PRELIMINARY EVIDENCE ON A NEW MARKET: THE FUTURES ON THE ITALIAN TREASURY BONDS

MARCELLO ESPOSITO
CLAUDIO GIRALDI

INTRODUCTION

The Italian Treasury bond (BTP) is the underlying asset of the Italian Government bond futures contract traded on LIFFE and MATIF. Since its beginning, the BTP futures contract has registered satisfactory volumes in London whereas it has practically stopped being traded in Paris, as is shown in Figures 1 and 2. This article provides some preliminary evidence on the main features of the LIFFE BTP futures contract during its first 6 months of life and a tentative explanation for MATIF failure.

The reader needs first to know some important aspects of the underlying Italian cash market. The domestic Italian Government bond market is the third largest Government bond market in the World after those of the United States and Japan. The secondary market in BTP's is split into three areas: screen-based trading (Telematico), over-the-

The authors wish to thank two anonymous referees for their comments and Angela Ancona for the estimation of the transfer function. They are also indebted to Rony Hamaui, Marco Ratti, Patrick Roger, Agnese Sironi, and the participants to the International Conference of Finance, Paris, June 29–July 1, 1992 for their useful suggestions.

■ *Marcello Esposito and Claudio Giraldi are Economists at Banca Commerciale Italiana, Milano, Italy.*

The Journal of Futures Markets, Vol. 14, No. 2, 121–146 (1994)

CCC 0270-7314/94/020121-26

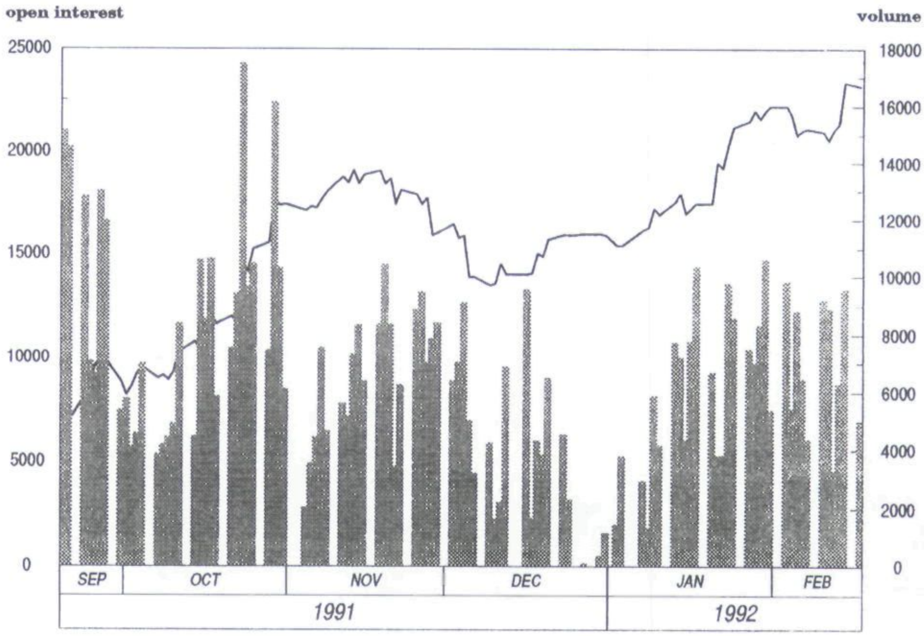

FIGURE 1
Open interest and volume on BTP Contract (LIFFE).

counter trading (telephone), and stock-exchange trading. The bulk of the business is carried out in the former where authorized primary dealers quote BTP's for a minimum amount of Lit. 5 billion (approximately $4 million). The market is very efficient for the deliverable BTP's, with bid/ask spreads in the region of 1–2 basis points and with daily turnover around Lit. 4000 billion (about $3300 million). MATIF and LIFFE decided to launch their BTP futures contracts because the underlying market had reached a good efficiency level and there was an explicit demand from international investors for an adequate hedging instrument for Italian Government debt given the significant price risk displayed by this market.

This article is organized as follows. It first deals with the long-lasting allegation against futures markets, namely that they cause excess volatility in the cash market. After reviewing the main issues concerning volatility in financial markets, a number of tests are used to verify the impact of future trading on BTP spot prices. It then looks at a particular aspect concerning efficiency of the BTP futures market, namely, whether riskless arbitrage produces positive profits. It is often argued that profitable arbitrage opportunities arise in the early months of an infant futures market. A model emphasizes the informational role of futures markets using a mean-variance framework.

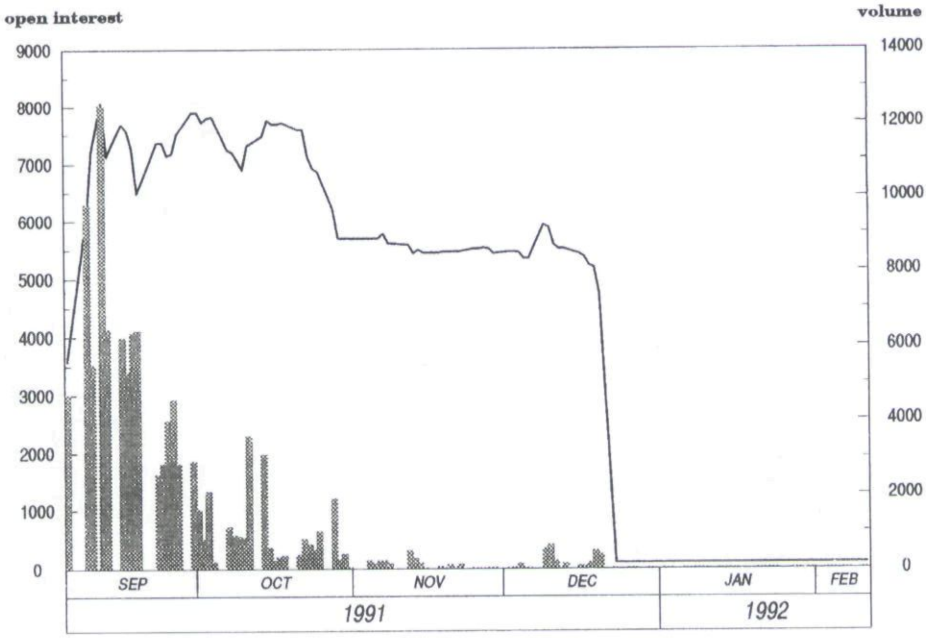

FIGURE 2
Open interest and volume on BTP Contract (MATIF).

THE EFFECTS OF BTP FUTURES TRADING ON THE ITALIAN CASH MARKET VOLATILITY

Is Volatility a Problem?

The issue of price volatility has long been disputed in economic literature. In models studying firms' behavior under uncertainty, price variance usually enters as a negative good in both the utility function and the optimal output level. This stems from the consideration that excess volatility increases the prospects of suffering unforeseen future losses and, through this channel, has an adverse effect on economic activity.

However, in the context of efficient financial markets models, there is no theoretical ground to always consider less volatility preferred to more. On the contrary, in these models more asset price volatility may be justified by the flow of new information. Volatility is undesirable only if it distorts prices and this occurs when it is excessive relative to the random arrival of objective new information [Shiller (1979), (1981)].

Related to this issue is the question of the impact of futures markets on the volatility of the underlying cash markets. The socio-economic function of futures markets—the transfer of risk from more (hedgers) to less (speculators) risk-averse agents—may be undermined if it results in an excessive rise in cash market volatility. This may occur only if speculation is destabilizing. On this issue, the theory is divided and has produced arguments both supporting and rejecting this allegation. A positive role for speculation in futures is advocated by Friedman (1953) who argues that only successful speculators—those who buy when prices are low and sell when they are high—will survive in this market. This result stabilizes futures prices and, through arbitrage, the spot market.

On the other hand, Kaldor (1939) provides an explanation of why speculation in futures markets may be destabilizing. It is possible that a small group of skilled speculators (maybe with superior information or better forecasts) will continuously make money at the expense of unskilled speculators. The skilled speculators will focus on foreseeing the behavior of other speculators rather than focusing on the underlying fundamentals in the market; hence, distorting cash prices.

Friedman and Kaldor reach opposite conclusions because of their different starting assumptions: the former assumes away irrational forecasting behavior and market power, the latter grounds his analysis on them. Recently, the debate still produces conflicting results even though the analysis is based on rational expectations, common knowledge, and no market power. For instance, while Turnovsky (1979) and Turnovsky and Campbell (1985) show that in their rational expectation model, futures markets always improve the stability of the spot market, Kawai (1983) and Newbery (1987) argue that speculation may still be destabilizing even though deceptive and misleading behaviors are ruled out. In conclusion, theoretical models have not yet produced a definitive answer to the question of whether speculation in futures markets is destabilizing and spills over to the cash market.

This theoretical deadlock has led researchers to conclude that the assessment of the impact of futures markets on spot volatility is an empirical question. A substantial amount of empirical research has produced more conclusive evidence. Most studies show that futures trading has no effect or tends to stabilize cash prices, [i.e., Froewiss (1978); Simpson and Ireland (1982, 1985); Bortz (1984); Edwards (1988)]. Those authors focused on the U.S. bond market. The rest of this section explores the question of volatility in the Italian Treasury bond market.

Data and Estimation

The Italian Treasury bond market is an electronic market where primary dealers are required to quote, on a screen-based system, their prices for given, fixed amounts. This market is both liquid and efficient. It is, therefore, interesting to check if the beginning of the BTP futures market on LIFFE[1] biased, through excess volatility, the spot prices; in particular, whether there has been a change in volatility in one of the bonds which were traded on the Telematico before the futures contract was launched and then became deliverable on LIFFE. The deliverable bonds are presently (March 4, 1992) four: the 3/2001, the 6/2001, the 9/2001, and the 1/2002 BTP's. For the latter three, however, there are too few data to warrant a statistically reliable analysis. A first impression on this matter can be derived from a simple inspection of the daily price change of the 3/2001 BTP in the period 3/5/1991–2/17/1992. If anything, the volatility of this bond seems to have decreased after the launch of the LIFFE contract (Fig. 3). However, a more rigorous analysis is needed to determine if there are significant changes in volatility.

The analysis is focused on the BTP 3/2001 (deliverable both on LIFFE and MATIF) but the BTP 3/1996 is used also for purposes that will be explained below. The data, provided by Pitagora data bank, are weighted average daily prices from Telematico (the Italian dealers market) during the period 3/5/1991–2/17/1992. LIFFE started the Italian contract on September 19, 1991.

A number of volatility measures, extensively employed in the literature for this kind of analysis, are used to test if the results are robust and independent from the measure chosen: the absolute daily percent price change $|\ln(P_t/P_{t-1})|$, the absolute daily price change $|(P_t - P_{t-1})|$, and the Parkinson measure, namely $[\ln(H_t) - \ln(L_t)]^2/4 \ln 2$, where H and L indicate the high and low prices, respectively, during the day.

Three methods are employed to check for a change in BTP volatility after the inception of the LIFFE contract. These methods are tested for all the volatility measures presented above and in all cases the null hypothesis is that LIFFE does not exert any influence on cash market volatility. The methodologies used are the following:

Analysis of Volatility Levels

This is a quite simple test aimed at assessing whether the 3/2001 BTP volatility after September 19, 1991, is significantly different from the one

[1]The tests carried out below were also applied to check for the impact of MATIF trading. The analysis produced the same results as in the LIFFE case.

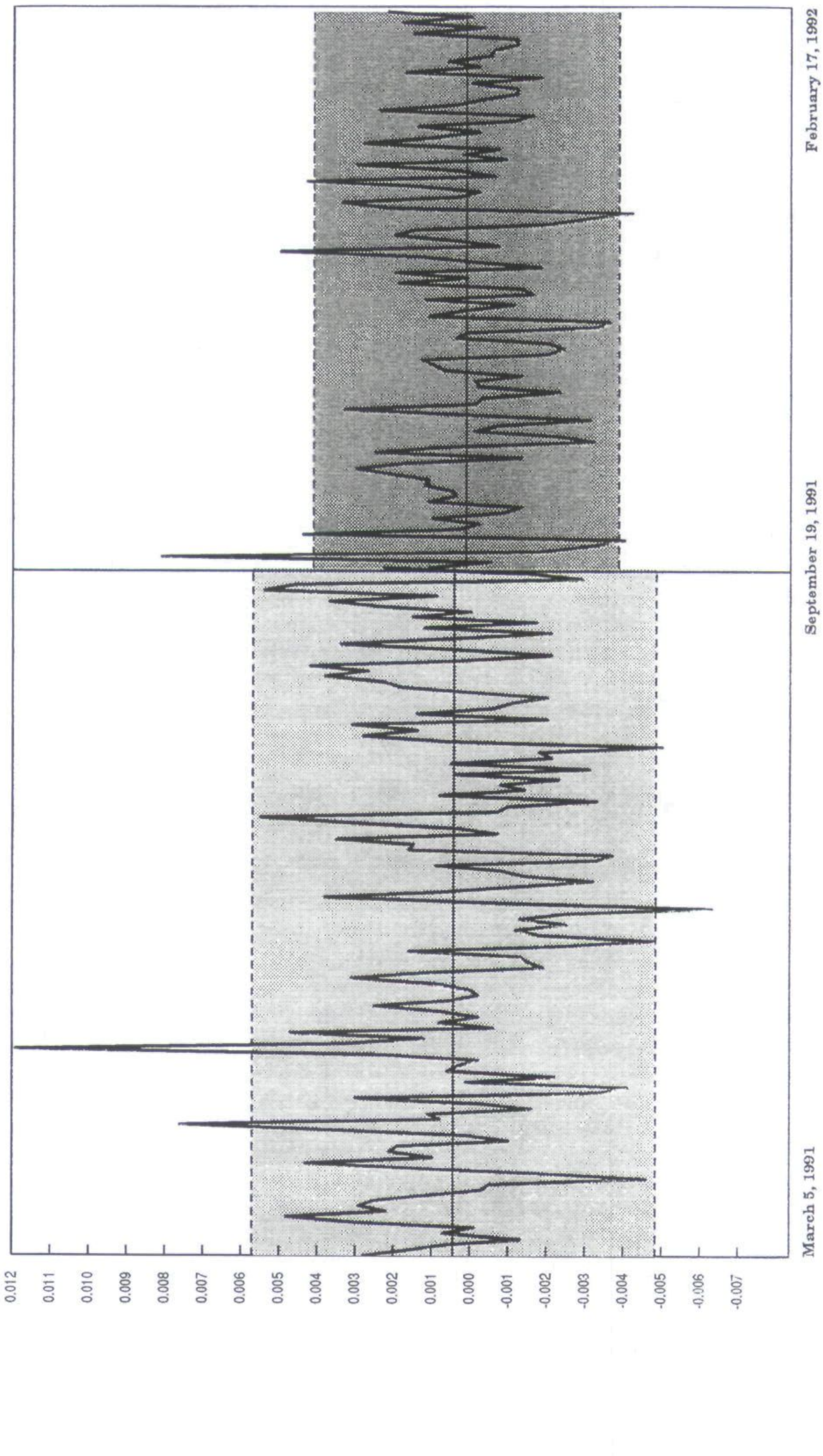

FIGURE 3
Price Percent Changes of the 3/2001 BTP Estimation Period: 3/5/1991–2/17/1992.

before that date. Specifically, the test is used to determine if the volatility means are equal before and after September 19, 1991, according to the usual statistics:

$$t = \frac{(\overline{v}_1 - \overline{v}_2)}{\sqrt{\frac{\sigma_1^2}{N_1} + \frac{\sigma_2^2}{N_2}}}$$

where $\overline{v}$ and σ denote the mean and variance of the 3/2001 BTP volatility; the subscripts 1 and 2 indicate the first and second subsamples. If this t-statistic is larger than the relevant critical level, one can conclude that the volatility has changed after the beginning of BTP futures trading. The t-test is also supplemented by a simple F-test on the ratio of the variances of the daily price changes before and after the introduction of the LIFFE contract.

Dummy Variables

This approach, already followed by Simpson and Ireland (1982, 1985), is designed to detect a change in the dependent variable (the volatility of 3/2001 BTP) due to the beginning of futures trading, holding other factors constant. The regression equations are:

$$v_t^{01} = \alpha + \beta_1 v_t^c + \beta_2 D_{t,1} + \beta_3 D_{t,2} + \varepsilon_t \tag{1}$$

where:

v_t^{01} = the volatility of 3/2001 BTP;
v_t^c = the control variable;
$D_{t,1} = 0$ if $t < T$ and 1 if $t > T$;
$D_{t,2} = 0$ if $t < T$ and v_t^c if $t > T$;
T = the day trading in the BTP futures contract began on LIFFE, i.e., September 19, 1991.

The control variable is included as a regressor to control for economic factors that might affect underlying cash market volatility. Initially the volatility of the 3/1996 BTP was chosen as the control variable, even though there were other candidates, namely, the 3/1998 BTP or supranational Eurolira bonds. However both these types of securities have problems because the former is deliverable on MATIF and the market of the latter is relatively illiquid compared to that of Treasury bonds. In any case, even the choice of the 3/1996 BTP may not be accurate if the control variable is itself correlated with the dummy variable. By running regressions of the volatilities of the 3/1996 BTP on the dummy $D_{t,1}$ it turns out that the volatility of the 3/1996 fell significantly after the introduction of the BTP *futures* contract on LIFFE.[2] Therefore, in the dummy variable analysis of the 3/2001 BTP volatility, the residuals of the regression of the volatility of the 3/1996 on $D_{t,1}$ are used as the control variable.

The dummy variables are used to test the null hypotheses that the BTP cash market volatility did not change as a consequence of LIFFE trading. The first dummy variable is a direct test of the LIFFE impact on the level of BTP volatility. The null hypothesis is $\beta_1 = 0$. To test whether a significant change in the relative volatility of the 3/2001 BTP with respect to the control variable has occurred after LIFFE inception, the second dummy variable is included. The null hypothesis $\beta_2 = 0$ applies. The results of the dummy variable analysis are verified by running a general test (Chow test) on the parameter stability before and after the launch of BTP futures.

Intervention Analysis

This methodology, first applied by Box and Tiao (1975) to environmental and economic problems, involves the estimation of a transfer function model (with the 3/2001 BTP volatility considered the output series and the control instrument, which is the same as in the dummy variable analysis, regarded as the input series) with an intervention variable (in this case the beginning of the BTP futures contract). Generally speaking, intervention analysis can be viewed as an attempt to eliminate spurious effects, deriving from time dependency, in the data so that a precise role can be assigned to the selected explanatory variables. In this sense, if problems from time-dependency exist, intervention analysis may improve on traditional regression methods. Refer to Box and Tiao (1975) and Wei (1990) for a thorough description of intervention analysis. Only the full model, consisting of the transfer function and the intervention term:

$$v_t^{01} = \alpha + \omega^*(B)D_{t,1} + \frac{\omega_0 - \sum\limits_{i=1}^{N} \omega_i B^i}{1 - \sum\limits_{j=1}^{M} \delta_j B^j} v_{t-b}^c + \frac{\theta(B)}{\phi(B)(1-B)^d} a_t \quad (2)$$

are reported here, where:

[2]In particular, the coefficients of the regressions of the different volatility measures on the dummy $D_{t,1}$ are all negative and statistically significant except for the one concerning the Parkinson's measure which is not significant.

ω^* = the intervention parameter associated to the beginning of BTP futures trading;
B = the backshift operator;
ω and δ = input and output model parameters, respectively;
b = the lag time before vol_t^c has an effect on the dependent variable;
N, M = the order of the polynomials;
$\theta(B)$ = the moving average portion of the noise process;
$\phi(B)$ = the autoregressive portion of the noise process;
a_t = a process $\sim N(0, \sigma_a^2)$.

Under the null hypothesis, the intervention parameter ω^* is expected to be equal to zero. This would imply an absence of a significative effect of BTP futures trading on the cash market.

Empirical Results

The results suggest that the beginning of BTP futures trading reduced the volatility of the underlying BTP market, as shown by Tables I–III. In Table I, this result is confirmed by the t-statistics and the F-test on the variance ratios: both exceed their critical levels. The Wilcoxon test, which is distribution-free also shows a reduction in the volatility of the underlying market. However this decline does not turn out to be significant.

TABLE I

Analysis of Volatility − Variables = Volatilities of 3/2001 BTP

	Variables			
Statisticss	$P_t - P_{t-1}$	$\lvert P_t - P_{t-1}\rvert$	$\lvert\ln(P_t/P_{t-1})\rvert$	Parkinson's Measure[a]
Mean: period 3/5/91–9/18/91	—	0.20	0.20	0.40
Mean: period 9/19/91–2/17/92	—	0.15	0.15	0.17
t-statistics	—	2.62[c]	2.83[c]	5.04[c]
Wilcoxon test[b]	—	−1.14	−1.18	−0.78
F-statistics	1.66[c]	—	—	—
Number of observations in the first period	134	134	134	132
Number of observations in the second period	102	102	102	102

[a]The means of the Parkinson's measure are multiplied by 100,000.
[b]For the Wilcoxon test, the asymptotic distribution was used.
[c]Significant at the 5% level.

In Table II, the constant dummy variable coefficients are negative and significantly different from zero at the 5% level implying that the volatility level in the underlying market declined during the estimation period. Moreover, the Chow test also shows that there has been a break in the regression after trading began in BTP futures. It is worth noting that these results are the same regardless of the volatility measure chosen.

As in the case of Table I, the dummy variables analysis is supplemented with a regression model in which the variables are rank transformed. The results, not reported here,[3] are in line with those of Table II in that the coefficients of the constant dummy variables are negative and significant.

Also the intervention analysis shows that spot price volatility decreased as a consequence of the beginning of BTP futures trading, as it is implied by the negative and significant intervention variable, i.e., $\omega^* < 0$. These results are consistent with those of Tables I and II. The summary statistics are good, implying that the chosen

TABLE II

Dummy Variable Analysis − Dependent Variable = Volatility of 3/2001 BTP Estimation Period 3/5/1991–2/17/1992

Explanatory Variables and Regression Statistics	*Different Measures of Volatility* $\|P_t - P_{t-1}\|$	$\|\ln(P_t/P_{t-1})\|$	Parkinson's Measure[a]
Constant	0.20^b	0.20^b	0.40^b
	(0.01)	(0.01)	(0.04)
Control variable (v_t^c)	1.11^b	1.12^b	−68
	(0.07)	(0.07)	(138)
Constant dummy variable ($D_{t,1}$)	-0.05^b	-0.05^b	-0.24^b
	(0.01)	(0.01)	(0.07)
Slope dummy variable ($D_{t,2}$)	0.19	0.18	152920^b
	(0.15)	(0.14)	(60110)
R^2	0.60	0.60	0.07
SE of regression	0.10	0.10	—
Durbin–Watson	1.89	1.9	1.98
Chow test F value	8.77^b	10.00^b	14.84^b
Number of observations	236	236	233

[a]In the Parkinson's equation, estimates are obtained after correcting for serial correlation. The regression coefficients are multiplied by 100,000.
[b]Significant at the 5% level.

[3]Estimates are available from the authors.

TABLE III
Intervention Analysis Output Series = Volatility of 3/2001 BTP[a]

	Time Series Results and Statistics		
Volatility Measures		*Ljung–Box Q*	*Standard Error*
$\lvert P_t - P_{t-1} \rvert$	$\mathrm{vol}_t^{01} = 0.20^{c} - 0.013^{c} D_{t,1} + \frac{1.18^{c}}{(1 + 0.11^{c}B)} \mathrm{vol}_t^{c} + a_t$	25.7^{b} (24 d.f.)	0.10
$\lvert \ln(P_t/P_{t-1}) \rvert$	$\mathrm{vol}_t^{01} = 0.002^{c} - 0.001^{c} D_{t,1} + \frac{1.19^{c}}{(1 + 0.11^{c}B)} \mathrm{vol}_t^{c} + a_t$	25.6^{b} (24 d.f.)	0.001
Parkinson's measure	$\mathrm{vol}_t^{01} = 0.000004^{c} - 0.000002^{c} D_{t,1} + \frac{-0.001^{d}}{(1 - 1.0002^{c}B)} \mathrm{vol}_t^{c} + (1 + 0.27^{c}B)a_t$	5.0 (23 d.f.)	0.000003

[a]Estimation period 3/5/1991–2/17/1992.
[b]χ^2 statistics with 24 degrees of freedom at the 95% level of significance = 36.42.
[c]Significant at the 5% level.
[d]Significant at the 10% level.

specification is adequate: almost all the variables are significant at the 5% level and the Ljung-Box Q suggests that the series were reduced to white noise in all cases.

THE ARBITRAGE PRINCIPLE IN THE BTP FUTURES MARKET

This section investigates whether there existed, in the period 9/19/91–2/17/92, an equilibrium between BTP futures and cash prices. This equilibrium is based on the arbitrage principle according to which there cannot be riskless profits in an efficient market. This proposition is tested by comparing the actual futures price and the so-called "fair" futures price.[4] The difference between the fair and the market futures prices is called value basis which is a measure extensively used by investors to evaluate the opportunity to carry out arbitrage between cash and futures. In traders' jargon, arbitrage opportunities can be exploited by two strategies, cash & carry and reverse cash & carry. The former consists in taking a short position of one futures contract and buying the underlying asset. The reverse cash & carry is the opposite strategy, whereby the trader takes a short position of one underlying asset and buys the

[4]The fair futures price of a futures contract is the equilibrium price in an efficient market. For a more complete discussion, see Duffie (1989).

corresponding futures. If the actual futures price is different from the price resulting from any of the above strategies, there is room for riskless arbitrage.

The main problem with the use of the fair futures price is due to its "uniqueness". In fact, as it is well known, the fair futures price is not unique, because it lies in an interval whose bounds are given by transaction costs. However, in addition to transaction costs, there are other factors—such as fiscal distortions, market imperfections, and embedded options—that create a fluctuation interval for the fair futures price. As to tax distortions, some variables which enter the calculations (for example, the borrowing rate, the remuneration on margins, commissions) are not the same for everyone and investors could face a different fiscal treatment of either the income from derivatives or the income from the underlying cash instrument. With regard to market imperfections, the reverse cash & carry arbitrage is not always feasible; and, in any case, is, in general, more expensive than the simple cash & carry. Finally, the textbook fair futures price does not take into account the so-called embedded options in the futures price, namely, the quality and the timing option. Indeed, these options, though important in more mature markets, do not really influence prices in the still young BTP futures market.[5]

Among all the factors mentioned above, fiscal distortions concerning the taxation of income from Treasury securities are the most important ones in hampering the uniqueness of the fair future price of the BTP contract. In the Italian system there is a withholding tax of 12.5% on income from BTP's, but institutional investors (e.g., banks) or nonresidents[6] receive a "fiscal" credit proportional to the holding period. The value of that credit depends on the final fiscal position of the investor and on the timing of the reimbursement. The major source of discrimination is the different reimbursement delay between resident and nonresident investors:[7] in fact, whereas the latter receive a quick

[5]The timing option is nonexistent in the BTP futures traded at LIFFE because the seller must deliver the underlying asset on the tenth calendar day of the delivery month. Even the quality option, which is important in all the futures markets, is less so with regard to the BTP contract due to the still small number of deliverable bonds at the time of estimation. At the first delivery date (December, 91), the three deliverable BTPs had almost the same duration and were delivered in very similar percentages: 24.2% BTP 03/2001, 29.8% BTP 06/2001, 46% BTP 09/2001, whereas, as the LIFFE wrote, "normally one would expect to see deliveries concentrated in a single issue".

[6]Only those nonresidents whose country has signed a double taxation agreement with Italy may recoup the 12.5% withholding tax.

[7]The tax credit is remunerated at a lower rate than the market interest rate. For more details, see Capra-Esposito (1992).

refund, Italian banks have to wait a long time before recouping the tax credit.[8]

Given this particular taxation regime, the different fiscal treatment enters the calculations of the fair futures price through the cost of carry. One would then expect some investors, i.e., the nonresidents, to receive the gross yield (they then have a reduced cost of carry); whereas, some other investors, i.e., the residents, the net yield. Those two extreme bounds determine an "arbitrage" tunnel. The tunnel bounds will, in turn, have the usual upper and lower limits given by transaction costs.

The arbitrage tunnel is illustrated in Figure 4. The daily series for the net and the gross fair futures prices are provided by LIFFE, and they are particularly accurate because all prices are taken at the same time, 3:30 PM GMT (i.e., the Italian Telematic close). The upper bound is constituted by the fair futures price calculated on the assumption of a zero tax credit; whereas, the lower bound is based on the hypothesis that the tax credit is recouped after 6 months. It is assumed that the financing of the cash & carry is obtained at the Euro deposit rates. The size of the tunnel is obviously an increasing function of the time to

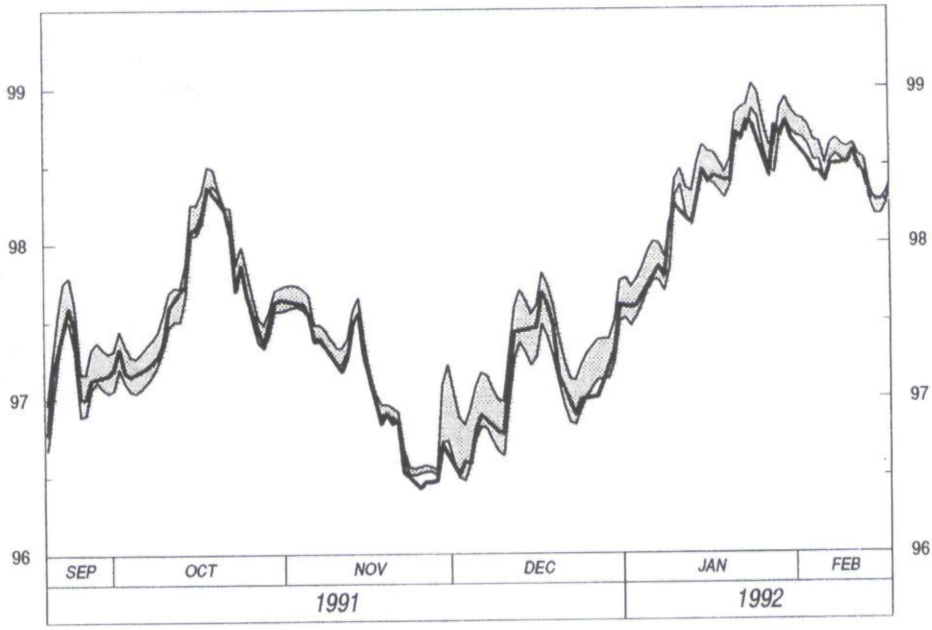

FIGURE 4
Fiscal Tunnel for cash & carry arbitrage.

[8]As it will be discussed later, the recent reform of the tax treatment of the interbank deposits will reduce the time of the reimbursement for Italian banks.

TABLE IV
Summary Statistics on the Fiscal Tunnel

	Breaks of the Upper Bound	Breaks of the Lower Bound
Percentage of breaks	3.9%[a]	25.4%
Max	14[b]	11[b]
Min	1[b]	1[b]
Mean	5.75[b,c]	5.2[b,c]
Median	4[b]	4.5[b]

[a]75% of the breaks of the upper bound occurred when the CTD changed.
[b]Data in basis points.
[c]Estimated transaction costs approximately equal to 3.5 b.p.

maturity, since the tax credit is proportional to the holding period of the underlying cash bonds. As can be seen, most of the times, it is the inferior bound which is broken. This means that, theoretically, there would have been room for reverse cash & carry also by nonresident arbitrageurs. Also, the upper bound is broken, which is, potentially, much more troubling because it means that for every class of investors a simple cash & carry arbitrage would have been feasible. Fortunately, this fact happened only four times, as reported in the summary statistics presented in Table IV. These results show that the size of the (upper and lower) breaks is not large, just 5 basis points (b.p.) most of the times, a level hardly exceeding the estimated transaction costs (3.7 b.p.) for a cash & carry arbitrage in the Italian market.[9]

Even though the breaks reported are not sizeable, one should be concerned about the position of the price inside the tunnel. It is clear that if the resources available to the arbitrageurs is unlimited and at zero cost, the position of the price inside that tunnel would be undetermined and one would discover what economists call a "money pump". However, the constraints imposed by capital ratios, the limits on credit lines, and the nonzero costs involved in arbitrage operations make the price position depend on the resources available to the different classes of arbitrageurs. Therefore, the position inside the tunnel may be regarded as a signal of the relative strength of the different classes of investors.

This question can be addressed by considering the value basis, which is equal to (minus) the profit of a cash & carry or of a reverse cash & carry transaction, and then is a simple function of the distance between the fair and the actual futures price. Given the particular

[9]See Esposito and Giraldi (1993).

Italian taxation system, even the value basis is not unique: the reference point for foreign investors is the "gross" value basis (who receive the gross yield from Treasury securities); whereas, it is the "net" basis for resident agents (who receive the net yield from Treasury securities). If the market for BTP futures is mainly populated by foreign investors, one would then expect the net value basis to show substantial reverse cash & carry opportunities and the gross value basis to be, on average, equal to the transaction costs. Evidence of this proposition is presented in Figures 5 and 6 which depict histograms of both the net and gross value bases.

As to the net value basis, there are sizeable reverse cash & carry opportunities in the period considered. This is not the case for the gross value basis that shows mostly unexploited cash & carry opportunities, even though the latter are not as big as the previous ones. In any case, the futures price is closer to the "gross" than to the "net" bound of the tunnel. However, it is surprising that for long periods of time (December, 1991–January, 1992) simple cash & carry opportunities are unexploited. This may be caused by both the presence of Italian investors and the existence of capital ratio and credit lines constraints for foreign financial intermediaries which allows foreign investors to finance only a limited

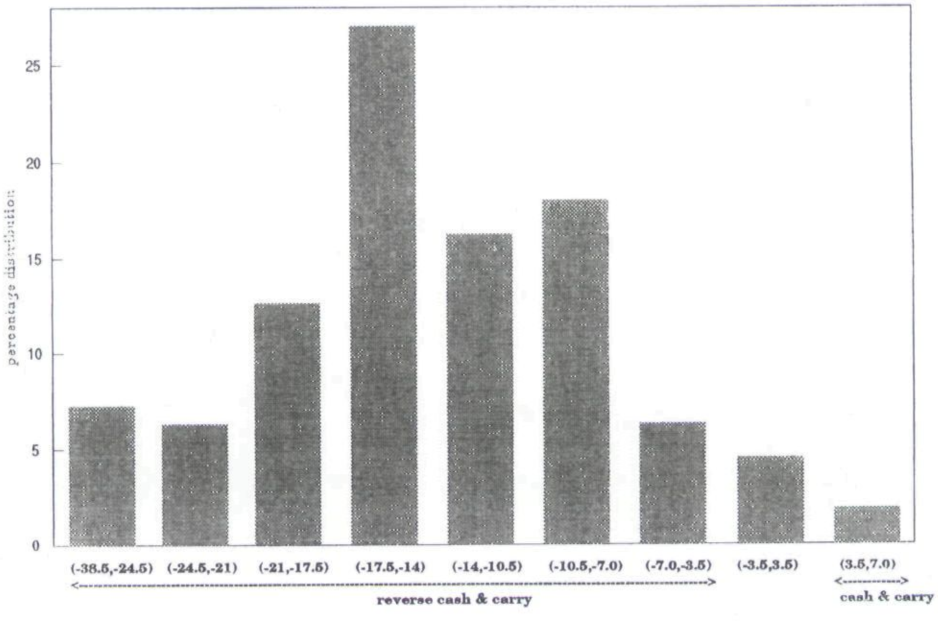

FIGURE 5

Percentage distribution of the intervals of the net value basis. The basis is measured in basis point. With respect to its traditional definition, it has been changed of sign. The value intervals are multiple of the transaction costs (approximately 3.5 b.p.).

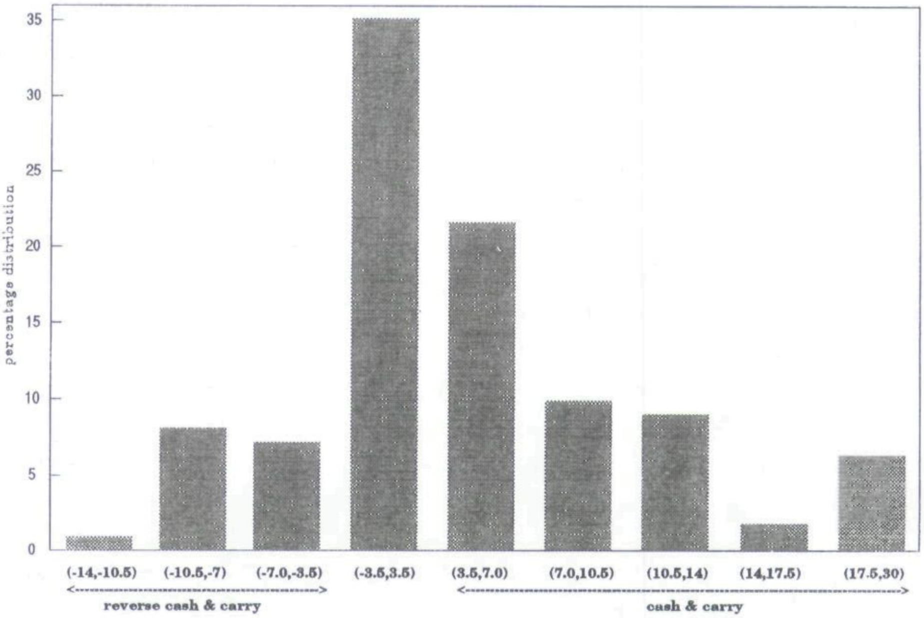

FIGURE 6

Percentage distribution of the intervals of the gross value basis. The basis is measured in basis point. With respect to its traditional definition, it has been changed of sign. The value intervals are multiple of the transaction costs (approximately 3.5 b.p.).

amount of Italian Treasury bonds. Hence, trading in the cash market originating from arbitrage transactions may not have been enough to squeeze the gross value basis.

However, this situation is likely to change after the recent reform of the taxation of income from Italian interbank deposit.[10] In the new regime, the total amount of the tax credit due to Italian banks will probably vanish and the withholding tax on Government bonds will be simply deducted by the banks' tax statements.[11] Since the gross value basis will then become the reference point for all the institutional investors (regardless of their nationality), the futures price will randomly float close to the "gross" bound thus eliminating the sizeable cash & carry opportunities seen in the previous period.[12]

[10] The withholding tax on interbank deposits was abolished at the beginning of February, 1992.

[11] This way, the maximum delay to recoup the tax on Treasury bonds will be about 17 months and Italian intermediaries will receive something very close to the gross return from Treasury bonds.

[12] There is already some preliminary evidence that the gross value basis is becoming the reference point for the majority of the arbitrageurs. In fact, while the gross basis has halved since February (from an absolute average of 7.5 basis points between December, 1991, and the end of February, 1992, to 3.7 between March and the end of May, 1992), the net basis has increased (from 14.8 to 18.7 basis points). The fact that the market price is floating around the gross fair futures price is an indication that in the same subperiods most market participants are considering the gross BTP yield as their reference rate.

VOLUMES OF ACTIVITY ON THE FUTURES AND CASH MARKETS

This section seeks to shed some light on how information flows between the cash and the futures markets and to determine the relative importance of international and domestic news in this process. This question is important in the context of the European Monetary System because the domestic financial markets are no longer isolated but are highly interdependent. Since the leading role in this integration process is played by Germany, BUND futures are included in the analysis.

The task of studying the way information spreads in the markets is difficult because agents' reactions to news arrivals are not directly observable. This problem is surmounted by using the dynamics of trading volumes in the markets considered as a proxy of the way information flows [Copeland (1976)]. What generates trading volume? Economic theory suggests that agents trade if some degree of heterogeneity among them is allowed. The heterogeneity can be attained by either preferences (for example, the coefficient of risk-aversion) or by the way information arrives at the market and is processed. In any case, one or both factors needs to be introduced to create enough differentiation in agents' demands. To see how this applies to the case of futures markets, this study derives the demand for futures of an investor who has a portfolio with two cash instruments (for instance, Italian and German long-term Government bonds) and who wishes to use the two available derivative instruments (BTP and BUND futures) to improve welfare. The derivation appears in the appendix.

Assuming mean-variance preferences, such an investor's demand for futures can be decomposed into a speculative and a hedging component: the former depends on the expected values of the futures prices (both domestic and foreign); whereas, the hedging demand is a function of the covariances between cash and futures prices. Therefore, the first important result is that, in addition to the obvious relationship between the cash and futures of a given asset, the speculative demand for one of the two futures will be affected by news[13] regarding the other futures. The influence will be both direct, because of a substitution effect, and indirect, through what it is revealed about the common fundamentals. The model also suggests another important fact, namely, that if one considers a very short time horizon (as in the empirical analysis below), it is plausible to assume that the major source of change in the demand

[13]The news can be seen as the innovations in the MA representation of the VAR system which describes the data generating process of the variables.

for futures will be originated by the "speculative" demand. In other words, it is likely that the news impinging on the market affects the expected values of the variables more than the covariance between them. This is consistent with some recent contributions [Grossman (1976)] advocating an informational role for the futures market.

Given the model results, one would expect to observe interesting relationships among trading volumes across the markets studied here, namely, the BTP cash and futures and the BUND futures. The correlation between the trading volumes on BTP cash and futures markets are examined first using the volume on the BUND futures as a control variable. According to the results of the univariate regression below,[14] the correlation between the Italian cash and futures instruments is quite high and statistically different from zero (the coefficients' standard errors are in brackets), but it is smaller than the correlation existing between the BTP futures and the BUND futures:

$$\ln(V_t^{fut}) = \underset{(2.15)}{-5.62} + \underset{(0.11)}{0.36} \ln(V_{t-1}^{fut}) + \underset{(0.18)}{0.49} \ln(V_t^{btp}) +$$

$$+ \underset{(0.19)}{0.15} \ln(V_{t-1}^{btp}) + \underset{(0.11)}{0.53} \ln(V_t^{\text{bund}}) - \underset{(0.12)}{0.04} \ln(V_{t-1}^{\text{bund}})$$

$$R^2 = 0.56 \; h\text{-Durbin} = 0.08 \tag{3}$$

These results are quite surprising because one would have expected the correlation between the BTP futures and cash volumes to be far greater than the one between the volumes of the two futures. To evaluate whether the results are robust, a VAR model is estimated where the three variables of interest are modeled according to the following specification:

$$V_t = \sum_{i=1}^{p} A_i V_{t-i} + u_t \tag{4}$$

The stationarity of the variables is checked by performing a Phillips–Perron test and calculating the rank of the cointegration matrix. Both tests indicate that the variables are stationary.[15]

The different criteria[16] used to identify the order of the VAR gives the same result, namely $p = 1$. Therefore, a VAR (1) is estimated next. Since the coefficients of the VAR per se do not have a clear interpreta-

[14] The variables are corrected for maturity and weekend effects. Note, also, that in the following regression and in the VAR, the natural logarithm of the volumes is used to avoid problems arising from the different measurement units. The estimation period runs from September 19, 1991, to February 17, 1992.

[15] The results are available on request to the authors.

[16] Akaike (1974), Hannan and Quinn (1979), Schwarz (1978).

tion, the system is transformed to a more interpretable specification by using the Wold decomposition in the MA form:[17]

$$V_t = \sum_{i=0}^{\infty} \Phi_i u_{t-i}$$

where

$$\Phi_0 = I_3 \ \Phi_i = \sum_{j=1}^{i} \Phi_{i-j} A_j \qquad (5)$$

where I_3 is the identity matrix of dimension 3. The interesting point to note in that decomposition is that the elements $\phi_{i,j}$ of the Φ_k matrix can be interpreted as the responses of the ith variable to news in the jth variable, k periods ago.[18]

If the innovations in the variables are cross-correlated, the residuals matrix can be diagonalized through, for example, a Cholesky decomposition so that the transformed residuals correspond to isolated shocks to the single variables [Sims (1981)]. In that case, the size of the "impulses" are normalized to one standard deviation.

The results are depicted in Figures 7–9. The link between the trading activity in the two futures markets seems to be at least as strong as the link between the BTP cash and its futures and this confirms the results obtained in the simple univariate regressions. This is interesting because, unlike previous literature which has only focused on the relationship between the cash and its derivatives instrument [Copeland (1976)], a significant correlation is found between two derivative markets. As discussed in the next section, this extension is useful in understanding the comparative advantage that LIFFE enjoys relative to other less international futures exchanges. In fact, since the kind of correlation found here seems to be strong also for other futures contracts traded on LIFFE [Esposito and Giraldi (1993)], it is likely that an international investor who seeks to exploit European yield curve changes (spread trading) would prefer to operate in the London exchange where several European long-term futures contracts are traded. The results of this study differ from those obtained by Anthony (1988). Causality tests (not reported here) on the coefficients of the MA representation (following Sims (1981) and Lutkepohl (1990)) show the absence of a simple lead–lag relationship of causality in favor of a more complex interaction.

[17] See Lutkepohl (1990).

[18] Not surprisingly the coefficients of the impulse-response function (IRF) can be used for causality analysis.

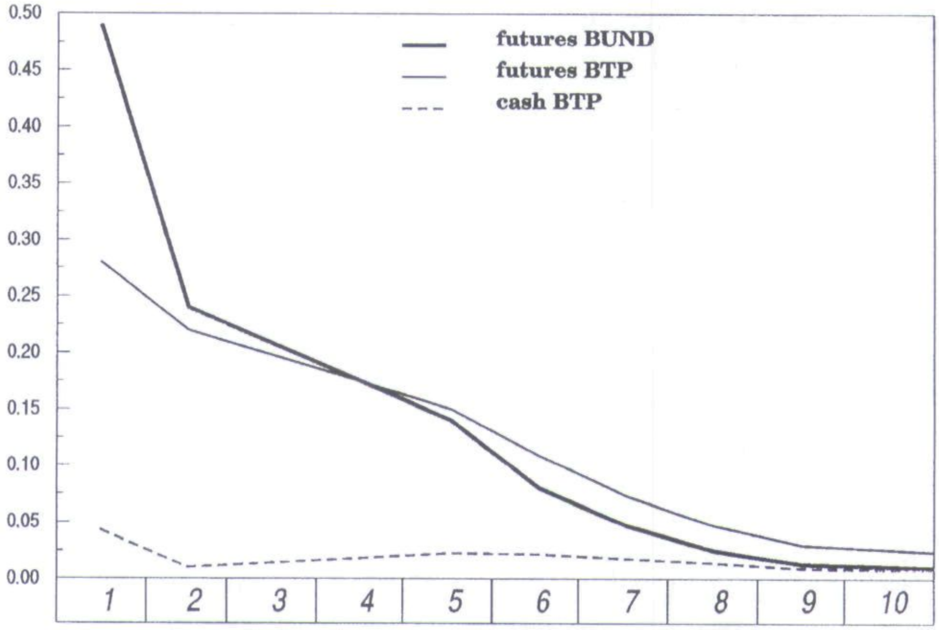

FIGURE 7
Responses to an impulse in Bund futures.

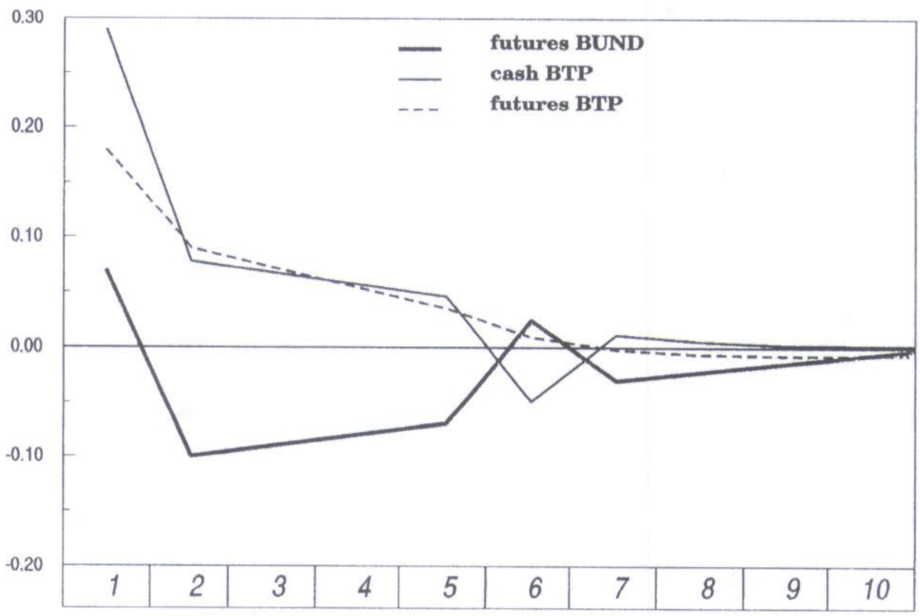

FIGURE 8
Responses to an impulse in BTP cash.

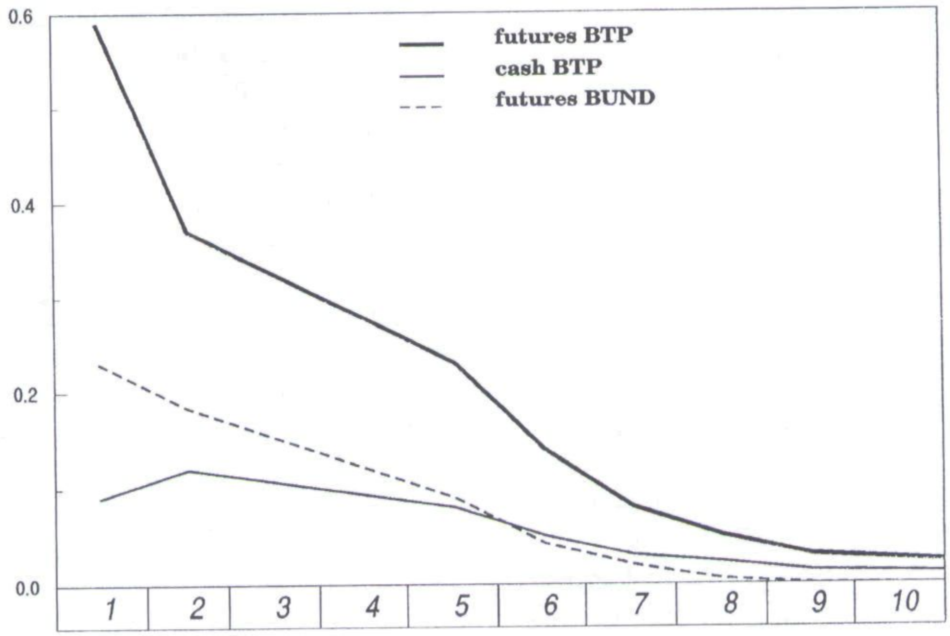

FIGURE 9
Responses to an impulse in BTP Futures.

A POSSIBLE EXPLANATION OF THE FAILURE OF THE BTP FUTURES CONTRACT ON MATIF

This section seeks to explain the success of the BTP futures on LIFFE and the failure of the analogous contract on MATIF. In addition to the traditional factors considered by the literature to explain the success or failure of a futures contract, the importance of trading on an informationally efficient marketplace is stressed. This feature is crucial to attract speculative demand which plays an important role in those futures markets, such as the BTP, where hedging demand is not strong enough to generate sufficient levels of liquidity. In fact, this study finds that the speculative demand for the BTP contract is greater than the hedging demand over the estimation period.

These arguments can be better qualified through the following example—which is consistent with the results obtained in the previous section—of the way in which shocks may be transmitted from one market to the other. In general, traders in a particular cash market may have privileged access to news generated in their own country and can use this information by taking the appropriate position in the corresponding futures contract. With this action, the information is revealed to their counterparts in the pit. In turn, the counterparts have the chance of covering the loss deriving from this transaction by taking the appropriate position in other futures traded in the near pits or directly in the cash markets. This is the way information quickly spills over to all the other futures markets. Moreover, if cash markets traders do not have direct access to the other cash markets, the information will flow from one cash market to the other through the futures market in London.

Therefore, trading interest rate futures contracts denominated in different currencies gives to LIFFE a special role in processing information concerning the underlying term structures. This represents a formidable advantage for certain kinds of trading strategies (*spread trading*).

These considerations point to a possible explanation of the failure of the BTP futures contract on MATIF. The global trading strategies of the international investors can be better implemented on markets that guarantee an efficient processing of all the relevant information at low transaction costs. The concentration of different futures markets in a single place represents the optimal solution to that problem: the efficiency of information processing is improved and the general transaction costs regarding spread trading are significantly reduced. LIFFE, with its large number of contracts traded, has guaranteed these conditions better than MATIF, which is more domestic oriented.

CONCLUSION

The objective of this article is to provide preliminary evidence on the basic features of the LIFFE futures contract on Italian Government bonds during its first 6 months. The article seeks to determine whether there is a change in BTP spot price volatility due to the beginning of the Treasury bond futures contract. Evidence suggests that futures trading reduced cash price volatility. This suggests that, during the estimation period, there were no signs of destabilizing speculation in the BTP futures market.

The efficiency of the BTP futures market is explained by analyzing arbitrage opportunities between the cash and the derivative markets. It is found that, due to fiscal distortions in the treatment of income from Treasury bonds, the equilibrium price is not unique, but there is a set of equilibrium quotations defining an arbitrage tunnel. Secondly, even though there are a few breaks of the tunnel, the small size of them does not indicate strong violations of the arbitrage principle.

Thirdly, the above fiscal distortions dictate a closer look at the arbitrage opportunities inside the tunnel. This part of the analysis reveals that profitable cash & carry opportunities are available to foreign agents for long periods of time. This seems to suggest the existence of obstacles to the implementation of that strategy, probably due to quantitative restrictions on its financing. Finally, the fact that the actual futures price is closer to the gross than to the net fair futures price, implies that the bulk of market activity is originated by nonresident agents who are (almost) tax-free yield receivers.

The study then considers how information flows across the BTP cash, its futures, and other futures markets. The demand is derived for BTP futures in a multivariate mean-variance framework by decomposing the trading into a speculative and a hedging component. In the two-by-two model (where the BTP and Bund cash and futures instruments are considered) the speculative demand depends on expectations on BTP and Bund futures prices; whereas, hedging demand is a function of the correlation among all the prices. The speculative demand is assumed to be the most important in the dynamics of the trading volumes at the high frequency examined. Within this framework, the relationship existing between the trading activity on the cash BTP market and the BTP futures is estimated using as a control variable the trading activity on the BUND futures markets. Quite surprisingly, integration is found between the two futures markets at least as strong as the one between the futures and its cash market. This implies that speculators, in addition to being the dominant sector of the BTP futures markets, may be using the revealed information to design global trading strategies.

Finally, some reasons are given for the success of the BTP futures on LIFFE and the failure of the analogous contract on MATIF. It is found that the demand for this product is dominated by Italian investors who are predominantly motivated by speculative purposes and that LIFFE offers a better informational environment for an investor speculating across European term structures.

A word of warning is in order. These results are based on data collected over a very short period of time. Therefore, even though interesting findings about the functioning of a new market during its first months of life are provided, it may be useful to revisit this topic in the future.

APPENDIX

This appendix derives the demand of an investor whose portfolio is made of two cash instruments and wants to use the two available futures contracts to improve his welfare. Assuming mean-variance preferences and denoting by q and S the vectors of the quantities and the prices of his cash endowments, his demand for the futures contracts, h, is given by:

$$\max_{\{h\}} E_t(U_r) = q'E_t(\Delta S) + h'E_t(\Delta f) - \frac{\rho}{2}(q'\Sigma_S q + h'\Sigma_f h + 2h'\Sigma_{(f,S)}q) \tag{A1}$$

where f denotes the futures prices vectors, ρ the coefficient of risk aversion, and Σ the covariance matrix of the variables "subscripted". The symbols Δ and E denote the first difference of the variable and its expectation, respectively. The first-order condition with respect to h is given by:

$$\nabla_h E_t(U_T) = E_t(\Delta f) - \rho(\Sigma_f h + \Sigma_{(f,S)}q) = 0 \tag{A2}$$

Solving with respect to h, one obtains:

$$h^* = \frac{1}{\rho}\Omega_f E_t(\Delta f) - \Omega_f \Sigma_{(f,S)}q$$

where

$$\Omega_f = \Sigma_f^{-1} \tag{A3}$$

If one focuses on the case of just two cash and futures contracts (the subscripts 1 and 2 may indicate, for instance, the BTP and BUND, respectively), it is found that the demand for the BTP futures is equal to:

$$h_1 = \frac{1}{\rho}(\omega_{1,1}E_t(\Delta f_1) + \omega_{1,2}E_t(\Delta f_2)) + \{q_1(\omega_{1,1}\sigma(f_1, S_1) + \\ + \omega_{1,2}\sigma(f_2, S_1)) + q_2(\omega_{1,1}\sigma(f_1, S_2) + (\omega_{1,2}\sigma(f_2, S_2))\} \tag{A4}$$

where the ijth element of Ω is denoted with $\omega_{i,j}$. The symbol σ denotes instead the element of the matrix Σ.

As usual, one can divide the demand for futures in to a component for speculative purposes (set $q = 0$) and into a component for hedging purposes (set $\rho = \infty$).

BIBLIOGRAPHY

Akaike, H. (1974): "A New Look at the Statistical Model Identification," *IEEE Transactions on Automatic Control,* AC-19:716–723.

Anthony, J. (1988): "The Interrelation of Stock and Options Market Trading-Volume Data," *Journal of Finance,* 43(4):949–964.

Bortz, G. A. (1984): "Does the Treasury Bond Futures Market Destabilize the Treasury Bond Cash Market?," *The Journal of Futures Markets,* 4:25–38.

Box, G. E. P., and Tiao, G. C. (1975): "Intervention Analysis with Applications to Economic and Environmental Problems," *Journal of the American Statistical Society,* 70:70–79.

Capra, F. M., and Esposito, M. (1992): "Futures sul BTP: Trading Tools," *Finanza, Imprese e Mercati,* 1:85–112.

Copeland, T. (1976): "A Model of Asset Trading Under the Assumption of Sequential Information Arrival," *Journal of Finance,* 31(4):1149–1168.

Duffie, D. (1989): *Futures Markets,* Englewood Cliffs, NJ: Prentice-Hall.

Edwards, R. F. (1988): "Futures Trading and Cash Market Volatility: Stock Index and Interest Rate Futures," *The Journal of Futures Markets,* 4:421–439.

Esposito, M., and Giraldi, C. (1993): "L'integrazione dei mercati futures sui titoli di stato europei a lungo termine" in *Il mercato dei titoli di stato in Italia,* Conti, V., and Hamaui, R., (eds.), Il Mulino, Bologna, in press.

Friedman, M. (1953): "The Case For Flexible Exchange Rates," *Essays in Positive Economics,* University of Chicago Press.

Froewiss, K. (1978): "GNMA Futures: Stabilising or Destabilising?," *Federal Reserve Bank of San Francisco Economic Review,* Spring:20–29.

Grossman, S. (1976): "The Existence of Futures Markets, Noisy Rational Expectations and Informational Externalities," *Review of Economic Studies,* 431–449.

Hannan, E. J., and Quinn, B. G. (1979): "The Determination of the Order of an Autoregression," *Journal of the Royal Statistical Society,* B-41:190–195.

Kaldor, N. (1939): "Speculation and Economic Stability," *Review of Economic Studies,* Spring:1–27.

Kawai, M. (1983): "Price Volatility of Storable Commodities Under Rational Expectations in Spot and Futures Markets," *International Economic Review,* 24:435–459.

LIFFE, *BTP Futures Contract Newsletter.*

Lutkepohl, H. (1990): "Testing for Causation Between Two Variables in Higher Dimensional VAR Models," Working Paper, Christian-Albrechts-Universitat Kiel, Germany.

Newbery, D. M. (1987): "When Do Futures Prices Destabilise Spot Prices?," *International Economic Review,* 28:291–297.

Perron, P. (1988): "Trends and Random Walks in Macroeconomic Time Series," *Journal of Economic Dynamics and Control,* 12:297–332.

Phillips, P., and Perron, P. (1988): "Testing for a Unit Root in Time Series Regression," *Biometrika,* 75:2.

Schwarz, G. (1978): "Estimating the Dimension of a Model," *Annals of Statistics,* 6:461–464.

Shiller, R. J. (1979): "The Volatility of Long-Term Interest Rates and Expectations Models of the Term Structure," *Journal of Political Economy,* 87:1190–1219.

Shiller, R.J. (1981): "Do Stock Prices Move Too Much to Be Justified by Subsequent Changes in Dividends?," *The American Economic Review,* 71:421–436.

Simpson, W., and Ireland, T. (1982): "The Effect of Futures Trading on the Price Volatility of GNMA Securities," *The Journal of Futures Markets,* 2:357–366.

Simpson, W., and Ireland, T. (1985): "The Impact of Financial Futures on the Cash Market for Treasury Bills," *The Journal of Financial and Quantitative Analysis,* 20:371–379.

Sims, C. (1981): "An Autoregressive Index Model for the US 1948–1975," in *Large Scale Macro-Econometric Models,* Kmenta, J., and Ramsey, J. (eds.), Amsterdam: North-Holland.

Turnovsky, S.J. (1979): "Futures Markets, Private Storage and Price Stabilisation," *Journal of Public Economics,* 12:301–327.

Turnovsky, S.J., and Campbell, R.B. (1985): "The Stabilising and Welfare Properties of Futures Markets: A Simulation Approach," *International Economic Review,* 26:277–303.

Wei, W.W.S. (1990): *Time Series Analysis,* Reading, MA: Addison-Wesley.