Taylor Rule, 1985:05-2005:5

	a	β	γ	$\sum_{i=1}^{l}\varphi_i$	$X_t = [\pi_t^{FCI}]'$	J- Stat.
Benchmark Model	1.208***	1.400*	0.290***	0.970***	---	0.099
Augmented Model 1	0.306***	1.657**	0.232**	0.980**	0.103**	0.071

Note:

1. Estimates are obtained by GMM estimation with correction for MA(12) autocorrelation. Two-stage least squares estimation is employed to obtain the initial estimates of the optimal weighting matrix.
2. In the benchmark model the instruments used are a constant and lags 1 to 6 of the nominal short term interest rate, inflation, output gap, and a world commodity price index (agricultural raw materials). In the model that includes asset price inflation, lags 1 to 6 of the constructed FCI is also included.
3. *J*-stat denotes the test statistic for overidentifying restrictions.
4. *, **, *** indicate level of significance of 10%, 5%, and 1% respectively.

Table 2: GMM Estimates of EU Forward Looking Taylor Rule, 1995:01-2005:05

	a	β	γ	$\sum_{i=1}^{l}\varphi_i$	$X_t = [\pi_t^{FCI}]'$	J- Stat.
Benchmark Model	0.998*	1.283**	0.818**	0.932**	---	0.132
Augmented Model 1	1.053***	1.843***	0.408**	0.922***	0.136	0.211

Note: See Table 1.

Table 3 GMM Estimates of Canada Forward Looking Taylor Rule, 1985:05-2005:05

	a	β	γ	$\sum_{i=1}^{l}\varphi_i$	$X_t = [\pi_t^{FCI}]'$	J- Stat.
Benchmark Model	0.608**	1.302**	0.973**	0.960**	---	0.142
Augmented Model 1	0.112**	1.655**	0.998*	0.955***	0.128***	0.206

Note: See Table 1

Table 4 GMM Estimates of UK Forward Looking Taylor Rule, 1985:05-2005:05

	a	β	γ	$\sum_{i=1}^{l}\varphi_i$	$X_t = [\pi_t^{FCI}]'$	J- Stat.
Benchmark Model	1.867***	1.170***	0.694**	0.777.**	---	0.139
Augmented Model 1	1.080***	1.630***	0.485**	0.960***	0.415**	0.150

Note: See Table 1

Appendix 3

Country	*Interest Rate*	*Exchange Rate*	*CPI*	*House Price*	*Output*	*Stock price*
USA	US TREASURY BILL RATE - 3 MONTH	US REAL EFFECTIVE EXCHANGE RATE INDEX - CPI BASED	US CPI - ALL URBAN SAMPLE ALL ITEMS	US AVERAGE PRICE OF HOUSE SOLD*	US INDUSTRIAL PRODUCTION - TOTAL INDEX	**US DOW JONES INDUSTRIALS SHARE PRICE INDEX**
UK	UK TREASURY BILL RATE - 3 MONTH	UK REAL EFFECTIVE EXCHANGE RATE INDEX - CPI BASED	UK RPI - ALL ITEMS EXCLUDING MORTGAGE INTEREST	UK HALIFAX HOUSE PRICE INDEX - ALL HOUSES	UK INDUSTRIAL PRODUCTION - TOTAL INDEX	**FTSE ALL SHARE - PRICE INDEX**
EUM	RT.MM.EUR. EURIBOR.3 MONTH	EU REAL EFFECTIVE EXCHANGE RATE INDEX - CPI BASED	HICP - OVERALL INDEX EURO AREA	Eurostat**	EU INDUSTRIAL PRODUCTION - TOTAL INDEX	**EM SHARE PRICE INDEX**
Canada	CN TREASURY BILL RATE - 3 MONTH	CN REAL EFFECTIVE EXCHANGE RATE INDEX - CPI BASED	CN CPI	CN HOUSING PRICE INDEX	CN INDUSTRIAL PRODUCTION - TOTAL INDEX	**CN TORONTO STOCK EXCHANGE COMPOSITE SHARE PRICE INDEX**

Source: All data are from the IMF-Financial Statistics collected by DATASTREAM
Source: (*) National Association of Home Builders; (**) Eurostat.

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