Money Market Rates And Implied CCAPM Rates:

Some International Evidence*

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Abstract

New Neoclassical Synthesis models equate the instrument of monetary policy to the implied CCAPM rate arising from a standard model with power utility. This paper identifies monetary policy shocks using a multi country dataset and examines the movement of money market and implied CCAPM rates. We find that an increase in the nominal interest rate leads to a fall in the implied CCAPM rate. Incorporating habit still yields the same result. The findings suggest that the movement of these two rates implied by the transmission mechanism of monetary policy in NNS models cannot be reconciled through the consumption Euler equation.

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1 Introduction

The dominant paradigm in recent years within monetary economics has been the New Neoclassical Synthesis approach to monetary modeling. This approach has spawned a growing literature that examines the effect of monetary policy on key variables, such as real expenditure and inflation\(^1\). The focus of this paper concerns a key ingredient of these models, namely the consumption Euler equation. Within a standard consumer optimization problem, it says that the expectation of the intertemporal marginal rate of substitution of consumption multiplied by the inverse of inflation has to equal the inverse of the gross nominal interest rate. It is a necessary condition for optimality. The Euler equation is the key link in the transmission mechanism of monetary policy within these New Neoclassical Synthesis models (or NNS for short). It reflects the stance of monetary policy through the instrument of monetary policy - the nominal interest rate. The NNS models assume that the central bank targets the nominal interest rate when setting monetary policy. Hence, a change in the nominal interest rate is transmitted through the Euler equation and has an impact on consumption, inflation and output.\(^2\)

However, the empirical problems associated with the standard Euler equation are well known. Hansen and Singleton (1982), Mehra and Prescott (1985), and others have documented the inability of aggregate time series data in being able to support the Euler equation. Monetary models typically assume that the interest rate in the consumption Euler equation is a money market rate and they equate it to the monetary policy instrument for a central bank. This is problematic for monetary models as Weil (1989) found evidence of the ‘risk-free

\(^1\)These New Neoclassical Synthesis models incorporate optimizing behaviour, rational expectations, and frictions in the form of nominal wage and price rigidities that allow monetary policy to have real effects. Recent works include King and Wolman (1996), Rotemberg & Woodford (1997, 1999), Clarida, Gali & Gertler (2000), Erceg, Henderson and Levin (2000), Fuhrer (2000) and Goodfriend and King (2001).

\(^2\)The transmission mechanism requires the presence of a rigidity for monetary policy to have real effects. This rigidity may be in the form of sticky wages or prices, or other types of rigidities, such as limited participation, so that changes in the nominal interest rate can affect real expenditure.
rate puzzle’, where the risk free rate appears to be too low when agents are very risk averse to intertemporal substitution. More recently, Canzoneri, Cumby and Diba (2001) find that the Federal Funds rate is negatively correlated with the implied CCAPM rate for the United States. An instance of this was observed in October 1979 for the US, where the Federal Reserve Board tightened monetary policy. The Federal Funds rate visibly increased as a result of the announcement by the Chairman, Paul Volcker, of a new approach to monetary policy, which was in the form of controlling non-borrowed reserves. The implied CCAPM rate during this period actually moved in the opposite direction and fell.

This observation poses a problem for NNS monetary policy models which equate the money market rate to the implied CCAPM rate and emphasize the transmission mechanism of monetary policy through the Euler equation. This implies that the two rates should be perfectly correlated. Thus the problem arises in these models if the central bank implements monetary policy, by changing the nominal interest rate, and the implication is that the implied CCAPM rate moves in a different direction. If this problem holds in general and is not merely a feature of the US data, then a possible resolution to this would be to try and break the link between the instrument of the central bank and the CCAPM rate, as in Limited Participation models. However, this is not discussed here in the paper.

Instead, this paper attempts to determine if this aforementioned problem highlighted by Canzoneri, Cumby and Diba (henceforth CCD, 2001) was an isolated event for the US, or whether a more significant problem exists. This is done by looking at data from six of the G7 countries. First, the implied CCAPM rates are constructed for all the countries under three scenarios. The baseline case consists of a benchmark model with power utility. The other two cases introduces habit into the utility specification. The correlations between the money market rate and the implied CCAPM rate are calculated for each country and their movements over the last thirty years are analysed. The initial analysis shows that the two
rates are not perfectly correlated as the theory would imply. There appear to be periods when they do move together and other periods when they diverge.

Since the transmission mechanism of monetary policy occurs through the Euler equation within the NNS models, the paper proceeds by identifying episodes where central bank used monetary policy to react to shocks. This is done by blending two different methodologies that have been used in the literature for identifying monetary policy shocks. The first methodology employed is in the same spirit as that of the ‘Narrative Approach’ utilised by Romer and Romer (1989, 2002). Historical events are examined over the last thirty years to try and identify episodes of monetary policy reactions to observable shocks. When analysing the movement of these rates, the money market and implied CCAPM rates do appear to be moving in opposite directions during periods where the central bank responded to a shock by actively setting interest rates.

An alternative methodology is employed to determine the extent and direction in which the real interest rate and the implied real CCAPM rates moved during those events. This part of the paper adopts the Christiano, Eichenbaum & Evans (1999) approach to identifying and analysing the effects of a monetary policy shock on key variables by examining impulse response functions from Vector Autoregressions to try and resolve the puzzle. These results show that all the countries exhibit ‘hump-shaped’ responses for consumption and output which arise from a money market rate shock. The directions of these movements suggest that the money market rates are inconsistent with the implied CCAPM rate from the Euler equation. In particular, the implied response of the CCAPM rate to an increase in the money market rate is negative and the implication is that movements in the two rates cannot be reconciled through the Euler equation.

The structure of the paper is as follows. Section 2 calculates and compares movements in the CCAPM rates, implied by the Euler equation, with associated money market rates. Sec-

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tion 3 adopts a narrative approach to identifying monetary policy shocks to try and account for observed movements in money market rates, and examine the associated movement in the implied CCAPM rate during periods where the central banks responded to some observed shock. Section 4 implements the Christiano, Eichenbaum & Evans (1999) methodology for identifying monetary policy shocks to trace out the dynamic responses of consumption, inflation and output, arising from a monetary policy shock. The implication of these impulse responses are then used to try and explain movements in the money market and implied CCAPM rates. Finally, section 5 concludes.

2 Comparison of Money Market And Implied CCAPM Rates

This section focuses on the methodology used to construct the implied CCAPM rates and compare their movements to the movements of money market rates. Implied CCAPM rates are constructed under three different scenarios. The first scenario considers the baseline case where consumers have period power utility functions and maximise expected lifetime utility. The other two cases considered are ones which incorporates habit into the utility specification. In particular, Abel’s (1999) habit specification is used. The reason for analysing models of habit is twofold. First, the literature on asset pricing has had some success in addressing both Mehra and Prescott’s (1985) equity premium and Weil’s (1989) risk free rate puzzles. This has come in the form of adding persistence into these models through the utility function, by incorporating habit. Both Abel (1999) and Campbell & Cochrane (1999) incorporate habit to try and develop a model that has a large equity premium and a risk free rate with low variability as its central features. Thus, one reason for considering habit models, is to see if it can address the problem noted by CCD, whilst still retaining the innovations provided by Abel (1999) and Campbell & Cochrane (1999).
The second reason for analysing habit models, is because the monetary literature has followed the success in the finance literature in addressing some issues. Recent work by Fuhrer (2000) was able to match the persistent responses of real expenditures and inflation, arising from a monetary policy shock, to those implied by the data by using habit. Also, Edge (2000) was able to generate a liquidity effect by incorporating habit. These works suggest that habit provides an avenue to generate the features we would wish to see within monetary models. Also, looking at habit provides a comparison to the standard baseline power utility case. The methodology used in the power utility version is outlined next along with its results. It is followed after by outlining Abel’s (1999) model of habit together with its results.

2.1 The Baseline Power Utility Case

Consider a basic framework where a representative agent maximises expected lifetime utility:

\[
\max U_t = \sum_{j=t}^{\infty} \beta^{j-t} E_t u(C_j) = \sum_{j=t}^{\infty} \beta^{j-t} E_t \left( \frac{C_j^{1-\theta}}{1-\theta} \right)
\]

Here, period utility is a power utility function where \( \theta \) denotes the coefficient of relative risk aversion. Consumers allocate income between consumption and holding two one-period bonds. The first bond is nominally riskless and pays out one dollar. The other pays out one unit of consumption good. The first order necessary conditions for optimisation imply that:

\[
\frac{1}{1 + i_t} = \beta E_t \left[ \left( \frac{U'(C_{t+1})}{U'(C_t)} \right) \left( \frac{P_t}{P_{t+1}} \right) \right] = \beta E_t \left[ \left( \frac{C_t}{C_{t+1}} \right)^{\theta} \frac{P_t}{P_{t+1}} \right] \equiv \frac{1}{1 + i_t^*}
\]

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This is the Euler equation which prices the nominally riskless bond. Here $i_t$ denotes the nominal interest rate, $i_t^*$ denotes the implied CCAPM rate and $P_t$ is the price of one unit of consumption good. The first order necessary condition for the real riskless bond implies:

$$\frac{1}{1 + r_t} = \beta E_t \left[ \frac{U'(C_{t+1})}{U'(C_t)} \right] \equiv \frac{1}{1 + r_t^*}$$

(3)

$r_t$ is the real interest rate and $r_t^*$ is the implied real CCAPM rate. The right hand sides of equations (2) & (3) define the inverse implied nominal and real CCAPM rates. In order to construct these, the paper follows Fuhrer (2000) in assuming that the dynamics of consumption can be succinctly captured in a vector autoregression (VAR) written below in companion form:

$$Z_t = AZ_{t-1} + \varepsilon_t$$

(4)

where $Z_t = [c_t \pi_t y_t i_t m_t]'$

The variables in the VAR are log of real consumption, log of inflation, log of real disposable income, the relevant money market rate and monetary aggregate for each of the countries. The lowercase letters represent natural logs of the variables, with the exception of the interest rates. $\pi_t$ is defined to be $\log \left( \frac{P_t}{P_{t-1}} \right)$. $\varepsilon_t$ is assumed to be iid $N(0, \Omega)$. Assuming that consumption growth and inflation are jointly lognormal variables, the right hand side of equations (2) & (3) can be expanded as follows:
\[ \frac{1}{1 + i_t^*} = \exp\{\ln \beta - \theta (E_t c_{t+1} - c_t) - E_t \pi_{t+1} \} + \frac{\theta^2}{2} Var_t(c_{t+1}) + \frac{1}{2} Var_t(\pi_{t+1}) + \theta Cov_t(c_{t+1}, \pi_{t+1}) \} \]  
\[ \frac{1}{1 + r_t^*} = \exp\{\ln \beta - \theta (E_t c_{t+1} - c_t) + \frac{\theta^2}{2} Var_t(c_{t+1})\} \]

Following Fuhrer (2000) and further assuming that \( \theta = 2 \) and \( \beta = 0.993 \), the first and second order moments in the above equations are conditional moments which can be obtained by first estimating the coefficient matrix, A, in the VAR\(^3\). The expectation terms in equation (5) are simply generated by performing one period ahead projections:

\[ E_t c_{t+1} = E_t e'_1 Z_{t+1} \]
\[ E_t \pi_{t+1} = E_t e'_2 Z_{t+1} \]

where \( e'_1 = [1 \ 0 \ 0 \ 0 \ 0]' \) and \( e'_2 = [0 \ 1 \ 0 \ 0 \ 0]' \) are the selection vectors which pick out the first and second element in \( Z_{t+1} \). Similarly, the variance and covariance terms in equation (5) are simply obtained from the variance-covariance matrix:

\[ Var_t(c_{t+1}) = e'_1 \Omega e_1 \]
\[ Var_t(\pi_{t+1}) = e'_2 \Omega e_2 \]
\[ Cov_t(c_{t+1}, \pi_{t+1}) = e'_1 \Omega e_2 \]

Thus equations (5) & (6) were then used to construct the implied nominal and real CCAPM rates, \( i_t^* \) and \( r_t^* \) and these were then plotted against the respective money market

\(^3\)Prior to constructing the companion form of the VAR in equation (4), the lag length of the VAR was picked using the Schwartz Criterion.
rates. The plots of the ex ante real money market and implied real CCAPM rates can be seen in figure (1). The graphs of the nominal rates are very similar and not reported here.

[Fig 1 about here]

Just eyeballing the plots reveals two important results. First, the implied CCAPM rates are on average, larger than their respective money market rates and so a spread exists between the two. This is not unexpected, given past work by Hansen & Singleton (1982) and others who showed the inability of the Euler equation to reflect aggregate time series data. This can be seen further in Table 1 which compares the means of these series. The means of the implied CCAPM rate appear to be different from the money market rate for both the nominal and real rates in every country. The existence of this spread between the implied real CCAPM rate and the real money market rate is one problem for monetary models which are equating these two rates. Examining the graphs in figure (1) reveals that these two rates are not always moving in the same direction over their samples, and this is true for every country. There are periods where they do move together, but there are also periods when they move in opposite directions. This is best highlighted by looking at the plots for France and Italy in figures 1(b) & (c). In both countries, the implied real CCAPM rate starts out high and positive, whilst the real money market rate is negative. Over time, they get closer together, around the mid 1980’s. Then, towards the end of their sample, they move apart again. Additionally, there are periods when the real money market rate moves very little, but the implied real CCAPM rate is very volatile, as in the case for Japan after 1996.

[Table 1 about here]
<table>
<thead>
<tr>
<th>Country</th>
<th>No. of Obs</th>
<th>Nominal Ex ante Real</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>CCAPM Rate</td>
<td>Money Market Rate</td>
</tr>
<tr>
<td>Canada</td>
<td>155</td>
<td>14.139</td>
</tr>
<tr>
<td></td>
<td>(3.054)</td>
<td>(3.450)</td>
</tr>
<tr>
<td>France</td>
<td>84</td>
<td>12.858</td>
</tr>
<tr>
<td></td>
<td>(4.587)</td>
<td>(3.517)</td>
</tr>
<tr>
<td>Italy</td>
<td>96</td>
<td>16.581</td>
</tr>
<tr>
<td></td>
<td>(6.262)</td>
<td>(3.746)</td>
</tr>
<tr>
<td>Japan</td>
<td>105</td>
<td>12.629</td>
</tr>
<tr>
<td></td>
<td>(9.127)</td>
<td>(3.213)</td>
</tr>
<tr>
<td>UK</td>
<td>127</td>
<td>15.282</td>
</tr>
<tr>
<td></td>
<td>(3.465)</td>
<td>(3.035)</td>
</tr>
<tr>
<td>US</td>
<td>169</td>
<td>11.375</td>
</tr>
<tr>
<td></td>
<td>(2.431)</td>
<td>(3.175)</td>
</tr>
</tbody>
</table>

The second result highlighted within the plots reveal a more serious problem, even after abstracting from the spread. Given the transmission mechanism of monetary policy within the NNS models, a movement in the money market rate should be reflected by a corresponding movement in the implied CCAPM rate in the same direction. That is, the money market and implied CCAPM rates should be perfectly correlated. The correlations between the money market and implied CCAPM rates are also reported in Table 1.

As can be seen, none of the correlations are close to one. The correlations between the nominal rates are small for most of the countries, the largest being 0.68 for France. Since the nominal CCAPM rate is assumed to reflect the stance of monetary policy within the NNS models, a low correlation is problematic for these models. Furthermore, when considering the real rates, the correlations are negative for four out of the six countries, even as much as -0.61 for Italy. These results shed some doubt on the validity of equating the money market rate to the implied CCAPM rate, particularly in this baseline case. Next, the paper proceeds by analysing the case where habit is introduced into the utility specification.
2.2 Incorporating Habit

This paper utilises Abel’s (1999) habit specification because of two reasons. First, the habit specification developed by Abel (1999) provides a tractable model to check if the movements in interest rates can be matched. Second, Abel develops an algorithm which can pick parameter values such that the approximate unconditional means and variances of the riskless rate can be calibrated to match the sample values in data. The calibration is useful here as it provides a method to eliminate the observed average spread between the implied CCAPM rate and the money market rate in the baseline case. Having eliminated the average spread, it is then possible to check if the movements between the two rates can be reconciled.

Under Abel’s specification, consumers maximise a utility function of the form:

\[
U_t = E_t \left\{ \sum_{j=0}^{\infty} \left( \frac{1}{1 + \delta} \right)^j \left( \frac{1}{1 - \alpha} \right) \left( \frac{\bar{C}_t}{v_t} \right)^{1-\alpha} \right\}
\]

\[v_t = C_t^{\gamma_0} C_{t-1}^{\gamma_1} (G^t)^{\gamma_2}\]

where \(\alpha\) is the coefficient of relative risk aversion, \(v_t\) is the benchmark level of consumption, and \(\delta\) is the rate of time preference. \(\bar{C}_t\) is individual consumption, whereas \(C_t\) is aggregate consumption and \(G\) is the unconditional growth in the reference or benchmark level of consumption. Under this specification, the nominal interest rate given by the Euler equation is:
\[
\frac{1}{1 + \hat{r}_t^*} = \beta E_t \left[ \left( \frac{C_{t+1}}{C_t} \right)^{-A} \left( \frac{C_t}{C_{t-1}} \right) \phi \right] \frac{P_t}{P_{t+1}} \]

where \( \beta = \frac{G^{\gamma_2(\alpha - 1)}}{1 + \delta} \)

\( A = \alpha - \gamma_0(\alpha - 1) > 0 \)

and \( \phi = \gamma_1(\alpha - 1) \)

Abel’s (1999) methodology provides a means to match the unconditional means and variances of the riskless rate to their sample values. Adopting his notation and letting \( m_f, s_f, m_e, \) and \( s_e \) represent the sample means and standard deviation of the riskless rate and the rate of return on equity, and let \( \mu \) and \( \sigma \) represent the mean and standard deviation of the growth rate of consumption. It is then possible to calculate \( \phi, \lambda, A, \beta \) as follows:

\[
\hat{\phi} = \frac{s_f}{\sigma}
\]

\[
\hat{\lambda} = \left[ \sqrt{\frac{s_e^2}{s_f^2} - 1} - 1 \right] \hat{\phi}
\]

\[
\hat{A} = \frac{m_e - m_f}{(\hat{\phi} + \hat{\lambda}) \sigma^2}
\]

\[
\hat{\beta} = 2 - m_f + \left( \hat{A} - \hat{\phi} \right) \mu - \frac{1}{2} \left( \hat{A}^2 - \hat{\phi}^2 \right) \sigma^2
\]

\( \lambda \) is the leverage parameter in Abel’s model. Following Abel (1999), three more restrictions are used to obtain unique values for all the parameters.: \( \gamma_0 = 0, \gamma_0 + \gamma_1 + \gamma_2 = 1, \) and \( G = 1 + \mu. \) As before, in order to proceed further, an assumption needs to be made about the distribution of consumption growth in the Euler equation (8). Two cases are considered here. The first case examined follows Abel (1999), where he assumes the growth rate of consumption is iid lognormal. Under this assumption, taking a lognormal expansion and imposing the restrictions above yields the implied inverse real CCAPM rate under iid
consumption growth, where $c_t$ denotes the log of consumption. :

$$\frac{1}{1 + r_t^*} = \beta \exp\{\phi(c_t - c_{t-1}) - \alpha E_t (c_{t+1} - c_t) + \frac{\alpha^2}{2} Var_t (c_{t+1} - c_t)\} \quad (9)$$

An alternative distribution is also considered as the second case. In this case, consumption growth and inflation are assumed to be jointly conditional lognormal variables since the dynamic interaction of consumption and inflation, and its impact on interest rates merit some study. This assumption allows an implied nominal CCAPM rate to be derived as well as an implied real CCAPM rate. As above, taking a lognormal expansion of equation (8) and use the restrictions on the $\gamma$'s to get:

$$\frac{1}{1 + i_t^*} = \beta \exp\{-\gamma_1 (\alpha - 1) c_{t-1} + (\alpha + \gamma_1 (\alpha - 1)) c_t - \alpha E_t c_{t+1} - E_t \pi_{t+1} + \frac{\alpha^2}{2} Var_t c_{t+1} + \frac{1}{2} Var_t \pi_{t+1} + \alpha Cov_t (c_{t+1}, \pi_{t+1})\} \quad (10)$$

The implied real CCAPM rate under conditional lognormality has the same form as that given in equation (9), but will differ from the iid case\(^4\). The statistics for the two rates under the two cases are reported in Table 2, and the results are depicted for iid consumption growth and lognormal consumption growth in figures (2) and (3) respectively.

\(^4\)The reason that these two implied real CCAPM rates will differ under these two distributional assumptions is because of the way expectations of consumption growth are formed. In the case of iid consumption growth, the expectation and variance terms in equation (9) are taken from a regression of the growth rate of consumption. When consumption and inflation are jointly lognormally distributed, then the expectation is calculated as the one-step ahead projection from the VAR in equation (4).
Considering first the case where consumption growth is iid lognormal. From Table 2, it is possible to see that Abel’s methodology manages to set both the mean and standard deviation of the implied real CCAPM rate, constructed from the parameters, very close to the mean and standard deviation of the actual ex-post real money market rate. With the exception of Japan, the means of the implied real CCAPM rates are slightly larger than the means of the corresponding real money market rates. These results are depicted in figure 2. The swings in the implied real CCAPM rate appear to be of the same order of magnitude as movements in the money market rates. The only exception is Japan, where there are large swings in the implied real CCAPM rate at the very beginning and end of the
sample. Furthermore, the results here are relatively better than those in the baseline model: the correlations between the implied real CCAPM rate and the ex-post real money market rate are all positive, with the exception of the United Kingdom. However, as before, the correlations are still not close to one. The largest is Italy with a value of 0.541.

The results for the second case where consumption growth and inflation are jointly conditionally lognormal shows that Abel’s methodology was once again successful in setting the mean of the implied series fairly close to the mean of the actual money market rates. These are reflected in Panel B of Table 2, where the mean of the nominal implied CCAPM rate is slightly larger than the corresponding mean of the nominal money market rate in every country. Looking at the real rates, the mean of the implied real CCAPM rate is slightly below the corresponding real money market rate, with the exception of the United Kingdom. However, the cost of eliminating the average spread in this case, is slightly increased volatility in the implied real CCAPM rates.

The correlations for the nominal series are only negative for Canada, the UK and the US, with the other correlations being fairly low. The correlations between the implied real CCAPM rate and the ex-post real money market rate are negative for France, Japan and the US. However, they are still very low in Canada, Italy and the UK. With the exception of the UK, the correlations are all lower in this case when comparing them to the results from iid consumption growth. However, they are only slightly larger when comparing them to the results in the baseline case. Overall, the evidence here is suggestive that monetary models which equate the money market rate to the implied CCAPM rate are still facing a problem, even with the inclusion of habit persistence. This raises an issue for NNS models which utilise the consumption Euler equation as a key ingredient in their transmission mechanism of monetary policy.

Given these initial results, it now makes sense to ask whether this problem is symptomatic
of the failure of the transmission mechanism of monetary policy in these NNS models? In
order to address this question, the movements of the money market and implied CCAPM
rates need to be examined around the time when the central bank implements monetary
policy. In particular, the approach adopted in this paper, is to identify periods when the
central bank actively and visibly pursues policy in response to some observed shock. This
is a key idea since resultant movements in money market rates can then be identified and
attributed as the response of a monetary policy action and therefore, distinguished from
other factors leading to changes in the money market rate. In addition, since the nominal
interest rate is assumed to reflect the stance of monetary policy in NNS models, it is assumed
to be the instrument of monetary policy when identifying these episodes. These episodes of
monetary policy reactions by central banks, to shocks, are identified in the next section.

3 Identifying Monetary Policy Responses

Over the last three decades, there have been some major historical events that have occurred,
which led to monetary policy actions by central banks. Some often cited examples are the
monetary responses to the OPEC oil shocks within the 1970’s, the ERM crisis in the early
1990’s, the Asian Crisis in the late 1990’s. Within these episodes, many central banks were
openly implementing monetary policy in the pursuit of some prior objective. This part of
the paper follows the Romer & Romer (1989) approach to identifying monetary shocks using
historical evidence. However, a broader definition of monetary policy shocks is considered
here, than that used by Romer & Romer (1989). In particular, they consider “an attempt
by the Federal Reserve to exert a contractionary influence on the economy in order to reduce
inflation” (Romer & Romer, 1989, pp 134) as a monetary shock. A broader definition is
used here, not limited only to monetary contractions. The monetary response by a central
bank to some observed shocks are viewed as periods where the central bank is visibly seen
to be moving the money market rate in the pursuit of some prior objective, e.g. reduction of inflation in the late 1970’s, stabilising the exchange rate in the early 1990’s. In following this methodology, the paper attempts to identify the monetary policy reaction to some observed shock. The intention here is twofold. First, the idea is to identify when the policy reaction occurred. Having done so, it would then be possible to obtain a general idea for the movements in the money market and implied CCAPM rates around these episodes in history arising from a monetary policy reaction used to offset these shocks.

It should be noted that the episodes identified here are not just over specific single quarters, but instead over one year starting at the quarter in which it is identified. This timeframe allows analysis of the effect of the policy on money market and implied CCAPM rates without having to identify the end of the period when the policy reaction was terminated. It serves to identify the policy action without having to identify the exact point in time it was implemented and also helps to account for lags in implementation. In addition, the general movement in the money market rates and implied CCAPM rates can be analysed during this timeframe.

A multi country dataset, consisting of six of the G7 countries, is used here in the hope that a greater number of monetary policy reactions to shocks can be identified, rather than just considering historical evidence from only a single country such as the United States. The description of the data can be found in Appendix A and the sample periods for the countries being considered are summarised in Appendix A.5. Seventeen monetary policy episodes were found across all the countries and these are summarised in Appendix A.6. The evidence of monetary policy reactions are drawn from a variety of sources. The movements in money market and implied CCAPM rates within the identified periods are examined, following the historical evidence used to identify the policy reactions and shocks, which are listed country by country next.
Monetary Policy Responses  
Canada

Canada has two identifiable episodes where the Canadian central bank visibly responded to some observed shock. The first episode for Canada, and in most industrialised countries, is from the third quarter of 1979 to the second quarter of 1980. Within this period, the Bank of Canada noted that (Bank of Canada, 1979, pp 3-12): “There is no question but that interest rates as conventionally stated are very high. In terms of our history they are at record levels.” (pg. 3). The statement continues later with:

“... it has now become clear ... that a substantial rise in interest rates was also needed in order to contain the rapidly expanding demand for money and credit in the domestic economy... it is my view that the actions taken by the Bank of Canada constitute a reasonable and prudent response to the potential inflationary damage that would be inflicted on the Canadian economy ...” (Bank of Canada, Nov 1979, pg. 9).

The statements above are indicative of the stance of monetary policy within Canada at that time. They suggest that the Bank of Canada was tightening monetary policy in order to combat inflationary pressures arising from the second OPEC oil shock. This is the basis for considering this as a monetary policy response to the OPEC oil shock for Canada.

The second episode occurs from the third quarter of 1990 to the second quarter of 1992. Again the Bank of Canada notes that (Bank of Canada, 1990b): “With strong demand pressures and a monetary policy committed to resisting inflation, there has been upward pressure on Canadian short-term interest rates.” (pg 17). Furthermore, it was noted that:

“I want to emphasize that if the Bank of Canada had not progressively tightened monetary conditions in response to intensifying inflationary pressures, the inflation problem that we face today would have been greater still ... It is true that the Bank of Canada’s actions to
limit the expansion of money and credit in our inflationary environment have been one factor pushing up short term interest rates ...” (Bank of Canada, 1990a, pg 12).

In addition at this time, the Bank of Canada adopted inflation targeting and announced explicit targets for reducing the rate of inflation in order to achieve price stability (Robert LaFrance, 1997). This was done to anchor inflationary expectations arising from a price level shock which occurred with the introduction of the goods and services tax in Canada. The statements above are also indicative that the Bank of Canada’s was tightening monetary policy.

France

France has three episodes of monetary policy responses to shocks. The first was where the French central bank was seen to be visibly moving the money market rate from the third quarter of 1979 to the second quarter of 1980. As noted in the Economic Commentary found in the Bank of England’s (henceforth BOE) Quarterly Bulletin (1980):

“Despite the growing signs of recession, the reduction of inflation remains the prime policy target in virtually every industrial country. As inflation rose in 1979, there was a strong increase in interest rates in all the major overseas countries.” (BOE Quarterly Bulletin, 1980, Vol. 20, No.2, pg 134)

The industrial countries referred to in the Economic Commentary are Canada, West Germany, Japan, France, Italy, the UK and the US. The statement above along with the general outlook for the economies in the industrial countries found in the Commentary (pg 119-140), were that the central banks were attempting to combat the inflationary pressure arising from the second OPEC oil shock. Thus, this statement is taken as providing evidence that the French (and other industrialised) central bank was tightening monetary policy
during this episode. For France, this was partly as a result of the inflationary pressure from the second oil shock, but also from participating in the European Monetary System and joining the Exchange Rate Mechanism (ERM) (Goodhart, 1987, 1992).

The second episode of a monetary policy reaction taken by the Banque de France considered here is from the second quarter of 1981 to the first quarter of 1982. In May of 1981, Francois Mitterand led his party in the upset victory, defeating the incumbent president. He pursued reforms leading to an inflationary environment. As noted in the the BOE’s Quarterly Bulletin:

“In France, ... market expectations [were] that the Franc would be devalued following the change in policies heralded by the election of the new government... official intervention to support the Franc was substantial, despite sharp increases in domestic interest rates.” (BOE, Quarterly Bulletin, 1981, Vol. 21, No. 4, pg 481-482)

In picking the third monetary policy response, there appears to be evidence that the Banque de France was moving the nominal interest rate during the ERM crisis from the third quarter of 1992 to the second quarter of 1993 as they responded to a speculative attack occurring on the French Franc-German Deutschmark exchange rate. Several commentators have noted this and some evidence is provided in the Bank of England’s Quarterly Bulletin:

“The French economy has experienced a period of prolonged exchange rate and interest turbulence. Market rates remained high throughout the autumn and early winter in defense of the franc’s parity within the ERM.” (BOE, Quarterly Bulletin, Vol 33, No. 1, pg 51)

Additional evidence can be found in Banque De France (1995), where they note that their intermediate objective at that time:

“... [the] intermediate objectives are currently the exchange rate and the growth of a monetary aggregate... The August 1993 decision to broaden the fluctuation margins without
changing the central [exchange] rates was taken to forstall speculation, but in no way modified the objective of maintaining the external value of the currency, which continues to be closely linked to the final objective of price stability.” (Banque De France, 1995, pg 12)

Italy

Italy has three identifiable episodes. Similarly to France, the first identified response considered arises partly from the second oil shock and also Italy’s decision to participate in the ERM from the third quarter of 1979 to the second quarter of 1980 (see the quote from the BOE Quarterly Bulletin, 1980, above). The second identified response considered here arises from the ERM crisis which occurred during the third quarter of 1992 to the second quarter of 1993. During this time, the Italian central bank’s attempted to defend the Lira-Deutschmark exchange rate during the speculative attack on its currency by raising short term interest rates. Evidence of the central bank’s response to the shock can be found in a statement in the BOE Quarterly Bulletin (1992, Vol. 32, No. 4, pg 361). It stated that, “Official interest rates were raised sharply in September in the defense of the lira.”. Additional evidence is provided by Eudey (1995):

“In an attempt to attract buyers to their currencies, the British, French and Italian governments offered very high rates of return on short-term instruments denominated in their home currencies.” (Gwen Eudey, 1995, pg 318)

The final episode considered for Italy is from the third quarter of 1995 to the second quarter of 1996. The evidence supporting this shock, is taken from the BOE Quarterly Bulletin which noted that, “In Italy, Spain and Sweden, the interest rate increase continues a period of monetary policy tightening started in the second half of last year.” (BOE Quarterly Bulletin, 1996, Vol 33, No. 3, pg 238-239). During this episode, the Italian government rejoined the ERM in Europe during the November of 1996.
Japan

Three episodes are considered for Japan. The first episode (as above for France and Italy) is from the second oil shock between the third quarter of 1979 to the second quarter of 1980. The second response considered here occurred from the third quarter of 1994 to the second quarter of 1995, when Japan was beginning to face deflationary pressure. The evidence is noted in the BOE Quarterly Bulletin:

“The Bank of Japan cuts its Official Discount Rate by 50 basis points on 8th September to a record low of 0.5%; Governor Matsushita said the easing was to prevent further spread of deflation and to secure economic recovery. The Bank of Japan also reaffirmed its intention of guiding market rates below official rates.” (BOE Quarterly Bulletin, 1995, Vol. 35, No. 4, pg 337)

The statement here is indicative of relaxed stance for monetary policy as the Bank of Japan attempted to boost output growth through monetary expansion, and mitigate any deflationary pressures. Finally, the last occurrence is recently from 1998, as Japan tried to stimulate its economy by lowering the nominal interest rate to near zero:

“... overnight rate in Japan has remained close to zero, as a result of the confirmed ‘zero interest rate policy’ adopted by the Bank of Japan (BoJ) in February 1999... the BoJ ‘will flexibly provide ample funds and encourage the overnight call rate to move as low as possible’ in order to ‘assume permeation of the effects of monetary easing’.” (BOE Quarterly Bulletin, 2000, Vol. 40, No. 2, pg 144)

The last two responses included here are different to the types of responses considered by Romer & Romer (1989) in that they are monetary expansions. Romer & Romer (1989) only look for monetary contractions where the Federal Reserve actively moved to cut back aggregate demand because of excessive inflation. They do not attempt to identify monetary
expansions because of the inherent difficulty in distinguishing the real effects of a monetary expansion, with the natural tendency of trend output to increase. In particular, the identification problem lies in an inability to separate an increase in output arising from trend output with an increase in output arising from an expansionary shift of monetary policy. This is not so problematic for the last two shocks proposed for Japan here, since the idea is to identify the timing of the policy response and the implications for money market rates, rather than focusing on the liquidity effect of a monetary policy action on real variables. The documentary evidence is suggestive that the Bank of Japan was actively pursuing expansionary policy within this period.

United Kingdom

The UK has two identifiable episodes. The first occurrence was during the second oil shock as the UK formally committed itself to monetarism under Prime Minister Margaret Thatcher in October 1979 and used monetary policy to fend off increasing inflationary pressures. In a speech given by the Governor of the Bank of England in 1980, the Governor said:

“A firm monetary policy has a central role in combating inflation, ...this task of promoting monetary stability can [not] always be accomplished without actions ... [that] are, harsh and disagreeable. I know that the present level of interest rates is bitter medicine... It is most hurtful to people committed to borrowing that they would not have undertaken had they known how high interest rates would rise.” (BOE Quarterly Bulletin, 1980, Vol. 20, No1, pg 61)

The statement above is indicative of the stance of monetary policy at that time, which was being used to fight off inflationary expectations arising from the second oil crisis and reinforce the UK’s commitment to monetarism. The period considered is from the fourth quarter of 1979 to the third quarter of 1980.
The second episode identified for the UK was in September 1992, at the time of the ERM crisis. Britain left the ERM, unable to fend off a speculative attack on its currency, despite raising short term interest rates to 12%. This is noted by Eudey (1995) above. Subsequently, the Bank of England lowered interest rates to help boost the domestic economy and mitigate the effects of the crisis. In addition, the Bank of England switched to inflation targetting.

**United States**

For the United States, four episodes are considered. These are given by the last four observations identified by Romer & Romer (1989), through their search of the FOMC meetings. It is only the availability of data which restricts attention to four of the six shocks. The first occurrence considered here is from mid 1967 till the end of 1968. Romer & Romer (1989) document evidence of concerns about inflation and inflationary expectations which led the Federal Reserve to tighten monetary policy. The second shock arose from the first OPEC oil shock and the period considered is from the second quarter of 1974 till the first quarter of 1975. It was in April 1974 that the Federal Reserve tightened monetary policy to fend off rising inflation occurring from the oil embargo that started in October 1973. The third and fourth responses occurred back to back in August 1978 and October 1979. Monetary policy had started to be tightened since August 1978, but in October 1978, the Federal Reserve decided much stronger measures were required to combat inflation. This led to the announcement by the chairman of the Federal Reserve Board, Paul Volcker, of a change in the instrument of monetary policy to controlling non-borrowed reserves. Monetary policy was tightened further. Thus, the periods considered are the third quarter of 1978 till the second quarter of 1979, and from the fourth quarter of 1979 till the third quarter of 1980.
Movements Of Money Market And Implied CCAPM Rates During The Episodes

Seventeen episodes were identified from the documentary evidence above, where central banks were actively pursuing policy to offset shocks. The quarters when these episodes occurred are the shaded areas in figures (1) to (3). Consider the results of the baseline case in figure (1). Comparing the movement of the implied real CCAPM rate with the respective real money market rate within the specific episodes identified above yields a problematic result, which can be seen upon closer examination of figures 1(a)-(f). There it is possible to see that within these episodes of monetary policy responses to shocks, there are periods where the real money market rate is moving in the opposite direction to the implied real CCAPM rate in every country.

Canada and the US are examples of two countries which had a negative correlation between the implied real CCAPM rate and the ex ante real money market rate. As can be seen in figure 1(a), the Canadian central bank was tightening monetary policy from the middle of 1979 and from early 1991. In both cases, the two rates move in opposite directions. Similarly for the US, figure 1(f) shows that the two real rates were moving in the opposite direction for all the periods. In 1974 and 1979, expectations were such that the ex-ante real Federal Funds rate was actually pushed above the implied real CCAPM rate.

Given that there is a negative correlation between the real money market rate and the implied real CCAPM rate for Canada and the US, the result is not totally unexpected. However, the more interesting result can be seen for those countries which had a positive correlation, namely the United Kingdom and France. Despite the positive correlation between the implied real CCAPM rate and the real money market rate for the UK, these two rates clearly move in opposite directions during the periods being considered. The ex-ante
real Treasury Bill rate is pushed up above the implied real CCAPM rate during the latter half of 1980 and these rates move in opposite directions during the ERM crisis.

For France, we get a similar result seen in figure 1(b). The general direction of motion of the call money rate is upwards during the latter half of 1979 arising from the second OPEC oil shock, whilst the implied CCAPM rate is moving downwards. The ex-ante real call money rate is actually pushed up above the implied real CCAPM rate in the middle of 1981 quite sharply, and similarly again near the end of 1992 and early 1993 in order to defend against the speculative attack on its currency in these last two years. Moreover, these divergent movements occur exactly at the point in time identified as a monetary policy response to a shock.

These results are also reflected in Italy (figure 1(c)) and to an extent in Japan (figure 1(d)). For Italy, as with the countries above, the implied real CCAPM rate and ex-ante real money market rates are moving in opposite directions, with the real official discount rate being pushed up above the implied real CCAPM rate during the ERM crisis in 1992 and later when Italy rejoined the ERM in 1996. A different problem can also be noted in Japan. There are three periods identified in Japan where the Bank of Japan moved interest rates as a result of monetary policy action. The first episode is after the second oil shock. The second is between 1994 and 1995 when Japan was facing deflationary pressures. The third is after the Asian crisis where the Bank of Japan lowered interest rates to record lows, in an attempt to stimulate the economy. What can be noted from figure 1(d) are the immense variability in the implied CCAPM rate when compared to the relatively low variability of the money market rate.

This is a slightly different issue, but it serves to highlight three problems in equating the money market rate to the implied CCAPM rate in this baseline model. The first problem in equating these two rates, arises from the difference in the means of the two rates. The
second problem can be thought to be a corollary of the first, when equating the variances and assuming a similar variability in the two rates. The third arises from the correlation between the two rates and the relative direction in which the rates are moving. These issues are all problematic for NNS models, which do equate the two rates, when the results show that within every period in every country, the real money market and implied real CCAPM rates are moving in divergent directions.

Next, consider the results from the version of the model with habit during the periods identified above. Implementing Abel’s methodology allowed the mean and the variances of the real money market rate to be set close to those of the real implied CCAPM rate, and this helps in accounting for the first two problems. Examining the movements of these rates in figures (2) and (3) shows that the implied real CCAPM and money market rates move in opposite directions in both cases under habit, for every country. Thus the third problem still remains, given the correlations in Table (2) and the direction of movements of these two rates at these identified periods of monetary responses. The implication is that the inclusion of habit will not lead to a resolution of the issue, and that this problem is an enduring feature of NNS models.

Given these results above, both from the initial analysis and the documentary evidence, the next step would be to try and explain the reason why these rates diverge. The approach adopted within this paper is to implement another identification scheme that is widely used in the monetary literature to analyse the effects of a monetary policy shock. This econometric identification scheme which is utilised, provides an approach that identifies monetary policy shocks and allows the effects of a monetary shock to be traced out to its impact on key variables. This is the focus of the next section.
4 The Impact Of Monetary Shocks

This section employs an alternative methodology to trace out the effects of a monetary shock on key variables. This alternative methodology in analysing the effects of monetary policy shocks is provided by Christiano, Eichenbaum & Evans (henceforth CEE, 1999). CEE look at the impulse response functions arising from monetary policy shocks in Vector Autoregression’s (VAR’s) to examine the dynamic response of key variables, such as output, to such shocks. This econometric methodology is used in the hope that it can provide a qualitative answer to the implications the theory has for the direction of movements of the real money market and implied real CCAPM rates at the times of a monetary policy action. This paper follows their methodology in analysing effects of monetary policy shocks. Here the monetary policy shock is assumed to originate from a change in the nominal interest rate, such as the Federal Funds rate. Thus the VAR given by equation (4) is used to examine the impulse response functions arising from an \(i_t\) shock, where the variable \(i_t\) is used to denote the money market rate.

The CEE monetary policy identification scheme focuses on a recursive ordering of the VAR. In particular, the central bank is assumed to follow a feedback rule \(i_t = f(\Omega_t) + S_t\) where \(\Omega_t\) summarises the information set available to the central bank, and \(S_t\) is a serially uncorrelated shock that is orthogonal to the elements of \(\Omega_t\). This recursiveness assumption means that the instrument of monetary policy, \(i_t\) is contemporaneously affected by variables in the information set of the central bank, \(\Omega_t\), but those variables themselves are not contemporaneously affected by the monetary policy shock. This recursiveness assumption boils down to the fact that the variables in the feedback rule are incorporated ahead of the monetary policy shock variables within the VAR. Variables after \(S_t\), are hit contemporaneously from a change in the money market rate. Thus considering the VAR in equation (4):
\[ Z_t = [c_t \ \pi_t \ y_t \ i_t \ m_t]' \]

The log of real consumption, inflation, and real output are assumed to be in the information set of the central bank and thus affected with a delay. The monetary aggregate is assumed to respond contemporaneously as the central bank adjusts reserves to keep the monetary aggregate consistent with the money market rate. As mentioned above, a change in the central bank rate is assumed to be the source of the monetary policy shock. The effects of the shock on these variables are analysed by examining the impulse response functions. The objective at this point is to document the dynamic responses of consumption, inflation and output from a monetary policy shock, and thus have an idea as to the direction in which the data suggests these variables may be moving. The impulse response functions of consumption, and output, along with their monte carlo generated standard errors, are shown below in figures (4) and (5) respectively.

[Fig 4 goes about here]

[Fig 5 goes about here]

In general, the results show the usual ‘hump-shaped’ response of consumption and output found in the literature. That is, an unexpected monetary tightening leads to a fall in consumption and output. The impact is not immediate, but instead the trough occurs several periods afterwards and these vary from country to country. The results from the impulse responses of consumption are all significant with the exception of France, whose standard errors suggest that the dynamic response of consumption may not be significantly different from zero.
The impulse responses of inflation from an increase in the money market rate, also showed a hump-shaped response, although it is not reported here (see Ahmad (2002)). Inflation increased initially as a result of the money market rate shock, and then declined several quarters later. This is true for all the countries with the exception of Italy. Inflation in Italy actually fell and then increases later. Furthermore, the results for Italy and France had sufficiently large standard errors which implied that the impulse response function may not be significantly different from zero. For output, all the countries with the exception of Japan, have significant impulse responses and finds that an unexpected monetary tightening leads to a fall in output, which is consistent with the literature.

There are a few key results above. Namely, consumption does not respond immediately to an unexpected monetary policy shock as would be implied by the Euler equation. If the Euler equation held, then in the equation above, a change in the nominal interest rate arising from a central bank policy action, would have a direct impact on expected consumption growth and expected inflation, and these are predicted in these NNS models (e.g. Rotemberg and Woodford, 1997). Some evidence of this is provided in Fuhrer (2000), who shows by simulation, that an implication of these types of models are that consumption and inflation respond immediately to such shocks. The basic intuition can be seen by abstracting initially from inflation:

$$\frac{1}{1 + r_t} = \beta E_t \left[ \left( \frac{C_t}{C_{t+1}} \right)^2 \right] = \frac{1}{1 + r_t^*} \quad (11)$$

A direct implication from the equation (11) above is that the left hand side falls as a result of an unexpected monetary contraction. The data appears to suggest that an increase in the money market rate leads to a fall in consumption today, but more importantly to a greater fall in consumption tomorrow. Thus, expected consumption growth falls for a period of time and as a result, \( \left( \frac{C_t}{C_{t+1}} \right) \) increases. This in turn implies that the implied real CCAPM
rate has moved in the opposite direction to the real interest rate, and fallen. Incorporating inflation only complicates the story a little. Consider the nominal Euler equation:

\[
\frac{1}{1 + i_t} = \beta E_t \left[ \left( \frac{C_t}{C_{t+1}} \right)^2 \frac{P_t}{P_{t+1}} \right] = \frac{1}{1 + \bar{i}_t^*} \tag{12}
\]

As before, an unexpected monetary contraction reduces the left hand side of equation (12). However, the right hand side may or may not increase. As above, expected consumption growth falls, but expected inflation increases so \( \left( \frac{P_t}{P_{t+1}} \right) \) falls. However, the degree to which the right hand side increases or decreases depends on the relative magnitude of the fall in expected consumption growth compared to the increase in expected inflation. Since the relative response of inflation from a money market rate shock was much less than that of consumption, for all the countries, the implication is that the right hand side of the Euler equation rises. Thus, the implied CCAPM rate falls as the nominal interest rate rises from an unexpected monetary tightening.

This hypothesis sheds some light on the problem highlighted before. To verify the hypothesis, consider the effect of a money market shock on the implied CCAPM rate. This can be used to check the direction in which the implied CCAPM rate may be moving as a result of an unexpected monetary policy shock. Thus, modifying the VAR above as follows:

\[
Z_t = \begin{bmatrix} c_t & \pi_t & y_t & i\bar{i}_t & i_t & m_t \end{bmatrix}'
\]

where

\[
\bar{i}_t = \frac{1}{\beta \left[ \left( \frac{C_{t-1}}{C_t} \right)^2 \left( \frac{P_{t-1}}{P_t} \right) \right]} - 1 \equiv \bar{i}_{t-1}^*
\]

The impulse response function of the implied CCAPM rate from a \( S_t \) shock can then by examined. The results are shown below in figure 6.
The results are quite striking. In all the cases, the implied real CCAPM rate falls as a result of an unexpected monetary contraction. Essentially this verifies the hypothesis above that consumption and inflation do not respond fully and contemporaneously to monetary policy shocks in the baseline case. The results for the implied nominal CCAPM rate are very similar. The results for the version of the model with habit are depicted in figures (7) and (8) below.

The results here seem consistent with the hypothesis. Consider figure (8) first where consumption growth and inflation are jointly conditionally lognormally distributed. The impulse responses show that the implied real CCAPM rate falls as a result of an increase in the money market rate in every country. Thus the results are consistent with those in the hypothesis above. The results for the implied nominal CCAPM rate are similar to the implied real CCAPM rate and not reported here.

In the case where consumption growth is iid, the results are slightly more encouraging. The implication of the theory in this case is that the expected value of consumption tomorrow is the same as today, when consumption growth is iid. Thus, the implication is that the implied real CCAPM rate should not change, and this is bourne out in the plots for France, Italy and Japan. Canada, the UK and the US all show an increase in the implied real CCAPM rate with the peak about 4-6 quarters. This is also reflected in the larger values of the correlation in the iid case, in Table 2. Essentially in this case, the channel through
which a monetary policy action is transmitted, is broken, but the results are nevertheless slightly better than in the baseline case, or in the case in which consumption and inflation are conditional lognormal variables. The evidence here suggests that the money market and implied CCAPM rate cannot be reconciled through the Euler equation and models which break the link between the instrument of the central bank and the implied CCAPM rate might succeed in resolving these problems.

5 Conclusions

This paper examines the transmission mechanism of monetary policy in NNS models. The recent result by Canzoneri, Cumby and Diba (2001) showed that the Fed Funds rate is negatively correlated with the CCAPM rate. Their result has a serious implication for the NNS monetary models, which equate the money market rate to the implied CCAPM rate. The transmission mechanism of monetary policy in NNS models occurs through the consumption Euler equation and the nominal interest rate is assumed to reflect the stance of monetary policy within these models. Central banks implement monetary policy by changes in its instrument - the nominal interest rate. The effect of this change is assumed to have an impact on the real variables in an economy through its impact on expected consumption growth in the presence of a nominal rigidity, like sticky prices. The essence of the problem is thus quite stark. A negative correlation between money market and implied CCAPM rates is indicative of a problem in modeling the transmission mechanism of monetary policy through the consumption Euler equation.

Since the problem concerns the transmission mechanism of monetary policy within NNS models, the methodology implemented here blends two different approaches to identifying and analysing the effects of monetary policy shocks in the literature. First, the paper constructs and analyses movements in the implied CCAPM rate and compares them to move-
ments in associated money market rates for six out of the G7 countries. This is done for three cases. The baseline case is with power utility. The alternatives include habit in the utility specification, utilising Abel’s (1999) methodology to set the unconditional means and the variances close to those found in the samples. The findings are that these two rates move in opposite directions for all the countries and the correlations between the rates are low, and often negative. Incorporating habit into monetary models yields similar results, despite the success in using Abel’s (1999) methodology to set the unconditional means and variances close to their sample values.

Since the direct implication of equating the money market and implied CCAPM rates in NNS models are for the transmission mechanism of monetary policy, the paper proceeds by identifying monetary policy shocks. The methodology employed here, follows in spirit, the methodology proposed by Romer and Romer (1989). This is done by examining historical evidence to document episodes where the central banks conducted monetary policy as a response to some observed shock. The direction and movement of the money market and the implied CCAPM rates are then examined within these episodes. The paper finds that the two rates move in opposite directions within every single episode.

In addition, a second methodology for identifying and analysing the effects of a monetary policy shock are employed to try to explain this problem. This methodology proposed by Christiano, Eichenbaum & Evans (1999), enables the dynamic responses of key variables arising from a monetary policy shock to be traced. The resulting impulse response functions show that consumption, inflation and output has the typical hump-shaped response for all the countries. That is, the full response of consumption, inflation and output, from an unexpected monetary contraction is not immediate. Instead the full effect of a policy shock occurs over time, sometimes lasting a few years. The implication here is that consumption falls today, but consumption tomorrow falls more. As a result expected consumption growth,
and thus the implied real CCAPM rate falls. Thus, by construction, an Euler equation from a model with power utility cannot reconcile the direction of movements of the money market rate to the implied CCAPM rate. This basic intuition holds even in the version with habit.

In general, the results here pose a challenging question of how central banks can smooth the direction of changes in money market rates given the large volatility in implied CCAPM rates. The more serious implication of these results are problematic for NNS models which model the instrument of monetary policy as the money market rate and equate it to the implied CCAPM rate. It suggests more work should be done in developing models which break up the two rates and model the transmission mechanism distinctly from the Euler equation, as in Limited Participation Models.
Appendix

A The Dataset

The dataset consists of quarterly data on the following variables for each of the countries: nominal and real nondurable goods and services along with their deflators; nominal and real GDP again along with their deflator; a commodity price index; a monetary aggregate; and a money market rate. The sources are presented as follows:

A.1 Interest Rates and Monetary Aggregates

Interest rate data are obtained from the following sources: OECD Main Economic Indicators for France and Italy; OECD Economic Indicators Database for Canada and the United Kingdom. These data are all quarterly. Interest rate data for Japan was provided by John Rogers and comes from the International Financial Statistics Database. The US data is obtained from the Federal Reserve Statistical Release within the historical data section. The data is monthly and so converted to quarterly by taking three month averages. The monetary aggregates for all the countries with the exception of the US is also obtained from the OECD’s Main Economic Indicators. US monetary aggregates are obtained from the Federal Reserve Statistical Release and again the data is converted to quarterly by taking three month averages.

A.2 Consumption, And GDP Data

Both the consumption and GDP data are quarterly data. They include both nominal and real consumption spending on nondurable goods and services along with their implicit deflators, and nominal and real GDP along with their price deflators. These are obtained from the OECD Quarterly National Accounts for Canada, France, Italy and Japan. The data for the
OECD *Quarterly National Accounts* use the fixed-weight standard of the 1993 SNA and base years vary according to country. For the UK, the data is obtained from the UK’s Office of National Statistic’s *Quarterly National Accounts*. For the US, the data is obtained from the Bureau of Economic Analysis’ *National Income and Products Accounts*. However, the US data is chain weighted which ensures that the prices used to compute the values are never too far out of date.

### A.3 Price Data

For Canada, France, Italy and Japan, and the UK the nominal (real) nondurable consumption goods and services are summed to create nominal (real) consumption, and the price level is the implicit deflator between the nominal and real consumption series. However, for the US, the chain-weighted components are not additive. To create the consumption based price index, the nominal expenditures on nondurable goods and services are summed to give nominal expenditures on consumption. Similarly, each of the individual nominal expenditure series on nondurables and services are divided by their implicit price deflators and these real based measures are summed to give real consumption expenditure. The nominal consumption based series is then divided by the real consumption based series to yield the consumption based price index.

### A.4 Other Data

The other data series included in the dataset are a measure of a share price index and stock returns for each of the countries. The share price indices are included in the VAR so as to be able to alleviate the price puzzle. These are: the TSE 300 composite share price index for Canada; the SBF 250 Share Price Index for France; the MIB Share Price Index for Italy; the TSE TOPIX Share Price Index for Japan; the FTSE Non-Financial Share Price Index, and
the Common Stock NYSE Share Price Index. All the data are seasonally adjusted with the exception of Japan. Data for Japan were seasonally adjusted before any analysis. The data for stock returns were calculated from yields and stock price indices from *Morgan Stanley Capital International Perspective*. It was generously provided by Robert Cumby.

A.5 Country Table

The following table gives the start and end dates of the common sample of all the variables:

<table>
<thead>
<tr>
<th>Country</th>
<th>Time Period</th>
</tr>
</thead>
<tbody>
<tr>
<td>France</td>
<td>1977:4 - 1998:2</td>
</tr>
<tr>
<td>Italy</td>
<td>1974:4 - 1998:3</td>
</tr>
<tr>
<td>Japan</td>
<td>1970:1 - 1999:1</td>
</tr>
<tr>
<td>United Kingdom</td>
<td>1969:1 - 2000:4</td>
</tr>
<tr>
<td>United States</td>
<td>1964:3 - 2000:4</td>
</tr>
</tbody>
</table>

A.6 Episodes of Monetary Policy Shocks

This table summarises the episodes where the central banks in these countries were observed to be moving the interest rate in their conduct of monetary policy.

<table>
<thead>
<tr>
<th>Country</th>
<th>Episodes Of Monetary Policy Shocks</th>
</tr>
</thead>
</table>
References


Figure 1: Comparison Of Ex-ante Real Money Market And Implied Real CCAPM Rates Across Countries.

Figure 1a: Real CCAPM Rate vs Expected Real Treasury Bill Rate For Canada

Figure 1b: Real CCAPM rate vs Expected Real Call Money Rate For France

Figure 1c: Real CCAPM Rate vs Expected Real Official Discount Rate For Italy

Figure 1d: Real CCAPM Rate vs Expected Real Interbank Rate For Japan

Figure 1e: Real CCAPM rate vs Expected Real Treasury Bill Rate For The United Kingdom

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Fig 5c: Impulse Response Of Output From A 1% Official Discount Rate Shock For Italy

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Fig 5d: Impulse Response Of Output From A 1% Interbank Rate Shock For Japan

Fig 5e: Impulse Response Of Output From A 1% Treasury Bill Rate Shock For The United Kingdom

Fig 5f: Impulse Response Of Output From A 1% Federal Funds Rate Shock For The United States
Figure 6: The Impulse Response Of The Implied Real CCAPM Rates From A 1% Change In The Money Market Rate Across Countries.
Figure 7: Impulse Response Of The Implied Real CCAPM Rate Under Habit With iid Consumption Growth Across Countries.

Fig 7a: Impulse Response Of The Implied Real CCAPM Rate From A 1% Treasury Bill Rate Shock For Canada

Fig 7b: Impulse Response Of The Implied Real CCAPM Rate From A 1% Call Money Rate Shock For France

Fig 7c: Impulse Response Of The Implied Real CCAPM Rate From A 1% Official Discount Rate Shock For Italy

Fig 7d: Impulse Response Of The Implied Real CCAPM Rate From A 1% Interbank Rate Shock For Japan

Fig 7e: Impulse Response Of The Implied Real CCAPM Rate From A 1% Treasury Bill Rate Shock For The United Kingdom

Fig 7f: Impulse Response Of The Implied Real CCAPM Rate From A 1% Federal Funds Rate Shock For The United States
Figure 8: Impulse Response Of The Implied Real CCAPM Rate Under Habit With Lognormal Consumption Growth Across Countries.