5-18-1994

An Empirical study of Covered Interest Arbitrage: Marqins Durinq the European Monetary System Crisis of 1992

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Research Honors
May 18, 1994

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I. Introduction

Interest parity in international financial markets exists when the interest rate differential between two counties is exactly offset by the forward exchange premium/discount. If at any moment the interest parity condition is not satisfied, traders can execute covered interest arbitrage. Covered interest arbitrage entails a series of four transactions in the currency and securities markets which results in a practically riskless profit. Although traditional economic theory predicts that the opportunities will be wiped out as individuals take advantage of the situation, covered interest arbitrage margins (CIAMs) have been observed to exist over extended periods of time.

Previous research in the area has attempted to rectify the discrepancy by identifying factors outside the basic arbitrage equation which work to negate profit opportunities. The most dominant of such factors in the literature have been transactions costs, partly because they are quantifiable. Other factors, such as political/financial-center risk, timing problems, and imperfect elasticities of demand and supply have been explored as well, but are more difficult to pin down empirically.

My research is an attempt to determine whether transactions costs are enough to explain away CIAMs, or if political/financial-center risk also plays an important role. The focus is on the time period summer/fall 1992 when the European Monetary System crisis occurred, bringing along with it heavy speculation, volatility, and intervention in the currency

markets. A higher political/financial-center risk for London is hypothesized to exist during this time period, creating the possibility of margins that cannot be explained away by simple transactions costs alone, and thus presenting an ideal time for further study.

Overall, the results of the research suggest that transactions costs may indeed be enough to explain away margins between developed financial centers such as London and New York, but are inconclusive until better data is obtained.

II. Basic Theory

If interest parity does not hold, covered interest arbitrage margins appear and riskless arbitrage is possible. For example, if a negative margin is found to exist between New York and London, a trader may execute the following set of transactions for a profit:

1) borrow dollars on the U.S. market at a lower rate of interest,
2) exchange dollars for British pounds on the spot market,
3) purchase higher yield British securities, and
4) enter a forward contract of corresponding maturity to buy back dollars.

This series of transactions is in itself riskless in that the exchange rate exposure has been nullified, thus guaranteeing a profit at maturity regardless of changes in exchange rates.

Simple supply and demand reasoning leads us to believe that the profit opportunity should be short-lived. As traders engage in the transactions, pressure is applied on each component in such a way that the interest differential and forward

premium/discount produce parity. For example, the purchase of pounds and sale of dollars on the spot market causes the dollar exchange rate to weaken. It will consequently cost individuals more to purchase pounds, adding to costs and reducing profit. Similarly, an increased flow of funds to London and the subsequent purchase of securities causes the interest rate on these securities to fall, also decreasing the amount of profit generated by arbitrage. The same reasoning applies for the U.S. interest rates as well as the forward exchange rate. These sorts of changes continue until interest parity is brought about and investors are indifferent to covered interest arbitrage.

What this then suggests is that if people do act rationally i.e. by taking advantage of profit opportunities, CIAMs should not be observed. It is an established fact, however, that margins exist in real life. For example, Grubel calculated margins for the time period of 1956 to 1960 and found them to deviate from parity at a range between negative two and five percent annualized (pg. 80). More recent sources such as Salvatore (pg. 397) and Rivera-Batiz (pg. 109) also attest to the fact that CIAMs exist.

III. Accounting for Observed Margins

A. Market Inefficiency

Early research in the area sought to find explanations for the CIAMs in the markets themselves. It was reasoned that the markets were not sufficiently efficient so as to act in a way

that could eliminate CIAMs. This was in the time of the gold standard and fixed exchange rates. Although these may have been valid factors forty years ago in relatively under-developed markets, today's financial markets are vastly different. Global communications and computerized trading ensure almost instantaneous access to the markets. Similarly, the international flow of capital has been deregulated to such an extent that short term funds are free to move between major financial centers without obstacles. Thus, the roots of the persistence of CIAMs are unlikely to be found in inefficient markets and obstacles to transacting.[1]

There exist two other major views or explanations of CIAMs, each of which will be considered separately in this section. One of them has been extensively explored by Frenkel and Levich, the other by Grubel. I do not wish to suggest that either explanation "belongs" or is solely represented by these people. Rather, for the sake of simplicity and convenience, the theory of transactions costs will be mainly associated with Frenkel and Levich while that of additional risks with Grubel.

B. Transactions Costs and the Neutral Band

Frenkel and Levich did not invent the concept of

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[1] The subsequent use of the concept of efficiency in this paper is more generalized than the strict definition found in economics/finance. By claiming that markets are efficient it is simply meant that when faced with possible profit opportunities, people act rationally.

transactions costs as they were already considered in the original piece on covered interest arbitrage, Keynes' A Tract on Monetary Reform, but the majority of modern literature dealing with transactions costs has been written by Frenkel and Levich. The concept of transactions costs stems from the fact that external costs not explicit in the covered interest arbitrage formula itself exist. These costs include such things as brokerage fees, time costs, subscription costs, and the costs of being informed. If in sum these expenses are greater than the possible profit derived from interest arbitrage, no rational investor will execute the arbitrage. Thus, small margins could exist for extended periods of time as almost an illusion--exact interest parity does not hold, but in effect interest arbitrage is not profitable.

The interest parity line can be seen in graphical form in Figure 1 (see end of paper for all Figures). Any point not lying on this 45 degree line does not satisfy the parity condition, i.e. the interest differential is not exactly offset by the discount/premium on foreign exchange. The existence of transactions costs can be seen to create a neutral band around the interest parity line (Figure 2). Any point contained within this band would not represent a profit opportunity as the costs of transacting would outweigh the potential returns. Such points are considered to attest to the existence of functional interest parity, whereas if points exist outside the neutral band, the interest parity condition is not satisfied. Keynes believed that

the yield advantage had to be in excess of 0.5% annualized to induce any flows. Subsequent empirical estimates have placed the number between 0.18% (Branson 1968) and 0.25% (Holmes and Schott).

In functional notation, we can define the neutral band as:

$$(i_{dom}-i_{for})/(1+i_{for})-(fw-sp)/sp < t_{dom}+t_{for}+t_{fw}+t_{sp} \quad (1)$$

where i_{dom}= domestic interest rate
i_{for}= foreign interest rate
sp= spot exchange rate
fw= forward exchange rate
t_{fw} and t_{sp}= transactions costs in currency markets
t_{dom} and t_{for}= transactions costs in securities markets.

This inequality basically states that for interest parity to hold in effect, the sum of the transactions costs in currencies and securities markets must be greater than or equal to the profit margin derivable from interest arbitrage.

C. Outside Risks

Grubel's work takes a distinctly different approach to solving the dilemma. Modern Portfolio theory, as developed by Tobin, forms the backbone of his explanation for why CIAMs exist. The basic premise is that the demand for any security is a function of the expected return and risk associated with holding it. Initially, if there is a slight earnings advantage in favor of a foreign security the flow of funds will be quick to exploit it. However, it takes a higher and higher expected return to induce more funds because of the risk associated with holding too

much of one asset. Thus, the supply of arbitrage funds is not perfectly elastic (Grubel 15-18).

In times of relative calm in international markets, this imperfection is assumed not to cause CIAMs. But, during times of heavy speculation and volatility, interest parity may be disrupted. Activity in the forward exchange markets is the chief source of the disruption. As evidence for his view Grubel cites the Suez Canal crisis of 1957 when heavy speculation against the pound existed, and CIAMs were observed to exist for a long period.

A non-technical explication of the outside risks associated with covered interest arbitrage may help shed some more light on the matter. Covered interest arbitrage is riskless only in the sense that exchange rate risk has been nullified, not in the sense that there are absolutely no other risks involved with it. Two basic considerations are behind the portfolio approach. First, the fact that funds are tied up for a definite amount of time adds risk to covered interest arbitrage that is not inherent in the transactions themselves. Anytime funds are tied up, a certain amount of risk is added--for example, opportunities with higher returns could arise, or the money might be needed elsewhere. Second, the higher the proportion of portfolio investments held in any single asset is, the less diversification there is, and clearly this is also a risk consideration. These two outside risks exist regardless of the time period under consideration. They are almost impossible to quantify, and thus

cannot be explored in the empirical section explicitly. There exists a third type of outside risk, however, that presents an opportunity for empirical investigation.

The third outside risk, which is explored by Frenkel and Levich in their empirical studies and hinted at by Grubel as well, is that of political/financial-center risk. International investments always carry with them an additional risk consideration which stems from the fact that foreign governments are sovereign (Rivera-Batiz pg. 115). In other words, a U.S. investor has no guarantee that his funds are safe when invested abroad. Each financial center carries with it a perceived amount of risk which investors must be compensated for in terms of higher returns if they are to invest there. Obviously, the political and financial stability of the United States allows it to offer much lower rates than say Hungary as far as foreign investors are concerned.

The difference in stable times between London and New York may be minimal, but in volatile times this is not necessarily so. If either were to experience instability, it would consequently be associated with a higher political/financial-center risk. Thus in this sense covered interest arbitrage is not entirely risk-free either. There clearly exist outside risks--capital controls, financial system collapse, repatriation problems etc.--that become more likely in times of turbulence.

Thus, what we gather from this discussion is that it is possible that outside risks can keep investors from taking

advantage of covered interest arbitrage and cause margins to persist, especially in volatile and turbulent times.

IV. Description of Time Period

In this study I wish to examine the role these two explanations (transactions cost and outside risk) played in determining interest parity during the time of the European Monetary crisis of 1992. The summer and fall of 1992 were characterized by a tremendous amount of turbulence in Europe that derived from both economic and political spheres.

German interest rates were kept high by the Bundesbank in an effort to keep inflationary pressures resulting from re-unification in check[2]. The other members of the European Exchange Rate Mechanism (ERM) were struggling with their own economic recoveries and thus would have wished to lower interest rates as a stimulus. Yet the ERM required that exchange rates of member countries fluctuate within a narrow band, and lower interest rates compared to Germany would have caused this band to be broken by many currencies. Simultaneously, there existed political friction over the ratification of the Maastricht Treaty. All these factors resulted in volatility, speculation, and turbulence. The pressure on the British pound finally proved too great to quell. Despite heavy intervention on its behalf, the pound was set to float as Britain disjoined the ERM indefinitely

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[2] The events of 1992 are from Bank of England Quarterly Bulletin, November 1992.

on September 16, 1992.

Since during this same period the United States enjoyed a period of calm, London is assumed to have a higher political/financial-center risk associated with it. Tying together our previous discourse, we reach the following synopsis. If political/financial-center risk does in fact lead to larger and more persistent CIAMs, this should definitely be evident during our period of study because of its volatile nature. Yet if transactions costs do an adequate job of accounting for the margins between New York and London even in summer/fall of 1992, they probably constitute a satisfactory explanation in normal times as well.

V. Data

The calculation of covered interest arbitrage margins and transactions costs require data on domestic and foreign interest rates, spot and forward exchange rates, and bid and ask prices on securities. The table on the following page indicates exactly how each variable is defined.

-Interest Rates- Traditional Pair of Securities:

i_{dom}	U.S. 90-day Treasury-Bill rate.
i_{for}	U.K. 90-day Treasury-Bill rate.

-Interest Rates- Non-Traditional Pair of Securities:

i_{dom}	90-day Eurodollar deposit rate in London.
i_{for}	U.K. 90-day Treasury-Bill rate.

-Foreign Exchange Rates:

sp	Spot price of pounds per dollar.
fw	Forward price of pounds per dollar.
US/DM	Spot price of dollars in terms of marks.
DM/UK	Spot price of marks in terms of pounds.
US/UK	Spot price of dollars in terms of pounds.

-Bid-Ask Prices:

Bid	Price a dealer paid for a U.S. or U.K. 90-day Treasury-Bill at purchase.
Ask	Price the investor must pay to the dealer for the U.S. or U.K. 90-day Treasury-Bill.

All data are weekly, from April 3 to December 24, 1992. The interest rates are Friday closing figures, collected from The Bank of England Quarterly Bulletin; the rest are collected from the Friday editions of The Wall Street Journal.

VI. Method of Study

A. The Point of Using Two Sets of Securities

The method by which we will accomplish a comparison of the opposing explanations involves using two pairs of securities, defined in section V as a traditional and non-traditional pair. Frenkel and Levich along with many other researchers have used this technique in their studies.

A test for interest parity requires that the securities used to calculate CIAMs be as similar as possible. They should be of the same maturity and risk class to produce a completely valid

test. As the discussion on political/financial-center risk revealed, however, using the traditional pair of simple U.S. and U.K. Treasury Bills introduces some error because of the different risks associated with each. What we must do, then, is to remove this risk from the calculation of CIAMs.

One way to accomplish this is to use a non-traditional securities pair in addition to the traditional one just mentioned. The non-traditional pair ideally consists of data collected at an external financial center, such as Paris, on the rates the two currencies command. Since such data was not available for use in this study, we create a substitute by basing both securities in London instead of some external center. It is hoped that this will serve the function of equalizing the political/financial-center risk adequately.

Comparing the CIAMs produced by the non-traditional as well as the traditional pair should then reveal that margins are smaller for non-traditional pair data. If transactions costs explain away all the margins produced by non-traditional pair data but only part of those associated with traditional pair data, we have evidence that political/financial-center risk is indeed an important consideration in establishing effective interest parity. If it should turn out, though, that the transactions costs are sufficient in encompassing all margins regardless of which data is used, then we could conclude that turbulence does not affect interest parity equilibrium much.

B. Calculating the CIAMs

The covered interest arbitrage margins are calculated using the first part of equation (1). The simple margins obtained with traditional pair data can be observed as an example from Figure 3.

C. Estimating the Neutral Band

As transactions costs are impossible to quantify directly, we must use a proxies for costs in the currency as well as securities markets. Again, these proxies are generally accepted and used in the literature concerning CIAMs, and thus will be adopted directly.

The triangular arbitrage equation (2) provides an indirect method for measuring transactions costs.

$$((US/DM)*(DM/UK))/(US/UK)=1 \qquad (2)$$

(for variable definitions, see section V.)
It should not be possible for the holder of dollars to purchase pounds through German marks and end up with a different amount than if they go directly from dollars to pounds. Thus, in the absence of transactions costs, equation (2) must equal 1. When the costs of transacting in these markets is figured in, there will result a slight discrepancy in the condition. This discrepancy is our proxy for transactions costs in currency markets.

In using equation (2) to reveal transactions costs, we are assuming that currency markets are efficient. It is very easy for

banks and traders to take advantage of any earnings potential derived from triangular arbitrage without even tying up funds. Thus, it is well within reason for the sake of the proxy to assume efficiency in nullifying such opportunities.

It is important that the data collected be as simultaneously recorded as possible. Exchange rates are in a continuous state of flux due to 24 hour trading, and clearly observations collected at different points in time cause unnecessary noise to be introduced.

Since it was not possible to find all three cross rates required to compute equation (2) in the forward exchange markets, it is assumed that transactions costs in forward markets are equal to those of the spot markets. In other words, in terms of equation (1), $t_{fw}=t_{sp}$.

To find a proxy for transactions costs in securities markets, the following is used:

(Ask Price-Bid Price)/(Ask Price) (3)

Dealers of securities require compensation, the difference between the bid and ask price, for their services and liquidity. Following the work of Demsetz (1968), Frenkel and Levich multiply the resulting figure by 2.5 to estimate total costs in securities markets. In this way the proxy is then extended to account for brokerage fees as well as the reward dealers command. The method will thus be used for our purposes as well.

Again, the spreads were not readily available for British securities, so we assume $t_{dom}=t_{for}$.

Figure 4 displays, among other things, the plot of a five week moving average of computed transactions costs. The moving average was utilized to smooth out excessive volatility from the measurement. Figure 5, on the other hand, shows the average transactions cost from over the entire period of study plotted as a neutral band around interest parity. Our average estimate of the transactions costs lands around 0.10%, which is a reasonable figure when compared to the findings of Branson, Holmes, and Schott.

VIII. Results

The overall results of computing CIAMs and transactions costs are seen in full in Figure 4 and Figure 5.

From Figure 4, the most immediately striking observation is that the margins generated by the non-traditional pair are without exception greater than the traditional pair margins. This runs contrary to expectations--recall that by equalizing political/financial-center risk it was expected that there exist less discrepancy between the interest rates and between London and New York. Thus, the margins were also expected to be smaller.

What this leads us to believe, then, is that our non-traditional pair data is not an adequate substitute for the ideal type mentioned earlier. It was hoped that basing both securities in London would do the job. However, the London T-Bill and Eurodollar deposits may not be completely comparable. There must exist some fundamental difference between these two types of

interest rates that render them inadequate for the purpose of our study. If Eurodollar data in Paris for both currencies had been found, they would have most likely produced margins smaller than those of the traditional pair.

The margins created by the traditional pair data are almost completely bound by transactions costs, i.e. the neutral band. This observation is made clear by looking at Figure 5. Here, the average total transactions costs through the entire time period is found and then plotted around interest parity, producing a neutral band. This neutral band contains within it all except one traditional pair CIAM. Recall that any point within the neutral band is not a profit opportunity as costs outweigh benefits.

The only point in our sample time period that did not fall within the neutral band occurred on September 18, very close to the time Britain let its currency float. There are two possible ways of interpreting this outline. First, it could be that a real CIAM, and thus an unexploited profit opportunity, existed at this time. In fact, a profit opportunity could have persisted for nearly two weeks around September 18 and we would not know about it because of the sparsity of observations. Thus it could be that the volatility surrounding Britain's exit from the ERM did really cause margins, giving support for Grubel's theory.

However, the September 18 point could merely reflect timing problems in the data. The exchange rates moved quickly during this period and the different measures that go into calculating CIAMs are not collected at exactly the same point in time. Thus,

additional noise created by the moves could be causing an inflated margin. The margin observed could then be just a result of measurement imperfections. Until more condensed (for example daily) data are found and tested to reduce the timing problem, it cannot be claimed with certainty that transactions costs negated all profit opportunities for the period of study.

IX. Conclusions

The major weakness of this study was the quality of data and the lack of true external center data. If we had obtained say daily observations, it would have been much easier to make a clear judgement on what the case of September 18 really represents. Also, real external center data for the non-traditional pair would have aided in exploring political/financial-center risk with more clarity.

Still, the results discussed above were successful in showing that for most of the time, transactions costs are sufficient in explaining away margins. Regardless of the one anomaly, the results do tend to lead us toward concluding that interest parity is maintained between London and New York largely by transactions costs alone, and that political/financial-center risk considerations are of secondary importance. This is not to say that the theory presented by Grubel is not applicable and should be abandoned, but that transactions costs clearly proved to be the dominant force in establishing effective interest parity in our study.

The fact that transactions costs appeared to do the job alone probably stems from the fact that both of the financial centers in question are known for their overall stability. Even though London was experiencing major turbulence, Britain is still an economically strong and politically stable investment site. Thus investors are less likely to respond negatively to adverse news because they have assurances of safety based on the historical track record of London.

Thus it could be that the political/financial-center risk consideration is of much greater importance when considering other financial centers. Were we to consider covered interest arbitrage between centers like New York and Kuala Lumpur or London and Prague, political/financial-center risk might assert itself as being of major importance in establishing interest parity because of the differential in risk class between the centers in question. This possibility presents an interesting area for further research.

Figure 1

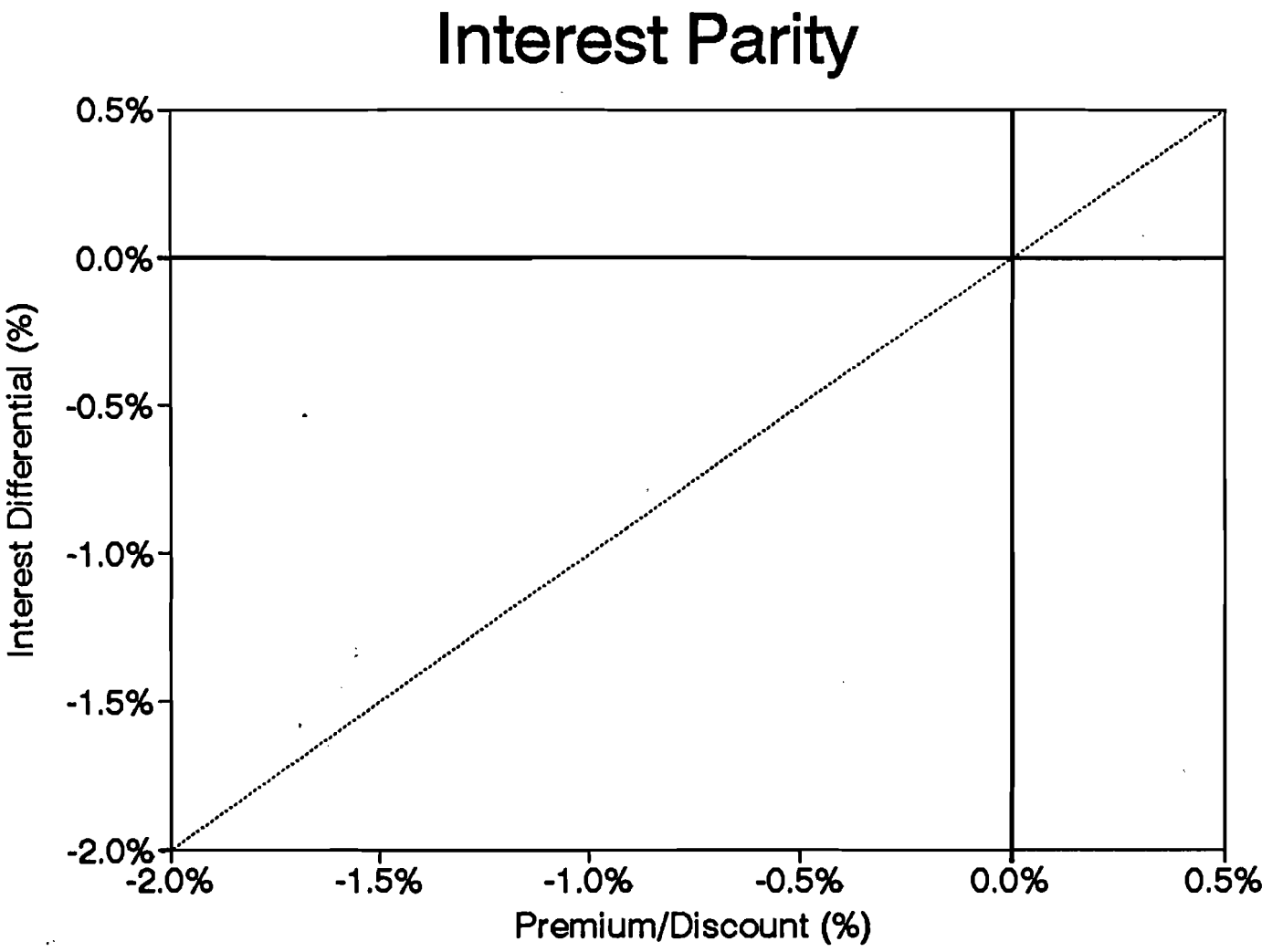

Interest Parity
0.5%
0.0%
-0.5%
-1.0%
-1.5%
-2.0%
Interest Differential (%)
-2.0%
-1.5%
-1.0%
-0.5%
0.0%
0.5%
Premium/Discount (%)

Figure 2

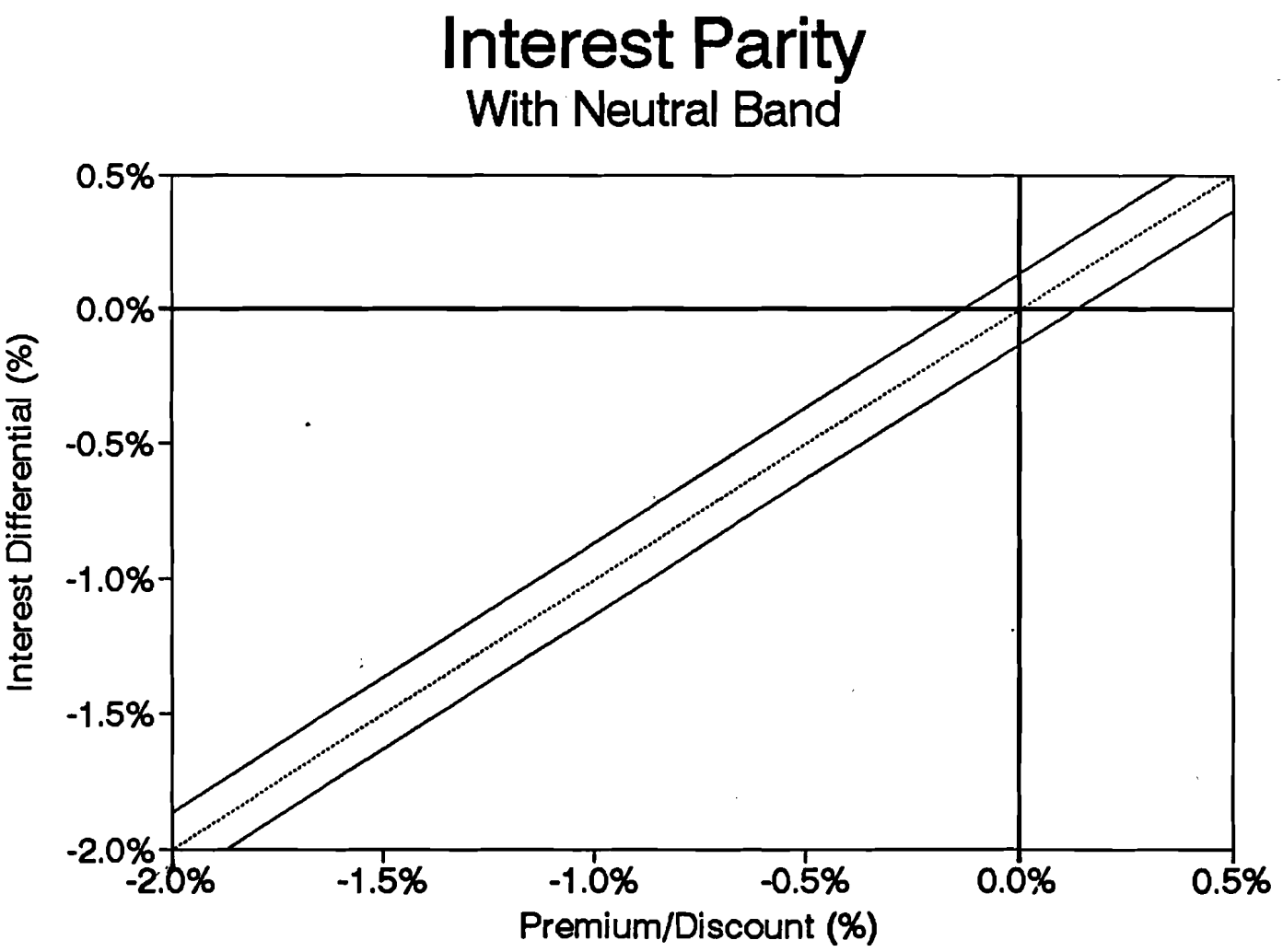

Interest Parity
With Neutral Band
0.5%
0.0%
-0.5%
-1.0%
-1.5%
-2.0%
Interest Differential (%)
-2.0%
-1.5%
-1.0%
-0.5%
0.0%
0.5%
Premium/Discount (%)

Figure 3

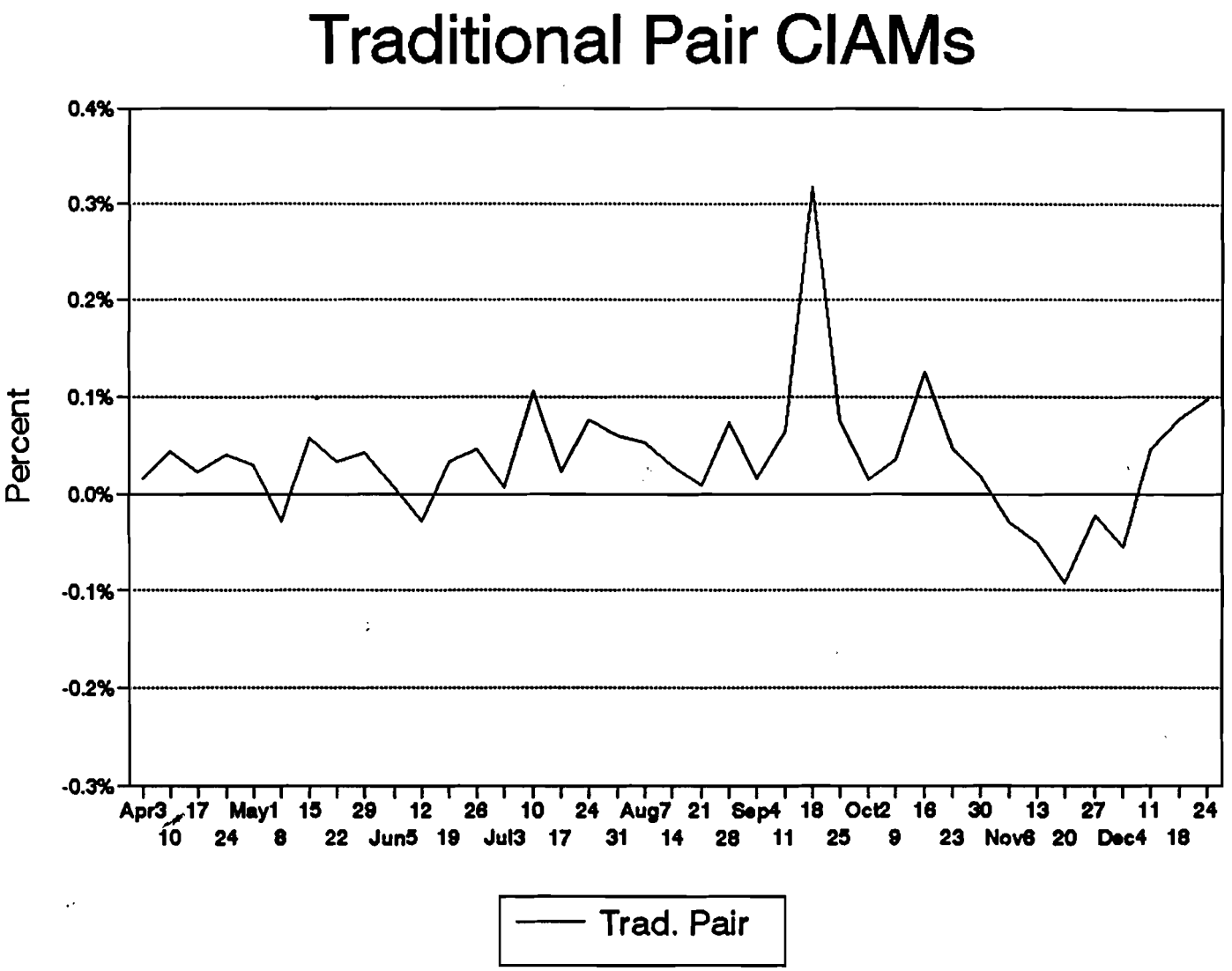

Traditional Pair CIAMs
Percent
0.4%
0.3%
0.2%
0.1%
0.0%
-0.1%
-0.2%
-0.3%
Apr3 10 17 24 May1 8 15 22 29 Jun5 12 19 26 Jul3 10 17 24 31 Aug7 14 21 28 Sep4 11 18 25 Oct2 9 16 23 30 Nov6 13 20 27 Dec4 11 18 24
Trad. Pair

Figure 4

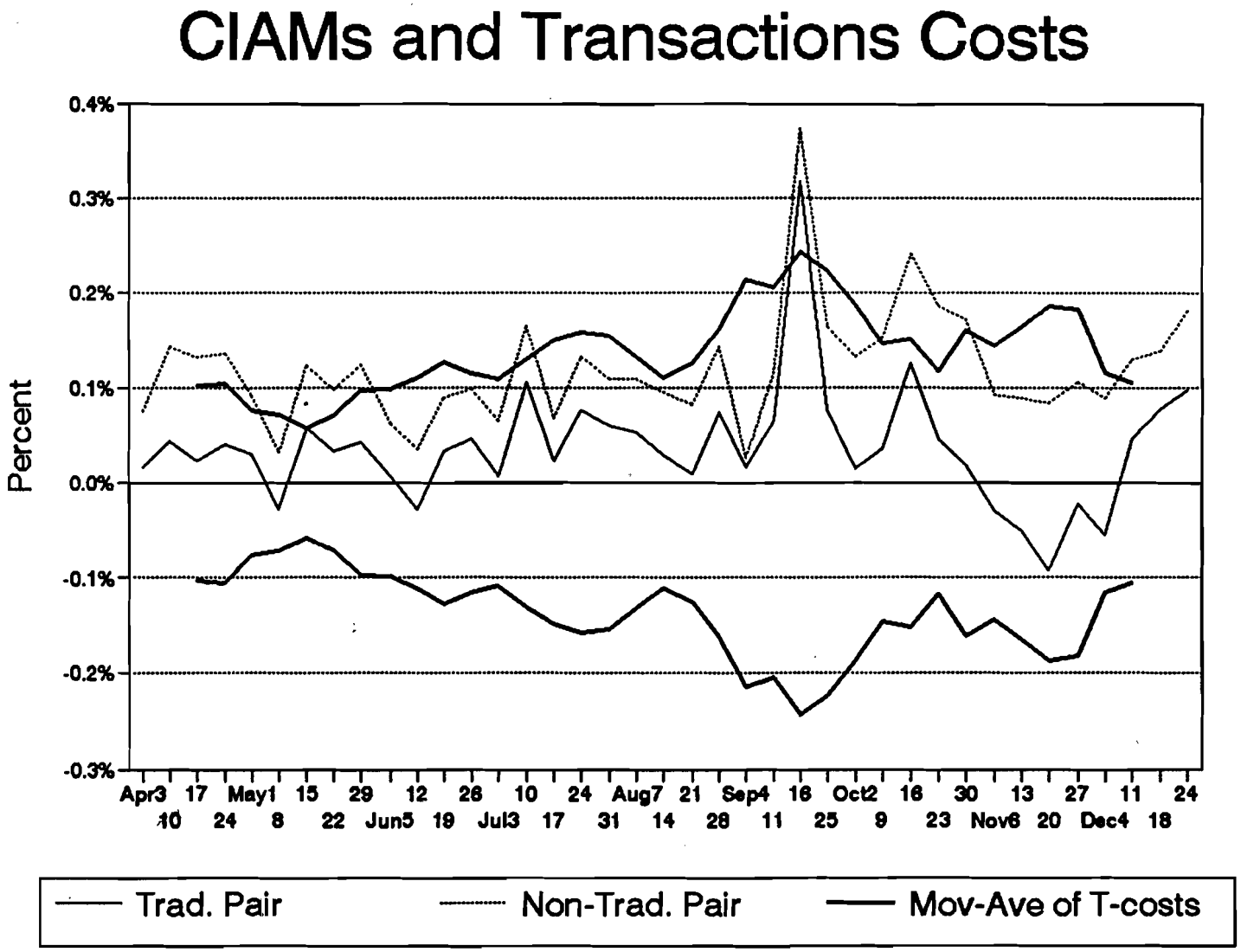
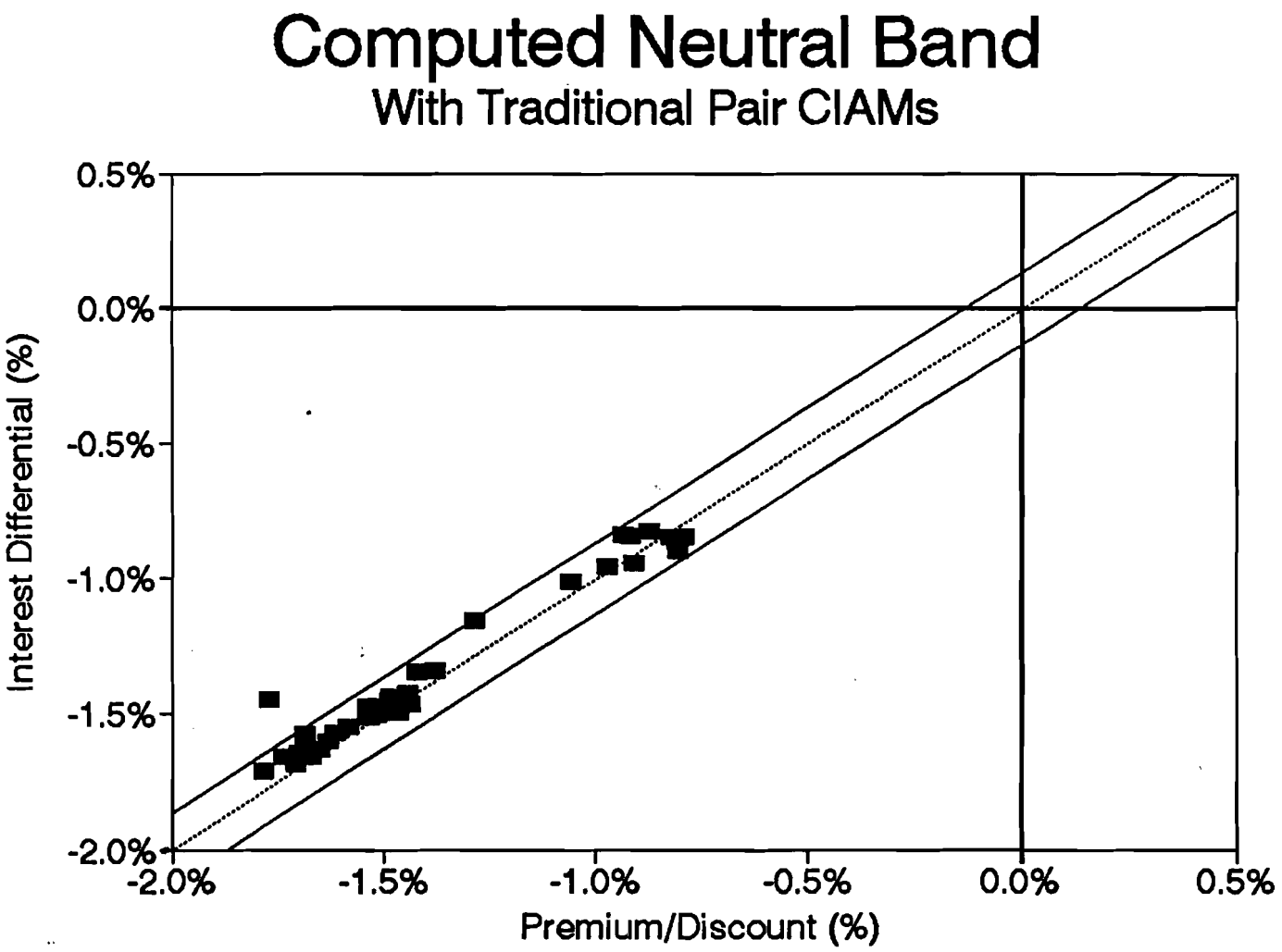

CIAMs and Transactions Costs
Percent
0.4%
0.3%
0.2%
0.1%
0.0%
-0.1%
-0.2%
-0.3%
Apr3 10 17 24 May1 8 15 22 29 Jun5 12 19 26 Jul3 10 17 24 31 Aug7 14 21 28 Sep4 11 16 25 Oct2 9 16 23 30 Nov6 13 20 27 Dec4 11 18 25
Trad. Pair
Non-Trad. Pair
Mov-Ave of T-costs

Figure 5


Computed Neutral Band
With Traditional Pair CIAMs
0.5%
0.0%
-0.5%
-1.0%
-1.5%
-2.0%
Interest Differential (%)
-2.0%
-1.5%
-1.0%
-0.5%
0.0%
0.5%
Premium/Discount (%)

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