

Capítulo 1

Economic cycles and calendar effects in stock prices: Evidence from Spanish market

João Dionísio

J.Dionísio
Universidade da Beira Interior, Department of Management and Economics, Estrada do Sineiro, 6200-309 Covilhã,
Portugal.
jdm@ubi.pt

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Abstract

This article examines the relationship between economic cycles and the day-of-the-week effects in Spanish market returns. During the period 1993 to 2011 the Spanish economy has experienced significant changes in their economic performance. In this period it is possible to identify three large and distinct economic sub periods. These sub periods provide an opportunity to evaluate the effect of the underlying economic fundamentals on the calendar effects. The effects of the sub periods' economic fundamentals on the day-of-the-week returns are assessed using a methodology incorporating orthogonal contrasts variables. This approach address the problem of multiple testing that arises when tests for the simultaneous effect of multiple variables on the dependent variable and the respective t statistics on the variables will not be independent since all the test statistics contain the same estimated term in the statistics. This feature increases the simultaneous significance level of the family of t -tests which may incorrectly lead to the rejection of null hypotheses. As a result, this approach allows for a robust analysis on the existence of the day-of-the-week effects, the economic conditions effects on returns and the interaction between both effects.

Daily return series from the main Spanish stock index, from 6 July 1993 to 30 December 2011, were used for the model estimation. Results suggest no evidence for an effect of the economic cycles on day-of-the-week returns. Additionally, results did not show any evidence for the existence of a day-of-the-week effects throughout the study period. However, results showed a moderately significant difference in returns between the first, second and the third economic sub period. This return differential is due to the negative extreme movements in returns occurred in the third sub period.

1 Introduction

The existence of calendar effects has been documented over the last three decades in the equity markets. These studies challenged the assumptions of the dominant theory (Efficient Market hypothesis) and suggested alternative explanations for possible regularities in prices both due to the behaviour of investors and institutional arrangements. However, various empirical studies have reported a decline on seasonality over time. Additionally, many studies reporting significant calendar effects are embedded with problems of multiple testing, which may incorrectly lead to the rejection of the null hypotheses for a given individual significance level since the respective t statistics on the variables will not be independent and the simultaneous significance level of the family of t -tests will increase.

The purpose of this paper is to add to this body of work on calendar effects an analysis on this field in Spanish equity market, examining the main and the interaction effects in returns by day-of-the-week and economic cycles. The times series approach to the economic cycle - day-of-the-week relation on returns is examined using daily data for the IBEX 35 index over the period 6 July 1993 to 30 December 2011. To our knowledge there are no studies analyzing the main and interaction effects of the economic cycles and day-of-the-week effects on returns.

Since the mid-90s the Spanish economy has experienced significant changes in performance that translated roughly into three distinct economic periods, as evidenced by the significant different values of the descriptive statistics of the main economic and financial indicators. From the values of these descriptive measures of the Spanish economy we identify three distinct economic periods. The effects of these sub periods on the day-of-the-week effects on returns are the focus of this study. Several studies have reported evidence of calendar effects in daily returns.

Other studies provided evidence of changes in the behavior of returns before, during and after significant events (e.g. Backman et al., 1994, and the effects of developments in information technology; Choudhry, 2000, and the effect of the crash of 1987; Holden et al., 2005, and the effect of financial crises).

In this article the evidence for the existence of the main and interaction effects by day-of-week and economic cycles are examined for the Spanish stock market. Our time series approach uses the method of orthogonal contrasts. Keef and McGuinness (2001) also applied the method of orthogonal contrasts to the relationship between settlement regime changes and day-of-the-week effects in the New Zealand Stock Exchange. This article has basically a descriptive nature, where the interest lies in determining the facts about the relationship between economic cycles and day-of-the-week effects in returns. Several studies have presented evidence that calendar effects have diminished or even disappeared in the last decades as a result of changes at the level of decision-making process (developments in information technology that improved information flows) and at the structures of transaction (upgrading and integration of the trading, clearing and settlement systems) and the reduction of transaction costs, making the market more efficient in incorporating information in prices. Several studies have also demonstrated the existence of a relationship between economic fundamentals and the pattern of returns in the stock market.

Thus, it would be expected that a main effect exist between economic conditions, characterized by the different values in descriptive statistics of the main economic indicators, and the behavior of returns. However, there are no studies on whether different economic conditions for periods affect the returns by the day-of-the-week. In the analysis of the hypothesized role of the different economic conditions on the day-of-the-week returns, we use the general linear model (GLM) using a series of orthogonal contrasts. The methodology involved in the use of orthogonal contrasts and the various hypotheses underpinning their construction are set out in section 1.3.

The paper is structured as follows. In section 1.2 we present the evolution of the Spanish economy over the period of analysis and identify the distinct economic sub periods that underpin the analysis. Section 1.3 briefly reviews the literature of the day-of-the-week effects in mean returns. In section 1.4 we present the model of analysis, the construction of orthogonal contrasts and the hypotheses that support their construction. In section 1.5 we provide a description of the data series, we analyse their distributional features and statistical tests of the assumption of independently and identically distributed normal returns are carried out. In section 1.6 results are presented and discussed. Finally, section 1.7 presents the conclusions.

1.2 Economic Cycles in the Spanish Economy

The trade and financial integration that occurred over the last decades made the interdependencies and relationships between countries more pervasive and profound, making the transmission of shocks and contagion faster and more powerful, increasing the risk of macroeconomic instability and financial volatility. After a long period of economic expansion that began in the mid-nineties, the Spanish economy began to show early signs of exhaustion in 2006. The international economic interdependence severely hit the Spanish economy from mid-2007 with the bursting of the housing bubble in the United States, triggered by episodes of turbulence in the sub-prime niche of the U.S. domestic mortgage market, giving way to the global financial and economic crisis with the shock waves extending to economies around the world. In September 2008 the international financial crisis has deepened with the collapse of Lehman Brothers bank and the Spanish gross domestic product (GDP) was severely hit.

Regardless of the adverse effects of the international crisis in the Spanish economy, it has accumulated over the last and a half decade significant internal imbalances which corrections continue currently. Spanish growth model was heavily based on domestic demand, and more specifically in the construction and property development activities sectors. The disproportionate growth in the real estate sector, coupled with the expansion of credit needed to finance it, is at the basis of the Spanish economic imbalances. In this sector a spiral of growth in demand, prices and supply, fueled a major housing bubble that burst when the impact of the international crisis was felt in Spain. Figure 1 in appendix presents the quarterly growth rate of GDP and quarterly change (in percentage points) in unemployment in the period 1993:01 to 2011:12. In this period three distinct sub-periods (see the shaded areas in the figure 1) are observed in terms of average economic growth, GDP growth variability and average change in unemployment rate, namely, 6 July 1993 to 30 December 2000, 2 January 2001 to 31 July 2007 and 1 August 2007 to 30 December 2011. During these sub periods the quarterly average growth real rate (and standard deviation) in GDP was 0.82% (0.52%), 0.83% (0.18%) and -0.13% (0.69%) while the quarterly average change (in percentage points) in the unemployment rate was -0.21, -0.21 and 0.81, respectively.

The evolution pattern of the industrial production index (IPI) and the industrial business survey (IBS) in the three sub periods are similar to those observed for the GDP, with the IPI and IBS clearly registering in the second sub period the higher average growth and the lower variability in industrial production (see Figure 1.2 in appendix). Since the mid-nineties the construction sector and the property development activities in Spain had a major role in the accumulating of economic imbalances and the triggering of the current crisis. The disproportionate growth in house prices led to a housing bubble of enormous proportions. Three factors contributed to their emergence and development. First, the monetary policy followed by the European Central Bank, since 2001, which kept the reference interest rate to very low levels for the cyclical position of the Spanish economy. Second, fiscal policy followed by the Spanish government promoted home ownership over other alternatives. Third, the advantages of an economic growth model based on the construction and property development activities, from the political economy point of view (reductions of unemployment as these are labor-intensive activities; increase in housing value - favoring the median voter, who is usually a home owner; and generation of large tax revenues for the different public administrations (Terol, Valiñas and Pendiello, 2006).

Initial increases in housing prices resulted from favourable market conditions for mortgages, followed by additional increases resulting from the contagion of positive expectations about the evolution of prices, leading to a bubble of massive proportions. The bursting of the housing bubble led to a severe drop in demand, which in turn resulted in an adjustment of supply either via prices or via quantities. An important growth indicator of the construction and property development activities is the production of cement (thousands of metric tons) in Spain (Figure 3 in appendix). In the first, second and third sub periods, the production of cement had a monthly average increase of 0.60%, 0.72% and -2.30%, respectively. In turn, steel production, an indicator more closely related to the manufacturing sector, showed a more moderate growth in these sub periods.

The disproportionate growth of the construction and property development activities led to a significant increase in credit to finance these activities. In turn, the disproportionate credit for these activities constituted the transmission channel of the housing crisis to the banking sector (Figure 1.4 in appendix). In these sub periods, bank credit to the construction sector experienced quarterly average growth rates of 1.13%, 4.72% and -2.35% for the first, second and third sub periods, while the credit granted to other industrial sectors showed average growth rates of 0.95%, 2.12% and 0.11%, respectively. In 2007 loans to construction and property development sectors accounted for almost 45% of the Spanish GDP (14.5% to construction and 30% to property development), when their overall weight in product was less than 20% (Carballo-Cruz, 2011).

The granted credit's pattern to households for the acquisition and rehabilitation of homes followed a similar pattern to the credit granted to the construction and property development sectors (Figure 1.5 in appendix). For these sub periods the quarterly average growth rates of the credit granted to families for purchase and rehabilitation of homes was 4.03%, 4.52% and 0.41% which compares with average growth rates for the remaining consumer credit of 2.34%, 3.28% and -0.80%, respectively. This unbalanced growth of the credit resulted in a high risk concentration of loan portfolios of banks in these sectors, on both the supply and demand side. The high stocks of real estate assets, which the construction or purchase was financed with bank loans, remained in the balance sheets of banks, creating solvency problems to the banking system by way of default losses and depreciation of real estate assets.

From mid-2008, the high unemployment, the high levels of indebtedness of households and businesses and the reduction of product worsened the solvency problems of banks and impeded the deleveraging process of banks and families. With the intensification of the crisis in the third sub period there was a marked contraction of the annual credit growth rate, which turned negative due to the prolonged crisis. The type of credit that has experienced a greater contraction during the crisis was credit to enterprises. Credit to households fell slightly, and since mid-2008 remained close to zero. The construction industry was the sector most affected by the bank credit, showing a sharp decline since mid-2008 (Figure 1.4 in appendix).

Regarding the risk premium of Spanish public debt (differential yield between treasury bonds of Spanish and German), there is a clear and distinct pattern in the three sub periods (Figure 1.6 in appendix). In the first sub period the risk premium showed a decreasing trend from mid-1995 until the introduction of the euro, reflecting the real convergence of the Spanish economy, the economic growth and the declining trend of the budget deficit and public debt (Figure 1.7 in appendix). In the second sub period, the risk premium of Spanish debt was close to zero reflecting the good performance of the economy, the reduced budget deficits and the stable level of public debt. In the third sub period, from late 2007, the risk premium showed a sharp increase, exceeding 400 basis points in August 2011. The latter pattern reflected tensions experienced in the financial markets of Europe, resulting from the crisis of sovereign debt in some European States, which increased the financing costs of the States and banks, making it difficult to access internal and external financial markets. In the case of the Spanish economy, the high risk premiums of the public debt are most affected by the high budget deficits experienced since 2007 and the prospects of the economic framework than actually by the level of public debt that is clearly sustainable.

The financing difficulties of the economy and the budget deficits from 2007 onwards are reflected in the net outflow of funds from the Spanish economy, particularly from foreign investors (Figure 1.8 in appendix). The patterns of price-to-earnings ratio and the turnover recorded in the three sub periods in the stock market (Figure 1.9 in appendix) reflect the performance of the Spanish economy over the full period (and the decrease in profitability of companies in the last sub period), the contagion effect of international financial crisis and the uncertainty in results of listed companies in Spanish market on the volatility of the transaction volumes.

1.3 Calendar Effects

A number of studies have focused on and reported evidence on the day-of-the-week effect (see, among others, Jaffee and Westerfield, 1985; Thaler, 1987; Agrawal and Ikenberry, 1994; Arsad and Coutts, 1997; Keef and Roush, 2005). The day-of-the-week effect, initially studied in US markets, refers to the finding by French (1980) and Gibbons and Hess (1981) that Monday returns are, on average, negative and lower than for the rest of the week. Several explanations for the existence of a day-of-the-week effect were advanced.

At the time, when fully electronic clearing and settlement market infrastructure were not yet implemented, Lakonishok and Levi (1982) have attributed some of the weekend effect to settlement practices and check-clearing conventions that make purchasing stock on Fridays attractive, but Dyl and Martin (1985) and Jaffee and Westerfield (1985) find no support for this rationale. Another hypothesis is that more stocks go ex-dividend on Mondays, thereby lowering prices and returns, but Lakonishok and Smidt (1988) report results inconsistent with this argument¹. Some have suggested that stock returns could be lower on Mondays if firms typically wait until weekends to release bad news, but this would not occur in efficient markets because agents would anticipate firms' behavior and discount stocks accordingly.

Several studies have corroborated the findings for U.S. equity markets and other developed markets. Jaffe and Westerfield (1985) also documented day-of-the-week effects with significantly negative Monday returns for the Australian, Canadian, Japanese and U.K. markets. Other studies which have found day-of-the-week effects in multi-country studies for developed markets are Dubois and Louvet (1996) and Tong (2000). Other recent studies have also shown a decline in the Monday effect in the US (Chen and Singal 2003; Marquering *et al.* 2006).

Other work casts some doubt on the robustness of the weekend effect. Connolly (1989) argues that previous findings depend heavily on the assumption that returns are normally distributed with a constant variance. Using estimators that are robust with respect to violations of these assumptions, he finds much weaker evidence of a weekend effect, particularly after 1975. In a multi-country study for developed markets, Chang *et al.* (1993), using procedures similar to Connolly, only found evidence of a day-of-the-week effect in 13 out of 23 countries, and their results were sensitive to the choice of statistical testing procedure.

Some relevant investigations have also studied this effect in Spanish market. Empirical evidence shows conflicting results depending on the period investigated. While Santesmases (1986) does not report a day of the week effect for the period 1979-83, subsequently Corredor and Santamaría (1996), Camino (1997) and García (2007) detected abnormally high returns on Fridays.

1.4 Methodology: Model and Hypotheses

1.4.1 Model

In this article we use the method of orthogonal contrasts to characterize the modulation of the day of the week return in the Spanish market by the economic cycles experienced in the Spanish economy. Orthogonality means that the observed *t* statistics of the contrasts variables are statistically independent. For any linear model, the orthogonality yields the following properties: (i) a constant, which in a matrix form, consist in a single column of ones, (ii) columns contrasts, excluding the constant, which all sum to zero, and (iii) cross-products of all pairs of contrasts which all sum to zero. These properties are widely reported elsewhere and content in any text dealing with the analysis of variance.

¹ Psychological explanations include Miller (1988), who attributes negative returns on Mondays to individuals selling rather than institutions. He argues that individuals sell on Mondays after using the weekend to decide to sell, uninfluenced by brokers who are unlikely to recommend selling. Rystrom and Benson (1989) attribute the negative Monday returns to investor pessimism on Mondays. Dyl and Holland (1990) and Lakonishok and Maberly (1990) report some support for this argument in that odd-lot selling, which is indicative of individuals' transactions, is higher on Mondays.

We describe below the general linear model used in this study. The description of the model helps to explain the intimate relationship between the economic logic of contrasts, its structure and the concomitant hypotheses. Using bold characters to represent matrices, and assuming linearity, the general model to describe systematic differences in daily returns is given by:

$$\mathbf{r} = \mathbf{X}\boldsymbol{\beta} + \boldsymbol{\varepsilon} \quad (1)$$

In this study there are three main contrasts for economic cycles and five for the day-of-the-week effects. Let D_j and C_j represent day-of-the-week and economic cycle's contrasts, respectively. Each set of contrasts consists of a constant, denoted by subscript zero, and two orthogonal contrasts for the economic cycles and four orthogonal contrasts for the days of the week. The precise form of these are described in the table 1 and discussed in subsequent sections. Thus, t th row of the equation (1.1) can be written as:

$$r_t = \mathbf{x}_t \boldsymbol{\beta} + \varepsilon_t. \quad (1.1)$$

Omitting subscripts for coefficients for convenience, we can see that \mathbf{x}_t (the vector of contrast variables) in equation (1.2.1) can be written as equation (1.2)

$$\mathbf{x}_t = \left\{ C_0 + \sum_{j=1}^2 C_j \right\} * \left\{ D_0 + \sum_{i=1}^4 D_i \right\} \quad (1.2)$$

$$= C_0 D_0 \quad (1.2.1)$$

$$+ C_0 \sum_{i=1}^4 D_i \quad (1.2.2)$$

$$+ D_0 \sum_{j=1}^2 C_j \quad (1.2.3)$$

$$+ \sum_{j=1}^2 C_j \sum_{i=1}^4 D_i. \quad (1.2.4)$$

Term equation (1.2.1) represents the grand constant, $C_0 D_0$. It characterizes the average daily rate of return across the total data set. Second term equation (1.2.2) captures the interaction constant of the economic cycle contrasts with the four day of the week (denoted by D_1, D_2, D_3, D_4 , see Table 1.3). These are the main effects of the day-of-the-week that emerge after controlling for economic cycles effects. Similarly, third term equation (1.2.3) represent the two main effects of economic cycles (denoted by C_1, C_2). Last term equation (1.2.4) captures the eight interactions between the two main effects of economic cycles and the four main effects of day-of-the-week (denoted by $C_1 D_1, C_1 D_2, \dots, C_2 D_4$). It should be noted that it is impossible to provide an unequivocally economic interpretation for any main effect if it is involved in a significant interaction. Thus, when the interaction terms are statistically insignificant, the main effect can be viewed as being consistent across the levels of the complementary interaction effect.

The structure of the orthogonal contrasts used to test the hypotheses is described in Table 1. The economic interpretation of the contrasts is simple. For example, day-of-the-week contrast D_1 compares the observed return on Monday with the observed average return over the rest of the week (ROW). Likewise, the economic cycle contrast C_1 compares the return during the EC3 period to the average return over the two earlier economic cycles.

Table 1 Contrasts by day-of-the-week (DW) and economic cycle (EC)

	Constant		Contrasts		
(i) Day-of-the-week (DW) contrasts					
Day	D_0	D_1	D_2	D_3	D_4
Monday	1	1	0	0	0
Tuesday	1	-0,25	-1	0,5	0
Wednesday	1	-0,25	0	-0,5	1
Thursday	1	-0,25	0	-0,5	-1
Friday	1	-0,25	1	0,5	0
(ii) Economic cycle (EC) contrasts					
Economic cycle	C_0	C_1	C_2		
EC1: 3 Jul 93 – 31 Dec 00	1	0,5	1		
EC2: 2 Jan 01 – 31 Jul 07	1	0,5	-1		
EC3: 1 Aug 07 – 31 Dec 11	1	-1	0		

The next section explains how the economic logic and empirical regularities reported elsewhere led to the development of the various contrasts and hypotheses. The empirical regularities, such as the prevalent Monday or “weekend” effect, are reflected in much of the day-of-the-week literature (see Section 1.3).

1.4.2 Hypotheses

The construction of the economic cycle’s contrasts is marked by the economic changes that occurred along the overall period, but with particular emphasis on the passage of EC2 to EC3. The significance of this change, discussed in section 1.3, is reflected in the role attributed to the C_1 contrast.

The contrast variable C_1 is designed to test for a difference in the day-of-the-week effects between the third and the average in the first and second economic cycles. The contrast C_2 is designed to test for a difference in the day-of-the-week effects between the first and the second economic cycles.

The construction of the economic cycles contrasts, along with the specific day-of-the-week contrasts and interaction terms are described relative to a number of possible day-of-the-week effects. These are described below.

There is a disseminated evidence of a significant negative return on Monday and lower than for the rest of the week.

Several explanations for the existence of a significant negative return were advanced: release of bad news while the markets are closed (price changes in the non-trading period between Friday close and the Monday open), that more stocks go ex-dividend on Mondays, psychological explanations (individual investor pessimism on Mondays and higher odd-lot selling on Mondays). Connolly (1989) using estimators that are robust to the non-normality and varying variance of returns find much weaker evidence of the Monday effect.

Subsequent studies by Chang et al. (1993)), Dubois and Louvet (1996), Chen and Singal(2003) and Marquering et al.(2006) also report a weakening of the Monday effect.

The appearance of such a Monday effect in the Spanish market during earlier sub periods and the weakening or disappearance in the last sub period would not be surprising given this previous evidence.

In the last decade, developments in the information technology, along with the integrated trading, settlement and clearing systems, which are now fully electronic and order flow instantaneously processed, have improved information flows and made markets closer to being efficient.

Day-of-the-week contrast D_1 tests for the Monday effect during the overall period. Rejection of the formulated null hypothesis (H1) would be supportive of such an effect in the Spanish market.

$$H_1 : [Monday = ROW]_{[for \text{ all EC}]}$$

The significance of D_1 , and the absence of significant interactions of D_1 with all economic cycles' contrasts, would confirm the uniformity of the Monday effect across the whole sample.

Considering the profound changes in the patterns of the main economic indicators in the third sub period of the Spanish economy, along with the technological changes occurred in the trading, clearing and settlement infrastructure and the development of information technology over the last decade, it is admissible that the Monday effect has diminished or disappeared.

This possibility is duly considered in C_1 contrast and stated in the null hypothesis H_2 below.

$$H_2 : [Monday - ROW]_{[for \text{ EC3}]} = [Monday - ROW]_{[for \text{ EC1 and EC2}]}$$

The significance of the interaction term between C_1 and the day-of-the-week effect contrast D_1 , defined as $S1D_1$, would lead to the rejection of this hypothesis.

The C_2 contrast tests for a difference in observed returns between the first and second sub periods. Combining this contrast with the day-of-the-week contrast D_1 , we obtain the interaction of C_2 by D_1 , C_2D_1 , allowing to test for a differential Monday effect between cycle 1 and cycle 2.

The significance of C_2D_1 would suggest rejecting the null hypothesis H_3 below.

$$H_3 : [Monday - ROW]_{[for \text{ EC1}]} = [Monday - ROW]_{[for \text{ EC2}]}$$

Large Friday returns, along with negative Monday returns have also been taken as a manifestation of the documented 'weekend effect'. Although the Monday effect has received the most attention, widespread evidence exist in favor of a Friday effect.

Agrawal and Tandon (1994) report significantly positive Friday returns for 18 out of 19 countries. Day-of-the-week contrast D_2 serves as a partial test for this effect in the Spanish market. It compares the average return on Friday with that observed on a Tuesday.

This hypothesis is formally stated as

$$H_4 : [Friday]_{[for \text{ all sub periods}]} = [Tuesday]_{[for \text{ all sub periods}]}$$

The implicit, and questionable, assumption is that Tuesday would represent a typical day-of-the-week.

A priori there is little evidence to suggest the contrary although Jaffe and Westerfield (1985) and Agrawal and Tandon (1994) find a significantly negative Tuesday effect in Australian stock returns, and Jaffe and Westerfield propose a linkage between Tuesdays in the Asia-Pacific and the (negative) Monday effect in the US.

The interaction of all economic cycle contrasts with D2 (C1D2, C2D2) provides a uniformity test for H4.

The remaining day-of-the-week contrasts, denoted by D3 and D4, are a direct consequence of the orthogonality constraints.

They can be viewed as a Wednesday and Thursday effect *versus* a Tuesday and Friday effect, and a Wednesday *versus* Thursday effect, respectively.

In the literature there is no evidence for these effects and as such there are no economic explanations, not being proposed hypotheses for these main effects or their interactions with the economic cycles' contrasts (C1D3, C2D3, C1D4 and C2D4).

While the main objective of this paper is to examine the impact of economic cycles in the day-of-the-week returns (as specified above in some hypotheses) it is expected that in periods with negative economic growth rates or with decreasing trend in growth, market returns are lower than those observed during periods of economic expansion or with increasing trend in growth.

Thus, it is expected that coefficients of the C1 and C2 terms are statistically significant.

The inclusion of the main effects for economic cycles therefore serves a primary role in controlling for systematic variation in returns.

The grand constant term C0D0 characterizes the average daily index return over the whole data-set, after controlling for the various contrast terms.

Considerations on the risk-return relation and time-value-of-money would suggest that this constant, after controlling for the temporal variation related to the different indicators of the economic cycles, should be positive. However, the grand constant might not be significant if return variability is high.

1.5 Data

The data employed in this study are daily closing prices from the Spanish Stock Market over the estimation period July, 6, 1993 to December, 30, 2011, encompassing 4649 trading days/daily returns that were available for analysis.

The capitalization-weighted IBEX-35 Price Index is used. It is a market capitalization weighted index comprising the 35 most liquid Spanish stocks traded in the continuous market of the Madrid Stock Exchange (Spanish Stock Market Interconnection System or SIBE), the computerized and integrated trading system legally defined for the negotiation of the major securities listed on Spanish stock markets.

This index is the main indicator of the blue-chip segment and contains the 35 largest companies in terms of turnover and free float capitalization in the Spanish market.

For a stock to be included in the IBEX 35, its average free float market capitalization must be greater than 0.30% of the average free float capitalization of the index during the control period (semester). In 2006, the IBEX-35 capitalization represented approximately 70% of the total Spanish market capitalization.

The long-term market index series is obtained from www.finance.yahoo.com.

The calculated return series of IBEX-35 is adjusted for net dividends and stocks splits, removing the possibility that day-of-the-week returns are affected by ex-dividend effects concentrating on specific week days. McGuinness (1997) report evidence for this effect.

The series of daily market returns are calculated as the continuously compounded returns

$$r_t = Ln(P_t / P_{t-1}).100 \quad (1.3)$$

Where r_t is the daily return in day t and P_t is the index level at the end of day t .

Table 1 reports descriptive statistics for the IBEX-35 return series over the full period and the three sub periods: 6 July 1993 to 30 December 2000, 2 January 2001 to 31 July 2007 and 1 August 2007 to 30 December 2011.

These statistics allow testing null hypotheses of normal, independent and identically distributed variables.

In addition, descriptive statistics for the returns on IBEX-35, for the whole period, and for sub subsamples partitioned by day-of-the-week and economic cycle, are shown in appendix 1.

With particular regard there is the low Monday return (mean=-0.041%) and the high Tuesday (mean=0.066) and Friday (mean=0.071) returns in the whole period.

Among the three periods, the lowest mean daily return (-0.048%) and the highest standard deviation (1.901%) occurs in the third period, reflecting the high uncertainty observed in this period and the decreasing trend in stock prices.

Similarly, during this period, Monday has the lowest mean return (-0,197%) and the highest standard deviation (2,215%) across all weekdays and the three sub periods.

By and large, there is evidence, in all periods, against the assumption that returns are normally distributed. The estimated skewness coefficients reject the symmetric distribution null hypothesis, with the returns in the first sub period (third sub period) being negatively (positively) skewed indicating the greater likelihood of observations lying below (above) the mean.

The evidence also indicates significantly fatter tails than does the stationary normal distribution for each period.

The kurtosis or degree of excess is significant at the 1% level across all periods indicating leptokurtic distributions.

The Jarque-Bera statistic and the comparison of the empirical distribution (Lilliefors statistic) with the theoretical one also reject the null hypothesis of normality of daily returns.

The independence assumption for the T observations in each period is tested by calculating the first three order autocorrelation coefficients.

Using the usual approximation of $1/\sqrt{T}$ as the standard error of the estimate, the statistics for the full period reject the second and third order zero correlation null hypothesis at the 1% level.

For the first sub period, the statistic rejects the first and second order zero correlation null hypotheses. In the second sub period, the first through third order zero correlation null hypotheses can not be rejected and in the third sub period the second and third order zero correlation null hypotheses are rejected at the 5% level.

The returns in all three sub periods also exhibit, mostly, negative autocorrelation.

The Ljung-Box $Q(10)$ statistic for the cumulative effect of up to tenth-order autocorrelation in the standardized residuals exceeds the 1% critical value from a χ^2_{10} distribution for the first two sub periods.

Table 2 Sample statistics for daily market returns, 6 July 1993 to 30 December 2011

Descriptive Statistics	Full period	First sub-period	Second sub-period	Third sub-period
Observations	4649	1867	1658	1124
Mean	0,023	0,0629	0,0282	-0,0476
Std. deviation	1,470	1,330	1,268	1,902
Minimum	-9,585	-7,327	-5,993	-9,585
Maximum	13,483	6,468	5,789	13,483
Skewness	-0,0088	-0,3155***	-0,030	0,234***
Kurtosis	8,211***	6,0733***	5,493***	8,148***
JB test	5260,7***	765,76***	429,74***	1251,6***
Empirical Distribution Test	0,0606***	0,0444***	0,0647***	0,0665***
r_1	0,022	0,070***	-0,026	0,011
r_2	-0,050***	-0,059**	-0,021	-0,065**
r_3	-0,040***	-0,014	-0,037	-0,064**
$Q(10)$ Standardized Residual	40,352***	27,414***	33,351***	18,038*
$Q(10)$ Squared Standardized Residual	1780,7***	812,52***	1173,2***	291,77***
ADF unit root test	-14,566***	-31,368***	-10,468***	-16,599***
P-P unit root test	-66,791***	-40,162***	-41,817***	-33,431***

JB statistic: Jarque-Bera test for a normal distribution. Empirical Distribution Test is a goodness-of-fit test that compares the empirical distribution of daily returns with the normal theoretical distribution function. The value reported is the Lilliefors statistic. r_1, r_2, r_3 are the first three autocorrelations coefficients. Asterisks indicate significance at the 10%*, 5%** and 1% *** levels. The reported ADF test is performed with an intercept and an optimal lag structure according to the Akaike Information Criteria.

The Ljung-Box $Q(10)$ statistic on the squared standardized residuals provides us with a test of intertemporal dependence in the variance.

The statistics for all three periods reject the variance zero correlation null hypotheses.

That is, the distribution of the next squared return depends not only on the current return but on several previous returns.

These results clearly reject the independence assumption for the time series of daily stock returns.

Finally, Augmented Dickey-Fuller and Phillips-Peron tests reject the null hypothesis of a unit root and we conclude that the IBEX-35 return series over the full period and sub periods is stationary and suitable for a regression-based analysis.

1.6 Results

The sub samples reveal a remarkable variability in mean returns between days-of-the-week and across economic periods.

For instance, in the first sub period the higher (lower) mean return is observed on Friday (Wednesday); in the second sub period the highest (lowest) mean return is observed on Thursday (Tuesday), registering during this period the smallest variation in returns among the three sub periods. In the third sub period, the higher (lower) mean return is observed on Tuesday (Monday) (see table 1 in appendix).

Thus, there is a high variability in the average returns by day-of-the-week throughout economic cycles. As expected, daily returns in the second (third) sub period exhibited lower (higher) volatility reflecting the stable (instable) behavior of economic and financial fundamentals in these periods.

How the average returns of the days-of-the-week are modulated by economic periods is examined by applying OLS regression to orthogonal contrast variables featured in equation (1.2) and outlined in section 1.4.

The estimated coefficients and standard errors of the orthogonal contrasts detailed in equation (1.2) and designed in Table 1 are shown in Table 1.3. This table also includes the R^2 , the adjusted R^2 and the F statistic of the null hypothesis that all slope coefficients are jointly zero.

The test results of Breusch-Godfrey Lagrange multiplier and White's heteroskedasticity used to test for higher order serial correlation and heteroscedasticity in the least squares residuals, respectively, reject the null hypotheses of no high order serial correlation and no heteroscedasticity in the residuals.

In this regard, the standard errors in OLS regression coefficients were estimated incorporating adjustments for heteroscedasticity and autocorrelation in the residuals using the Newey-West procedure (with the option of automatic search for order of serial correlation, which resulted in a lag = 9).

Additionally, and as reported in the empirical literature involving daily returns and long series, residuals in the OLS regressions exhibit leptokurtosis² and a modest skewness.

If the true error distribution is considerably fatter tailed than the normal, it could be that the null hypotheses of no calendar effects were more likely to be rejected than the chosen significance level would indicate.

The problem with these undesirable properties (high leptokurtosis/high variance) is that outliers can drive unnaturally the results.

Logically, daily returns tend to present a higher number of extreme returns in periods of high uncertainty in economic fundamentals, reflected in high standard deviation of the main economic indicators.

In periods of relative stability in the economic fundamentals, as is the case of the first and second sub periods in the Spanish economy, extreme movements in returns tend to be rare (see the bottom of the Table 1.3).

The continuous problem is that it is difficult to distinguish between two explanations for the observed outliers.

In a first case they could be due to chance (economic stable periods), which would suggest their retention or, alternatively, to a systemic effect which would suggest their inclusion (economic instability - third sub-period).

The problem of leptokurtosis in residuals was addressed globally through a winsoring/filtering technique.

The estimated regressions were performed with two arbitrary cut off points, $|r| < 3,5\%$ and $|r| < 3\%$. The winsoring technique has led to the rejection of 140 returns for the cut off of $|r| < 3,5\%$ (Table 3) and 226 returns for the cut off of $|r| < 3\%$ (Table 1.4).

Other regressions with lower cut off points were also estimated, producing no change in the significance of the estimated coefficients relative to the regression with the cut off $|r| < 3\%$ (see Table 1.4 for regression with cut point $|r| < 2,5\%$).

By and large, the overall results were largely unaffected by the winsoring of outliers. The estimated results for the overall sample and the winsorized data with cut points of $|r| < 3\%$, $|r| < 3,5\%$ and $|r| < 2,5\%$ are shown in columns of Table 1.3 and Table 1.4.

Below the results of OLS regressions are discussed in direct relation to the hypotheses formulated in section 1.4.

² The distribution of stock returns and hence the error term of regression models is also a key issue in examining calendar effects. Fama (1965) and Officer (1972) noted that empirical distributions of individual stocks returns showed some degree of leptokurtosis for every stock, with distributions more peaked in the centre and having longer tails than the normal distributions. Fama (1965) suggest that the variance of returns might be infinite and best modelled by a stable paretian distribution. Blateberg and Gonedes (1974) and Jensen and de Vries (1991) argue that daily stock returns could be adequately modelled by a fat-tailed distribution such as the Student-t distribution.

For the overall mean return, standard errors of the estimated coefficients make them insignificantly different from zero in the two regressions in Table 1.3.

This result reflects the inherent variability in returns during the study period (mean $r = 0.023\%$, st.dev = 1,470%, $n = 4649$ obsv), but particularly in the third sub-period (mean $r = -0.048\%$, st.dev = 1,901%, $n = 1124$ obsv).

The estimated coefficients in the regressions with outliers removed (columns in Table 1.3 and Table 1.4) increased the size of the global conditional mean and its t-statistic values but proved to be statistically insignificant.

This suggests that returns were still highly variable after the removal of outliers.

Given the high variability in returns, even after the process of winsoring extreme observations, it would be expect that only a true day-of-the-week effect on the market and affected by the underlying economic conditions of the periods stand out in the estimated regressions.

Table 1.3 Estimated OLS regression model with orthogonal contrasts for model (1)

Explanatory Variable	Dependent variable		$r_t = Ln(IBEX35_t / IBEX35_{t-1}) * 100$	
	All data, $n = 4649$		Winsored (3%), $n = 4423$	
	Estim.Coeff.	t stat.(NW)	Estim.Coeff.	t stat.(NW)
D_0C_0 (Grand Constant)	0.014	0.661	0.027	1.484
D_1	0.013	0.312	-0.059	-1.645*
D_2	-0.030	-0.737	0.013	0.453
D_3	-0.075	-1.352	0.063	1.573
D_4	-0.003	-0.109	-0.026	-0.935
C_1	0.062	1.757*	0.033	1.135
C_2	0.017	0.813	0.027	1.395
D_1C_1	-0.055	-0.771	0.084	1.444
D_1C_2	0.051	1.241	-0.035	-0.947
D_2C_1	0.086	1.208	0.021	0.443
D_2C_2	0.006	0.193	0.020	0.735
D_3C_1	-0.037	-0.396	-0.020	-0.303
D_3C_2	-0.036	-0.716	0.049	1.245
D_4C_1	0.013	0.242	-0.051	-1.216
D_4C_2	-0.047	-1.441	0.021	0.678
	$k = 15$		$k = 15$	
	$R^2 = 0,002$; $Adj R^2 = -0,000$		$R^2 = 0,004$; $Adj R^2 = 0,000$	
	$F_{14,4635} = 0,992$; ($p = 0,457$)		$F_{14,4409} = 1,265$; ($p = 0,220$)	
Breusch-Godfrey (p=5)	6,823***		1,938*	
White statistic	7,979***		5,051***	
residuals skewness	0,0324		-0,1284	
residuals kurtosis	8,3732		2,9708	
	Actual obsv.		Actual obsv.	Rejected obsv.
1° sub period	$n = 1867$	-	$n = 1808$	59
2° sub period	$n = 1658$	-	$n = 1595$	63
3 sub period	$n = 1124$	-	$n = 1020$	104

Asterisks indicate significance at the 10%*, 5%** and 1%*** levels. t stat.(NW) stands for t statistics adjusted for residuals' heteroskedasticity and autocorrelation following Newey-West.

Table 1.4 Estimated OLS regression model with orthogonal contrasts for model (1)

Dependent variable	$r_t = Ln(IBEX35_t / IBEX35_{t-1}) * 100$			
	Winsored (3,5%), $n = 4509$		Winsored (2,5%), $n = 4270$	
Explanatory Variable	Estim.Coeff.	t stat.(NW)	Estim. Coeff.	stat.(NW)
D_0C_0 (Grand Constant)	0.024	1.237	0.034	2.042**
D_1	-0.059	-1.539	-0.046	-1.383
D_2	0.018	0.601	0.016	0.607
D_3	0.047	1.060	0.042	1.169
D_4	-0.020	-0.726	-0.031	-1.181
C_1	0.037	1.157	0.048	1.851*
C_2	0.033	1.593	0.013	0.744
D_1C_1	0.092	1.454	0.053	0.998
D_1C_2	-0.036	-0.943	-0.038	-1.090
D_2C_1	0.033	0.670	0.013	0.306
D_2C_2	0.017	0.620	0.025	0.969
D_3C_1	0.005	0.069	-0.031	-0.535
D_3C_2	0.060	1.429	0.034	0.949
D_4C_1	-0.058	-1.405	-0.043	-1.046
D_4C_2	0.003	0.093	0.003	0.115
	$k = 15$		$k = 15$	
	$R^2 = 0,003$; $Adj R^2 = 0,000$		$R^2 = 0,003$; $Adj R^2 = 0,000$	
	$F_{14,4495} = 1,232$; ($p = 0,243$)		$F_{14,4255} = 1,116$; ($p = 0,336$)	
Breusch-Godfrey ($p=5$)	2,6046**		0,7198	
White statistic	5,1657***		4,9773***	
residuals skewness	-0,1249		-0,1201	
residuals kurtosis	3,2466		2,6898	
	Actual obsv.	Removed obsv.	Actual obsv.	Removed obsv.
1° sub period	$n = 1835$	32	$n = 1765$	102
2° sub period	$n = 1622$	36	$n = 1552$	106
3 sub period	$n = 1052$	72	$n = 953$	171

Asterisks indicate significance at the 10%*, 5%** and 1% *** levels. t stat.(NW) stands for t statistics adjusted for residuals' heteroskedasticity and autocorrelation following Newey-West.

The purpose of the main effects of the economic sub periods in regression (C_1 and C_2) is to capture the systematic temporal variation in returns. However, the degree of the total explained variance by the orthogonal contrasts and the interaction effects was small. The overall coefficient of determination on 14 degrees of freedom for the global sample and the winsorized data regressions ranged between 0.02 and 0.04%. Nevertheless, the estimated coefficient for the C_1 contrast of the sub periods is positive and significant at the level of 10%. This result, only significant for the overall data regression, was expected in light of the descriptive evidence that rates of return in the first and second sub periods were lower than those observed in the third sub period.

But, it seems that this statistical significance is due to the extreme returns observed in the third sub period and related to the high variability in economic and financial fundamentals in this period of the Spanish economy. Concerning the contrast variable C_2 , the null hypothesis associated with the absence of temporal variation in returns between the first and second sub period fails to be rejected for all the estimated regressions, allowing to conclude that the returns in these two sub periods would be generated by the same process. Hypotheses H2 and H3 would imply the presence of a Monday effect modulated by the inherent characteristics of the economic cycles in the Spanish economy.

The results presented in Table 3 and Table 4 show that these null hypotheses fail to be rejected to the common levels of statistical significance. The interaction terms with the contrast D1, D1C1 and D1C2, are not significant, indicating no Monday effect even when it is partitioned by sub periods.

The H1 hypothesis implies the presence of a Monday effect for the overall period. Results reported in Table 3 show that this null hypothesis is rejected for the winsored data regression with a cut point of $|r| < 3\%$ for a significance level of 10% but with a p-value (0.0999) very close to the threshold of not being rejected. In Table 3, column B, the negative coefficient on the contrast variable D1 indicates that after controlling for other effects, such as the main effects of the sub periods to capture systematic temporal variation in returns, a not so robust Monday effect remains. The sign of the coefficient associated with the contrast variable D1, with the value 1 for Monday returns and -0.25 for the returns of all other days of the week, indicates that the Monday returns would be lower relative to other weekdays. In turn, the insignificant coefficient on the contrast variable D1 for the global data regression and for the winsored regressions with the other levels of cut off points suggest that daily returns have identical underlying return generating process for all days of the week. Also, the effect of the contrast variable C1 is not robust across different regressions, being significant for the global data regression (column A, Table 3) and for the winsored data regression with $|r| < 2,5\%$ (Table 4), but insignificant for the other regressions.

The H4 hypothesis implied the presence of a large Friday return in relation to any other day of the week. The results presented in Table 3 and Table 4 and the interaction terms associated with this contrast (D2C1 and D2C2) shows that these null hypotheses cannot be rejected at any level of significance.

In sum, with the estimated effects free of ‘confounding effects’ of multiple testing, the overall pattern of results does not support the existence of the day-of-the-week effects, or that they may be affected by the economic fundamentals underlying the sub periods.

However, one of the contrast variables of the economic sub periods captured, but moderately, some systematic temporal variation in returns experienced by the market in the third period.

1.7 Conclusion

This study examined the issues of the day of the week effect, the effect of the different economic fundamentals and their interaction in returns of the Spanish equity market. These issues were addressed using a different methodology from the usual ones, which are usually embedded with the problem of multiple testing. A number of orthogonal contrast variables were specified for the weekdays and economic cycles and their main effects and interactions were analyzed. The methodology allowed examining the stability and significance of the day-of-the-week effects according to the mooted hypotheses in the literature and its possible modification motivated by the different behavior of periods’ economic fundamentals.

This study found no day-of-week effect, particularly the two most commonly reported in the literature: the negative Monday returns and the higher Friday return. The Monday effect, although significant at the 10% level for the winsored regression, with absolute values of returns less than 3%, was not robust across the overall period and for other winsored data regressions.

Hypotheses have been proposed to evaluate whether periods associated with different economic fundamentals may influence the day-of-the-week effect pattern.

The null hypotheses of identical mean returns among days of the week across different economic fundamentals were not rejected.

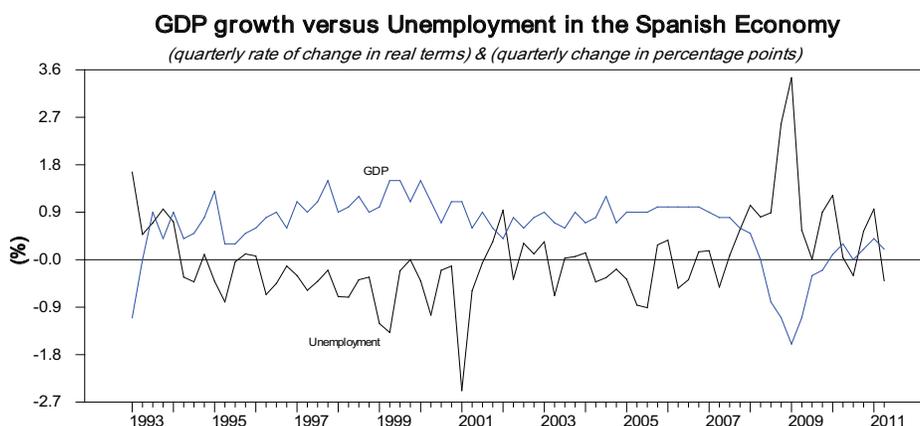
In sum, the hypothesized day-of-the-week effect is not supported by the data period and the different behavior of economic indicators does not induce varying differentials in the average of the day-of-the-week returns over the sub periods. Finally, distinct temporal movements in daily returns between the first and second and the third sub period were captured but this difference did not prove robust, since this will have been due to negative extreme movements occurred in returns in the third period.

Appendix

Appendix Table 1 Descriptive statistics for daily returns and sub-periods

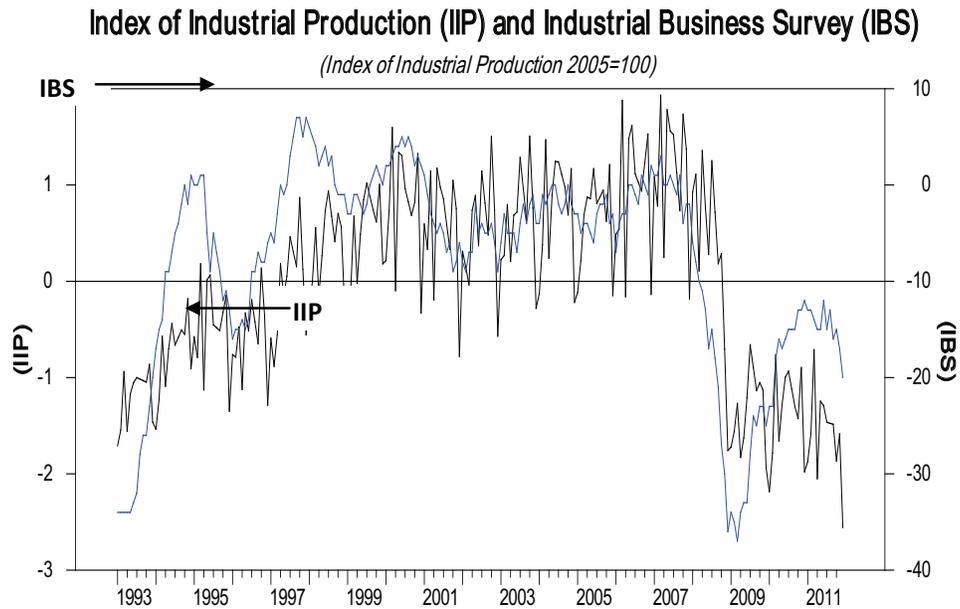
	Mon.	Tues.	Wed.	Thurs.	Frid.	All days
Sub period 1	July 6, 1993 - December 30, 2000					
Mean	0,014	0,136	-0,0438	0,030	0,177	0,062
St.Dev.	1,322	1,300	1,350	1,321	1,352	1,330
<i>n</i>	368	380	377	372	370	1867
Sub period 2	January 2, 2001 - July 31, 2007					
Mean	0,002	-0,006	0,001	0,126	0,022	0,029
St.Dev.	1,398	1,160	1,258	1,282	1,244	1,269
<i>n</i>	325	334	335	336	328	1658
Sub period 3	August 1, 2007 - December 30, 2011					
Mean	-0,197	0,055	0,010	-0,083	-0,031	-0,048
St.Dev.	2,215	1,700	1,909	1,802	1,852	1,901
<i>n</i>	222	228	228	226	220	1124
All sub periods	July 6, 1993 - December 30, 2011					
Mean	-0,041	0,066	-0,014	0,037	0,071	0,023
St.Dev.	1,609	1,363	1,474	1,440	1,454	1,470
<i>n</i>	915	942	940	934	918	4649

Figure 1 Growth of GDP and change in Unemployment in the Spanish Economy



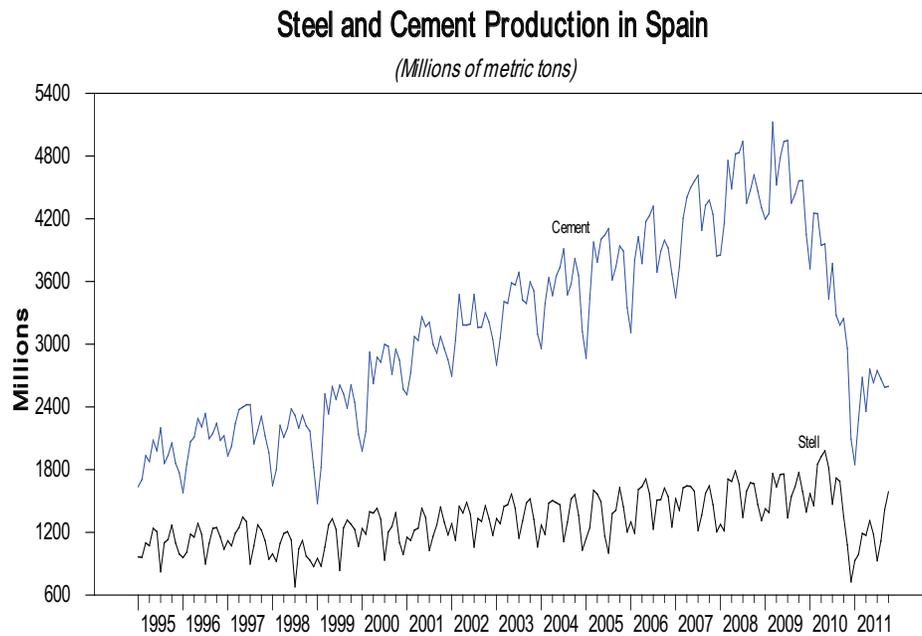
Source: (Spanish GDP, Base: 2000, National Institute of Statistics of Spain; Unemployment: Statistical Bulletin of Banco de España.

Figure 1.2 Industrial Production Index and the Indicator of Industrial Climate in Spain



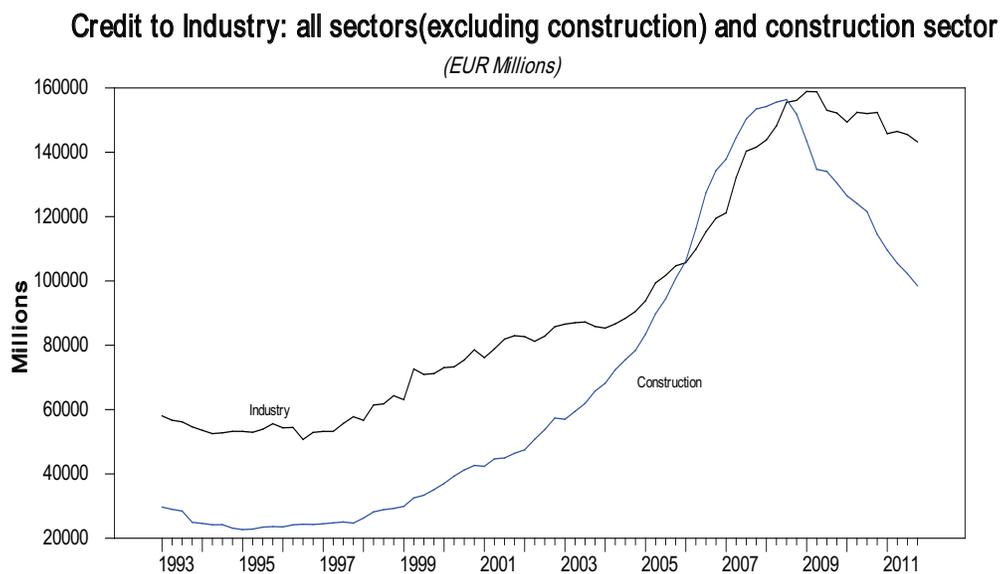
Source: Index of industrial production (IIP) (left scale, base 2005 = 100), National Institute of Statistics of Spain; Indicator of industrial climate (IBS), (right scale), Ministério de Industria, Turismo y Comercio).

Figure 1.3 Production of cement and steel in Spain



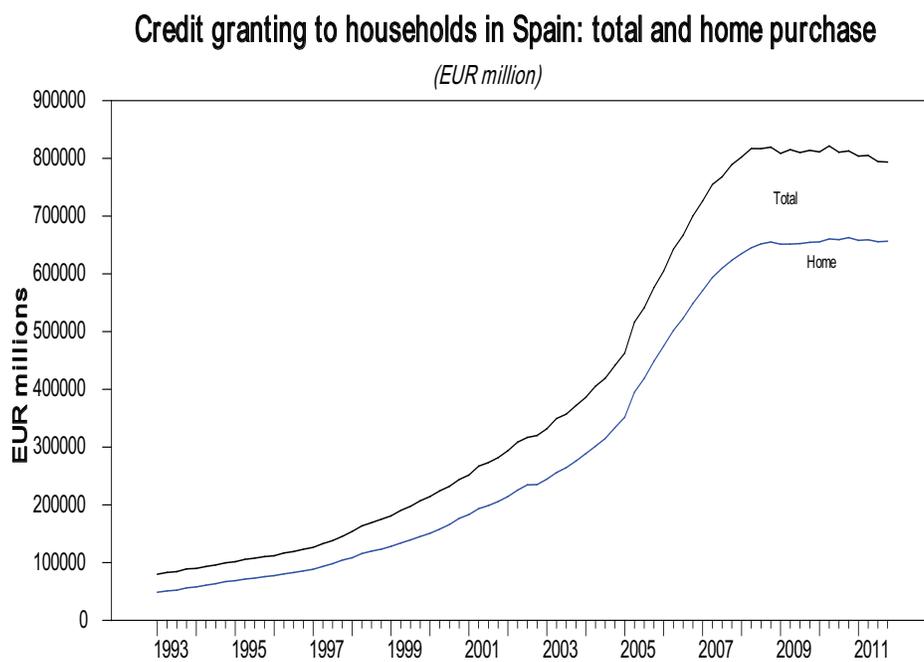
Source: Statistical Bulletin of Banco de España).

Figure 1.4 Credit granted to Industry in Spain: all sectors (excluding construction sector) and the construction sector



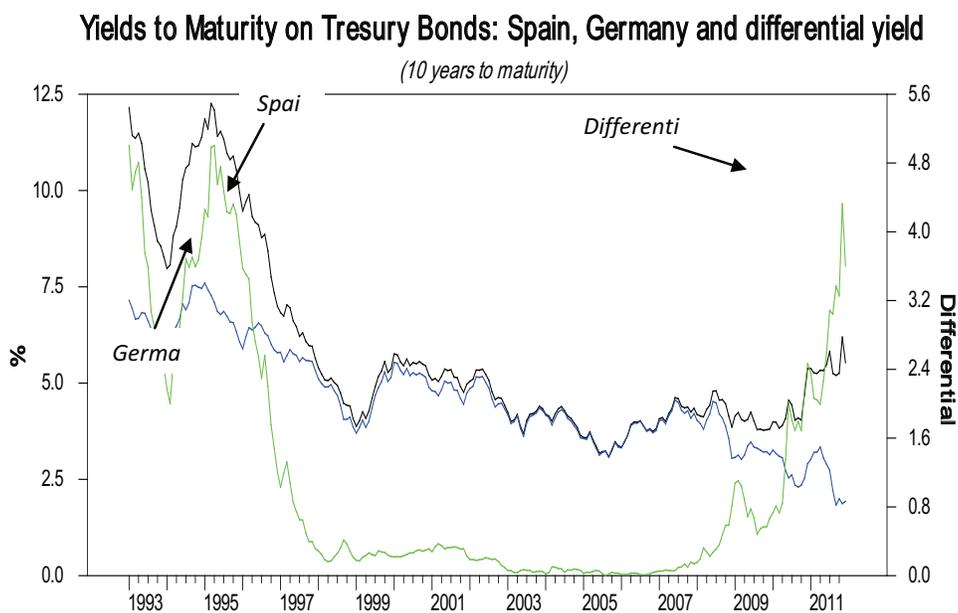
Source: Statistical Bulletin of Banco de España.

Figure 1.5 Credit granted to families in Spain



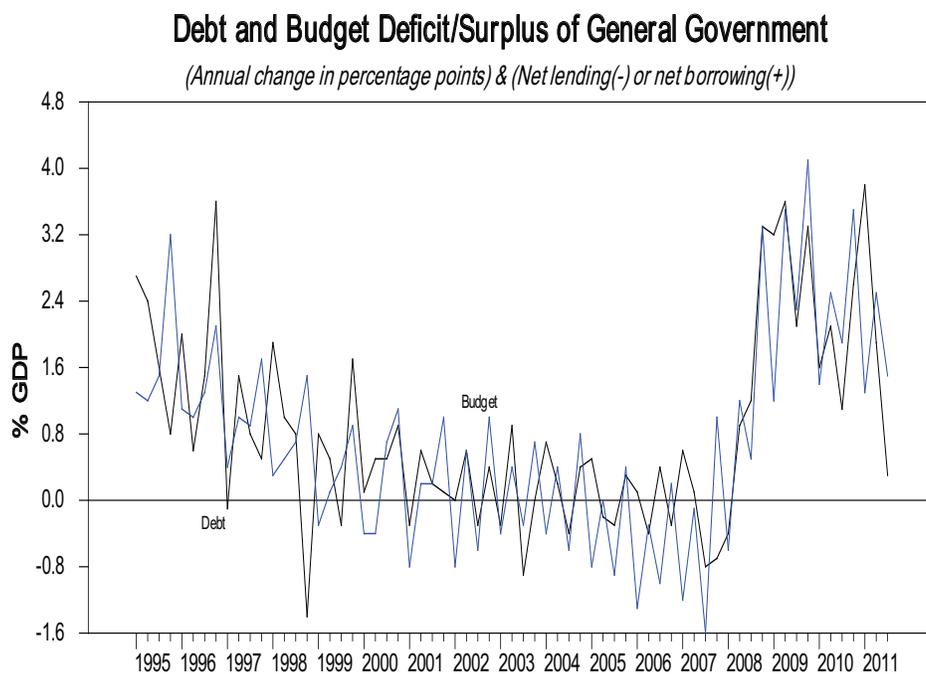
Source: Statistical Bulletin of Banco de España).

Figure 1.6 Rates of Long-Term Interest (Public Debt) of Spain and Germany



Source: Statistical bulletin of the Deutsche Bundesbank and statistical bulletin of the Banco de España

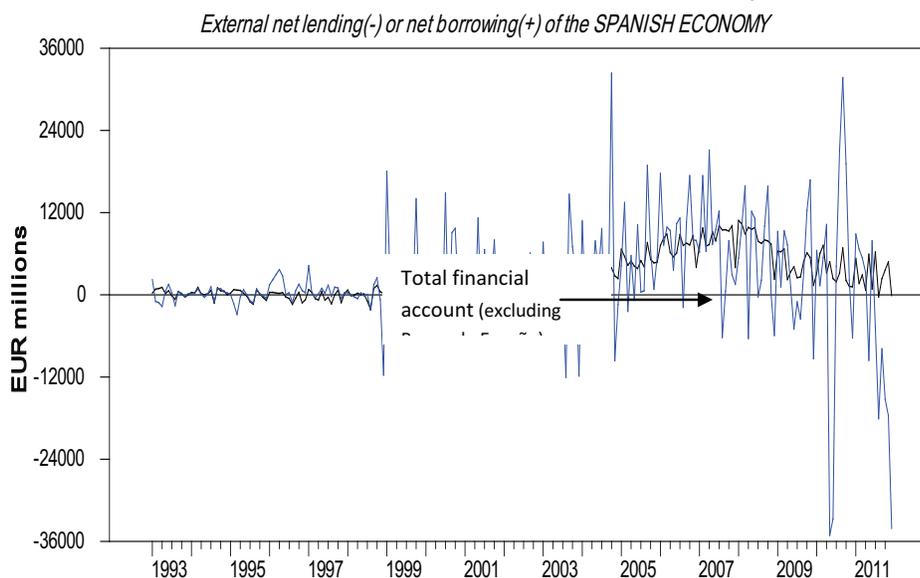
Figure 1.7 Public debt and Budget deficit/surplus of Spain General Government



Source: Statistical Bulletin of Banco de España.

Figure 1.8 Balance of payment of the Spanish Economy: Investment

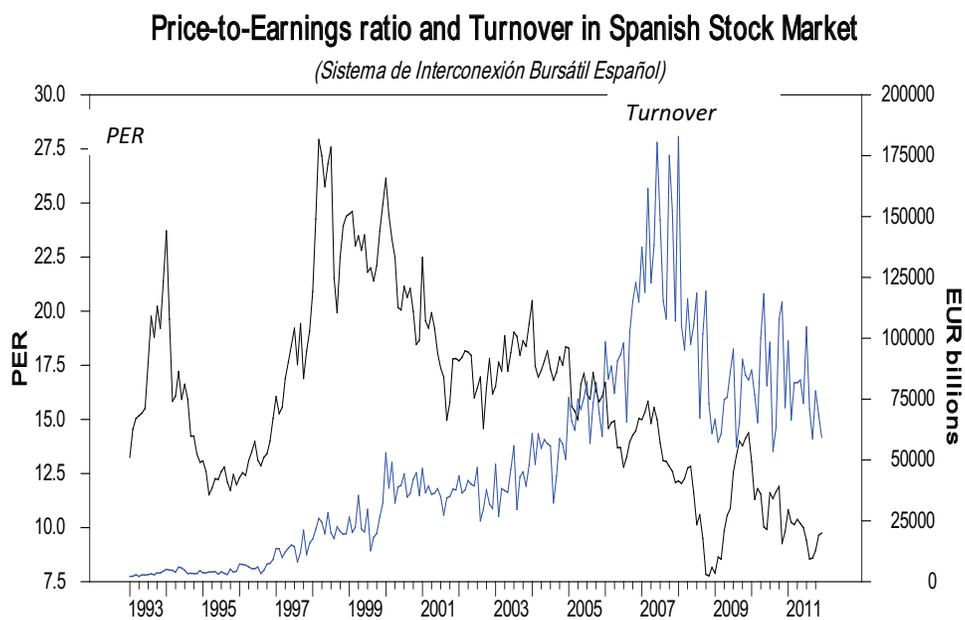
BALANCE OF PAYMENTS: Total financial account and excluding Banco de España



Flows

Source: Statistical Bulletin of Banco de España.

Figure 1.9 Price-to-Earnings (PER) and Turnover in Spanish stock market



Source: Bolsa de Madrid and Sistema de Interconexión Bursátil Español – SIB.

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