This is the author's version of an article from the following conference:


Access to the published version:

http://www.ijeb.com/ABEAI/AbeaiMain.htm
Fisher Hypothesis: Further Evidence for Australia

Joseph Macri, Department of Economics, Macquarie University, Sydney, NSW 2109, Australia, Phone: 612 9850 9469 Fax: 612 9850 8586, Email: jmacri@efs.mq.edu.au

Abstract

This objective of this paper is to examine the Fisher Hypothesis for Australia using the Johansen (1991) cointegration approach. The empirical results seem to suggest that there is a significant long-run cointegrating relationship for the period 1979-2005. Financial deregulation of financial markets during this period is likely to explain the existence of this strong long-run relationship.

Introduction

One of the longest-standing propositions in financial economics is the Fisher Hypothesis (Fisher, 1930). It is usually expressed as the sum of the ex-ante real interest rate and the expected inflation rate. It argues that a mirrored one-to-one relationship exists between the nominal rate of interest and the expected inflation rate, assuming a stationary ex-ante real interest rate. Importantly, a key variable in understanding investment and saving decisions is arguably the ex-ante real interest rate. Therefore, any permanent shocks to either the inflation rate or nominal interest rates, in the absence of a one-to-one adjustment, may be transmitted into permanent shocks to the real interest rate; this may be problematic in the context of saving and investment decisions. Furthermore, the existence of this relationship has important implications for policy makers, debtors and creditors, particularly given that it is commonly argued that inflationary expectations may directly influence the nominal interest rate. The primary motivation in re-visiting this issue for Australia is that since 1979 Australia has undergone significant financial deregulation and this Fisher relationship does depend upon the nominal rate and the expected inflation rate moving freely. Furthermore, previous empirical studies for Australia have dealt with much a smaller time series data set (see, for example, Miskin and Simon, 1995; Hawtrey, 1997).

Brief Literature Review

The Fisher relationship has been empirically investigated time and again for many countries, but not surprisingly, the evidence has been mixed. For example, this relationship has been found to be robust in some countries over certain periods, for example, the U.S., Canada and United Kingdom in the post-war period up until 1979. However, this relationship has not been so strong for the US or other countries post 1979 (see, for example, Fama, 1975; Nelson and Schwert, 1977; Mishkin, 1984, 1988; Fama and Gibbons, 1982). Various explanations have been put forward for the apparent inconsistency of the Fisher equation as an interest rate theory and the lack of supporting empirical evidence. A range of factors include, the inadequate measurement of inflationary expectations (see, for example, Woodward, 1992); taxation effects (see, for example, Darby, 1975); the need to distinguish between short and long-run Fisher effects (see Mishkin, 1992; Mishkin and Simon, 1995); shifts in expected inflation (see Evans and Lewis, 1995). Crowder and Hoffman (1996), more recently, have
suggested that the estimator choice may account for the contradictory evidence. There have been several significant studies undertaken for Australia. Carmichael and Stebbing (1983) pursued an ‘inverted’ version of the of the Fisher relationship. However, their study was undertaken when financial markets were still under direct regulations. Miskin and Simon (1995) examined the short and long-run Fisher effects. This study found no evidence of a short-run Fisher effect, but their evidence suggests that a long-run Fisher effect does exist. The implication from their study is that the long-run level of interest rates should not be used to characterize the stance of monetary policy; however, short-term interest rates do reflect the stance of monetary policy. Hawtrey (1997), in the most recent study, found that the Fisher effect does not hold prior to financial deregulation of the 1980’s, but does exist following deregulation.\footnote{Theoretical Framework}

Theoretical Framework

The real (inflation-adjusted) end of period investment value is usually represented in the literature by the following equation:

\[ 1 + r_t = \frac{1 + i_t}{1 + \pi_t} \]  

(1)

Rearranging and solving for \( i_t \), we have

\[ i_t = r_t + \pi_t + (r_t, \pi_t) \]  

(2)

where \( i_t \) is the \textit{ex-ante} nominal interest rate, \( r_t \) is the \textit{ex-post} real rate of interest, and \( \pi_t \) is the \textit{ex-post} inflation rate. Traditionally, \( r_t, \pi_t \) is considered small and therefore usually excluded from equation 2. The usual convention is followed, therefore, equation 2 becomes

\[ i_t = r_t + \pi_t \]  

(3)

If inflation expectations are formed given the information at hand at time \( t \), we can write

\[ \pi_t = \pi_t^e + \nu_t \]  

(4)

where \( \nu_t \) is the conditional expectation operator and \( \nu_t \) is a white noise error term. This implies from equation (3) the following

\[ r_t = r_t^e + \mu_t \]  

(5)

and substituting (4) and (5) into equation 3, we have

\[ i_t = r_t^e + \pi_t^e + \epsilon_t \]  

(6)
where $\varepsilon_t$ is the error term, $r_t^e$ is the ex-ante real interest rate and $\pi_t^e$ is the expected inflation rate. Equation (6), the Fisher Hypothesis, is generally estimated in the following manner

$$i_t = c_0 + c_1 \pi_t + \varepsilon_t \quad (7)$$

where $c_0$ attempts to capture the average (constant) real interest rate, and $c_1$ should not be significantly different from one if it is to capture the full Fisher effect.

Data, Methodology and Empirical Results

This study uses quarterly short-term interest rate and Consumer Price Index (CPI) data for the period 1979(1) to 2005(2). The short-term interest rate used is the 90 day Bank Accepted Bill Rate (BABR), which is sourced from the Reserve Bank of Australia website (www.rba.gov.au), and the CPI is used for inflation, which is sourced from the Australian Bureau of Statistics (ABS) catalogue number 6401. This period is an interesting period for Australia as it reflects a significant movement away from a highly regulated financial system to a deregulated system. Figure 1 plots the two series for the period 1970-2005 and there is reason to believe that both inflation and the nominal rate of interest exhibit a stochastic trend. Table 1 also presents sample statistics.

Time Series properties and testing for unit-roots

We begin with some preliminary analysis of the data by performing the standard Augmented Dickey Fuller (ADF) unit root test in order to determine the order of integration of the variables. If a series contains a unit root, it suggests evidence of random walk behaviour. The standard Augmented Dickey-Fuller (1979, 1981) unit root test, with the lag length determined by Akaike’s information criteria (AIC), is illustrated by equation (8), where $Y_t$ is the respective time series, $t$ is a linear time trend, $\Delta$ is the difference operator, and $\varepsilon_t$ denotes the error process with zero mean and constant variance. The null hypothesis of a unit root is $\rho = 1$, against the alternative hypothesis that $\rho < 1$. The critical values of these tests depend on whether a constant and/or trend is included. However, the inclusion of a trend would add little value since trend-stationarity of interest rates and inflation is unlikely, which is consistent with the study by Hawtrey (1997).

$$\Delta Y_t = \alpha + (\rho - 1)Y_{t-1} + \alpha_2 t + \sum_{j=1}^{p} \gamma_j \Delta Y_{t-j} + \varepsilon_t \quad (8)$$

From Table 2 we can see that the variables fail to reject the null hypothesis of a unit root in
levels for the ADF,\(^vi\) which suggests that all the variables may be integrated of order one \(I(1)\). We examine the data by taking first differences and it is clear that the variables are stationary in first differences.

**Cointegration Tests**

Cointegration analysis is a useful tool to examine whether a long-run equilibrium relationship between two series of random variables exists. Table 3 presents the results using the standard Johansen framework (1988, 1991). We can move sequentially to determine the number of cointegrating relations (i.e. from \(r = 0\) to \(r = k-1\)) until we fail to reject.

[Table 3]

We can see from Table 3 that the trace test statistic, which tests the null hypothesis of \(r\) cointegrating relations against the alternative of \(k\) cointegrating relations, (where \(k\) is the number of endogenous variables), indicates one cointegrating relationship at the 5% level. This suggests a long-run relationship exists between the interest rate and inflation. From Table 3 the normalized equation can be re-written as follows:

\[
i = 2.80 + 1.32\pi
\]

This relationship suggests that a 1% increase in inflation leads to a 1.32% increase in interest rates in the longer run. An implication of this Fisher result is that the central bank can influence the yield curve via short-term interest rates, which in turn is influenced by inflationary expectations. This is also consistent with previous studies. However the long-term interest rates will be determined, in part, by the return on productive investments. What is also interesting is the estimated constant, which reflects the real interest rate; estimates of the real rate of interest have ranged between 3-5 % for Australia over the last 20-30 years.

**Summary and Conclusions**

This study has re-examined the Fisher Hypothesis for Australia using the Johansen cointegration framework, given that additional data has been available since the financial system has undergone significant deregulation. The results seem to suggest that the nominal interest rate is a positive function of inflation. The implication from this study is that monetary policy can influence short-term rates. However, it is important to note that the long-term rates will rely upon other fundamental factors, other than inflationary expectations.

**Tables and Figures**

Figure 1: Inflation (CPI) and the short-term interest rate (BABR).
Table 1: Descriptive Statistics (1979-2005)

<table>
<thead>
<tr>
<th></th>
<th>Inflation (CPI)</th>
<th>Interest Rate (BABR)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Observations</td>
<td>106</td>
<td>106</td>
</tr>
<tr>
<td>Mean</td>
<td>5.15</td>
<td>4.90</td>
</tr>
<tr>
<td>Standard Deviation</td>
<td>3.45</td>
<td>4.63</td>
</tr>
<tr>
<td>Jarque-Bera</td>
<td>8.42</td>
<td>10.50</td>
</tr>
<tr>
<td>Probability</td>
<td>0.01</td>
<td>0.00</td>
</tr>
</tbody>
</table>

Table 2: Unit Root Tests (1979:1 -2005:2)

<table>
<thead>
<tr>
<th>Variable</th>
<th>Levels</th>
<th>First-Differences</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Constant (t-statistic)</td>
<td>ADF Statistic</td>
</tr>
<tr>
<td>CPI (Inflation Rate)</td>
<td>1.01</td>
<td>-1.54 (4)</td>
</tr>
<tr>
<td>Bank Accepted Bill Rate (BABR)</td>
<td>1.09</td>
<td>-1.30 (6)</td>
</tr>
</tbody>
</table>

Notes: 1. ADF statistics are obtained using a regression with a constant term only. 2. Critical values at the 1%, 5% and 10% level are 3.49, 2.88, and 2.58, respectively (MacKinnon, 1991). 3. Numbers in parentheses are the lags determined by the AIC Criterion.

Table 3: Johansen Cointegration Test
Eigenvalue | Likelihood Ratio | 5% Critical Value | 1% Critical Value | Hypothesized No. of CE(s)
--- | --- | --- | --- | ---
0.106698 | 15.71417 | 15.41 | 20.04 | None*
0.032143 | 3.528475 | 3.76 | 6.65 | At most 1

Normalized Cointegrating Coefficients: 1 Cointegrating equation
BBTB | CPI | C
1.0000 | -1.325746 | -2.799183

Log Likelihood | -288.7835

Note: *Denotes rejection of the hypothesis at the 5% level.

References


Acknowledgments: I wish to thank Arusha Cooray, Brigitte Granville, Alex Malley, Michael McAleer and Dipendra Sinha for useful comments. All remaining errors are mine.

ENDNOTES