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STERILIZATION AND THE PROFITABILITY OF UK INTERVENTION 1973-86

by

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This paper is derived from my research at the European University Institute. While I am grateful for discussions with Emil Claassen and Eric Peree, the views expressed and any errors are those of the author.

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ABSTRACT

This artcile uses the profitability criterion to provide a quantitative assessment of exchange market interventions by the UK authorities from January 73 until December 86. The paper argues that the profit calculation should include the interest rate differential when intervention is of the sterilized type and exclude it when intervention is not sterilized. It is shown that intervention in the UK is fully sterilized and that by incorporating the interest rate differential intervention has generally proved profitable.

Sterilization and the Profitability of UK Intervention 1973-86

In his classic 1953 essay, "The Case for Flexible Exchange Rates" Milton Friedman proposed an appealingly simple criterion by which the success or failure of interventions by the authorities should be judged. Specifically, he argued:

"...it would do little harm for a government agency to speculate in the exchange market provided it held to the objective of smoothing out temporary fluctuations and not interfering with fundamental adjustments. And there should be a simple criterion of success - whether the agency makes or loses money." (1953, p.188)

Following Friedman's suggestion that making a profit from intervention would imply stabilizing the exchange rate some theoretical models were set up to investigate whether there was a clear cut relationship between profitable speculation and reduced price variability (eg: Baumol (1957), Telser (1959) and Johnson (1976)). The models revealed that profitable speculation may be associated with increased price variability while losses may be associated with decreased price variability and this was taken as a rejection of Friedman's criterion. In retrospect, this debate was somewhat misguided because it is quite clear that associating profitability with price stability is wrong, this does not mean, however, that making profits by increasing price variability decreases welfare. The argument is succinctly expressed by Dean Taylor:

"The objective of intervention should be that of promoting economic efficiency, not of slowing exchange rate movements. When an economic shock causes the equilibrium exchange rate to shift and the central bank resists the adjustments, the variance of the exchange rate movements is small, but the deviations from the

equilibrium rate are large, and the central bank loses money. If the central bank allows the exchange rate to adjust immediately, greater stability results in the sense that the exchange rate will immediately reflect the new equilibrium value. Although the variance is larger (since it depends on squared deviations), the central bank does not lose money. Even greater economic efficiency occurs if the central bank anticipates the drop in the fundamental equilibrium exchange rate and sells its currency, depressing the price before the drop occurs. The central bank then makes a profit and the lower price will signal the new equilibrium to the market. Thus if the objective of intervention is to promote economic efficiency by reducing deviations from the equilibrium exchange rate, successful intervention will produce profits, even though it may not reduce variability as measured by the variance of exchange rate movements." (1982, pp.358-9)

The profitability criterion is open to criticism in that a central bank may lose money from its interventions but in so doing achieve some sort of social benefit due to a divergence between private and social costs. As such, authorities may deliberately lose money by their exchange market interventions but achieve a social welfare gain for the economy as a whole. Although this argument is difficult to counter it is equally difficult to prove. The profitabilty criterion remains the most useful criterion with which to judge intervention since it is at the end the day the only easily quantifiable measure (1). Indeed, McCormick (1979) using a two period consumer-producer surplus model of the foreign exchange market shows that profitable central bank intervention necessarily increases total welfare. Whether the authorities make or lose public money from their interventions is also of importance in itself. In fact, making profits from intervention has been cited in the Bank of England Quarterly Bulletin as one of the motivations for UK intervention policy in recent years:

"Recently, intervention has been largely confined to smoothing out fluctuations in the rate - for example, selling sterling when it is strong in demand, with the aim of buying it back at a profit quite soon, perhaps even the same day. Such operations help to lessen short-term fluctuations without affecting the overall trend." (Dec 1980, p.442)

In his study, Taylor uses the profitability criterion to assess interventions by the authorities of 9 countries and finds that according to his measure of profitability:

"...central banks have failed to stabilise the exchange markets and have lost billions of dollars"(1982, p.356).

The UK authorities are singled out for particular criticism:

"Although foreign currency speculation has become a costly nationalised industry...it receives little public notice. For example, British steel's average annual loss for the 6 years ending in March 1978 was about £120 million, while British foreign exchange losses averaged over £200 million per year. British Steel received considerable publicity and public attention for its loss, while the latter received almost none." (1982, p.366)

In what follows, we demonstrate that both theoretically and empirically Taylor's study has seriously mismeasured the profitability of central bank intervention and that for the United Kingdom, at least, he has drawn unwarranted conclusions.

Measuring Profitability

For the purposes of his calculation of the profitability of intervention Taylor employs the following formula: It is assumed that purchases and sales of dollars during a given month are evenly spread. If during month i, ni dollars are purchased while ei is the average price of the dollar then ni*ei is the amount of domestic currency sold. Taylor calculates the profitability of intervention as equal to the sum of dollars purchased less the sum

of the dollar value of domestic currency sold. Expressed algebraically:

$$\text{Profit} = \sum_{i=1}^{f} (ni - \frac{ni*ei}{ef})$$

Where ef is the price of the dollar at the end of the period in pounds per dollar. The cumulative net intervention figure is valued at the end of period exchange rate so that net purchases and sales in dollars are made equal, the above calculation produces the net profit or loss in dollars.

This calculation of profits is open to severe theoretical criticism because it is based purely on the movement of the exchange rate and takes no account of the interest rate differential which is always used by a private speculator when calculating his profits. For example, a private speculator may purchase $1000 for a year at $2/£1, then sell at the end of the year the $1000 at $1.95, according to Taylor's measure he will make a loss of $25. However, if the interest rate differential between the US and the UK is 5%, the speculator by having a positive dollar balance resulting from his initial purchase would actually make a profit of $25. According to the efficient market hypothesis, a currency that is expected to depreciate will have a higher interest rate differential to ensure the arbitrage of expected returns. Thus, although a speculator will lose on the exchange rate movement he will gain on the interest rate differential. Taylor's measure is therefore theoretically flawed.

The Taylor neglect of the interest rate differential would be justified if the interest rate differential over the relevant time frame is negligible but in general this is unlikely to be the case.

A point that has not been discussed in the literature is that the appropriate profitability calculation for intervention by the authorities will depend upon the nature of the intervention operation. If intervention is of the non sterilized type, that is, a change of domestic for foreign money or vice-versa then it is not appropriate to include the interest rate differential in the calculation of profitabilty since money held in the reserves gains no interest and no interest is paid by the authorities on their monetary liabilities. If, however, intervention is of the sterilized type, that is, a change of domestic for foreign bonds leaving the domestic monetary base unchanged then it is necessary to include the interest rate differential in the profitability calculation since interest is received on foreign bonds held by the authorities and they pay interest on bonds that they have issued to private agents. As such, it is necessary to find out whether intervention is of the sterilized or non sterilized type before calculating profitability.

Although actual intervention data is not made publically available, the UK Treasury announces each month "the underlying change in the reserves" which corrects the official reserve

changes for the effects of official borrowing and repayments and constitutes a very close monthly approximation to net official intervention. In order to see whether intervention in the UK is of the sterilized or non sterilized type we ran the following reduced form regression which was originally applied to West German data by Obstfeld (1983).

$$\Delta DC = a1 + a2\ INT + a3\ (YT - Y) + a4\ \%\Delta P(-1) + ut$$

In the above regression, the dependent variable ΔDC stands for the change in the domestic component of the monetary base, the series was generated by taking the change in the unadjusted money base and deducting the change in the underlying reserves, that is, our intervention proxy ($\Delta DC = \Delta M0 - INT$). If the authorities engage in sterilization operations the coefficient a2 will lie between 0 and -1, with -1 representing a case of complete sterilization. The coefficient a3 represents the fact that when output (Y) is below the trend output (YT) the authorities may expand domestic credit as part of a counter-cyclical strategy, so that the expected sign of a3 is positive. The term $\%\Delta P(-1)$ stands for the one period lagged inflation rate, the expected sign for the coefficient a4 is negative since a rise in the domestic inflation rate may induce a more contractionary domestic credit policy. The regression was run using monthly data, since monthly income data is not available we used the seasonally adjusted and unadjusted industrial production indices as proxies for the trend and actual output. The results of the regression are reported in table 1.

The regression results reveal that at the conventional 95% confidence level one cannot reject the null hypothesis that the Bank of England fully sterilizes its foreign exchange market interventions , that is, that the coefficient a2 is -1. While Obstfeld (1982) has pointed out that such reduced form estimates should be treated with caution, our results are in line with those obtained by Kearney and MacDonald (1986) who utilize more sophisticated regression techniques on UK data for up until the end of 1982. The estimation results also provide some evidence that domestic credit policy has been motivated by counter-cyclical considerations since for the entire sample period the a3 coefficient is correctly signed and marginally significant and correctly signed for each sub period, although not significant. On the other hand, the lagged inflation rate does not seem to be of any use in explaining the evolution of domestic credit.

The result of complete sterilization implies that the Taylor neglect of the interest rate differential cannot be justified on the grounds that UK intervention was of the non sterilized type. Hence, it is necessary to include the interest rate differential when calculating the profitability of UK intervention.

Another problem with the Taylor calculation is that it is not particularly informative when there is large scale cumulated intervention in a given direction. If authorities, as is the case of the UK, pursue a "leaning against the wind" exchange rate

policy (2), then as sterling depreciates they will purchase sterling in a bid to slow down the movement. If the fall in sterling continues then the cumulated net purchases of sterling will be large and when valuing it at the new lower exchange rate one is bound to report a loss. Hence, the Taylor calculation will be heavily dependent upon how much cumulative intervention is arbitrarily allowed for. Hopefully, one can identify periods when net purchases and sales of sterling are approximately equal so that one does not have the problem of having to measure cumulated net intervention. This will provide a more meaningful measure of profits.

In order to overcome the deficiencies of the Taylor study we have included the interest rate differential in our calculation of profitabilty and imposed the rather strict constraint that purchases and sales of sterling during the time period be approximately equal. This latter procedure ensures that our profitabilty calculation is not distorted by valuing the net cumulative intervention. In order to calculate the profitability of UK intervention we used the following calculation:

(1) The net monthly intervention figure for each purchase (+) and sale (-) of dollars was divided by the monthly average exchange rate. This yielded two series - the sterling value of dollars purchased and the sterling value of dollars sold. The two series

were added to yield the net sterling value of dollar purchases or sales.

(2) In order to minimize the problems inherent in valuing the end of period cumulative intervention, we selected periods where net cumulative intervention did not exceed $40 million. The sterling value of cumulative intervention was found by taking the net cumulative intervention figure and dividing it by the end of period exchange rate.

(3) Exchange rate profits were calculated as the sterling value of cumulative intervention minus the net sterling value of dollar purchases and sales. That is, (2) - (1).

(4) In order to take account of the interest rate differential we firstly calculated a series of the average dollar balance held during the month. For this, we took the cumulative intervention figure for the month in question and added the previous month's cumulative figure and divided by two (for the first month the net intervention figure was divided by two).

(5) We next applied the US interest rate (annual rate converted to a monthly rate using the compound interest rate formula) to the monthly average balance and did likewise with the UK interest rate. The interest rate gain or loss each month was calculated as the average dollar balance plus US interest earnings less the

average dollar balance plus the UK interest earnings. This dollar figure was then divided by the end of month exchange rate to yield the sterling value of the interest gain or loss. This series was summed to yield the interest rate gain or loss for the period in question.

(6) The net profit from foreign exchange interventions was calculated as the exchange rate profit/loss plus the interest rate gain/loss.

The above calculation is based upon the following assumptions:

-All intervention is made in dollars.

-Intervention is spread out evenly throughout the month.

-Profits and losses on intra-month trading are ignored.

-All interest rate gains/losses are converted at the end of the month into sterling.

-Net cumulative intervention at the end of the period can be closed out at the end of period exchange rate.

In order to calculate the profitability of intervention, it was not clear as to what is the appropriate set of interest rates to employ for the calculation. The theoretically preferred interest rate is the eurocurrency interest rate, since this is the set of interest rates used by banks to calculate the forward premium/discount. However, the reserves do not necessarily earn eurocurrency interest rates, so we also used treasury bill

interest rates, to see if the choice of interest rate made any significant difference to the results. In table 2, we present the results of our calculations using 3 month eurocurrency interest rates and in table 3, we present the results using 3 month treasury bill rates.

An examination of the tables reveals results which undermine the conclusions reached by Taylor. Using eurocurrency interest rates non of our sub periods yielded a net loss, while using treasury bill rates only the period October 73 - July 79 revealed a fairly minor loss. In our first six sub periods, the calculation shows that if we take into account only the exchange rate movement the authorities incurred heavy losses but once we include interest rate gains we see that intervention almost always proved profitable. The neglect of the interest rate differential in the Taylor calculation is shown to be particularly inappropriate in the case of the UK because this was in fact a substantial source of profit, only using treasury bill rates in two of the last three sub periods did the authorities lose out on the interest rate differential.

The last reported result in the tables was obtained by applying our formula to the entire sample period. Although net purchases of sterling clearly exceeded net sales, the calculation reveals that while the authorities lost more than £687 million on the exchange rate movement, this was more than compensated for by

interest rate gains yielding a net profit of £555 million when using eurocurrency interest rates and £375 million when using treasury bill interest rates.

Conclusions

In evaluating intervention policy, the profitability criterion is both simple and appealing. A non interventionist cannot logically argue that private speculation is stabilizing when it makes profits and then apply a different criterion when evaluating central bank interventions. In this paper, it has been shown that when calculating the profitability of intervention it is necessary to distinguish between the nature of intervention operations. When intervention is of the non sterilized "money for money" type, it is not necessary to include the interest rate differential into the profitability calculation. If, however, intervention is of the sterilized "bond for bond" type one should take account of the interest rate differential when calculating intervention profits.

In this paper, we have presented results which reveal that intervention by the UK authorities was of the sterilized type. By taking account of the interest rate differential it has been shown that intervention by the UK authorities has generally been profitable, the implication being that the Bank of England's intervention has been stabilizing rather than destabilizing. Our results have shown that the UK authorities have made profits of £555 million until the end of 1986. An important question that should be asked is whether profits of approximately £40 millions per year can be regarded as abnormal profits ? Our answer is that such profits cannot be regarded as abnormal because in earning these profits the central bank has often had to take very large

open positions in the foreign exchange market, for example, from January 1973 to November 1976 the cumulative net sales of dollars amounted to $15,728 million, had sterling not recovered so dramatically in the subsequent years the authorities may have incurred substantial losses. It remains an important question for future research as to whether the authorities profits reflect the gains for outguessing the market or a reward for reducing a possible risk premium ? This question like the issue of the effectiveness of sterilized interventions has yet to be resolved.

Data Appendix

This appendix lists the sources for the data used in this study.

The Underlying Change in the Reserves - the Bank of England.

The unadjusted monetary base (calendar month series) - the Bank of England.

Exchange Rate End of Period - International Financial Statistics line ag.

Exchange Rate Period Average - International Financial Statistics line rh.

3 month Eurodollar and Eurosterling interest rates - Bank of England Quarterly Bulletin, various issues.

3 month US and UK Treasury Bill Rates - Bank of England Quarterly Bulletin, various issues.

Industrial Production Indices for the UK (unadjusted and seasonally adjusted) OECD Main Economic Indicators.

Consumer Price Index for UK - OECD Main Economic Indicators.

Footnotes

(1) Mayer and Taguchi (1983) argue against the use of the profitability criterion and suggest a number of alternative criteria with which to assess intervention. Their main criticism against the use of the profitability criterion is that profitable speculation may involve increasing price variability, however, as we have already argued this criticism is not appropriate.

(2) Evidence that the UK authorities have pursued a "leaning against the wind" exchange rate policy is presented by Argy (1982) and Kearney and MacDonald (1986).

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Table 1. Sterilization Test

Estimated Equation:

$$\Delta DC = a1 + a2\ INT + a3\ (YT - Y) + a4\%\Delta P(-1) + ut$$

Beach-MacKinnon Estimation

Sample Period	a1	a2	a3	a4	$\bar{R}^2$	DW	SE	Rho
Mar 73-Dec 86	55.47	-1.02	6.55	10.72	0.85	2.12	721.3	-0.28
	(2.0)	(-30.1)	(2.1)	(0.4)				(-3.6)
Mar 73-Dec 79	98.21	-1.01	5.13	-14.19	0.95	2.05	197.6	-0.21
	(2.8)	(-38.7)	(1.6)	(-0.6)				(-1.8)
Jan 80-Dec 86	21.13	-1.12	8.35	43.94	0.44	2.05	351.0	-0.27
	(0.5)	(-7.9)	(1.5)	(0.8)				(-2.3)

Notes: Monthly Data.

The Durbin-Watson statistic for all three periods in the ordinary least squares estimation was in the grey area, so we used the Beach MacKinnon estimation method to correct for first order autocorrelation.

The t-statistic is in parantheses.

Table 2: The Profitability of UK Intervention Using Eurocurrency Interest Rates

£'s Millions

Sample Period	Sterling Value of Net Cumulative Intervention	Exchange Rate Profit	Interest Profit	Net Profit
Feb 73 - Nov 82	-23.57	-708.88	1081.48	372.60
Apr 73 - Jul 80	-4.28	-845.48	1074.34	228.86
Aug 73 - Apr 82	-5.03	-604.53	1035.26	430.73
Oct 73 - Jul 79	-6.14	-805.97	909.42	103.45
Jan 74 - Nov 83	6.83	-329.28	893.06	563.78
Feb 74 - Jan 84	9.98	-250.82	859.21	608.39
Jul 74 - Mar 86	-5.39	112.84	739.34	852.18
Jun 76 - May 77	-6.99	-36.17	99.59	63.42
Nov 77 - Nov 86	9.75	1106.30	18.47	1124.77
May 79 - Dec 86	6.78	971.65	6.00	977.65
Nov 84 - Sep 86	-27.59	8.65	2.09	10.74
Jan 73 - Dec 86	-2392.00	-687.13	1242.27	555.14

Notes: Monthly Data.

A positive sign for sterling value of net cumulative intervention indicates net purchase of dollars, so a negative sign is net sales of dollars.

Table 3: The Profitability of UK Intervention Using Treasury Bill Interest Rates

		£'s Millions		
Sample Period	Sterling Value of Net Cumulative Intervention	Exchange Rate Profit	Interest Profit	Net Profit
Feb 73 - Nov 82	-23.57	-708.88	880.37	171.49
Apr 73 - Jul 80	-4.28	-845.48	875.84	30.36
Aug 73 - Apr 82	-5.03	-604.53	832.81	228.28
Oct 73 - Jul 79	-6.14	-805.97	733.25	-72.72
Jan 74 - Nov 83	6.83	-329.28	690.64	361.36
Feb 74 - Jan 84	9.98	-250.82	655.21	404.39
Jul 74 - Mar 86	-5.39	112.84	521.37	634.21
Jun 76 - May 77	-6.99	-36.17	76.21	40.04
Nov 77 - Nov 86	9.75	1106.30	-73.83	1032.47
May 79 - Dec 86	6.78	971.65	-82.40	889.25
Nov 84 - Sep 86	-27.59	8.65	2.31	10.96
Jan 73 - Dec 86	-2392.00	-687.13	1061.71	374.58

Notes: Monthly Data.

A positive sign for sterling value of net cumulative intervention indicates net purchase of dollars, so a negative sign is net sales of dollars.

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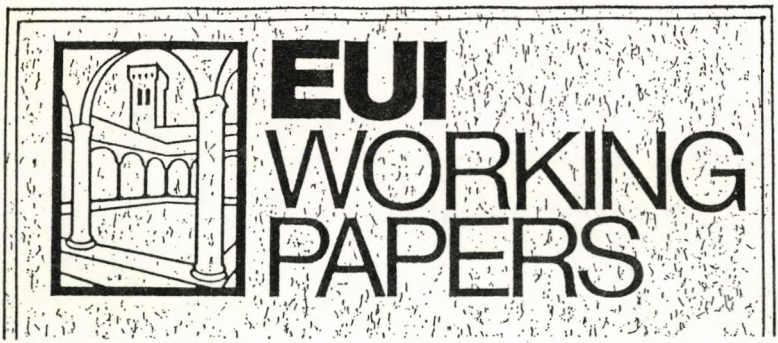

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