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CENTER FOR ECONOMIC STUDIES

A CHARACTERIZATION OF THE PRICE BEHAVIOUR OF INTERNATIONAL DUAL STOCKS: AN ERROR CORRECTION APPROACH

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Abstract

This paper deals with the interrelations between stocks listed and traded in two international unsynchronized markets. The data exhibits first order nonstationarity and the series across markets are cointegrated. This gives a justification for an error correction model which incorporates a short run adjustment mechanism. The model is applied for different day-groups. The main findings are: (1) The domestic country emerges as the dominant market and the foreign market as the satellite one; (2) The adjustment mechanism coefficient is highly significant for most shares; (3) Different behavioural patterns emerge for middle-of-the-week days as compared with beginning/end-of-week days; (4) The model fits better for the more heavily traded shares.

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1 Introduction

In recent years, developed and emerging financial markets have witnessed a growing trend of securities listed and traded in more than one stock market. A study by Neumark, Tinsley and Tosini (1991) investigated this phenomenon by examining the values of U.S. stocks that trade in several national markets. They find that the price volatility of foreign price movements in response to domestic ones fully reflect the domestic market (U.S.), but only to a lesser extent the other way. This asymmetry was also found by Chowdhry and Nanda (1991)[1]. In their theoretical analysis, they show that one of the markets may emerge as the dominant one and that timely release of price information in one market adversely affect the returns informed traders are expecting to gain, subsequently, in other markets. One of the explanations to this phenomenon is that when market makers are competing to offer trading through lower costs, they will make price information available to the public at lower costs to deter informed trading from trading at their location.

The purpose of this paper is to examine this issue via a case study in which we characterize the price behavior of internationally dually listed stocks. Specifically, we investigate the relationship between prices of shares listed and traded both in the OTC in U.S. and in the Tel Aviv Stock Exchange (TASE) in Israel. The paper differs from previous studies in a number of ways. The first difference is the methodology by which we explore the relationship between the prices of dually listed stocks. Since in most cases international dually listed stocks are traded in different time zones, and the problem of unsynchronized data arises, we propose a methodology designed to handle data of dually traded stocks in such cases.

Second, according to Chowdhry and Nanda (1991), when a security is traded in several locations, informed investors have more opportunities to exploit their private information. Therefore, any systematic linkages between the price of the dually listed stocks may suggest a potential for short-term arbitrage opportunities. The methodol-

[1]This assymetry was also found for stock indices by Eun and Shim (1989), Hamao, Masulis and Ng (1990) and others.

ogy employed in this paper also enables us to explicitly test the availability of arbitrage opportunities.

Third, following Garbade and Silber (1979), Neumark, Tinsley and Tosini (1991), Chowdhry and Nanda (1991), this paper extends the empirical evidence on the question of which of the markets is the dominant and which is a satellite. According to Garbade and Silber (1979) when the adjustment of prices is asymmetrical, it may indicate that one of the markets is a satellite. For example, if prices of stocks traded in the OTC adjust with some time delay to those traded in the TASE whereas the prices of stocks traded in the TASE adjust rapidly to those traded in the OTC, then the OTC market for these securities will be considered as a satellite market and the TASE will emerge as the dominant market. This may occur when investors participating in trading in New York form their expectations on the share price behavior, based on the information released in Tel Aviv[2].

The remainder of the paper is as follows. In the following section, we present the methodology by which the price behavior of the dually-listed stocks are examined. In Section 3, we describe the data and the problem of nonsynchronization. The results are discussed in Section 4. Section 5 concludes the paper.

2 Methodology

2.1 An Error Correction Model

We apply in this study an error correction model (ECM) for the share prices of dual stocks traded both on the OTC and TASE. This model incorporates a short run adjustment mechanism for the price differential existing between the two markets prior to the start of trade in the studied market. Let x_t, y_t, SP_t, IX_t be share prices (in dollars) in Tel Aviv and New York, and the S&P500 and Israeli indices respectively at time t.

[2]See discussion in Garbade and Silber (1979) and Hauser and Tanchuma (1995).

All data was transformed by a natural logarithm. The models under consideration are

$$\Delta y_t = \gamma_1 + \gamma_2 \Delta x_t + \gamma_3 (x_t - y_{t-1}) + \gamma_4 \Delta SP_t + \epsilon_t \tag{1}$$

and

$$\Delta x_t = \delta_1 + \delta_2 \Delta y_{t-1} + \delta_3 (y_{t-1} - x_{t-1}) + \delta_4 \Delta IX_t + u_t \ . \tag{2}$$

In equations (1) and (2) we attempt to explain the behavior of stock returns in the US and Israeli markets, respectively[3]. The difference in the models results from the time difference between New York and Tel Aviv, a phenomenon known as the *data synchronization problem*, discussed below.

The underlying *assumption* of all series considered is that it is stationary ($I(0)$) in first differences. It is further assumed that ϵ_t, u_t are $I(0)$ and that the error correction terms $(x_t - y_{t-1})$ in (1) and $(y_{t-1} - x_{t-1})$ in (2) are also $I(0)$. In other words, although x_t, y_t are $I(1)$, they are cointegrated with a cointegrating vector $(1, -1)$, so that their difference is stationary[4]. This means that all terms in (1) and (2) are $I(0)$. This assumption is verified in the next section with the appropriate testing apparatus. The cointegrating vector $(1, -1)$ is taken to explore the possibility of no arbitrage opportunities between the two markets. Any other cointegrating vector, say $(1, -\eta)$ with $\eta \neq 1$, would lead an arbitrage possibility with nonzero expected profit.

The model assumes a linear dependence between the return in market i and the known return in market j, an error correction term and the return on the market i index, $i \neq j$. The return on share prices in market j is observed before the start of a new trading session in market i and so is the adjustment term. The use of the index is based on CAPM model. Because the return on the stock in market j is already incorporated, the overall market j effect is not included. The parameters γ_3, δ_3 have the interpretations of being the short run adjustment response coefficients, and γ_4, δ_4 are the standard beta coefficients.

[3] We have attempted to fit (1) and (2) with both indices, but it apears that the 'away' index is highly insignificant for the data under consideration. Thus, the foreign market index is not incorporated on the right-hand side of the equality signs in (1) and (2).

[4] The cointegrating vector comprises of the coefficients of the variables in the error correction terms.

2.2 Tests of Unit Root and Cointegration

In order to test the validity of the assumed model, we conduct tests for unit roots and cointegration in the series involved. Six different tests for a unit root were applied for each series in both levels and first differences. These tests are the two augmented Dickey-Fuller (DF, Dickey and Fuller 1979) tests and the four Phillips-Perron (PP) tests. The two augmented Dickey-Fuller tests are for stationarity of the residuals of regression equation, one containing a time trend and one which does not. The Phillips-Perron tests use a nonparametric correction for serial correlation. This results in four tests—two accounting for a linear time trend and two which do not. The tests are z and t tests (see Davidson and Mackinnon (1993, Ch. 20)). The asymptotic distributions and critical values of these statistics are given in the references above. The overall performance of all tests is taken into consideration when deciding on the nature of the series.

The tests of cointegration for x_t and y_t verifies whether their difference is stationary. The tests adopted are exactly those of the unit root listed above, but applied to the residual of the cointegration regressions. More specifically, the augmented Dickey-Fuller tests are applied to the residuals from the regressions

$$y_t = \beta_0 + \beta_1 x_t + \nu_t \tag{3}$$

and

$$y_t = \beta_0 + \beta_1 t + \beta_2 x_t + \nu_t \,. \tag{4}$$

A test for a unit root is then conducted on

$$\Delta\hat{\nu}_t = \alpha_* \hat{\nu}_{t-1} + \sum_{j=1}^{p} \phi_j \Delta\hat{\nu}_{t-j} + \eta_t \,,$$

where $\hat{\nu}_t$ is the least squares residuals from (5) or (6) and p is a predetermined lag-length chosen to ensure the uncorrelatedness of the errors. A test for no cointegration amount to a test of $\alpha_* = 0$. The Phillips-Perron tests are constructed using a nonparametric correction for serial correlation.

3 Data

The data include daily closing prices of five firms based in Israel whose shares are listed and traded both in the OTC and TASE, the S&P 500, the TASE general stock index from July of 1988 to September of 1993. There are three problems that should be addressed concerning the synchronization of this data. The first one is that prices of shares traded on the TASE are denominated in Israeli new shekels and had to be translated to U.S. dollars at a representative exchange rate, published by the central Bank of Israel, implying that the volatility of the exchange rate is embedded in the dollar return volatility of these shares. To examine this, we calculated the effect of the exchange rate on the dollar return volatility and found this effect to be negligible[5].

The second problem is due to the time difference between Tel Aviv and New York since trading in New York begins approximately at the time of the conclusion of trading on the TASE. This justifies the need to adjust for the time periods in which the terms in the error correction factors appear. The third problem relates to different trading days in a period of one week, being Sunday through to Thursday in Israel and Monday through to Friday in the U.S. Table 1 highlights these features.

Table 1

Days and Hours of Trading in New York and Tel-Aviv (Eastern Standard Time)

	Sunday	Monday–Thursday	Friday	Saturday
Tel-Aviv	0330–0930	0330–0930	closed	closed
New York	closed	0930–1600	0930–1600	closed

To deal with the latter two problems, some modifications to the models (1) and (2) are required. Model (1) is suitable for the Tuesday, Wednesday and Thursday trading days, whereas for Monday, it becomes

$$(y_t - y_{t-2}) = \gamma_1 + \gamma_2 \Delta x_t + \gamma_3 (x_t - y_{t-2}) + \gamma_4 (SP_t - SP_{t-2}) + \epsilon_t \ . \qquad (5)$$

[5]The correlation coefficient between the return on the shares and the exchange rate was negative and close to zero, and that the daily volatility of exchange rates in relation to the share price volatility was negligible, less than 3% of the volatility of share prices.

For Fridays, we have

$$\Delta y_t = \gamma_1 + \gamma_3(x_{t-1} - y_{t-1}) + \gamma_4 \Delta SP_t + \epsilon_t. \tag{6}$$

The adjustments for the beginning/end-of-week periods is a direct result of the trading weeks in Israel and the U.S. not being synchronized. Similarly, (2) is suitable for Wednesdays and Thursdays. The following adjustments were carried out for the remaining days:

$$\begin{aligned}
&\text{Sundays:} && (x_t - x_{t-2}) = \delta_1 + \delta_2 \Delta y_{t-1} + \delta_3(y_{t-1} - x_{t-2}) + \delta_4(IX_t - IX_{t-2}) + u_t \\
&\text{Mondays:} && \Delta x_t = \delta_1 + \delta_2 \Delta y_{t-2} + \delta_3(y_{t-2} - x_{t-1}) + \delta_4 \Delta IX_t + u_t \\
&\text{Tuesdays:} && \Delta x_t = \delta_1 + \delta_2(y_{t-1} - y_{t-3}) + \delta_3(y_{t-1} - x_{t-1}) + \delta_4 \Delta IX_t + u_t.
\end{aligned} \tag{7}$$

4 Results

This paper offers an error correction model to explore the relationship between the price behavior of dually listed stocks. The model enables us to explicitly test any systematic linkages between these prices which may suggest a potential for short-term arbitrage opportunities. It also enables us to address the question of which of the markets acts as the dominant market and which of them acts as a satellite one. The main findings are that arbitrage opportunities are generally not available and that the domestic market acts as the dominant market and the foreign market acts as a satellite market.

The results for the unit root tests for the five individual stocks, in each country, and the stock market indices are reported in Table 2a. All data were transformed first by a natural logarithm. The corresponding tests for the first differences are reported in Table 2b. In each case, six different tests for a unit root, discussed in section 2, were conducted. The figures for all series considered clearly indicate that the data are not stationary in levels but achieve stationarity after differencing once only.

Six different tests for cointegration between the pairs of share prices in the U.S. and Israel were carried out and are reported in Table 3. Overall, it is evident that all

the pairs of series examined are cointegrated. Moreover, the estimates of the cointegrating vectors are approximately (1, -1), supporting the hypothesis of no arbitrage opportunities between the two markets.

We turn now to the estimation of the ECM models as given in equations (1)–(5). In Table 4 we present the effects on share prices traded in the American market while in Table 5 analogous effects on share prices traded in Israel appear. As highlighted in section 2, we fitted separate models for different groups of days of the week.

The main feature of Table 4 is that the five dual stocks can be separated into two groups of share price behaviours. The first group, comprising of the three big companies, Teva, Elbit and Elron, while the second constitutes the small firms Aryt and Robotec. In general, for all days of the week, all the variables (ECM, Δx_t and ΔSP_t) are highly significant in explaining the behaviour of share prices in the first group. In the second group, changes in share prices in the U.S. are only explained by the ECM variable. The U.S. index does not appear to affect these shares. A comparison of the figures for different days of the week reveals that qualitatively, the results are invariant to the day of trade.

Quantitatively, the beta coefficients of the more heavily traded stocks in the American market are about 0.5. This means that the dual stocks of firms based in Israel and listed in the U.S. are somewhat insensitive to changes in the U.S. market[6]. The ECM effect for all stocks in the U.S. market is strong. The magnitude of this effect is about 0.6–0.7 for Aryt and Robotec, about 0.4–0.5 for Elbit and Elron, and about 0.3 for Teva. It is clear that U.S. prices of Aryt and Robotec depend strongly on the prices in Israel. The degree of this dependence is smaller for Elbit, Elron, and Teva. The coefficient of determination, R^2, is larger for all stocks on Monday through to Thursday (days in which the Israeli stock market is open), than on Friday, when the Israeli stock market is closed.

Results for model (2) and (4) are exhibited in Table 5. The beta coefficients are generally greater than unity and are significant for most stocks on most days. The error

[6]See Hauser and Tanchuma (1995).

correction factor is much smaller than in the previous case and often insignificant. In particular, the factor is insignificant on Mondays for all stocks. This coefficient tends to be significant but small for Teva and Elbit on the other days. For Aryt, Robotec and Elron it is mostly insignificant. Finally, the estimate $\hat{\delta}_2$ is significant in the middle of the week for most stocks, with magnitude of about -0.2–0.1, and insignificant on Mondays.

Broadly speaking, the foregoing discussion is indicative of the domestic country being the dominant market while the foreign market acts as a satellite. The only share for which the basic model fits well in both directions is Teva. In the light of Teva being considered as an international company, this result is not surprising. The second main aspect of the results is that the ECM coefficient is generally significant in both directions, but is much greater when the American share prices are treated as dependent variables. The converse is true for the beta coefficient. Both outcomes are consistent, of course, with the aforementioned dominance feature.

5 Conclusions

The approach taken in this paper was to model the dual stock behaviour in the two markets as an error correction mechanism. The justification for this modeling strategy is the findings that all series involved possess a unit root as well as the stock prices in the two markets being cointegrated of order one. Overall, we found two distinct behavioural groups; one which constitutes the bigger firms Teva, Elbit and Elron and the smaller firms Aryt and Robotec. Generally speaking, the model seems to fit better for the bigger shares. The main determinant in the behaviour of the smaller shares is the short run adjustment component in the model. Except for Teva, the effect of the Israeli market on the share prices in the U.S. is stronger than the reverse direction. This is a result of Teva being an international company, at least as far as stock-holding is concerned.

There are two considerations in breaking the model into different day-groups. The first is the data synchronization problem which implies that certain data points are lost

if the general model is applied and the second is the additional information that this breakdown entails. Different patterns for middle-of-the-week days and beginning/end-of-the-week days emerge. This difference is attributed to the instantaneous adjustment property of the markets to new information, which is not available to the same extent in the beginning of the week as compared with the middle of the week. It would be interesting to extend the methodology to other sets of dual stocks encompassing different markets.

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Table 2a: Unit Root Tests in Levels

This table reports the t and z statistics of six different tests for a unit root, including two augmented Dickey-Fuller (DF) tests and four Phillips-Perron (PP) tests. * indicates that the hypothesis of a unit root is rejected at the 10% level of significance

Stock	Test					
	C t-test (DF)	CT t-test (DF)	C z-test (PP)	C t-test (PP)	CT z-test (PP)	CT t-test (PP)
Teva $n = 1280$						
U.S.A.	−0.82048	−2.8212	−1.6381	−0.98228	−29.465*	−3.8683*
Israel	−0.58698	−2.5976	−0.96589	−0.71202	−18.448*	−3.0461
Robotec $n = 334$						
U.S.A.	−2.0420	−2.3667	−21.407*	−3.3095*	−25.539*	−3.4957*
Israel	−2.4550	−2.3651	−12.745*	−2.5129	−14.866	−2.4536
Elbit $n = 1278$						
U.S.A.	−1.9753	−1.7117	−2.3027	−1.8599	−14.123	−2.4929
Israel	−2.1825	−1.7311	−2.2872	−1.9115	−13.921	−2.5758
Elron $n - 1277$						
U.S.A.	−2.3087	−1.9692	−3.2222	−1.7450	−17.740	−2.9012
Israel	−2.5158	−2.1742	−2.9819	−1.8903	−13.476	−2.5764
Aryt $n = 331$						
U.S.A.	−1.4368	−3.3414*	−3.3398	−1.1846	−34.384*	−4.3210*
Israel	−1.0396	−2.8184	−2.0421	−0.84356	−26.932*	−3.8121*
Index						
SP $n = 1402$	−1.1217	−2.5318	−2.2332	−1.2031	−18.701*	−3.0893
IX $n = 1302$	−0.15669	−3.5695*	−0.11844	−0.14727	−28.972*	−3.8185*
Asymptotic						
Critical Value	−2.57	−3.13	−11.2	−2.57	−18.2	−3.13

C ≡ Regression containing a constant
CT ≡ Regression containing a constant and a linear time trend
DF ≡ Augmented Dickey Fuller test
PP ≡ Phillips Perron test

Table 2b: Unit Root Tests for Data in First Differences

This table reports the t and z statistics of six different tests for a unit root, including two augmented Dickey-Fuller (DF) tests and four Phillips-Perron (PP) tests. * indicates that the hypothesis of a unit root is rejected at the 10% level of significance

Stock	Test					
	C t-test (DF)	CT t-test (DF)	C z-test (PP)	C t-test (PP)	CT z-test (PP)	CT t-test (PP)
Teva $n = 1280$						
U.S.A.	−6.4460*	−6.4475*	−1374.1*	−38.597*	−1374.1*	−38.582*
Israel	−6.3477*	−6.3442*	−1197.7*	−33.518*	−1197.7*	−33.505*
Robotec $n = 334$						
U.S.A.	−4.6210*	−4.6197*	−399.00*	−22.676*	−399.22*	−22.622*
Israel	−4.2535*	−4.2918*	−322.35*	−17.677*	−323.01*	−17.679*
Elbit $n = 1278$						
U.S.A.	−7.0058*	−7.2130*	−1350.7*	−37.796*	−1352.4*	−37.836*
Israel	−7.2605*	−7.4195*	−1164.9*	−32.735*	−1166.8*	−32.771*
Elron $n - 1277$						
U.S.A.	−7.0236*	−7.1768*	−1430.4*	−40.376*	−1431.2*	−40.390*
Israel	−7.4058*	−7.5730*	−1112.0*	−31.405*	−1113.5*	−31.427*
Aryt $n = 331$						
U.S.A.	−4.7840*	−4.7608*	−410.28*	−23.070*	−410.36*	−23.043*
Israel	−4.2779*	−4.2659*	−300.94*	−16.484*	−301.23*	−16.471*
Index						
SP $n = 1402$	−6.1223*	−6.1558*	−1377.2*	−36.796*	−1377.2*	−36.784*
ISDX $n = 1302$	−6.3236*	−6.3225*	−1224.4*	−33.981*	−1224.4*	−33.969*
Asymptotic						
Critical Value	−2.57	−3.13	−11.2	−2.57	−18.2	−3.13

C ≡ Regression containing a constant
CT ≡ Regression containing a constant and a linear time trend
DF ≡ Augmented Dickey Fuller test
PP ≡ Phillips Perron test

Table 3: Tests for Cointegration Between Logs of Prices in the Two Markets

This table reports tests of cointegration. The tests verify whether the differences between the log prices in the two markets are stationary. * indicates that the hypothesis of a unit root is rejected at the 10% level of significance.

Stock	Test						
	C t-test (DF)	CT t-test (DF)	C z-test (P)	C t-test (P)	CT z-test (P)	CT t-test (P)	Cointegration vector is
Teva $n = 1280$	−2.9529	−3.1639	−340.90*	−14.344*	−348.02*	−14.509*	0.98764 (584.49)
Robotec $n = 334$	−3.6652*	−3.8040*	−210.99*	−12.591*	−222.38*	−13.034*	0.98351 (46.699)
Elbit $n = 1278$	−6.4355*	−6.6761*	−610.49*	−20.297*	−612.76*	−20.321*	1.0104 (1009.6)
Elron $n = 1277$	−5.0471*	−4.9339*	−616.35*	−20.601*	−615.25*	−20.573*	1.0020 (702.33)
Aryt $n = 331$	−3.9748*	−4.0115*	−217.28*	−13.053*	−214.74*	−12.942*	0.98088 (122.26)
Asymptotic Critical value	−3.04	−3.50	−17.1	−3.04	−23.4	−3.50	

C ≡ Regression containing a constant
CT ≡ Regression containing a constant and linear time trend
DF ≡ Augmented Dickey Fuller test
PP ≡ Phillips Perron test

Table 4a: Price Linkages Between Dually Listed Stocks

This table reports the results of the error correction model

$$\Delta y_t = \gamma_1 + \gamma_2 \Delta x_t + \gamma_3 (x_t - y_{t-1}) + \gamma_4 \Delta SP_t + \epsilon_t$$

for Tuesdays, Wednesdays, Thursdays.

	$\hat{\gamma}_1$	$\hat{\gamma}_2$	$\hat{\gamma}_3$	$\hat{\gamma}_4$	$\bar{R}^2$	F	n
Teva	$0.15552E-01$ (0.0000)	0.33620 (0.0000)	0.25432 (0.0000)	0.49491 (0.0005)	0.2126	64.197	1158
Robotec	$-0.24981E-02$ (0.2853)	$0.12406E-01$ (0.8955)	0.60966 (0.0000)	0.56980 (0.2407)	0.3403	32.297	298
Elbit	$-0.27735E-02$ (0.0001)	0.31556 (0.0000)	0.39530 (0.0000)	0.38692 (0.0000)	0.4703	208.467	1158
Elron	$-0.45858E-02$ (0.0000)	0.44321 (0.0000)	0.41511 (0.0000)	0.61724 (0.0000)	0.4413	185.023	1158
Aryt	$0.20241E-03$ (0.9344)	$0.21006E-01$ (0.8258)	0.67560 (0.0000)	0.29215 (0.5704)	0.4612	51.512	298

- P-values appear in brackets

Table 4b: Price Linkages Between Dually Listed Stocks

This table reports the results of the error correction model

$$(y_t - y_{t-2}) = \gamma_1 + \gamma_2(\Delta x_t) + \gamma_3(x_t - y_{t-2}) + \gamma_4(SP_t - SP_{t-2}) + \epsilon_t$$

for Mondays.

	$\hat{\gamma}_1$	$\hat{\gamma}_2$	$\hat{\gamma}_3$	$\hat{\gamma}_4$	R^2	F	n
Teva	$0.17639E-01$ (0.0000)	0.32708 (0.0000)	0.29419 (0.0000)	0.36097 (0.1062)	0.3743	43.476	868
Robotec	$0.34478E-03$ (0.9353)	0.46541 (0.0045)	0.43194 (0.0013)	0.19474 (0.7987)	0.5370	22.262	223
Elbit	$-0.19838E-02$ (0.1487)	0.17022 (0.0028)	0.46568 (0.0000)	0.44607 (0.0036)	0.6232	117.891	868
Elron	$-0.53610E-02$ (0.0139)	0.24206 (0.0012)	0.56058 (0.0000)	0.79868 (0.0012)	0.5283	80.148	868
Aryt	$-0.58851E-02$ (0.2741)	$0.64761E-01$ (0.6954)	0.69876 (0.0000)	1.9476 (0.0448)	0.5177	20.318	223

- P-values appear in brackets

Table 4c: Price Linkages Between Dually Listed Stocks

This table reports the results of the error correction model

$$\Delta y_t = \gamma_1 + \gamma_3(x_{t-1} - y_{t-1}) + \gamma_4 \Delta SP_t + \epsilon_t$$

for Fridays.

	$\hat{\gamma}_1$	$\hat{\gamma}_2$	$\hat{\gamma}_3$	R^2	F	n
Teva	$0.80981E-02$ (0.0017)	0.13177 (0.0002)	0.36119 (0.0253)	0.0654	9.677	578
Robotec	$0.14396E-02$ (0.7158)	0.57844 (0.0000)	0.98048 (0.1259)	0.2837	13.479	148
Elbit	$-0.12061E-02$ (0.3891)	0.17253 (0.0022)	0.45392 (0.0010)	0.0733	10.736	578
Elron	$0.64637E-03$ (0.6762)	0.28751 (0.0000)	0.54808 (0.0004)	0.1597	24.376	578
Aryt	$0.26136E-02$ (0.5524)	0.67871 (0.0000)	0.56354 (0.4407)	0.2840	13.496	148

- P-values appear in brackets

Table 5a: Price Linkages Between Dually Listed Stocks

This table reports the results of the error correction model

$$\Delta x_t = \delta_1 + \delta_2 \Delta y_{t-1} + \delta_3 (y_{t-1} - x_{t-1}) + \delta_4 \Delta IX_t + u_t$$

for Wednesdays and Thursdays.

	$\hat{\delta}_1$	$\hat{\delta}_2$	$\hat{\delta}_3$	$\hat{\delta}_4$	$\bar{R}^2$	F	n
Teva	$-0.16002E-02$	0.13446	$0.47101E-01$	1.0376	0.4321	119.179	1158
	(0.2869)	(0.0000)	(0.0306)	(0.0000)			
Robotec	$-0.22954E-02$	0.10932	0.18653	1.0699	0.3535	23.058	298
	(0.2859)	(0.0780)	(0.0094)	(0.0000)			
Elbit	$0.14813E-02$	$0.71312E-01$	0.11563	1.2336	0.5461	187.056	1158
	(0.0297)	(0.0078)	(0.0000)	(0.0000)			
Elron	$0.14019E-02$	$0.66385E-01$	$0.43538E-01$	1.3153	0.5451	185.952	1158
	(0.0568)	(0.0037)	(0.0921)	(0.0000)			
Aryt	$-0.14184E-02$	0.31002	$-0.36913E-01$	1.3141	0.3586	22.995	298
	(0.5586)	(0.0000)	(0.6251)	(0.0000)			

- P-values appear in brackets

Table 5b: Price Linkages Between Dually Listed Stocks

This table reports the results of the error correction model

$$(x_t - x_{t-2}) = \delta_1 + \delta_2 \Delta y_{t-1} + \delta_3 (y_{t-1} - x_{t-2}) + \delta_4 (IX_t - IX_{t-2}) + u_t$$

for Sundays.

	$\hat{\delta}_1$	$\hat{\delta}_2$	$\hat{\delta}_3$	$\hat{\delta}_4$	$\bar{R}^2$	F	n
Teva	$-0.13087E-01$ (0.0000)	0.21506 (0.0002)	0.21421 (0.0000)	1.0516 (0.0000)	0.5901	106.086	867
Robotec	$-0.82768E-03$ (0.7915)	$-0.86375E-01$ (0.3856)	$0.97434E-01$ (0.3669)	1.1260 (0.0000)	0.2760	8.368	222
Elbit	$-0.18122E-02$ (0.1389)	$0.91465E-02$ (0.8905)	$0.26564E-02$ (0.9592)	1.2938 (0.0000)	0.6329	125.692	867
Elron	$0.63844E-03$ (0.6583)	-0.13439 (0.0311)	0.19761 (0.0000)	1.2919 (0.0000)	0.5719	97.630	867
Aryt	$-0.66675E-03$ (0.8638)	$-0.18112E-01$ (0.8831)	0.10912 (0.4385)	0.80753 (0.0074)	0.0930	2.981	223

- P-values appear in brackets

Table 5c: Price Linkages Between Dually Listed Stocks

This table reports the results of the error correction model

$$\Delta x_t = \delta_1 + \delta_2 \Delta y_{t-2} + \delta_3 (y_{t-2} - x_{t-1}) + \delta_4 \Delta IX_t + u_t$$

for Mondays.

	$\hat{\delta}_1$	$\hat{\delta}_2$	$\hat{\delta}_3$	$\hat{\delta}_4$	$\bar{R}^2$	F	n
Teva	$-0.23062E-02$	$-0.28341E-01$	$0.62799E-02$	1.0354	0.4877	74.941	1157
	(0.1244)	(0.4403)	(0.7651)	(0.0000)			
Robotec	$0.13698E-02$	$0.46205E-01$	$0.28948E-01$	0.25379	-0.0212	0.586	297
	(0.5917)	(0.5601)	(0.6829)	(0.3020)			
Elbit	$-0.71074E-03$	$-0.28739E-01$	$0.28030E-01$	1.2511	0.5721	104.861	1157
	(0.4458)	(0.9492)	(0.2922)	(0.0000)			
Elron	$-0.23048E-02$	$-0.52553E-01$	$0.51391E-01$	1.3442	0.5395	92.007	1157
	(0.0323)	(0.2372)	(0.0748)	(0.0000)			
Aryt	$0.37640E-02$	0.11085	$0.48757E-01$	0.43548	-0.0022	0.958	298
	(0.4152)	(0.3949)	(0.6882)	(0.3286)			

- P-values appear in brackets

Table 5d: Price Linkages Between Dually Listed Stocks

This table reports the results of the error correction model

$$\Delta x_t = \delta_1 + \delta_2(y_{t-1} - y_{t-3}) + \delta_3(y_{t-1} - x_{t-1}) + \delta_4 \Delta IX_t + u_t$$

for Tuesdays.

	$\hat{\delta}_1$	$\hat{\delta}_2$	$\hat{\delta}_3$	$\hat{\delta}_4$	$\bar{R}^2$	F	n
Teva	$-0.81821E-02$ (0.0000)	0.14369 (0.0000)	0.11760 (0.0000)	1.1340 (0.0000)	0.5542	90.495	869
Robotec	$0.19215E-02$ (0.4959)	$0.56857E-01$ (0.4572)	$0.26209E-01$ (0.7746)	0.77570 (0.0004)	0.2108	5.720	224
Elbit	$0.13265E-03$ (0.8961)	0.12080 (0.0003)	$0.80682E-01$ (0.0322)	1.3298 (0.0000)	0.5867	103.662	869
Elron	$-0.32263E-03$ (0.7478)	$0.97288E-01$ (0.0001)	$0.33487E-02$ (0.9147)	1.4304 (0.0000)	0.6220	119.474	869
Aryt	$0.18495E-02$ (0.6026)	0.15714 (0.0397)	$0.68419E-01$ (0.4984)	0.83632 (0.0021)	0.2476	6.814	224

- P-values appear in brackets

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