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DAY-OF-THE-WEEK AND SIZE EFFECTS IN EMERGING MARKETS: EVIDENCE FROM CHILE

PABLO MARSHALL*
EDUARDO WALKER*
Pontificia Universidad Católica de Chile

Abstract

This paper studies empirical regularities of daily log returns for the years 1989 through 1996, using aggregate indexes and quintiles rated by size, for a specific emerging market: the case of Chile.
Within the context of the existing literature on emerging markets, this study's contributions are the following: First, earlier studies use aggregate indexes. This one extends the samples and also considers more detailed information, which gives a better representation of individual stock behavior. Second, non-parametric statistical tests are used as a complement of classical ones.
The study's main result shows important day-of-the-week effects on average returns and traded volumes, but not on variances. These results, obtained with both classical and non-parametric methods, are valid for aggregate indexes, quintiles and sub-periods. We also find a seasonal pattern in the size-effect, which it is significantly positive on Fridays and significantly negative on Mondays. In the case of this emerging market, the evidence is inconsistent with the hypothesis that the weekend effect is due to small-investor-portfolio-adjustment-on-Mondays. Unless there is a reason to believe that bad news is put off to the weekend (and good news to Fridays) especially in the case of smaller firms, the seasonal size-effect and the absence of effects in variances also contra-

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dict this hypothesis. There is stronger evidence that favors the hypothesis that investors comply with weekly investment plans, as proposed herein.

Other results confirm that daily returns in the Chilean stock market behave very much like the more developed countries, although the different effects (size, kurtosis and autocorrelation) are more pronounced. This is also true for the size-based quintiles. Results are also consistent with those obtained by other authors that analyze emerging market monthly index returns.

I. Introduction

Studying the returns on financial instruments helps us understand how markets determine the prices of capital assets. In a modern economy, the capital market plays an important role in resource allocation, and thus in the creation of wealth and social welfare.

This paper examines evidence from an "emerging market": the Chilean stock market. Specifically, we study the empirical regularities of daily logarithmic returns, adjusted for dividends, splits and other distributions, for the years 1989 through 1996, both for aggregate indexes and for quintiles rated by size.

Earlier studies on the characteristics of emerging markets have generally used aggregate indexes and/or monthly returns. Examples of this are Bekaert, Erb, Harvey and Viskanta (1998), Bekaert and Harvey (1997), Harvey (1995), Aggarwal and Rivoli (1989), Agrawal and Tandon (1994), Aggarwal and Leal (1996).

Within the context of the existing literature on emerging markets, this study's contributions are the following: first, while many of the earlier studies consider only the characteristics of aggregate indexes, this one considers also stock-price indexes for size-rated quintiles. The latter's performance can be considered, for a number of the characteristics examined, as representative of individual stocks. The indexes' advantage over individual stocks is that the latter carry too much "noise", preventing some important features from being detected. We also consider a relatively recent database.

A second contribution of this work is the use of non-parametric statistical methods as a complement of classical methods used in earlier studies of stock returns, which assume no particular distribution.

The main conclusion hereof is the generalized presence of the "week-end effect" on Chilean stocks: on Mondays, returns are significantly lower than the weekly average, while on Fridays the opposite occurs. Monday average returns are negative in absolute value. This effect is found with both classical and non-parametric methods. It is present in aggregate indexes and also across our size-quintiles and most sub-periods. This is to say that results are robust and do not depend on the aggregation criteria or on the type of test used. This supports the findings of Aggarwal and Leal (1996), but for all the size groupings and periods considered. A sell-on-Friday-buy-on-Monday strategy would offer an additional

return of an annualized 2.7% higher than a buy-and-hold strategy, although transaction costs would make profits disappear. On the other hand, no similar effect is found on variances, which tends to contradict Agrawal and Tandon (1994) and also Aggarwal and Leal (1996).

A Monday effect is found on traded volumes (in CH$) as well. They are significantly lower than the weekly average on that day of the week. Mondays are also significantly lower than Fridays.

In addition, although the evidence for an unconditional size-effect is weak, it is not so for such an effect conditional on the day of the week. There is a negative size-effect on Mondays and a positive one on Fridays.

Jointly, the "week-end effects" in Chile provide evidence against the hypothesis that it exists because small investors adjust their portfolios on Mondays (e.g. Kamara, 1997). They probably contradict the hypothesis that bad news are put off to the week-end, (Pattel and Wolfson, 1984 and Penman, 1987), unless there are reasons to believe that bad news have a larger impact on smaller firms on Mondays. However, this leaves the existence of a positive Friday size-effect unexplained. In addition, considering that on Mondays traded volumes are significantly lower (for most periods and size-quintiles) and that volatilities do not increase, the overall evidence contradicts this hypothesis. However, the hypothesis that investors comply with weekly investment plans, as proposed herein, does fit the facts well.

Other results of the study confirm that daily returns in emerging stock markets behave very much like the more developed countries, although the effects are more pronounced. This is consistent with the results based on monthly indexes obtained by Bekaert, Erb, Harvey, and Viskanta (1998), Bekaert and Harvey (1997), Harvey (1995), and Aggarwal and Rivoli (1989). Daily frequency distributions for stock returns are significantly different from Normal; they show some degree of asymmetry (long right-side tails) and a significant degree of kurtosis (thick tails together with high peaks in the middle). Higher average returns are found in smaller companies than in larger ones. Likewise, there is statistically significant daily return autocorrelation both for levels and variances, for the various indexes, categories, and sub-periods studied.

II. Literature Review

2.1 The shape of daily returns' frequency distribution

Frequency distributions for one stock and various holding periods have been analyzed in the literature to a substantial degree. Fama (1976) was one of the first to analyze stock returns, focusing mainly on the large-sized companies' stocks that make up the Dow Jones index. For daily logarithmic returns he finds leptokurtosis and asymmetry, with long right tails, for the case of individual stocks. Campbell, Lo, and MacKinlay (CLM, 1997) find evidence consistent with the above for the United States stocks based on capitalization deciles during a more recent period (1962 through 1994). In this case, it is usual to find evidence of significant asymmetry.

Recent studies on return distributions in emerging markets, are Bekaert, Erb, Harvey, and Viskanta (1998), and Bekaert and Harvey (1997). They find qualitatively similar results using aggregate indexes and monthly data, albeit more pronounced.

2.2 Short-term predictability

Short-term predictability of the characteristics of daily returns is also studied in the literature. Within this context, the most important finding has been the existence of autocorrelation. However, the existence of auto-regressive heteroscedasticity can also be verified (See CLM, p. 481).

Fama (1976, Table 5.1) shows evidence of daily autocorrelation (with one to ten-day lags) for the Dow Jones stocks. Coefficients are in many cases significant from a statistical standpoint. However, they are not so from an economic point of view, because of their low magnitudes.

For the case of stock portfolios, CLM find the autocorrelation levels to be remarkably higher than for individual stocks, especially for the index with equally weighted stock returns. For this index, the first order autocorrelation amounts to 35%. A recent study on the predictability of returns in emerging markets, although with aggregate indexes and monthly data, is Harvey (1995). He finds that monthly returns are significantly more predictable than in the developed markets, and to depend more on local information variables.

2.3 The day-of-the-week effect

Abundant evidence can be found in the literature on the different expected returns for different days of the week. Particularly French (1980) and Gibbons and Hess (1981) find S&P 500 returns to be negative on Mondays, and high on Wednesdays and Fridays. Ariel (1990) also finds that on the day before a holiday, the situation is similar to that of Fridays. This evidence tends to contradict the Efficient Markets Hypothesis, even if transaction costs eliminate potential earnings, because investors would be expected to reorganize their investments by selling on Wednesdays and Fridays, and buying back on Monday afternoons or Tuesday mornings.

There have been various attempts to explain the phenomenon based on market "microstructure". But, as noted by Kamara (1997), given that this phenomenon is present in many assets and countries,[1] the explanation is unlikely to be of this nature. One alternative explanation is that, often, bad news are postponed for the week-end (Pattel and Wolfson, 1982, and Penman, 1987), although Damodaran (1989) argues that this can explain only part of the effect. It is also stated that individual investors' activities cause part of the phenomenon: during weekdays stock-brokerage houses recommend more 'buys' than 'sells' and toward the end of the week no new recommendations take place. Therefore, sales (portfolio adjustments) would take place on Mondays (see Kamara, 1997, for cites).

Kamara argues that the situation has changed in the United States, mainly because of new markets having lower transaction costs, such as S&P futures'. He finds that during his period of analysis (1963 through 1992) Mondays' negative seasonality became insignificant after April 1982. This coincides with increased transaction volumes by institutional investors as well as with the date when index futures were introduced. Conversely, for small companies the seasonality continues to be present along the entire period. Kamara shows evidence that investors in S&P futures try to take advantage of the Monday seasonal by closing buying positions and taking short positions on Fridays. His most general conclusion is that the market attempts to take the opportunity provided by the Monday seasonal through the lowest cost market. Since for small companies they are still high, the phenomenon persists.

Day-of-the-week effects in emerging markets are also studied in Aggarwal and Rivoli (1989), Agrawal and Tandon (1994) and Aggarwal and Leal (1996), but they concentrate on aggregate stock indexes.

2.4 Size effects

Important evidence regarding the existence of a size-effect also exists in the literature since Banz (1981). For example, Ibbotson Associates (1998) estimate it at 1.7 percent per year. This extra return is usually considered to be a risk premium not directly associated with market beta. Fama en French (1992) consider size to be one of the three most important determinants of the cross-section of expected returns.

2.5 Hypotheses for emerging markets

No *a priori* reasons exist to expect the shape of the stock return distribution for emerging markets to be different from that of other countries. To the extent that in an emerging market there is more macroeconomic instability and more dependency on a few fundamental variables, higher variances and even thicker tails than for developed countries may be justified. Lack of liquidity plus eventual macroeconomic frenzies may further justify this hypothesis.[2]

As for autocorrelation, inasmuch as they are a reflection of the efficient markets hypothesis, because of eventual lower traded volumes and poorer information quality, they are expected to be larger.

With regards to the "day-of-the-week effect",[3] if no active index futures market exists, a similar phenomenon may be expected, especially for smaller companies, as long as the valid argument is that of small investors adjusting their portfolios on Mondays. For larger companies the phenomenon should decline, particularly for more recent periods, since there is a tendency for domestic and foreign institutional investors to be the ones who purchase such stocks, many of which are also traded as ADRs, presumably setting their prices. Should the "bad news" hypothesis prove to be right, then the phenomenon should be apparent for most of the stocks and periods. Conversely, lower information and transaction costs should make the phenomenon disappear.

The "day-of-the-week" effect can also exist for higher-order moments, such as the second. To the extent that more information is accumulated during the weekend, higher return volatility might be expected for Mondays. Such a result may indirectly support the bad-news-during-the-week-end hypothesis.

Finally, inasmuch as the extra return earned by smaller firms corresponds to a risk premium, we also expect it to be present in emerging markets.

2.6 The plan compliance hypothesis (PCH)

An alternative hypothesis, along the line of the portfolio adjustment idea, is that investors, both institutional and individual, seek to complete their plans before the end of the week (month, holiday, etc.), many times delayed, especially purchases. On Mondays (or early in the month, or after a holiday) the planning period is young and plans just become formulated.[4] If the same delay affects the planned sales (not mainly the purchases) we would be left with an ambiguous effect. However, to the extent that sales are interpreted as an explicit recognition of past mistakes, and that investors are reluctant to admit them, sales would occur randomly over time and should not be concentrated in certain days of the week or month.[5] Altogether, the above means positive price pressures on Fridays and negative price pressures on Mondays. This will be termed herein the "plan compliance hypothesis" (PCH).

PCH could be distinguished from the bad-news hypothesis in that the latter probably implies high transaction volumes on Mondays,[6] whereas PCH means relatively lower volumes on Mondays and higher ones late in the week, particularly Fridays.

It is interesting to notice that some of the results found in the literature regarding other "seasonals" are also consistent with the PCH. For example, Agrawal and Tandon (1994) document the following "effects": week-end; turn-of-the-month effect; end-of-December; and pre-holiday, among others. These are present in many of the nineteen country indexes analyzed by them, including a few of the so-called emerging markets. However, they find that the daily seasonals disappear in the 1980's.

III. Data Description And Sample Selection

The data used herein are daily returns taken from a sample of stocks traded at the Santiago Stock Exchange, from January 2, 1989 through December 31, 1996.

Returns are calculated as percentages, as the adjusted differences of price logarithms. The adjustments include dividends, preemptive subscription rights, exchanges, free issues and splits, and are incorporated in the return calculations. Only returns for two consecutive working days are considered (which obviously includes returns from Friday to Monday, that is assigned to this latter day). This means that returns for over two or more days are not considered, because there were days where no trade took place.

The period analyzed is divided into four sub-periods, namely the two-year periods covering the years 1989-1990, 1991-1992, 1993-1994 and finally 1995-1996.

In order to avoid survivorship biases in selecting the sample, the stocks selected for each sub-period were chosen according to information available in the immediately previous two-year span, based on two general criteria: Chilean peso-denominated volume and number of days with transactions. Thus, stocks selected for the 1989-1990 period are those that during 1987-1988 were traded on a number of days equal to or larger than 250, with daily average volume of Ch$ 300,000 or more. Stocks selected for the 1991-1992 sub-period are those that during 1989-1990 were traded on a number of days equal to or larger than 250, with daily amounts of Ch$ 500,000 or more. Those selected for 1993-1994 are those that during 1991-1992 were traded on a number of days equal to or larger than 250, with daily amounts traded of Ch$ 700,000 or more. Finally, stocks selected for the 1995-1996 sub-period are those that during 1993-1994 were traded on a number of days equal to or larger than 250, with daily volumes traded of Ch$ 1,000,000 or more.

The number of stocks selected for each sub-period is the following: for 1989-1990, 33 stocks; for 1991-1992, 34 stocks; for 1993-1994, 68 stocks and, finally, for 1995-1996 the number of stocks selected was 81. The overall number of different stocks selected for the entire period is 97.

For each of the sub-periods an equally-weighted index was calculated, as the mean of daily returns of the stocks selected for the sub-period, and a value-weighted index, based on the market capitalization of the day previous to that for which the return is calculated. The value-weighted index represents a strategy to buy and hold a fixed and identical fraction of the total number of outstanding shares of each of the stocks considered.

In addition, stocks selected for each sub-period were grouped into quintiles according to company size, defined as the market capitalization at the beginning of the period. For each quintile an equally-weighted index return is calculated as a way to represent a typical stock from the respective quintile. Quintile 1 represents the smallest firms in terms of market capitalization, and Quintile 5 the largest.

We also consider in the analysis value- and equally-weighted indexes for the entire period. These indexes are obtained by merging together the corresponding indexes of each sub-period.

IV. The Results

4.1 The shape of the distribution, size and other characteristics

Table 1 shows basic descriptive statistics for each period and for each index. Also the number of stocks originating each of the indexes is shown, together with the weight of each quintile and the number of daily return observations. Descriptive statistics stand for the mean, the standard deviation, the symmetry coefficient defined as the standardized return's third moment, the kurtosis coefficient defined as the fourth moment of standardized returns, and the minimum and maximum values. In the lower segment of the table the descriptive statistics for the equally- and value-weighted indexes for the entire 1989-1996 period are shown.

Comparing the average returns of the different periods, the equally-weighted index's average return is higher in almost every case. This suggests that average returns of larger companies have been lower compared to those of smaller companies. This effect can be confirmed by observing the behavior of average returns within the quintiles. Larger companies' quintiles yield, for most sub-periods, present lower returns than smaller companies. Formal hypothesis tests only find differences in the quintiles' average returns in the 1991-92 and 1995-96 sub-periods at a 6% significance level. For the other sub-periods, the equal-expected-returns hypothesis is accepted. Thus, the existence of a size-effect is not clear.

Also differences in average returns for the different sub-periods can be observed, for both equally- and value-weighted indexes. Particularly, the average return for 1995-96 is significantly lower than the average returns of previous periods. The highest returns are observed for the 1991-92 period, where the equally- and value-weighted average returns are 0.255% and 0.232%, respectively.

In terms of the returns' standard deviations, Table 1 shows value-weighted indexes having greater dispersion than the equally-weighted indexes for all the periods examined. This result is opposed with the fact that, for most periods, the first quintiles (standing for the smaller companies) have greater dispersion. It can be explained because the value-weighted index is more concentrated in a few large companies and, therefore, is less diversified. As for return distribution symmetry, Table 1 shows that there is a positive asymmetry in most indexes and periods, suggesting a higher presence of unusually high returns than unusually low ones. This can be verified by comparing in Table 1, the minimum and maximum returns. In terms of kurtosis, coefficients are larger than 3, which is the Normal distribution's coefficient.

Table 2 shows daily return normality, autocorrelation, and heteroscedasticity tests for each of the return indexes and each of the periods examined. The normality test used is Doornik and Hansen's (1994), broken down into one symmetry test and one kurtosis test.

As for the symmetry test of the distribution and for significance levels of 5%, distribution symmetry is accepted for both the equally-weighted and the value-

TABLE 1

BASIC DESCRIPTIVE STATISTICS FOR DAILY RETURNS

Periods; indexes; number of stocks on each index; weight of each Quintile; number of observations; mean, standard deviation, symmetry and kurtosis coeficients and minimum and maximum values. Returns were calculated as percentages, as the differences of price logarithms adjusted by dividends and other distributions. Quintile 1 represents the smallest.

	Index	Stocks	Weight	*n*	Mean	Stand. Dev.	Symmetry	Kurtosis	Minimum	Maximum
1989-1990	Equally Weighted	33		494	0.210	0.878	0.198	4.452	–2.629	3.505
	Value Weighted	33		494	0.222	1.121	0.108	4.472	–3.754	4.662
	Quintile 1	6	0.023	485	0.187	2.510	0.660	8.500	–10.178	14.310
	Quintile 2	7	0.059	494	0.243	1.536	0.158	4.952	–4.513	7.041
	Quintile 3	7	0.122	494	0.289	1.288	–0.076	4.084	–4.810	4.164
	Quintile 4	7	0.226	493	0.323	1.555	0.729	6.586	–4.912	9.393
	Quintile 5	6	0.569	494	0.206	1.480	0.095	4.297	–5.090	5.567
1991-1992	Equally Weighted	34		498	0.255	1.123	–0.081	4.344	–4.565	3.850
	Value Weighted	34		498	0.232	1.274	–0.058	4.264	–4.939	4.843
	Quintile 1	7	0.023	498	0.249	2.343	–0.136	7.287	–15.212	9.488
	Quintile 2	7	0.063	498	0.185	1.729	0.461	5.964	–6.549	9.691
	Quintile 3	7	0.125	498	0.442	1.634	0.415	5.106	–5.837	7.424
	Quintile 4	7	0.220	498	0.134	1.421	0.327	5.649	–4.800	7.397
	Quintile 5	6	0.569	496	0.256	1.450	0.412	5.204	–5.196	7.274
1993-1994	Equally Weighted	68		504	0.222	0.720	0.151	4.051	–2.480	3.067
	Value Weighted	68		504	0.182	0.962	–0.101	4.14	–4.107	3.448
	Quintile 1	13	0.010	504	0.337*	1.228	0.429	3.832	–2.977	4.996
	Quintile 2	14	0.032	504	0.263	1.180	0.161	3.598	–3.706	4.580
	Quintile 3	14	0.081	504	0.279	0.997	0.142	4.026	–2.743	4.233
	Quintile 4	14	0.172	504	0.232	1.085	0.084	4.28	–3.849	3.801
	Quintile 5	13	0.704	504	0.152	1.064	0.084	4.312	–4.478	4.832
1995-1996	Equally Weighted	81		498	0.067	0.812	0.900	10.727	–3.856	5.430
	Value Weighted	81		498	0.011	1.034	0.883	10.639	–4.599	7.053
	Quintile 1	16	0.015	498	0.153*	1.043	0.459	4.226	–3.402	4.330
	Quintile 2	16	0.040	498	0.09	1.193	0.345	6.93	–5.216	5.682
	Quintile 3	17	0.085	498	0.056	1.036	0.558	10.274	–5.253	6.521
	Quintile 4	16	0.166	498	–0.032	1.015	0.624	10.081	–4.968	6.777
	Quintile 5	16	0.694	498	0.001	1.176	0.703	9.436	–5.002	7.700
1990-1996	Equally Weighted			1994	0.189†	0.898	0.231	5.829	–4.565	5.430
	Value Weighted			1994	0.162	1.106	0.195	5.607	–4.939	7.053

(*) Significant at the 5% with respect to Quintil 5.
(†) Significant at the 5% with respect to value weighted.

TABLE 2

NORMALITY, AUTOCORRELATION AND HETEROSCEDASTICITY TESTS FOR DAILY RETURNS

Periods; *p* values of the Doornik and Hansen (1994) normality test for the symmetry and kurtosis; autocorrelations of order 1 and 5 and *p* values of the Ljung and Box (1978) test; *p* value of the sign test for autocorrelation; autorregresive heteroscedasticity as the autocorrelation of order 1 for the squared residuals of an AR(5) model and *p* values. Returns were calculated as percentages, as the differences of price logarithms adjusted dividends and other distributions. Quintile 1 represents the smallest.

Period	Index	Normality		Autocorrelation				Heteroscedasticity	
		p Value Simmetry	*p* Value Kurtosis	*r* (1)	*r* (5)	*p* Value Ljung–Box	*p* Value Signs	*r* (1)	*p* Value Signs
1989-1990	Equally Weighted	0.071	0.000	0.405*	0.083	0.000	0.000	0.164*	0.000
	Value Weighted	0.321	0.000	0.361*	0.070	0.000	0.000	0.160*	0.000
	Quintile 1	0.000	0.000	0.222*	0.017	0.000	0.440	0.166*	0.000
	Quintile 2	0.149	0.000	0.235*	–0.002	0.000	0.000	0.135*	0.000
	Quintile 3	0.486	0.000	0.326*	0.066	0.000	0.000	0.121*	0.000
	Quintile 4	0.000	0.000	0.285*	0.048	0.000	0.000	0.114*	0.000
	Quintile 5	0.382	0.000	0.327*	0.073	0.000	0.000	0.217*	0.000
1991-1992	Equally Weighted	0.453	0.000	0.276*	0.076	0.000	0.000	0.244*	0.000
	Value Weighted	0.591	0.000	0.305*	0.014	0.000	0.000	0.214*	0.000
	Quintile 1	0.210	0.000	0.125*	0.080	0.007	0.000	0.145*	0.000
	Quintile 2	0.000	0.000	0.173*	0.052	0.002	0.002	0.202*	0.000
	Quintile 3	0.000	0.000	0.338*	0.140*	0.000	0.000	0.171*	0.000
	Quintile 4	0.003	0.000	0.209*	0.012	0.000	0.001	0.058	0.000
	Quintile 5	0.000	0.000	0.233*	0.022	0.000	0.000	0.295*	0.000
1993-1994	Equally Weighted	0.163	0.000	0.420*	0.086	0.000	0.000	0.236*	0.000
	Value Weighted	0.349	0.000	0.267*	–0.023	0.000	0.000	0.331*	0.000
	Quintile 1	0.000	0.129	0.239*	0.015	0.000	0.000	0.116*	0.000
	Quintile 2	0.136	0.012	0.393*	0.039	0.000	0.000	0.172*	0.000
	Quintile 3	0.187	0.000	0.304*	0.107*	0.000	0.000	0.197*	0.000
	Quintile 4	0.438	0.000	0.379*	0.118*	0.000	0.000	0.226*	0.000
	Quintile 5	0.437	0.000	0.254*	0.017	0.000	0.000	0.327*	0.000
1995-1996	Equally Weighted	0.000	0.000	0.307*	–0.043	0.000	0.000	0.261*	0.000
	Value Weighted	0.000	0.000	0.233*	–0.074	0.000	0.000	0.296*	0.000
	Quintile 1	0.000	0.006	0.282*	0.020	0.000	0.000	0.248*	0.000
	Quintile 2	0.002	0.000	0.287*	–0.026	0.000	0.000	0.434*	0.000
	Quintile 3	0.000	0.000	0.340*	–0.008	0.000	0.002	0.250*	0.000
	Quintile 4	0.000	0.000	0.226*	–0.066	0.000	0.000	0.197*	0.000
	Quintile 5	0.000	0.000	0.218*	–0.070	0.000	0.000	0.289*	0.000
1990-1996	Equally Weighted	0.000	0.000	0.340*	0.060	0.000	0.000	0.261*	0.000
	Value Weighted	0.000	0.000	0.300*	0.007	0.000	0.000	0.255*	0.000

(*) Significant at the 5%.

weighted indexes in the 1989-1990, 1991-1992 and 1993-1994 periods. On the contrary, in the 1995-1996 period, distribution symmetry is rejected at every reasonable level of significance. The kurtosis test is rejected for all the sub-periods and in all the calculated indexes.

Comparing the results with those of CLM (p. 67), standard deviations found for Chile are higher between 18% for the simple average and 38% for the weighted average, which confirms the hypothesis of greater variability in emerging markets. As for asymmetry, CLM (p. 21) find it positive for individual stocks but negative for indexes. Excess kurtosis above the Normal distribution, is estimated between 26% (for the simple average) and 34% (for the weighted average). By contrast, here asymmetry is positive in aggregate indexes, the same as in quintiles, being significant in several cases, especially when we consider the entire period. As for kurtosis, excesses above the normal distribution are much higher in the Chilean case, as expected, almost twice the coefficient of a Normal distribution.

4.2 Short-term predictability

Autocorrelation is analyzed in Table 2. It shows first and fifth order autocorrelation coefficients; the p-value of the Ljung and Box (1978) test for the first 5 autocorrelation estimates; and the p-value of a non-parametric sign test.[7] First-order return autocorrelation fluctuates around 0.35 and is larger in equally- than in value-weighted indexes. The fifth-order ones are much lower in magnitude. The standard error of the autocorrelation coefficients, considered separately, is approximately 0.045, showing that first-order autocorrelations are significant while most of fifth-order ones are not. Both the Ljung-Box (1978) test and the sign test report p-values that are too small to accept that the returns correspond to a random sequence.

It is worth noting that the order of magnitude for the daily autocorrelation coefficient for the equally-weighted index has an order of magnitude similar to its homonym based on United States CRSP information (CLM, p. 67), contrary to what was expected. However, the value-weighted index autocorrelation is much higher than its American equivalent, reaching levels 66% higher. Thus, "large" company returns in Chile are more highly auto-correlated than "large" companies in the United States. Naturally, most "large" Chilean companies would be rather "small" for US standards, and will probably behave more like that asset class. Provided that this order of magnitude in the auto-correlation patterns is not exploitable by trading strategies in the US,[8] in all likelihood it is even less exploitable in Chile, provided higher transaction costs and lower liquidity.

The last two columns of Table 2 show indicators that measure the auto-regressive heteroscedasticity of the return indexes. The first of these two columns shows the first-order autocorrelation of the squared residuals of a fifth order auto-regressive model for observed returns; whereas the second shows the p-value of a non parametric sign-test for the squared residuals. Although the first order autocorrelation coefficients are smaller than those for the observed returns, both tests imply significant short-term auto-regressive heteroscedasticity.

4.3 Day-of-the-week effect

Table 3 shows the "day-of-the-week effects" for each index and every period. These are defined as the arithmetic difference between the average return of one day and the average returns of all the days of the week. The last two columns in Table 3 stand for hypothesis tests to measure the statistical significance of the day-of-the-week effects on averages. The first one is the F-test of a variance analysis model and the second is Kruskall-Wallis' non-parametric test. Individual tests, that compare the mean of each day with respect to the mean of the week and the mean of Mondays, are also reported in Table 3. The individual tests are computed using the Newey and West (1987) standard error correction for heteroscedasticity and serial correlation.

The day-of-the-week effects on returns are statistically different from zero in most periods and for most of the indexes. The only sub-period where effects are not significant at 5%, for neither the equally- nor the value-weighted indexes, is 1993-1994. It is worth noticing that in most cases the day-of-the-week effects are significant only on Mondays and Fridays. Kruskall-Wallis' non-parametric tests confirm the results of the F-test. On a more detailed level, these results confirm those of Agrawal and Tandon (1994) and Aggarwal and Leal (1996). It is also interesting to notice that, except for the 1993-1994 period, there is a monotonic behavior in daily returns: they seem to increase as Friday approaches. For almost all periods and quintiles, and with a significance level equal to 5%, the mean return on Friday is higher than the mean return on Monday.

Figure 1 shows the average (across periods) day effects by quintiles. This representation shows that day effects increase monotonically during the week and that the effects for quintiles 1 and 2 are more pronounced, particularly on Mondays and Fridays. This is analyzed below in more detail.

Comparing day-of-the-week effects on returns with those of other (more developed) countries in the world, the results found herein are more pronounced (see Jaffe and Westerfield, 1985, p. 435). Considering the entire period and taking the weighted index as a reference, the Monday effect (as the difference in daily average in each country) is 50%, 17%, 17% and 163% higher than in the United States, Canada, the United Kingdom and Australia, respectively. Also, returns on Fridays are between 1 and 7 times those of the other countries. When compared with previous findings for Chile (Aggarwal and Leal, 1996) Monday's below-average returns are less negative here but Friday's above-average returns have increased. The comparison with other emerging markets leads to the same conclusions as before.

Table 4 shows day-of-the-week effects on variances of each of the indexes and sub-periods. Day-of-the-week effects on variances are defined as the ratio of the one-day variance to the averaged variances of all the days of the week. The two last columns of Table 4 show two test statistics to study their significance. The first is Bartlett's test, of equal variances whereas the second is Kruskall-Wallis' non-parametric test applied on the absolute values of the differences between the returns and the average of the respective day.

TABLE 3

DAY-OF-THE-WEEK EFFECTS ON MEANS FOR DAILY RETURNS

Periods; differences between the mean of each day and the mean of the week; p value of the F test; p value of the non parametric Kruskal-Wallis test. Returns were calculated as percentages, as the differences of price logarithms adjusted by dividends and other distributions. Quintile 1 represents the smallest.

Periods	Index	Monday	Tuesday	Wednesday	Thursday	Friday	p Values F	Kruskal-Wallis
1989-1990	Equally Weighted	–0.142	–0.109	–0.068	0.134 †	0.185 *†	0.023	0.028
	Value Weighted	–0.188	–0.098	–0.074	0.159 †	0.200 *†	0.058	0.032
	Quintile 1	–0.084	–0.001	–0.236	–0.012	0.333	0.607	0.093
	Quintile 2	–0.241	–0.172	–0.131	0.184	0.361 *†	0.023	0.064
	Quintile 3	–0.057	–0.086	–0.138	0.168	0.113	0.377	0.289
	Quintile 4	–0.311*	–0.212	–0.087	0.267 †	0.343 *†	0.008	0.021
	Quintile 5	–0.179	–0.114	–0.136	0.23	0.199	0.134	0.102
1991-1992	Equally Weighted	–0.315*	–0.201*	0.015†	0.147 †	0.354 *†	0.000	0.000
	Value Weighted	–0.317*	–0.095	0.041†	0.106 †	0.265 *†	0.018	0.012
	Quintile 1	–0.702*	–0.483*	0.062†	0.359 †	0.765 *†	0.000	0.000
	Quintile 2	–0.488*	–0.299	–0.053	0.304 *†	0.536 *†	0.000	0.000
	Quintile 3	–0.169	–0.218	–0.046	0.073	0.360 *†	0.095	0.009
	Quintile 4	–0.364*	–0.258*	0.173†	0.13 †	0.319 *†	0.002	0.000
	Quintile 5	–0.330*	–0.068	–0.013	0.175 †	0.236 †	0.049	0.045
1993-1994	Equally Weighted	–0.158*	0.053†	0.058†	0.022	0.025	0.181	0.166
	Value Weighted	–0.119	0.083	0.083	–0.014	–0.034	0.525	0.658
	Quintile 1	–0.311*	0.047†	0.094†	0.074 †	0.097 †	0.083	0.035
	Quintile 2	–0.334*	0.073†	0.081†	0.05 †	0.129 †	0.035	0.051
	Quintile 3	–0.198*	0.043	0.091†	–0.006	0.070	0.237	0.356
	Quintile 4	–0.125	0.078	0.003	0.06	–0.015	0.702	0.835
	Quintile 5	–0.179	0.114	0.099	0.018	–0.053	0.272	0.352
1995-1996	Equally Weighted	–0.200*	–0.080	0.017	0.043 †	0.219 *†	0.005	0.000
	Value Weighted	–0.231*	–0.048	–0.022	0.021	0.280 *†	0.013	0.003
	Quintile 1	–0.290*	–0.089	–0.035	0.122 †	0.293 *†	0.001	0.002
	Quintile 2	–0.273*	–0.088	–0.035	0.097 †	0.299 *†	0.012	0.002
	Quintile 3	–0.220*	–0.209*	0.124†	0.039	0.265 *†	0.002	0.000
	Quintile 4	–0.219*	–0.050	0.060	–0.029	0.238 *†	0.028	0.007
	Quintile 5	–0.252*	–0.048	–0.018	0.019	0.300 *†	0.023	0.007
1990-1996	Equally Weighted	–0.204*	–0.084*	0.006†	0.087 *†	0.194 *†	0.000	0.000
	Value Weighted	–0.214*	–0.039†	0.008†	0.068 †	0.177 *†	0.000	0.000

(*) Significant at the 5% with respect to the mean of the week.
(†) Significant at the 5% with respect to monday.

TABLE 4

DAY-OF-THE-WEEK EFFECTS ON VARIANCES FOR DAILY RETURNS

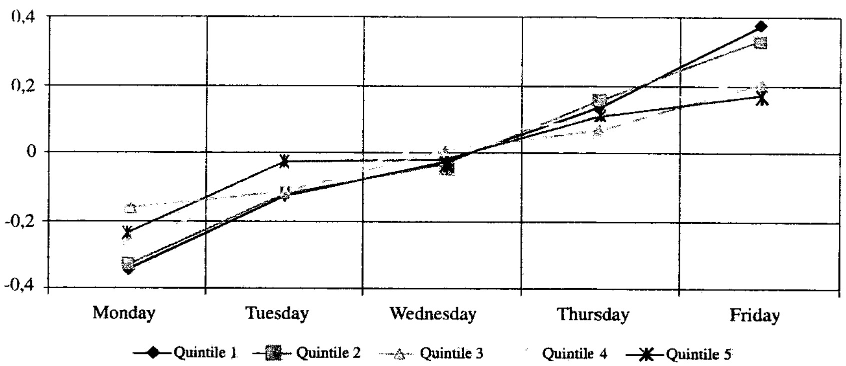
Periods; ratios of day-specific and general variances; *p* value of the Bartlett test; *p* values of the Kruskall-Wallis test for the absolute values. Returns were calculated as percentages, as the differences of price logarithms adjusted by dividends and other distributions. Quintile 1 represents the smallest†.

Periods	Index	Monday	Tuesday	Wednesday	Thursday	Friday	*p* Values Bartlett	Kruskal-Wallis
1989-1990	Equally Weighted	0.984	1.063	1.026	0.944	0.978	0.801	0.843
	Value Weighted	1.061	1.063	0.991	0.916	0.962	0.530	0.311
	Quintile 1	1.198*	1.062	0.900	0.879	0.928	0.009	0.344
	Quintile 2	0.902	0.957	1.124	1.007	0.992	0.263	0.796
	Quintile 3	1.042	1.125*	0.942	0.912	0.967	0.222	0.518
	Quintile 4	1.008	1.052	0.914	0.931	1.085	0.360	0.351
	Quintile 5	1.096	0.995	1.026	0.986	0.886	0.334	0.357
1991-1992	Equally Weighted	0.992	0.975	0.968	1.129	0.923	0.329	0.889
	Value Weighted	1.038	0.967	0.956	1.137*	0.881	0.125	0.280
	Quintile 1	0.824*	0.894	1.085	1.099	1.074	0.010	0.069
	Quintile 2	0.987	1.010	0.765*	1.242*	0.935	0.000	0.428
	Quintile 3	1.008	1.147*	0.858*	1.063	0.889	0.022	0.726
	Quintile 4	0.999	0.916	1.037	1.156*	0.866*	0.043	0.364
	Quintile 5	1.058	0.895	0.961	1.111	0.960	0.210	0.243
1993-1994	Equally Weighted	1.028	0.983	1.020	0.995	0.973	0.979	0.854
	Value Weighted	0.964	1.018	1.056	1.023	0.933	0.746	0.301
	Quintile 1	0.996	1.081	0.890	0.984	1.038	0.389	0.146
	Quintile 2	1.112	0.892	1.067	0.976	0.936	0.156	0.998
	Quintile 3	1.005	0.966	1.024	0.992	1.013	0.983	0.749
	Quintile 4	1.086	0.947	1.033	0.999	0.925	0.502	0.640
	Quintile 5	0.982	1.032	1.064	0.976	0.941	0.757	0.255
1995-1996	Equally Weighted	0.946	1.114	0.867*	1.05	1.002	0.126	0.982
	Value Weighted	0.937	1.079	0.910	1.008	1.055	0.374	0.943
	Quintile 1	1.017	0.987	0.939	1.059	0.994	0.828	0.542
	Quintile 2	1.032	1.118	0.873*	0.982	0.976	0.175	0.683
	Quintile 3	0.946	1.09	0.854*	1.083	1.008	0.097	0.355
	Quintile 4	0.891	1.204*	0.896	1.004	0.969	0.013	0.236
	Quintile 5	0.971	1.046	0.902	1.025	1.048	0.543	0.573
1990-1996	Equally Weighted	0.986	1.028	0.969	1.048	0.967	0.375	0.862
	Value Weighted	1.009	1.025	0.975	1.035	0.954	0.444	0.465

(*) Significant at the 5% with respect to the mean of the week.
(†) Test of hypotheses comparing the variances on friday with respect to the variances on monday are not significant at the 5%.

FIGURE 1

AVERAGE DAY EFFECTS BY QUINTILES



The general results that follows from Table 4 are that no day-of-the-week effects exist for variances. Both tests report very high p-values. Daily variance tests do not show higher variances for specific days either. Even if we compare the variances on Fridays with respect to the variances on Mondays, the associated p-values for all periods and quintiles are higher than 5%. These results contradict previous findings. It should be noted, however, that the reported tests assume independent samples.

Apart from the tests for mean and variance effects reported in Table 3 and Table 4, Kolmogorov-Smirnov non-parametric tests, that compare the return distribution of different days were performed using the standarized returns according to day-specific means and variances. The results of these tests show no significant differences in the distributions. Of all 120 possible comparisons with respect to the distribution of Mondays, in only two cases the null hypothesis of equal distributions is rejected at the 5% significance level.[9]

Tables 3 and 4 also show new results: the week-end effect exists for both large and small companies (no significant differences between quintiles) and that said effect does not tend to decline over time. This poses a doubt on the validity of the hypothesis of small investors adjusting their portfolios, significantly affecting the prices of the less liquid (smaller) stocks. The "bad-news" during the week-end hypothesis is a plausible explanation for the phenomenon in Chile. Nevertheless, the variance tests show no signs of volatility-increasing information arriving during the week-end, so as to be reflected on Mondays. Finally, the evidence is consistent with our "plan compliance hypothesis" (PCH).

4.4 Daily seasonals in traded volumes

If the portfolio-adjustment-on-Mondays hypothesis were correct, we should observe higher trading volumes, at least for some of the smaller stocks, on that

TABLE 5

DAY-OF-THE-WEEK EFFECTS ON (Ch$) TRADED VOLUMES

Periods; ratios of day-specific and general variances; p value of the Bartlett test; p values of the Kruskall-Wallis test for the absolute values. Returns were calculated as percentages, as the differences of price logarithms adjusted by dividends and other distributions. Quintile 1 represents the smallest†.

Periods	Index	Monday	Tuesday	Wednesday	Thursday	Friday	p Values F	Kruskal-Wallis
1989-1990	Total Traded Volume	–0.222*	0.029†	0.064 †	0.150 *†	–0.022 †	0.000	0.000
	Quintile 1	–0.098	–0.061	0.040	0.107	0.012	0.760	0.885
	Quintile 2	–0.238*	0.084†	0.064 †	0.130 †	–0.040	0.042	0.060
	Quintile 3	–0.235*	0.128†	0.029 †	0.086 †	–0.008	0.058	0.173
	Quintile 4	–0.178*	–0.046	0.047 †	0.145 *†	0.032 †	0.047	0.041
	Quintile 5	–0.194*	0.036†	0.072 †	0.112 *†	–0.027	0.004	0.002
1991-1992	Total Traded Volume	–0.145*	0.017†	0.030 †	0.028 †	0.070 †	0.023	0.050
	Quintile 1	–0.163*	0.006	0.096 †	0.097 †	–0.036	0.128	0.214
	Quintile 2	–0.151*	0.048	0.058 †	–0.030	0.075 †	0.183	0.255
	Quintile 3	–0.158*	0.007	0.116 †	0.045	–0.009	0.137	0.096
	Quintile 4	–0.170*	–0.004	0.033 †	0.017	0.123 †	0.077	0.113
	Quintile 5	–0.169*	0.020†	0.060 †	0.020 †	0.069 †	0.035	0.044
1993-1994	Total Traded Volume	–0.177*	0.005†	0.071 †	0.054 †	0.047 †	0.022	0.039
	Quintile 1	–0.243*	–0.003†	0.041 †	0.049 †	0.156 *†	0.002	0.005
	Quintile 2	–0.218*	0.027†	0.161 *†	0.068 †	–0.037	0.003	0.010
	Quintile 3	–0.109*	0.000	0.086	0.025	–0.002	0.534	0.400
	Quintile 4	–0.159*	0.087†	0.029 †	0.059 †	–0.016	0.060	0.041
	Quintile 5	–0.166*	0.019†	0.067 †	0.046 †	0.034 †	0.017	0.015
1995-1996	Total Traded Volume	–0.241*	0.032†	0.043 †	0.130 *†	0.037 †	0.000	0.000
	Quintile 1	–0.172*	0.052†	0.020	0.036	0.064 †	0.185	0.137
	Quintile 2	–0.163*	0.013†	0.039 †	0.098 †	0.014 †	0.030	0.010
	Quintile 3	–0.216*	0.029†	0.083 †	0.071 †	0.032 †	0.001	0.002
	Quintile 4	–0.258*	0.077†	0.047 †	0.142 *†	–0.008 †	0.000	0.000
	Quintile 5	–0.193*	0.001†	0.055 †	0.089 *†	0.049 †	0.000	0.000
1990-1996	Total Traded Volume	–0.194*	0.026†	0.044 †	0.089 †	0.035 †	0.001	0.005

(*) Significant at the 5% with respect to the mean of the week.
(†) Significant at the 5% with respect to monday.

day of the week. Alternatively, one should probably also observe a sale-induced increase in trading volumes on Mondays if the bad-news hypothesis were right.

Table 5 shows evidence of daily seasonals in (Ch$) traded volumes. The numbers in the table represent the difference between the log of the trading volume and the log of the weekly average traded volume. Thus, they can be roughly interpreted as percent differences.

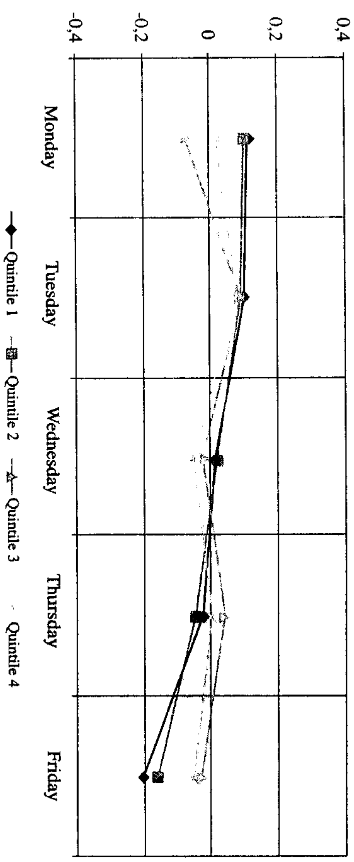
The only effect that is clearly observed is a significantly reduced trading volume on Mondays (between 15% and 20%). The day of the week that tends to have the highest trading volume is Thursday (around 9%), although it is seldom significantly higher than average. Our hypothesis of weekly plan compliance is broadly consistent with this evidence, although taken to an extreme it implies higher purchase-induced trading volumes on Fridays, which is not observed.

4.5 Daily seasonals and the size-effect

As mentioned above (section 4.1), the evidence regarding a size effect is not strong. However, the analysis of the return differences between the largest quintile and the rest (Q5-Qk) indicates certain surprising facts: it has clear seasonal patterns. Figure 2 illustrates this effect. At least with respect to quintiles 1 and 2, the excess return of Q5 tends to be positive on Mondays and negative on Fridays. The negative effects on Fridays and the Monday minus Friday excess returns are both significant. Friday excess returns are significantly smaller. This reveals an interesting daily pattern for the size effect.

FIGURE 2

DIFFERENCES BETWEEN QUINTILE 5 AND OTHER QUINTILES



V. Conclusions

This article studies the case of a specific emerging market: the Chilean stock market, for the years 1989-1996. Specifically, daily logarithmic returns are analyzed in order to determine the extent to which empirical regularities found in the literature are also present in this market. Alternative hypotheses are contrasted with this new evidence.

Results show significant differences in returns of different sub-periods and also that returns of quintiles of larger companies have been, for most sub-periods, lower in terms of average returns and standard deviations than for the smaller companies. However, the evidence for an unconditional size-effect is weak. Distribution Normality is rejected for all indexes and for all periods, because of excess kurtosis. Distribution asymmetry is, in general, positive, although it is not always significant.

As for short-term predictability, results show strong evidence of autocorrelation for both returns and return variances.

The study shows significant day-of-the-week effects for average returns, traded volumes and size premia but not for variances and standardized return distributions. Effects on means are found for both large and small companies; they remain present over time; are more pronounced than those in other (developed) countries of the world; and are particularly significant on Mondays and Fridays. Effects with traded volumes show significant reductions on Mondays. The size premia (defined as small minus large) is significantly positive on Fridays and negative on Mondays. In any case, international comparisons have to be performed with great care given the important liquidity differences between Chile and more developed countries. However, provided that these conclusions hold even for the largest, more liquid portfolios, it is unlikely that liquidity is the sole responsible for these exacerbated effects.

Our results pose a doubt on the general validity of the hypothesis of small investors adjusting their portfolios on Mondays since, for all quintiles, traded volumes tend to be lower on that day. The "bad-news" for the week-end hypothesis seems an unlikely explanation for the phenomenon in Chile. This is true because of the daily patterns in the size-effect (unless there are reasons to believe that small firms are particularly prone to bad news during the weekend, which still leaves the reversal of that pattern on Fridays unexplained) and because the variance tests show no signs of volatility-increasing information on Mondays (or increases in sale-induced trading volumes for any quintile).

Finally, the evidence is most consistent with our "plan compliance" hypothesis (PCH). PCH indicates that investors, both institutional and individual, seek to complete their typically delayed plans (especially purchases) before the end of the planning interval (week, month, next holiday, etc.). On Mondays (or early in the month, or after a holiday) the planning period is young and plans just become formulated. The same pattern should not affect sales as much, if we think that these are interpreted as an explicit recognition of past mistakes and that investors are reluctant to do so. Thus, sales should occur randomly. Altogether, this means

positive price pressures and higher purchase-induced trading volumes towards the end of the week (or planning period) and negative price pressures and lower volumes on Mondays (or at the beginning of the planning period). The monotonically increasing average return towards the end of the week is also consistent with the PCH. The fact that smaller (lower volume) firms tend to exhibit the same but exacerbated pattern, leading to the daily seasonal in the size-effect, also supports this hypothesis. In this sense, the day-of-the-week-effect is human nature.

Notes

1 See Roll (1984) and Jaffe and Westerfield (1985).

2 We thank an anonymous referee for pointing this out.

3 Aggarwal and Leal (1996) and Soria and Zúñiga (1996) find the effect on the IGPA Chilean stock-price index. Using data until 1991, the former also find the effect for most of the emerging markets analyzed.

4 This phenomenon was first documented by Osborne (1962).

5 This would be a "cognitive dissonance" phenomenon, such as the one presented by Goetzman and Peles (1994) to explain mutual fund contributors' behavior.

6 Significant and unexpected bad news during the weekend should be sufficient justification for selling without cognitive dissonance.

7 It compares the runs of observations above and below the median with the expected runs of a totally random sequence of observations.

8 See Cochrane (1999), p.18.

9 An alternative and robust approach for studying distribution characteristics of returns is based on semi or non-parametric statistics; see Gallant, Rossi and Tauchen (1993).

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