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The Forward Premium Bias under different Monetary Policy environments[❖]

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1. Introduction

Overwhelming empirical research documents the existence of a forward premium bias in OECD nations under floating exchange rates[1]. During this time agents would have earned excess returns from investing in high-interest yielding bonds relative to the returns available on low-interest bonds[2].

Ex post deviations from uncovered interest parity have been attributed both to the existence of a foreign exchange risk premium and to systematic forecasting errors. Domestic investors who decide to hold foreign bonds will demand compensation for bearing foreign exchange risk. Thus, if agents form expectations rationally, foreign bonds should yield predictable excess returns over domestic bonds, equal to the foreign exchange risk premium. Hence, Fama (1984) argues that it is the risk averse behaviour of economic transactors that explains the existence of a forward premium bias. "[A]ny forward rate can be interpreted as the sum of a premium and an expected future spot rate" (p. 337).

However, more recent empirical research suggests that the existence of a foreign exchange premium is unable to satisfactorily explain ex post deviations from uncovered interest parity. Froot and Frankel (1989) found, using survey data, that excess returns were in fact primarily the result of systematic forecast errors rather than foreign exchange risk premia.

Systematic forecast errors may arise because of the existence of irrational traders - see Froot and Thaler (1990), and MacDonald and Torrance (1990). Alternatively, rational agents may make expectational errors as a result of infrequent shocks to the economy. Lewis

[1] For example Canada, France, Netherlands, Japan, Switzerland, West Germany and United Kingdom (Cumby and Obstfeld, 1981; Fama, 1984); Belgium and Italy (Fama, 1984). These studies used US cross-rates. See also Hodrick (1987), Froot and Thaler (1990) and Lewis (1995) for surveys.

[2] Froot and Thaler (1990).

(1995) demonstrates that if agents incorporate uncertainty in respect of economic shocks into their expectations, forecast errors may arise which appear systematically wrong, ex post. Thus, ex post deviations from uncovered interest parity not related to risk premia - ostensible failures of rational expectations - may actually reflect a small sample problem.

Lewis (1989a) demonstrates that changes in the money market that are not fully understood will affect exchange rate forecast errors. Agents will gradually update their beliefs that a new regime is in place, generating systematic forecast errors during the transition. This argument provides one possible explanation for the observed deviations from uncovered interest parity across OECD nations. The sample period over which studies have found a forward premium bias (1970's to 1990's) was characterised by a series of inflation and disinflation episodes for many of the OECD countries. If there were more permanent monetary shocks during this time than agents expected then investors may have consistently expected monetary policy reversals which never eventuated. In disinflating economies this would have resulted in exaggerated inflation forecasts and consequently excess returns on domestic bonds. In inflating economies the reverse would have occurred. Inflation would be under-forecasted and domestic bonds would have yielded negative excess returns.

Lewis (1989a, 1989b) observes that learning should take place over time if agents are rational. Agents will gradually update their beliefs as they realise that a monetary shift was permanent. In the mean time forecast errors will be observed. Because the learning occurs gradually these forecast errors will appear to be systematic in small samples. This explanation of the failure of uncovered interest parity, while plausible, lacks empirical testing.

We test this argument by comparing ex post deviations from uncovered interest parity prior to the inflationary/disinflationary period with deviations during this period. Unfortunately, most OECD nations operated fixed exchange rate regimes during the Bretton Woods period, with the exception of Canada. Canada operated a floating exchange rate between March 1957 and May 1962, as well as after March 1970. Hence, Canada's exchange rate experience provides a unique opportunity to test this argument. If ex post deviations from uncovered interest parity were due to inflation expectation errors then these deviations should be less pronounced before the inflationary/disinflationary period (as well as in more recent data, due to learning).

Canada is also unusual in that its central bank, the Bank of Canada (in conjunction with the government), formally pursues an inflation target of 1-3 percent inflation per annum[3]. If monetary shocks generate systematic forecast errors, so that we observe ex post deviations from uncovered interest parity following changes in monetary regime, then the adoption of an inflation target could be expected to have precipitated deviations from uncovered interest parity after February 1991.

2. Data and Method

Regression analysis was based upon the International Monetary Fund's *International Financial Statistics* series for end of quarter 90-day forward *(with reference 156..B..ZF...)* and spot *(with reference 156..AE..ZF...)* Canada/US exchange rates. Quarterly data was used as 30-day forward exchange rate data was available only from January 1970.

Four periods are examined using this data. These are the Bretton Woods period, during which Canada operated a floating exchange rate (i.e. 1957:2 to 1962:1 and 1970:2 to 1972:4); the post-Bretton Woods era (i.e. 1973:1 to 1996:2); and the four years either side of the adoption of explicit inflation rate targeting in Canada (i.e. 1987:2 to 1991:1 and 1991:2 to 1995:1)[4]. For the periods where the 30-day forward exchange rate data was available we also repeat the analysis with end of month 30-day forward and spot Canada/US exchange rates from the Bank of Canada. We

[3] McCallum (1996) documents the forming of an agreement between the Canadian government and the Bank of Canada which lead to explicit inflation rate targeting from Feb 1991.

[4] The selection of four years either side of Canada's adoption of inflation rate targeting represents a compromise between an a prori expectation that significant learning will occur after the first few years from the change in monetary regime and the problem of a small number of observations. This specification is supported by the results of alternative specifications presented below.

employ the standard regression equation where all variables are in logs:

$$s_{t+1} - s_t = \alpha + \beta(f_{t,t+1} - s_t) + u_{t+1}$$

We expect that the forward premium bias should be small in the first period (i.e. the pre-inflationary/disinflationary period). Further, the bias should be smaller for the third period than for the second period (due to learning); and the bias will be greater after Canada's adoption of an inflation rate target.

3. Results

The results of the regression analysis are summarised in Table 1 at the end of the paper. In the first period (prior to the inflationary/disinflationary period) there is no apparent forward premium bias (β = 0.9841). We are thus unable to reject the null hypothesis that there is no forward premium bias (β = 1) with a p-value of 0.990.

In the second period, as anticipated by previous research, a significant forward premium bias is observed (β = -0.6508). The null hypothesis that uncovered interest parity holds ex post (β = 1) is easily rejected at the five percent level of significance (p-value = 0.003)[5]. By contrast during the third period, following the period characterised by monetary shocks and prior to Canada's adoption of an explicit inflation target[6], deviations from uncovered interest parity are much smaller (β = 1.0911). Indeed we cannot reject β = 1; the p-value from this test is 0.949.

If monetary shocks generate systematic forecast errors so that we observe a forward premium bias following changes in monetary regime, then the adoption of an inflation target might have precipitated deviations from uncovered interest parity after February 1991. Indeed, for the period from February 1991 to January 1995 a large forward premium bias is observed (β = -2.4245). The p-value of a test that β = 1 is 0.067, a rejection at the 10% level although not at the 5% level. The Chow test provides statistical support for structural change between the pre and post inflation targeting periods ($F_{2,28}$ = 4.1685; p-value = 0.019).

One concern with the results for the third and fourth periods is the small number of observations used. We also test the impact of inflation targeting under two alternative specifications with increased sample size. First, the analysis is performed using the 30-day forward rate and monthly data. No qualitative differences are observed with the increased number of observations. However, we are now able to reject uncovered interest parity, ex post, at the five percent level in the post-inflation targeting period (p-value = 0.018)[7]. Second, the analysis is performed with quarterly data for the five years either side of inflation targeting. While the observed deviation from uncovered interest parity in the post-inflation period is of reduced significance (p-value = 0.146)[8], the Chow test is again statistically significant ($F_{2,36}$ = 3.4360, p-value = 0.043).

4. Conclusions

The empirical results provide support for the argument that ex post deviations from uncovered interest parity are caused by systematic forecast errors arising from changes in monetary regime. No forward premium bias was apparent for Canada over the Bretton Woods period, as well as prior to the adoption in Canada of an inflation target (when learning would be expected to have taken place). However, a forward premium bias was found during the inflationary/disinflationary period as well as subsequent to the new monetary regime.

If the forward premium bias is substantially caused by forecast errors arising from monetary changes then the bias should be less (more) pronounced for countries characterised

[5] Using monthly data with 30-day forward rates over the same period gave an even stronger rejection of uncovered interest parity. In this case β = -1.2143 and the p-value is 0.00001.

[6] During this period Canadian inflation had stabilised at around four percent per annum.

[7] The Chow test for structural change yielded very similar results to those obtained with quarterly data ($F_{2,92}$ = 4.2858; p-value = 0.017).

[8] This result supports our specification of periods. Reduced significance over the longer period is consistent with learning.

by stable (unstable) monetary policy. Examination of this implication offers a fertile testing ground for explaining deviations from uncovered interest parity. This paper provides evidence from one country along these lines.

Whilst Canada was the only OECD country to float its exchange rate during Bretton Woods, other non-OECD countries could be examined where monetary stability existed together with floating exchange rates. Another interesting area for future research is examination of the impact of inflation targeting on the forward premium bias. Future research will benefit from a longer sample against which to assess the effects of such formal monetary regimes.

Table 1: The Forward Premium Bias in Different Monetary Environments

Sample Period	No. of Observations	α	β	p-value (β=1)	DW
1957:2 to 1962:1, 1970:2 to 1972:4	31	-0.174E-03 (0.302E-02)	0.9841 (1.301)	0.990	1.96
1973:1 to 1996:2	94	0.520E-02 (0.270E-02)	-0.6508 (0.5500)	0.003	1.91
1987:2 to 1991:1	16	-0.0141 (0.967E-02)	1.0911 (1.4235)	0.949	1.91
1991:1 to 1995:1	16	0.2366 (0.1090)	-2.4245 (1.8711)	0.067	2.18

Note: Standard errors are in parentheses.

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Book Review

The World Bank. Greening Industry: New Roles for Communities, Markets, and Governments - A World Bank Policy Research Report. Published by Oxford University Press, 1999. PP xv + 150. ISBN 0-19-521127-8.

This book provides a summary of the World Bank's research and project work undertaken in the field of pollution control in developing nations. The report covers a period of six years and focuses on the following countries: China, Singapore, Colombia, Malaysia, Mexico, Indonesia and the Philippines. There are 7 chapters.

The aim of the book is to describe the experience of different policy approaches to combating pollution. It has been proven that conventional command and control approaches, such as pollution standards, are too costly and ineffective particularly in the context of developing nations. Project work in the countries mentioned has involved the World Bank both as a participant (helping to establish programs) and as an observer (assessing each program's impact) in helping it to formulate a "new model" of controlling pollution.

The report starts with the adoption of Kuznet's positive relationship between economic development and inequality and links this to the case for development and the associated pollution damage that can follow. Here, evidence gathered in China has shown that this association is not proven until at least middle-income status has been reached (the report mentions $20,000 as representing middle-income status). Apparently, pollution intensity falls as per capita income increases. Economic development induces a decline in pollution intensity and improves environmental performance.

Evidence has also shown that the assumption that pollution havens would be created can not be supported. In this context the choice of an appropriate regulatory approach for controlling pollution becomes critical. Successful approaches, that is those that are technically efficient and also cost-effective, focus on flexible combined options giving incentives to industry to curb pollution, inform communities and are also backed up by the government.

The "new model" consists of three pillars: producers, local communities and the government. Ideally, producers will be able to bear the cost and be charged for emission units so that social costs are internalised. This message is nothing new. Further, the World Bank postulates the publication of environmental ratings that account for a form of informal regulation. Again, this is nothing new.

The third pillar, government, has to make sure that the local communities (the second pillar) are educated in the understanding of environmental issues. This may involve an active policy of encouraging awareness of the environmental impact of various actions such as the introduction of economic reforms along the lines of privatisation, deregulation and opening of markets to international trade. Once more, nothing new in this as such. But it is the combination of the three individual options that can provide a successful strategy, even if each by itself is not considered a newly developed one.

The World Bank recognises certain successful incentive-based options. These options leave flexibility to plant managers, for example in the form of payment for individual emission units rather than regulating pollution via discharge limits. This is exemplified by the Colombian experience where organic discharges decreased by 18 percent as a result of the producers' awareness of costs, penalties, and abatement costs.

The report provides examples of a variety of approaches:

- A combined approach of fixed fee and charge per unit above the allowed standard in the Philippines.

- A threefold approach of operating licenses, pollution charges and surcharges in Malaysia.

- Charges for excess pollution in China.

The equi-marginal principle (marginal abatement costs equal marginal pollution penalties) describes the cost-minimising production output and pollution discharge. The incentive-based strategy can here result in an increase in marginal pollution penalty due to strong enforcement and/or a fall in marginal abatement costs due to economic reforms.

The relevance of the three groups in the "new model" is highlighted once more in chapter 3's case study of Indonesia's pulp and paper factory and the country's pollution control agency BAPEDAL. Local communities, as one of the affected groups, concerned about their health have exerted pressure for the regulator to be stringent with the enforcement of policy means and thereby have executed informal regulation. The polluters have had to take into consideration consumers' and investors' interests (environmental performance being represented in stock value). The third group, government, has acted through its environmental control agency PROPER, which publicly rewards the greenest plant and discloses environmental performance rankings.

Another case study (that of Mexican brick makers) focuses on the government's role in education and training, and the ISO 14001 certification of businesses.

Chapter Four, titled Knowledge, Poverty and Pollution, by not addressing the relationship between poverty and pollution at all well, disappointed me. Scope existed here to point to developing policies that could incorporate environmental issues. The case study of Ciudada Fuarez (Mexico) showed a positive relation between public education and environmental clean-up, but heavily polluted areas remain unreported as described. This is likely to account for the majority of cases and presents environmental injustice. Here the simple relationship between economic injustice and environmental injustice remains. Clearly, better standards of life and better education create environmental awareness.

The overall picture and message of the book comes across well and is easily understood. Economic reforms (trade reform, privatisation and deregulation in particular) must be accompanied by information systems to sustain them so that transparency can be maintained in order for local communities to participate actively.

The report declares the presented model to be new. In my opinion it is no more than a combination of textbook models which have been accepted widely for a long time. The superiority of incentive-based strategies over command and control ones has long been accepted for industrialised countries. Surprisingly, no reason has been given as to why this acceptance should not have been given for developing nations; in particular in view of the elaboration provided on Kuznet's research early in the book.

This publication falls into the category of Applied Environmental Economics, it accepts the theoretical textbook framework and presents several case studies. The prime novelty is the book's geographical focus. An elaboration of global environmental policies is missing and permit trading for instance is only mentioned briefly.

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Economic Journal *(April 2001)* includes papers on *Trust and Growth* by P.J. Zak and S. Knack; *Rich and Poor Countries in Neoclassical Trade and Growth* by A.V. Deardorff; and *Human Capital, Heterogeneity and Estimated Degrees of Intergenerational Mobility* by S. Han and C.B. Mulligan.

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