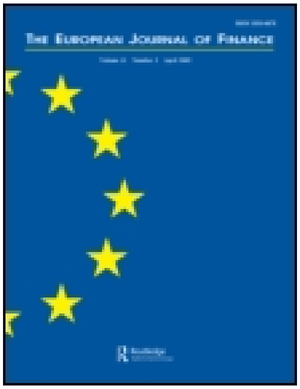

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The effect of the establishment of an organized exchange on weak form efficiency: the case of Istanbul Gold Exchange

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The effect of the establishment of an organized exchange on weak form efficiency: the case of Istanbul Gold Exchange

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Evidence is presented from IGE (the Istanbul Gold Exchange) that an institutional regulation such as the establishment of an organized exchange is an important component of informational efficiency that should not be disregarded in the process of financial liberalization.

Keywords: weak form efficiency, gold market, institutional regulation

1. INTRODUCTION

During the past three decades, empirical studies of market efficiency have focused on the distributional and time series properties of returns in the stock markets of developing countries. Few studies have investigated the returns of precious metals such as gold (Booth and Kaen, 1979; Solt and Swanson, 1981; Akgiray *et al.*, 1991), although they have attracted considerable attention by investors. Besides, efficiency studies in emerging markets are even less in number and still concentrated on the stock markets (Muradoğlu and Ünal, 1994; Muradoğlu and Metin, 1996). However, gold has an important role in the economic history of emerging markets since the introduction of financial markets and instruments is a recent phenomena of the past two or three decades whereas gold has been known for centuries.

The Turkish experience in financial liberalization introduces an interesting case for gold market efficiency in two respects. The liberalization process started in 1980 by an IMF-induced structural adjustment and stabilization package. Boratav *et al.* (1996) described the policy shifts with regard to the financial system in three phases. First, during 1981–83 interest rates were freed and legal and institutional frameworks for new financial instruments were introduced. During 1984–88, while the new financial markets expanded on one side, government bonds started dominating financial markets due to the increasing public sector borrowing requirement. Finally, during the 1989–1992 period, inter-bank money market and foreign exchange markets gained momentum with the active participation of the Central Bank. In this process, Turkish investors were faced with a variety of investment alternatives such as stocks, corporate and government bonds, foreign exchange, bank deposits with various maturity structures, not all of which were available before the liberalization process. Studies concerning the markets for these newly introduced instruments reveal that they are not efficient in the weak and semistrong forms (Aydoğan and Booth, 1996; Balaban and Kunter, 1996).

In this process the role of the gold market in Turkey is unique for two reasons. Primarily, unlike others, gold was the major investment instrument before the liberalization process and continued to be an important one after the introduction of other alternatives (Muradoğlu, 1996). Traditionally, gold has been used by households both for personal adornment and savings, and gold craftsmanship in Turkey is one of the best in the world. Therefore, Turkey is one of the most important gold importers in the world. Moreover, although this instrument is not new to the Turkish investor, institutional regulations have only recently been introduced: the Istanbul Gold Exchange was established in July 1995. Before the Istanbul Gold Exchange was operational, gold prices were determined at the 'Grand Bazaar' in Istanbul where the major gold artisans and jewellery shops are located.

This study aims to test the effect of the establishment of the Istanbul Gold Exchange (IGE) on the weak form efficiency of the gold market in Turkey. For that purpose, first stationarity of the time series is tested at log levels and differences and then independence, randomness and normality of the stationary series of gold returns are examined at different phases of the establishment of the IGE. To our knowledge this is the first study investigating the efficiency of the Turkish gold market. This study is expected to contribute to the literature on efficiency of precious metals by introducing a case of a developing country where an official exchange is established as part of the liberalization process. Analysis of efficiency before and after the establishment of a gold exchange is expected to offer an institutional explanation to the contradictory empirical results of the studies conducted in developed markets (Solt and Swanson, 1981; Agarwal and Soenen, 1988). The remainder of the paper is organized as follows. The following section describes the data. The third section presents the method of the analysis. The fourth section presents our findings. We summarize our findings by pointing out their implications in the final section.

2. ANALYSIS OF DATA

As part of the financial liberalization process, studies for a legal framework for gold transactions started in 1982 and were completed on 4 October 1993 when the law for the establishment of IGE was passed to be enacted as of 15 March 1994. However, due to a major economic crisis at the beginning of 1994, the establishment of IGE was postponed until 26 July 1995.

This study is based on 1288 daily observations of 24 carat gold prices covering the period 1 January 1992 to 20 March 1996. The analysis is conducted at three sub-periods corresponding to three different institutional phases of the gold market. The first period consists of 539 daily observations over the period 1 January 1992 to 3 October 1993. In this period, gold prices were determined at the Grand Bazaar and a legal framework for gold transactions did not exist in Turkey. The second period from 4 October 1993 to 25 July 1995 contains 558 daily observations and signifies the transition from unorganized gold transactions to a gold exchange. During this period, transactions took place and prices were determined at the Grand Bazaar but the legal framework for a gold exchange was completed. During the third period which comprises the 191 daily observations from 26 July 1995 to 20 March 1996 IGE was operational and prices were determined at the official gold exchange.

For the period before the establishment of IGE, the data on the free market closing prices is obtained from the Turkish daily newspaper, *Hürriyet*. For the period after the establishment of IGE, the data on the IGE afternoon session closing prices published in the same newspaper is considered.

3. METHODOLOGY

Before proceeding to the statistical hypothesis tests to investigate whether the weak form of the Efficient Markets Hypothesis holds for the Turkish gold market, we introduce the series of the differences in the logarithm of gold prices ($\ln r_t$) that represent the gold returns with continuous compounding:

$$\ln r_t = \ln P_t - \ln P_{t-1} \tag{1}$$

By applying this transformation to the original series of nominal gold prices (P_t), we smooth out the inflationary effect while keeping the relevant information in the nominal gold prices. This is a deliberate choice since the stationarity of the series under consideration is achieved by this transformation. It is important to note that the possibility of applying a logarithmic transformation only is ruled out in our case since the time series of the logarithmic nominal gold prices ($\ln P_t$) fails to satisfy the requirement of stationarity (cf. results presented in Table 1). In investigating the stationarity of the series under consideration we employ the Augmented Dickey–Fuller (ADF) unit root test for stationarity. The general form of the model employed in deriving the ADF test statistic is

$$\Delta Y_t = \rho Y_{t-1} + \sum_{i=1}^{k} \gamma_i \Delta Y_{t-i} + \beta t + \mu \tag{2}$$

Table 1. ADF unit root test statistic for $\ln r_t$ and $\ln P_t$

Period		$\hat{\rho}$	Standard error
I	$\ln r_t$	−1.1214*	0.0653
	$\ln P_t$	−0.0128	0.0073
II	$\ln r_t$	−1.7000*	0.0862
	$\ln P_t$	−0.0116	0.0070
III	$\ln r_t$	−0.8580*	0.1005
	$\ln P_t$	−0.0647	0.0245

*Significant at $\alpha = 0.01$

where Y_t stands in our case for $\ln r_t$ and for $\ln P_t$, respectively. The number of lags on the right-hand side of equation (2), k, is usually suggested by the number of significant lags found in the autocorrelation analysis. Alternatively, one can determine the value of k by conducting the linear regression analysis on the basic model with only one lagged term and successively extending the regression model by adding a lagged term at a time until the coefficient estimate of the last lagged term turns out to be statistically insignificant. At the end of this procedure, the model excluding the last lagged term serves as a basis for the derivation of the ADF test statistic.

In our case, the value of k is found to be equal to 1 for the periods I and III. For period II, k can be taken to be either 2 or 3, since the p-value of γ_3 was found to be 0.011. Since in either case the calculated value of the ADF unit root test statistic is significantly larger than the tabulated value at $\alpha = 0.01$, we decided to report the test result for $k = 2$ only. The critical values for the ADF unit root test are depicted from the reprint of the corresponding table of Fuller (1976) reprinted as Table 4.2.c in Banerjee *et al.* (1993).

As a first step in testing gold market efficiency we investigate whether gold returns are normally distributed. For that purpose we conduct a Jarque–Bera (JB) test for normality. The critical value for this test is obtained from the χ^2 table with two degrees of freedom. In order to provide additional insight into the results of the Jarque–Bera test, we conduct individual hypothesis tests on the coefficients of skewness ($\beta_1^{1/2}$) and kurtosis (β_2) of the distribution of $\ln r_t$. The critical values for these tests are depicted from the standard normal table. To further support our findings on the coefficients of skewness and kurtosis, we supply some descriptive statistics on the distribution of $\ln r_t$.

For investigation of the autocorrelation structure of the gold return series the usual autocorrelation tests and the Ljung–Box (LB) test for autocorrelation are conducted. The critical values for the usual autocorrelation test at each time lag are obtained from the standard normal table for the test statistic.

$$\frac{0-\mathrm{AC}_k}{1/\sqrt{n}} \tag{3}$$

where AC_k is the calculated value of the autocorrelation coefficient at lag k and n is the sample size for the period under consideration. The critical value of the Ljung–Box tests statistic is obtained from the χ^2 distribution with the degrees of freedom equal to the maximum number of lags at which the test is conducted.

Finally, to support the conclusions of the autocorrelation analysis we conduct the runs test for randomness. The nonparametric runs test is conducted on the series of signs of $\ln r_t$. The critical values for this test are obtained from the standard normal table by applying the large sample approximation with the following formula for the test statistic:

$$z = \frac{(R + 0.5) - m}{s_m} \tag{4}$$

where R is the total observed number of runs of each sign, and s_m is the standard deviation of m computed as the square root of

$$s_m^2 = \frac{\Sigma_{i=1}^{3}(n_i^*)^2(n(n+1) + \Sigma_{i=1}^{3}(n_i^*)^2) - n^3 2n\, \Sigma_{i=1}^{3}(n_i^*)^3}{n^2(n-1)} \tag{5}$$

and m is the total expected number of runs of each sign computed by

$$m = \frac{n(n+1) - \Sigma_{i=1}^{3}(n_i^*)^2}{n} \tag{6}$$

with n being the sample size in the period under consideration and n_i^*, $i = 1, 2, 3$, being the total number of runs with (+) or (−) sign, or (0), respectively, in the series $\ln r_t$.

4. RESULTS

In testing gold market efficiency we first investigate whether gold returns are normally distributed. The descriptive statistics given in the first part of Table 2 indicates that the distribution of gold returns ($\ln r_t$), approaches a symmetric one towards period III and the standard deviation (std) of the distribution is smallest in this period compared to the other periods. To verify whether this observation would result in a conclusion that the distribution under consideration is a normal one, we conduct individual hypothesis tests on the coefficients of skewness ($\beta_1^{1/2}$) and kurtosis (β_2) in addition to a Jarque–Bera (JB) test for normality. As can be depicted from the second part of Table 2, the null hypothesis that the distribution of gold returns ($\ln r_t$) is not skewed is rejected at $\alpha = 0.01$ for period I, whereas we fail to reject this null hypothesis at the same

Table 2. Descriptive statistics and normality tests for the distribution of $\ln r_t$.

Parameter	Period I	II	II
Mean	0.0016	0.0025	0.0024
Median	0	0.0009	0.0018
Mode	0	0	0.0041
Std	0.0086	0.0275	0.0057
$\beta_1^{1/2}$	0.6850*	−0.1241	−0.3482
s_{β_1}	0.1056	0.1037	0.1777
β_2	5.1107*	74.7624*	3.2574*
s_{β_2}	0.2112	0.2074	0.3554
JB coefficient	627.57*	129722.45*	87.84*

*Significant at $\alpha = 0.01$

Table 3. Autocorrelation analysis and Ljung–Box test statistics for the ln r_t series.

Lag	Period I AC	Period II AC	Period III AC
1	−0.133*	0.1514*	0.066
2	0.028	−0.2988*	0.089
3	0.100	−0.2249*	0.000
4	0.082	−0.0414	0.129
5	0.035	0.0787	−0.073
6	−0.022	0.0153	−0.019
7	−0.067	0.028	−0.116
8	0.023	0.0169	−0.090
9	−0.005	0.0436	−0.015
10	−0.009	0.0476	0.036
LB_9	22.775*	97.453*	11.100

*Significant at $\alpha = 0.01$

significance level for periods II and III. Obviously, the distribution of gold returns (ln r_t), is significantly leptokurtic at $\alpha = 0.01$ for all periods and as a result of this, the Jarque–Bera null hypothesis of normality is rejected at $\alpha = 0.01$ for all periods.

For investigation of the autocorrelation structure of the gold return series, the usual autocorrelation test and the Ljung–Box (LB) test for autocorrelation are conducted. The autocorrelation coefficients up to ten time lags and the results of the LB test statistics at nine time lags are summarized in Table 3. Considering the results presented in Table 3, we can conclude that for period I the autocorrelation coefficient at lag 1 is significantly different from 0, whereas the autocorrelation coefficients at higher lags are not significantly different from 0. For period II the autocorrelation coefficients up to three time lags are significant, whereas for period III none of the autocorrelation coefficients up to ten time lags is significantly different from 0. Moreover, the Ljung–Box test statistics indicate that the gold return series (ln r_t) is autocorrelated in periods I and II, whereas it is not autocorrelated in period III. This observation confirms the results obtained in the usual autocorrelation analysis.

Given the statistical evidence that the gold return series, ln t_t, is not autocorrelated in period III, the natural question to ask is whether this observation would result in the conclusion that the series (ln r_t) is in fact a random series. The results of the runs test conducted on the series of signs of ln r_t presented in Table 4 will help to answer this question. The comparison of the calculated z values of Table 4 with the critical z values at the significance level $\alpha = 0.01$ leads to the conclusion that the randomness hypothesis is rejected for all periods, even for period III where no significant autocorrelation was observed. To provide an explanation for this seemingly contradictory result, first note that the autocorrelation test is conducted on the ln r_t values, whereas the runs test considers only the signs of ln r_t to arrive at the conclusion that the series of signs is not a random one. To investigate further the question

Table 4. Test for randomness of the series $\ln r_t$.

Period	Total observed number of runs ($i = 1, 2, 3$)	Total expected number of runs ($i = 1, 2, 3$)	z_{calc}
I	349	462.113	−15.520*
II	298	499.092	−31.811*
III	86	174.653	−27.477*

*Significant at $\alpha = 0.01$

of whether the nonrandomness of the series of signs would imply the presence of an autocorrelation structure in the series of $\ln r_t$ values, we graphically analysed the changes in the signs and magnitudes of $\ln r_t$ values over time during period III. As suggested by the usual autocorrelation test results, no specific pattern in the change of magnitudes of $\ln r_t$ values was observed. The sign changes of the series ($\ln r_t$), however, seem to be tractable since the blocks of positive sign of sometimes remarkable length are existent. The average length of the blocks with positive sign is three times that with negative sign, whereas blocks with 0 sign of length 1 are rarely observed.

5. CONCLUSIONS

The results of this study provide evidence that the weak form efficiency of the Turkish gold market has improved after the establishment of IGE. Tests for normality indicate that, unlike the first two periods, distribution of gold returns approached a symmetric one and the standard deviation of the distribution became smallest after IGE became operational. In this period, the hypothesis of normality is still rejected for the same reason as concluded by comparable studies, namely due to the thick tails of the distribution (Booth and Kaen, 1979; Solt and Swanson, 1981; Akgiray *et al.*, 1991; Cheung and Lai, 1993). During the first two periods (before IGE was operational) the series is not random and is autocorrelated up to three lags. The fact that the usual autocorrelation tests and the Ljung–Box test result in no significant autocorrelation in period III (after the establishment of IGE), although the series of signs seems to be still tractable, leads to the conclusion of an improvement towards the weak form of efficient market hypothesis in the third period.

This study, to our knowledge, is the first investigating the weak form efficiency of a traditional investment instrument, gold, in the process of the establishment of an organized exchange, IGE. Evidence is presented that such an institutional regulation is an important component of informational efficiency. Hence, the important policy implication is that in the process of financial liberalization, the institutional setting should not be disregarded so that informational efficiency can be improved. Further studies are expected to contribute by documenting the possible shifts in market efficiency as a result of the establishment of an institution. Changes in the informational efficiency of different financial markets in several other countries remain as challenging topics for further research.

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