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Accounting Based Valuation and Implied Discount Factor

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Summary

The focus of this doctoral thesis is on the determination of the implied cost of capital in the equity market. Three issues are investigated in detail: the relations between the cost of equity capital, the credit spread and the economic growth; the links between realized market returns and the cost of capital; and the forecasting power of the implied discount factor in predicting market returns.

The problem of estimating the cost of capital is one of the most debated and important issues in finance, and various models have been proposed. It is almost unanimously accepted that investors will require a return that depends on the risk-free rate and a premium that compensates them for the undiversifiable risks they bear. However, there is not an unanimous consensus on its estimation. One approach estimates expected returns from historical returns (market models), while a second approach derives expected returns directly from market prices and forecasts of future cash flows (dividend discount models). Market models advantageously provide a solid theoretical background, but are severely limited by basing estimations on past realizations. Dividend discount models, in contrast, do not give any insight into the required risk premium, but the estimation is based on present information and is forward looking. In this dissertation the latter approach is used.

This work, which is mainly empirically oriented, is organized into three chapters. In chapter one, the relation between the equity and the debt cost of capital at the individual stock level is investigated. The cost of equity is estimated using the simple dividend discount model, while the cost of debt is approximated by the premium on the respective Credit Default Swap (CDS). Using a cointegration approach, we demonstrated the existence of a long

term relation between these two variables. There is also a weak evidence of a Granger causality from CDS premium to the discount factor. These findings are robust to different model specifications.

In chapter two, we extended the findings of the first chapter by analysing the overall US stock markets with aggregated individual estimates. In particular, the relation between the cost of equity derived from stock prices and analysts forecasts and the cost derived from corporate bond spread is investigated. The first is derived using the Finite Horizon Expected Return Model, while the second is derived from a non arbitrage argumentation which we will refer to as the promised yield under risk neutral probability (PYRN). We demonstrated that those two measures are indeed cointegrated, and that any deviation from the parity will be slowly corrected, implying predictability in market returns. Evidence of Granger causality from PYRN to the implied discount factor is also provided. Incorporating this information into a trading strategy yields superior returns-variance performance. Finally, we demonstrated that most of the observed volatility in market returns is due to changes in the discount factor, and only a tiny fraction can be attributed to unexpected revisions in earnings perspectives.

In chapter three, we concluded the analysis by studying the international level. The individual implied discount factors are aggregated by country in order to have a measure of the national equity implied discount factor. We showed that this measure explains the cross sectional difference in the average realized returns between the countries considered. Furthermore, almost 70% of the variability of returns can be explained by changes in this factor. We further demonstrated that the growth outlook of a country explains the observed difference in the level of the implied discount factor: the higher the rate of growth of the GDP, the higher the the discount factors. This finding is coherent with the predictions of the Solow model. In addition, the excess growth in earnings (with respect to ROE) is correlated with the excess growth of the GDP with respect to its long term average. Thus, higher GDP growth will translate into higher firm profits that will be reflected in higher market returns. Finally, we showed through principal component analysis (PCA) that one component is able to account for more than 50% of the

cross-sectional difference in the implied discount rate. This factor is strongly correlated with the credit spread on US corporate bonds. Thus the variability in the time series of the discount factor is mainly determined by changes in the perceived default risk. In other words, the cross-country differences in the long term levels of the implied discount rates are determined by the respective growth outlook of the economies, while the time series dynamics are mostly determined by changes in the perceived credit risk.

Chapter 1

The relationship between Credit Default Swap and Cost of Equity Capital

(Joint with Prof. Giovanni Barone-Adesi)

We try to assess the relationship between the equity and the debt cost of capital. Using a very simple dividend discount model we compute the implied discount rate and we compare it with the corresponding premium on the corporate credit default swap using a cointegration approach. We demonstrate the existence of a cointegrating relationship between the implied discount factor and the CDS premium and we find weak evidence of Granger causality from CDS premium to the discount factor. Our findings are robust to the choice of different parameter assumptions and model specification.

1.1 Introduction

Estimation of the cost of equity capital is one of the most central aspect in finance. In the traditional models, the cost of capital is estimated ex-post on the basis of realized returns. The most known and used model is the capital asset pricing model (CAPM) of Sharpe (1964), Lintner (1965) and Mossin (1966). The CAPM predicts that the expected return on a stock is positively related to its systematic risk, the beta. Unfortunately, many empirical estimates and tests of this model based on realized past returns do not support the basic prediction of the CAPM: for example, Reinganum (1981), Coggin and Hunter (1985), Lakonishok and Shapiro (1986), and Fama and French (1992). Another popular model is the Fama-French three factors model (1993). In their specification, the expected return on any stock depends not only on the market beta, but also on its size and the book-to-market ratio (B/M).

The estimation of the expected return based on past realized returns has severe limitations. In particular, in order to obtain accurate estimates, a long time series is needed and most importantly it has to be stationary. For those reasons many authors have recently proposed alternatives approaches. The starting point of most of those approaches is the well known dividend discount model (DDM), which states that the expected return on any share is the discount factor that equates the share's current price with the expected stream of future dividends. They use accounting data and stock market prices and, by reverse engineering, estimate the implied cost of equity capital. Since it is not possible to predict dividends up to infinity, one must impose some restriction to eliminate the need for an estimate of the terminal value.

Gordon (1993) estimated the expected return as the sum of the expected dividend yield and the expected rate of growth in prices. Recognizing the limitation of this measure, he found a significant positive correlation between this variable and the market beta. In a later work, Gordon (1997) proposed to estimate the expected return using the finite horizon expected return model (FHERM). In this model, the expected return is obtained by finding the discount rate that equates the share's current price to the sum of expected

dividends, where the dividends up to a finite horizon N are obtained from analysts' forecasts and the dividends from $N + 1$ to infinity are equal to the forecast for normalized earnings in period $N + 1$. He finds that those estimates can be in agreement with the predictions of the CAPM .

In a different approach Botosan (1997) used the accounting-based valuation formula developed by Edward and Bell (1961), Ohlson (1995) and Feltham and Ohlson (1995), (the EBO valuation model). The model states that current stock prices are a function of current and future book values, future earnings, and future stock prices. She analyses the association between the implied cost of equity capital and the market beta, firm size, and a measure of disclosure level. She demonstrates that the expected rate of return is negatively associated with disclosure level, in particular for firms with low analysts following; furthermore, it is increasing in beta and decreasing in firm size.

Ohlson and Juettner (2000 and 2005), without imposing restrictions on dividend policy, developed an alternative parsimonious model relating a firm's share price to next year expected earnings per share, the short and long-term growth in earnings per share (EPS), and the cost-of-equity capital.

Gode and Mohanram (2001) used the Ohlson and Juettner model (2000) to determine the implied cost of equity capital. They found that the expected return is related to conventional risk factors such as earnings volatility, systematic and unsystematic return volatility and leverage.

Gebhardt, Lee and Swaminathan (2001) estimated the implied cost-of-capital using a residual income model for a large sample of US stocks. Examining the firm characteristics that are systematically related to the derived cost of capital, they found B/M, industry membership, forecasting of long-term growth, and the dispersion of analysts' earnings forecasts explain around 60% of the cross sectional variation in future implied cost of capital.

Botosan and Plumlee (2001) tried to verify if the cost of capital estimated from the unrestricted dividend model is a valid proxy for the expected cost of equity capital. They showed that their estimates are consistently associated with six risk proxies, suggested by theory and prior research. In particular, they found a positive and strong relationship between market beta and the

derived rate of return. In the second part of their work, they analysed the extent to which their restricted form model correlated with the unrestricted form; the EBO valuation model correlates most highly. However, they note that there is no gain in using such a specification because of the need for forecasts of future stock prices. Among the other models with less need for data, the Gordon model shows the highest correlation. Conversely the Ohlson and Juettner model and the Gebhardt, Lee, and Swaminathan specification correlate less with the unrestricted dividend model; in addition, the association between the derived expected return estimates and the risk factors are less consistent with the theory than the ones obtained using the dividend model or the Gordon model.

To summarize, the evidence presented so far indicates that market beta (and other risk factors) computed on ex-post realized returns are not able to explain the cross sectional difference in the expected rate of returns. The association of risk factors with the cost of equity capital, computed on the basis of accounting variables and current stock prices, is more consistent with the theory. In particular, there exists a strong and positive relationship between the implied cost of equity capital and the financial leverage of the firm.

The goal of this paper is to provide additional evidence in favour of the usefulness of estimating the expected return on equity through accounting based models and to provide further evidence of the close relation between CDS premium and cost of equity. We empirically investigate if the cost of equity, derived from the dividend discount model, is related with the cost of debt, approximated by the premium on the corresponding CDS¹. According to the structural model of Merton (1974), the cost of equity and the cost of debt are in fact strongly related since they share the same underlying source of risk. Several studies have shown a strong link between credit spread and

¹A credit default swap (CDS) is a financial derivative that allows investors to buy protection against the default event of the underlying company. In the case of a default of the underlying company, the investor will receive the face value of the defaulted bond; in exchange, the investor agrees to periodically pay a fixed amount. The premium is approximately equal to the spread between the yield of a bond issued by the firm and the corresponding government yield. For this reason, they are usually seen as a valid and easily available proxy for the cost of debt.

equity returns. Many studies have shown that the credit spread can predict expected return in stocks and bonds (e.g. Campbel (1987) and Fama and French (1989)). Several others studies have documented a negative correlation between credit spread and stock return (e.g. Kwan (1996) and Norden and Weber (2009)). Vassalou and Xing (2004) using Merton (1974) option pricing model to compute default measures for individual firms found that default risk is systematic risk and that the size effect is a default effect.

We report strong evidence of a close link between the implied cost of equity and the premium on the corresponding CDS. In agreement with previous studies we find that the larger the credit spread the larger the implied cost of equity and thus the lower the stock price. Furthermore, a large fraction of the variability in the time series of the implied discount factor is captured by variation in the credit spread. These findings can also be interpreted as evidence in favour of the hypothesis that the implied discount factor is a good proxy for the unobservable expected return on equity.

Given the fact that both the implied cost of equity capital and the CDS premiums are strongly persistent and close to be $I(1)$ processes, this study is performed using the tool-kit of cointegration analysis. It is well known that OLS provides spurious results if the dependent variable is non stationary (or close to it), unless it is possible to identify a cointegrating vector in such a way that a linear combination of the variables is stationary.

The paper is organized as follows. In section two, we present the model specification, our data sources and the summary statistic. In section three, we present our main results; we analyse the aggregate and the individual firm results. In section four, we present some robustness checks. In section five, we summarize the relevant econometric issues and techniques to deal with cointegration, and in section six, we state our conclusions.

1.2 Methodology and Data

Empirical Models Specifications

The implied discount rate or the cost of equity capital is the rate of returns investors require for an equity investment. This rate represents the ex-ante expectations about future returns. In most practical applications, however, realized (ex-post) returns are used because, on average, expectations should be equal to realized returns. However, many studies have shown that estimates based on past realizations are too imprecise to allow reliable conclusions. Despite this, the CAPM or the Fama-French models remain the most used techniques to estimate the cost of capital.

An alternative approach is to estimate the unobservable discount rate using the analysts' consensus forecasts about future cash flows (earning, dividends, etc.) of a firm and its current stock price. The expected rate of return is thus obtained by equating the current stock price with the intrinsic value of the firm, according to a specific equity valuation model, and solving for the internal rate of return. This methodology, in contrast to the classical ones (e.g. the CAPM), requires a model of corporate valuation since the intrinsic value is not an observable variable. In addition, it has to rely on the assumption that the observed stock price always reflects the true firm value (EMH) and that analysts' forecasts reflect the true market expectations about future cash flows. Although the EMH is generally largely supported by the literature, the last hypothesis is more controversial. Many authors argue that analyst forecasts are on average quite precise and, in general, are more accurate than simple time series models (see, for example, O'Brien 1988, Brown 1996). Many others instead argue that forecasts errors are too large and that they are systematically optimistically biased (see Brown, 1993 and the references therein).

In the typical neoclassical model, the theoretical stock price is defined as the present value of the future cash flows to shareholders. Although many different models have been developed, to keep things as simple as possible, we have used a simple dividend discount model. We thus proceed as follows:

first, we obtain a time series of the implied discount rates. To do this we consider the following equity valuation model:

$$P_{t,k} = \sum_{s=1}^{\infty} \frac{E_t [DPS_{s,k}]}{(1 + r_{t,k})^s} \quad (1.2.1)$$

Here, $P_{t,k}$ is the intrinsic price at time t of the security k , $E_t [DPS_{s,k}]$ denotes the expectation at time t of future dividends payment at time s for security k and finally $r_{t,k}$ is the implied discount rate or cost of equity capital. Since it is not realistically possible to forecast all the stream of dividends up to infinity we must introduce some assumptions about future dividend growth. Specifically we assume a constant growth in dividends (g_k) after time T . In this way it is possible to rewrite the above formula as:

$$P_{t,k} = \sum_{s=1}^T \frac{E_t [DPS_{t+s,k}]}{(1 + r_{t,k})^s} + \frac{E_t [DPS_{t+T+1,k}]}{(r_{t,k} - g_k) (1 + r_{t,k})^T} \quad (1.2.2)$$

Since analysts usually focus more on earnings than on dividends², it is convenient to modify the previous equation in order to deal with earnings per share (EPS). One problem in considering directly earnings is that only a part of them are distributed to shareholders; the rest is reinvested to allow the firm to grow. The simplest and the most intuitive way to deal with this is to assume a constant payout ratio $(1 - k)$. The previous model can thus be rewritten as:

$$P_{t,k} = \sum_{s=1}^T \frac{(1 - k) E_t [EPS_{t+s,k}]}{(1 + r_{t,k})^s} + \frac{(1 - k) E_t [EPS_{t+T+1,k}]}{(r_{t,k} - g_k) (1 + r_{t,k})^T} \quad (1.2.3)$$

In order to ensure that the choice of one particular specification does not drive our results, we simply use both alternatives throughout the paper. At this point we are able to solve for $r_{t,k}$ in such a way that the observed market price and the theoretical one are equal. We solve this equation for every monthly observation, in order to be sure to take into an account any

²As reported in Block (1999), analysts considered earnings and cash flow to be far more important than dividends and book value in security valuation.

1.2. METHODOLOGY AND DATA

revisions in market expectations.

Finally, given the accuracy of the forecasts and the fact that there is little evidence to suggest that analysts provide superior forecasts when the forecasts are over three or five years³, we have decided to focus only on the three year horizon; using more estimates does not give much additional information.

We further assume a constant payout ratio of 30%⁴ and a long term growth rate of 4%⁵. This rate should mirror the growth rate of the overall economy. Changes in those assumptions over a reasonable range do not alter in a qualitatively way our results. Further details are discussed in section four.

One goal of this work is to try to investigate if there is any relationship between the cost of equity and the CDS premiums. The logic behind this is that there exists a common factor that affects simultaneously the cost of the equity capital and the riskiness of the debt of a firm. The most important determinant of the CDS price is the likelihood that a credit event occurs. It is therefore natural to empirically investigate the link between equity and CDS premium. This has also interesting implications for practitioners. In the recent times capital structure arbitrage have become popular among hedge funds managers. Capital structure arbitrage tries to take advantage from mispricing between CDS premium and equity prices⁶. It is therefore impor-

³O'Brien (1988) compares consensus analyst forecast with time series forecasts, the analysts outperform the time series model for one-quarter ahead forecasts and do worse for four-quarter ahead forecasts.

⁴The Dividend Payout Ratio of the US S&P500 shows a historical downward trend since the 1920s. For most of the 20th century, the biggest part of earnings were paid out by the companies. Starting in the 1960s, things started to change as the corporate management realized that earnings can be more usefully used to repurchase back stock or to reinvest back the money in the company. Consequently, the dividend payout ratio began sliding from over 60% to around 50%. The trend sped up over the past two decades: by the late 1980s, just 40% of S&P 500 profits turned into dividends; by 2004, it was 35%; today, it's a record-low 29%

⁵The average yearly nominal growth rate of the US GDP during the period 2004-2010 was 3.98 % (source: World Bank)

⁶Yu (2006) examined the risk-return of the capital structure arbitrage, he found this strategy to provide Sharpe ratio similar of those of other fixed-income arbitrage strategies. However the monthly excess returns on the strategy are not significantly correlated with either equity or bond factors.

tant in order to hedge the positions to gauge the linear relationship between CDS premium and stock prices.

This task is achieved by estimating the following regression for each firm in the sample.

$$r_{t,k} = \alpha_k + \beta_k CDS_{t,k} + \epsilon_{t,k} \quad (1.2.4)$$

Where $r_{t,k}$ is the implied cost of equity at time t for firm k and $CDS_{t,k}$ is the corresponding CDS premium.

Since both the variables are highly persistent in order to avoid spurious regression, the residuals $(\epsilon_{t,k})$ must to be stationary. If it is the case, the above relationship can be interpreted, from an econometric point of view, as a cointegrating relationship.

Finally, to reduce the noisiness of the data, we repeat all the analysis by aggregating the data as cross section averages:

$$r_{t,M} = \frac{1}{N} \sum_{k=1}^N r_{t,k} \quad (1.2.5)$$

and

$$CDS_{t,M} = \frac{1}{N} \sum_{k=1}^N CDS_{t,k} \quad (1.2.6)$$

Where N is the total number of stocks in the sample.

Data set and descriptive statistics:

The analysis is performed on the 30 stocks composing the Dow Jones Industrial Average (on 1st March 2010), covering the period 15.01.2004 - 18.03.2010 for a total of 75 monthly observations per firm (See Table 1.1 for details on individual stocks). Data on analysts' forecasts for earning per share (EPS) and dividend per share (DPS) are obtained from the I/B/E/S summary statistics database⁷. Given the accuracy and the number of analysts' estimates,

⁷Summary history consists of chronological snapshots of consensus level data taken on a monthly basis. The snapshots are as of the Thursday before the third Friday of every month (which is the Thomson Reuters monthly production cycle). Historical files are updated and delivered via electronic delivery (FTP) on a monthly basis.

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we use only the mean estimate for forecasts up to three years. Summary history consists of chronological snapshots of consensus level data taken on a monthly basis. Monthly data on prices and credit default swap premiums are obtained from the DataStream database. We are forced to choose such a short time interval (2004-2010) because the CDSs are a relatively new product; data on CDS premiums are available starting in 2004. Monthly data on the yield of the three month US Treasury Bill and of the 10 year constant maturity Treasury note⁸ are obtained from the Federal Reserve Statistical Release.

We choose to analyse the DJIA stocks because they are the most liquid and the most followed by analysts. Additionally, their cash flows are quite stable, resulting in more accurate forecasts. Obviously, the sample is quite small, and conclusions on the general validity of this work are, accordingly, difficult to draw. Travelers (TRV) and Intel (INTC) have to be discarded from the analysis since we do not have enough CDS data. We also have to discard Cisco (CSCO) from the DPS analysis because all I/B/E/S forecasts for the dividend of this stock are zero. Finally the analysis on General Electric (GE) has to be limited to the period 15.01.2004 - 14.06.2007 because we do not have CDS data after this date.

Table 1.2 presents descriptive statistics for the selected sample. The mean for the entire data sample of the discount rate estimated on EPS basis is 6.33%, 6.88% computed on DPS. The implied risk premium (computed as the difference between the discount rate and the 10 year treasury constant maturity) are 2.23% and 2.77%, respectively. Those numbers may appear small, but they are consistent with the selected sample of large, stable firms. These firms are generally seen as low risk stocks, and for this reason, the required risk premium is relatively low⁹. During the same period, the mean 3 month T-bill rate was around 2.37% yearly while the average 10 year rate was relatively higher at 4.10%. The average premium on the CDS was 26.32, 43.37 and 54.49 basis points for the 1 year, 5 year and 10 year maturities,

⁸For the 10 year note, we use yields on actively traded non-inflation-indexed issues adjusted to constant maturities

⁹The level of those estimates are sensible to the choice of the long-term growth rate and the payout ratio

respectively.

The year-by-year statistics indicate that although the overall discount rate did not increase too much during the financial crisis (from around 6% to 6.8%), the risk premium almost doubled, from an average of 1.6% from 2004 to 2007 to a peak of 3.65% in 2009. This is consistent with an increase in risk aversion typical of such periods of financial instability. The yield on the 3 month T-Bill was around 1.36% in 2004, rose to an average of 4.73% in 2006, and then dropped to 0.14% and 0.10% in 2009 and 2010, respectively. Conversely, the yield on the 10 year note remained substantially stable, around the range 4.22-4.80%, until 2007. In 2009 it dropped to 3.18% before recovering to 3.76% in 2010.

The analysis on the CDSs' statistics highlights a dramatic increase in the default risk especially over the short horizon. The average 1 year CDS premium rose in fact from an average of 6 basis points, for the years 2004-2007, to more than 70 basis points in 2009 with a peak of 200 bps (see Figure 1.5). In the first months of 2010, it adjusted to a mean of 27 basis points. Longer horizon CDSs present a similar pattern.

During the sample period, EPS and DPS forecasts rose at an average rate of about 11-12% per year. This rate of growth, however, was not uniform, ranging from an average of around 30% in 2004 to a negative average value in 2008 and 2009. Interestingly, the two and three year horizons are more negative as a result of the financial crisis and the worsening in the future economic perspective. Conversely, the ratio between dividends and earnings remained quite stable during the full sample period and through the various horizons, averaging about 0.35 (see Table 1.3).

The analysis of the correlations of monthly changes (Table 1.4) shows that CDS premiums are highly correlated across different maturities, from 0.78 to 0.97, with, not surprisingly, the correlation being higher between the narrower maturities. The same appears to also be true for EPS and DPS forecasts over different horizons. As an example, the Spearman rank correlation between the one year and the two year horizon EPS forecasts is 0.90, while the correlation between the two year and the three year horizon is 0.8, and while the correlation between the one year and the three year is only

0.73. The correlation between monthly changes in EPS and DPS forecasts is quite high (around 0.6 depending on the considered horizon). This may be a consequence of the fact that managers tend to smooth dividends more than earnings¹⁰.

Interestingly, neither the EPS nor DPS monthly changes appear to be significantly correlated with the monthly changes in the level of the risk-free rate or the CDS premiums. Even the changes in the short-term and in the long-term risk free rate seem not to be strongly correlated. Finally, we observe a small negative correlation between the changes in the risk-free rate and in the CDS premium, particularly for the 5 and 10 year maturity. We can rationalize this correlation with the following business cycle story: interest rates tend to decrease when the economy is slowing, while simultaneously default risks tends to increase. The correlation between the changes in the discount rates computed according to different model specifications is quite high. The values reported are consistent with prior research (e.g. Botosan and Plumlee (2001)). This confirms that the different models give substantially the same output, and ensures that our qualitative interpretation of the results is not driven by the choice of a particular equity valuation model.

Monthly changes in CDS premium and in implied discount rates also show a quite remarkable positive correlation. This confirms the existence of a link between the cost of equity capital and the risk premium in the corporate bonds. Although derived from earnings per share and dividends per share forecasts, changes in the implied discount rate present only a small correlation with changes in EPS or DPS. Thus, most of the volatility in the expected return is due to changes in risk aversion, rather than changes in cash flows. Interestingly, the relationship with the risk-free rate is not strong and it is somewhat ambiguous. The correlation with changes in the 10 year yield is around 0.1-0.2 while the correlation with changes in the 3 month rate is negative (around -0.1). This is a slightly surprising, as traditionally, risk-free rates play an important role in the determination of the cost of capital.

¹⁰Lintner (1956) showed that dividend-smoothing behaviour was widespread. Lintner observed that firms are primarily concerned with the stability of dividends. His findings seem to hold for a wide set of firms and recent time periods (e.g., Fama and Babiak (1968), Brav, Graham, Harvey and Michaely (2005))

1.3 Results

Before discussing our analysis, we first give an overview of the stock market and of the level of the US government bond interest rates during the period taken into consideration by this work. Figure 1.1 is the value of the Dow Jones Industrial Average Index (DJIA) for the period 1.1.2004-18.03.2010. The market remained relatively flat during the years 2004-2005 and then experienced a strong rally from 2006 to mid 2008. The DJIA then dramatically decreased because of the financial crisis of 2008 and 2009, following which it quickly recovered.

Figure 1.2 reports the value of the US government bond interest rate for the USA. The first panel shows the yield on the 10 year constant maturity Treasury note (10YTN); the second panel, the yield on the three month Treasury bill (3MTB); the third panel, the difference between the yield on the long term government bond and the short term rate on the Treasury bill (TERM). From 2004 to 2007, inflation pressure pushed up the three month yield, while long term interest rates remained substantially stable at about 5%. In the following two years, the three month rate reached the zero level as a direct consequence of the extraordinary easy monetary policy that the FED (and many other central banks) undertook in order to counteract the deep financial crisis.

The long term rates showed a slightly different behaviour. After a strong decline coinciding with the more acute phase of the crisis, the yield on the ten year US bonds started in 2009 to increase as the economy gave some sign of recovery. Consequently, the yield differential between long and short term interest rates widened. This difference is often used as an indicator of the investor expectation on the future growth of economic activity.

Although the period under consideration is relatively short, all these different market conditions and dynamics make it a very interesting period. The presence of these dynamics is an important condition necessary to detect any interesting relationship.

Figure 1.3 and Figure 1.4 plot the cross-sectional average of earning per share (EPS) and dividend per share (DPS) forecasts made by analysts. As

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already explained, we have considered just forecasts ranging from one year to three years. The EPS and DPS measures tend to move together, and the forecasts for different horizons seem to be highly correlated.

Interestingly, it seems that the analysts' forecasts tend to lag the DJIA index. We observe an important reduction in the forecasts some months after the big draw-down of the stock market, and an increase some weeks after the beginning of the recovery. Figure 1.5 plots the average credit default swap premium for the 30 firms composing the Dow Jones Industrial Average (as of 1st March 2010). This time series is computed taking the arithmetic mean of the individual CDS premiums.

$$CDS_t = \frac{1}{N} \sum_{k=1}^N CDS_{t,k} \quad (1.3.1)$$

As already mentioned, the credit spread remained substantially flat during the pre-crisis period. Conversely, during the crisis, the average premium strongly increased, reflecting the overall deterioration of the credit quality. This change automatically translates into higher financing cost and indirectly causes an increase in the cost of equity and a decrease in the stock prices.

Figure 1.6 reports the average of the implied discount rates of the individual stocks, computed using the different equity valuation models. Although there are some differences in the estimates coming from different models, the overall behaviour seems to be the same. The Gordon model seems the most variable. It appears that there is, especially during the recent financial crisis, a common movement between discount rates and CDS premiums. The two figures appear, in fact, very similar. Interestingly, we observe on both the graphs a double peak on November 21, 2008 and on March 9, 2009. This may indicate a common factor affecting both the cost of equity, approximated by the implied discount rate, and the default risk of a company, approximated by the premium on the CDSs. This impression is also confirmed by the correlation between monthly changes in the discount rate and in the premium of the CDS. As Table 4 reports, the average correlation is in the range 0.4-0.6, depending on the measure we use to compute the implied discount rate and

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the maturity of the CDS.

Over the next sections, we want to assess if there exists a cointegration relationship between the CDS and the implied discount rate. The starting point is to assess if the time series we use have a unit root. To check this, we use the common Augmented Dickey-Fuller test. That is, we estimate the following zero drift $(P + 1)^{th}$ order autoregressive $[AR(P + 1)]$ model:

$$y_t = \zeta_1 \Delta y_{t-1} + \zeta_2 \Delta y_{t-2} + \dots + \zeta_{p-1} \Delta y_{t-p+1} + \rho y_{t-1} + \epsilon_t \quad (1.3.2)$$

The null hypothesis that $\rho = 1$ can be tested using the following t-statistics:

$$t_T = \frac{\hat{\rho}_T - 1}{\hat{\sigma}_\rho} \quad (1.3.3)$$

Table 1.5 reports the values of the t-statistics for all the time series used in this paper. Based on this test, the implied discount rates, computed both on EPS and on DPS, are not stationary for all the stocks considered. The evidence for the presence of a unit root in the CDS time series is weaker; in fact, the ADF t-test fails to reject the null of a unit root in four cases at the 5% level and in eleven cases at the 10% level. If we consider just the last 40 months of the sample, the null of a unit root can not be rejected for any series. These results can be somewhat problematic from a theoretical stand point as neither the discount factors nor the premium on CDS are allowed to increase indefinitely.¹¹

The fact that the time series appear non stationary is most probably due to the short time series considered and the particular behaviour during the financial crisis. In addition, it is also known that the discriminatory power of statistical tests for the presence of unit roots is generally quite low against the alternative of roots which are close to unity. For these reasons, it is more reasonable to conclude that these time series are highly persistent with a slow mean reversion behaviour. Given this strong persistence, it is more convenient from an econometric stand point to treat them as $I(1)$ processes,

¹¹Variables such as interest rates are often modeled in cointegrating relationships, even though it is highly unlikely that the interest rate could theoretically have a unit root.

although this assumption may not be without consequences.¹²

Aggregate results

Over the next section, we will consider the relationship between the cross sectional average of the CDS premium and the cross sectional average of the implied discount rates. We first investigate for cointegration between the premium on the average CDS premium and the average implied discount rate obtained using EPS forecasts, as in equation 1.2.3. We assume the fraction of EPS that is paid out in any period is 0.3; this value is consistent with the average ratio between DPS and EPS during the analysed period as reported in Table 1.3. We further assume that the long term growth rate is constant at 4%, corresponding to the average US GDP growth rate over the last few years. The qualitative interpretation of the results are, in any case, not affected by different choices of those parameters. Deeper investigation of this issue will be presented in robustness check part of the paper.

Results are presented in Table 1.6: Panel A reports the estimates from the Johansen procedure, Panel B shows the numbers coming from the standard OLS regression. The OLS residuals appear to be positively autocorrelated, as highlighted by the Durbin-Watson statistics. This may lead to an overestimate of the level of significance. A low Durbin-Watson statistic and an high R^2 , as in this case, are often symptoms of spurious regression. This eventuality can be ruled out if the two time series are cointegrated or nearly cointegrated. This is the case if the individual time series have a unit root while their linear combination is stationary. Stationarity in the residuals is largely confirmed both by the ADF t-statistics and by the likelihood ratio test, mitigating the concern of spurious results. The cointegrating vector in panel A and the β estimates in panel B provide similar estimates and confirm the hypothesis that the implied discount rate and the CDS premium are pos-

¹²It is shown analytically, using local to unity asymptotic approximations, that whilst point estimates of cointegrating vectors remain consistent, commonly applied hypothesis tests no longer have the usual distribution when roots are near but not one. Furthermore Elliot (1998) has shown that for near unit roots, extremely large size distortions may occur from approximating slowly mean reverting processes by ones with unit roots.

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itively related. Similar results are obtained using different CDS maturities and considering the alternative estimates of the implied discount rate, namely using the DPS model as in Equation 1.2.2. The estimates are reported in panel C and D.

Finally, we want to consider the role of the risk-free rates. We individually include in the previous regression the yield on the three month US Treasury bill (3MTB), the 10 year yield on treasury notes (10YTN) and the difference between the two (TERM). A priori, it is not clear what the impact of these variables is. We might expect 3MTB and 10YTN coefficients to be positive, since the higher the interest rates are, the higher the cost of capital and the discount factor are. On the other hand, short term interest rates tend to move with the economical cycle: in periods of expansion, interest rates tend to be higher; in periods of contraction, they tend to be lower¹³. At the same time, we expect the discount factor to increase during periods of crisis, as stocks tend to be riskier. We might, therefore, expect the two to be negatively correlated.

The same story apply to the TERM factor. It is well known that the spread between long and short term interest rates can predict the economic cycle. High spreads suggest that investors anticipate an expansion of the economy; a lower spread, that investors are pessimistic about future growth. For this reason, investors may require a lower discount rate when they perceive the economy to recover and a higher premium when they fear a recession. So we might also expect a negative correlation.

Table 1.7 reports our results. As before, Panels A and B consider the discount rate computed from EPS, and Panels C and D consider the discount rate that comes from DPS forecasts. The coefficients on CDS still remain significant and indeed do not change much with respect to the previous case. All the statistics are comparable to the previous case and do not change significantly, indicating that the effect due to CDS premiums dominates and is by far the most important factor.

Regarding the impact of the risk-free variables, as expected, there is no

¹³This hypothesis is supported by the negative correlation between CDS premium and interest rates (Table 1.4).

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clear sign. The three month rate appears to be in general slightly positively, related to the implied discount factor, except for the 1 year CDS, $r(DPS)$ case. The Johansen and the OLS procedure give generally the same picture although the magnitudes of the effects are different. Things appear messier for the ten year yield; the two methodologies give opposite pictures. OLS suggests a positive relation while the other procedure suggests a negative one. No clear relation can be identified. Finally, the TERM factor appears again to be weakly negatively related to the discount factors (again with the exception of the 1 year CDS, $r(DPS)$ case).

A technical explanation for these weak results is that the "risk-free" variables are also cointegrated with the CDS premium as shown in Table 1.15. Since the explanatory variables tend to be cointegrated, we may have some identification issue, and thus we are not able to fully capture the effect of the risk-free rates. In this regard, we can notice a negative relationship between the CDS premium and the three month and the ten year yield: the higher the interest rate, the lower the required compensation for credit risk. As discussed previously, an explanation for this is the business cycle story that during expansion, interest rates tend to be high while during recession, they tend to be low. On the contrary, CDS premiums tend to be high during recession when credit risk is more severe, but low in economic boom. This story is also confirmed by the negative sign on the TERM factor. When this spread is high, investors believe in a growing economy, and the perceived credit risk is therefore lower.

Individual results

In the previous section, all the analyses were conducted using aggregate data. One might ask if the previous findings apply also at individual level. This section tries to answer this question. As before, the individual implied discount rate is computed on the basis of DPS ($r(DPS)_{t,k}$) and EPS ($r(EPS)_{t,k}$) analysts' forecasts according to equation 1.2.2 and 1.2.3 respectively. As before, we impose for every stock a constant pay-out ratio of 30% and a constant long term growth rate of 4%. To test for cointegration between the time

1.3. RESULTS

series of the individual implied discount rates and of the respective one year and five year CDS premium, we use, as in the previous section, both the standard OLS and the Johansen procedure. Table 1.9 reports the results obtained applying the Johansen procedure for $(r(EP S)_{t,k})$. Panel A is for the one year CDS premium; Panel B, the five year.

Focusing first on the one year term, the likelihood ratio test accepts the null of a cointegrating relation for 25 of 28 cases at the five percent critical value. Two more are significant at the ten percent level. Only IBM shows no cointegration. We find a positive coefficient between the discount rate and the CDS premium for the great majority of stocks analysed. The only exceptions are Caterpillar, Home Depot, and General Electric. However, in the case of General Electric, we must note that the CDS time series covers only the period January 2004 to June 2007, during which period the premiums were practically flat at a very low level. The lack of variation makes it difficult to identify any relationship with CDS premiums. Results using the five year CDS are very similar.

When the implied discount rates are computed on the basis of DPS forecasts, our conclusions do not change significantly. Table 1.10 presents the figures for this case. Results are qualitatively similar to the $(r(EP S)_{t,k})$ case. We again find a cointegrating relation, at 5% significance level, in 24 of 27 cases. Interestingly, in this case, Caterpillar and Home Depot have the expected cointegrating sign. Only General Electric continues to show a negative relationship. Again, we obtain comparable results considering the five year CDS case.

The numbers presented so far confirm the findings we obtained in the previous section. Furthermore, the choice between $r(EP S)_{t,k}$ and $r(DPS)_{t,k}$ does not alter the results from a qualitative view. This is not surprising given the strong correlation between the two time series (see Table 1.4).

In order to check whether the choice of a different econometric technique leads to a different conclusion, we perform the same analysis as before, applying the standard OLS procedure. Results are presented in Table 1.13 ($r(EP S)_{t,k}$ case) and Table 1.14 ($r(DPS)_{t,k}$ case). The numbers are comparable with those presented before. Almost all the betas are positive and

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statistically significant, confirming the positive relationship between the discount rate and the CDS premium. Interestingly, the alphas appears to be quite stable, around the 6% level for every stock considered, which supports our hypothesis of a constant and common risk factor. However, their level critically depends on the choice of g and k , and, for this reason, no definitive conclusion can be made at this stage. The ADF t-statistics show that the null of the presence of a unit root in the residuals cannot be rejected for some stocks (6 out of 28 at the 10%). In any case this may be due to our small sample size and to the low power of the test. We are not too concerned about it.

An additional confirmation of the strong link between the CDS premium and the implied discount factor is given by Figure 1.10, where the actual market prices are plotted against the “fitted” prices. The later are derived by Equation 1.2.3, using as discount rates the fitted values coming from Equation 1.2.4. Despite the model’s simplicity, the fitting is quite good. More importantly, it is able to maintain a good fitting during the big crash associated with the financial crisis for almost all the stocks we considered. This indicates that changes in the discount rate are able to explain the big drops in prices and the subsequent strong recovery¹⁴.

The role of the risk free rate is considered in Tables 1.11 and 1.12. In Panel A the three month Treasury bill rate (3MTB) is considered; in Panel B, the difference between the ten year and the three month yield (TERM). As for the aggregate case, these variables do not rule out the CDS factor, and there is not a clear relation. The positive sign prevails for the 3MTB, in 20 of 28 cases for $r(EPs)_{t,k}$ and 15 of 27 cases for $r(DPS)_{t,k}$, while the negative sign prevails in front of the TERM coefficients for 20 out of 28 for $r(EPs)_{t,k}$ and 17 out of 27 for $r(DPS)_{t,k}$.

This may be explained by firms different responses to the business cycle. For some firms, the “signaling” aspect of the risk free rate dominates; for others, the “cost of capital” aspect dominates. As for the aggregate case, we

¹⁴This is consistent with the findings in Campbell and Vuolteenaho (2004) showing that discount-rate news causes much more variation in monthly stock returns than cash-flow news, additionally returns generated by cash-flow news are never subsequently reversed, while those generated by discount-rate news are offset in the future.

may have some identification problem since both TERM and 3MTB appear to be cointegrated with the CDS term (see Table 1.16). Both the 3MTB and the 10YTB are negatively related to the CDS premium (Panels A and B), while the TERM factor is positively related to the default risk. In general the numbers presented so far are consistent with the story presented in the previous section; investors require a higher premium when they perceive the economy will do badly in the future, as signaled, for example, by the low spread in the TERM factor.

To summarize, the results obtained suggest the presence of a positive cointegration relationship between the cost of equity capital and the risk premium in corporate bonds. Conversely, any of our measures related to the risk-free rates seems to be important factors in explaining the observed implied discount rate. The picture presented here confirms the findings of the previous section.

Vector autoregressive specification and Granger Causality

As a last check of the relationship between the CDS premium and the implied discount rate, we estimate a vector autoregressive model (VAR(p)) on level, that is:

$$y_t = c + A_1 y_{t-1} + A_2 y_{t-2} + \dots + A_p y_{t-p} + \epsilon_t \quad (1.3.4)$$

Where y_t is the 2×1 vector containing the observations for the cross sectional average of the individual implied discount factors and CDS premiums:

$$y_t = \begin{bmatrix} r(x)_t \\ CDS_t \end{bmatrix} \quad (1.3.5)$$

And A_i is a 2×2 matrix of coefficients. The lag length is determined according to the standard likelihood statistics. For the average discount rate computed using EPS data ($r(EPS)_t$), according to the likelihood statistics, the optimal number of lag (p) is three, while for the rates computed using DPS ($r(DPS)_t$), it is two. Table 1.18 reports the coefficients estimates for the

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VAR(3) model for $r(EP S)_t$: Panel A for the one year CDS premium, Panel B the five year maturity. Looking at the first equation, the coefficients for the CDS variable (up to lag two for one year CDS and up to lag one for five year CDS) are significant in explaining the level of the discount rate measure. In addition, the value of the estimates of the first lag of the discount rate, although significant, is well below the value of one. This confirms that the level of the implied discount factor is related to the level of the CDS premium. In the second equation of the VAR model, the level of $r(EP S)_t$ seems not to be statistically important in explaining the level of the CDS premium, whose value seems to be driven only by the past lagged value of the variable itself. We get similar results using $r(DP S)_t$ (see Table 1.17). In this case, according to the likelihood ratio statistics, the suggested specification is a VAR(2). As before, the lagged CDS premium is statistically significant in explaining the implied discount factor, whereas the inverse is not true.

The corresponding input response functions (Figures 1.11 and 1.12) show and confirm the positive relation between changes in the level of one variable and the level of the other variable. Such shocks seem to be quite persistent. The preceding results seem to indicate causality from the CDS premium to the discount factor. As a test of this hypothesis, we implement the Granger causality test. To briefly illustrate how it works, it is convenient to rewrite the preceding VAR(p) model as:

$$\begin{aligned} r(x)_t &= \sum_{j=1}^p A_{11,j} r(x)_{t-j} + \sum_{j=1}^p A_{12,j} CDS_{t-j} + \epsilon_{1,t} \\ CDS_t &= \sum_{j=1}^p A_{21,j} r(x)_{t-j} + \sum_{j=1}^p A_{22,j} CDS_{t-j} + \epsilon_{2,t} \end{aligned} \quad (1.3.6)$$

Where p is the maximum number of lagged observation as determined previously, $\epsilon_{1,t}$ and $\epsilon_{2,t}$ are the residuals for each time series, and the matrices A include all the coefficients of the model. CDS_t are said to Granger cause $r(x)_t$ if the inclusion of the CDS terms in the first equation reduces the variance of $\epsilon_{1,t}$. This can be tested by performing an F-test of the null hypothesis that all the coefficients are jointly significantly different from zero. Obviously the same testing procedure applies also for the other variable.

The results are presented in Table 1.19. For most of the model specification we used, the CDS premiums is not Granger caused by the $r(x)_t$, the Granger causality probabilities for this relation are in fact, except for the $r(EP S)_t$ 1 year CDS specification, well above the 10% critical level. Results seem to be more favourable to causality between the CDS premium and the discount factor. Granger causality probabilities are in fact all below the 1% level, except in the case of $r(DPS)_t$ and the 1 year CDS, which is at the 5.66% level.

1.4 Robustness check

The most sensitive part of the paper is the estimate of the implied cost of equity capital. For this reason, we want to check whether the results obtained so far are substantially affected by the choice of a specific equity valuation model or of a specific parameter setting. We thus repeat our analysis, first by changing the parameters assumptions, specifically the long term growth rate g and payout ratio $(1 - k)$, and second by computing the cost of capital with an alternative model, the finite horizon expected return model (FHERM, Gordon 1997). This model is derived from the well known proposition that current stock price equals the discounted sum of all future dividends. In order to derive a treatable formula Gordon assumes that beyond year T , the return on equity (ROE) reverts to the expected cost of equity capital (r). The model can be written as follows:

$$P_{t,k} = \sum_{\tau=1}^T \frac{E_t(DPS_{t+\tau,k})}{(1 + r_{t,k})^\tau} + \frac{E_t(EP S_{t+T+1,k})}{r_{t,k}(1 + r_{t,k})^T} \quad (1.4.1)$$

where $P_{t,k}$ is the price of the stock k at date t , $r_{t,k}$ is the cost of equity capital, $DPS_{t,k}$ is the dividend per share for year t , and $EP S_{t,k}$ is the earnings per share for year t .

Figures 1.7 and 1.8 show that different assumptions on the long-term growth rate and on the pay-out ratio affect substantially only the level of the implied discount rate. We observe a proportional parallel shift of the

1.4. ROBUSTNESS CHECK

curve; as g increases, so does the discount rate. Changes in $(1 - k)$ lead to similar movements of the curve, but the response is less pronounced than for changes in g . Using the finite horizon model, the average implied discount rate is more volatile than under our previous specification. In particular, we note a more pronounced increase in the level of expected return during the turbulent period of the financial crisis. As Figure 1.6 shows, the implied cost of equity capital, computed according to the FHERM, rises from an average of 6% in 2004 to a peak of 12% at the end of 2008. Nevertheless, the overall behaviour appears to be very similar under the different specifications. This impression is also confirmed by the correlation analysis between monthly changes in the discount rates derived from different equity valuation models. The correlation matrix is presented in Table 1.4. As already mentioned, the correlation between the different expected return models is quite high; the Spearman rank correlations range from 0.75 to 0.88, while the canonical correlations range from 0.83 to 0.97. Given these results, we do not expect our results to be seriously affected by changes in the model assumptions, as shown in Table 1.8.

As we expect from graphical inspection, changes in the long term growth parameter should affect mainly the alpha estimates (see Panels A to D). In fact, the alphas are proportionally to g , and are about 1.5-2.5% higher than g . The betas are only marginally affected, slightly decreasing as g increases. All other statistics remain unchanged. These findings are valid either if the discount rates are computed using EPS forecasts or DPS forecasts.

Analysing the impact of changes in the payout assumptions leads to slightly different scenarios, as shown in Panels E and F. As in the previous case, an increase of the retention ratio (k) mainly causes an upward shift of the level of implied expected return. As a consequence, as k increases, the alphas increase. Similarly, and more interestingly, the betas are also increasing in k . This is intuitively explained because at higher pay-out ratios, earning forecasts are more highly weighted. In general, the higher the earnings are, the lower the default probability of the firm and, consequently, the lower the CDS spread. As the parameters remain constant, higher earnings translate to a lower discount. Since these two factors act in the same

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direction, it is not surprising to observe an increase in the betas if we give more weights to EPS.

Finally, Panels G and H report the same estimates as before, but computed with the discount rates implied by the Gordon model. Using this model, we see an increase in the betas compared with the previous cases while the alphas are in-line with previous results. This is not surprising, given the previous analysis on the changes in the payout assumptions. In fact, this model gives more weight on the forecast for EPS at time T than on the forecasts for DPS. Both the ADF t-test and the likelihood ratio test reject the null of no cointegration. The results from the Gordon model confirm and strengthen our hypothesis of a relationship between the cost of debt and the cost of equity. This robustness analysis demonstrates that our conclusions do not depend in a critical way on the parameter assumptions we have imposed nor on the specific model.

1.5 Cointegration, unit root and spurious regressions

As already illustrated both the premium on the credit default swap and the implied cost of equity capital are strongly persistent, and the hypothesis of stationarity can not be excluded by formal tests. Therefore, we assume for technical reasons that the time series are integrated of order one. In this section a brief introduction of the econometrics needed for the analysis of cointegration is presented. Define a matrix $y_{t,k}$ containing the observed variables. Assume the variables to be integrated of order one.

$$y_{t,k} \sim I(1) \tag{1.5.1}$$

where

$$y_{t,k} = (r_{t,k}, CDS_{t,k}) \tag{1.5.2}$$

First, we must verify whether the series are cointegrated by estimating the following cointegrating regression with a constant term using standard OLS

1.5. COINTEGRATION, UNIT ROOT AND SPURIOUS REGRESSIONS

regression:

$$r_{t,k} = \alpha_k + \beta_k CDS_{t,k} + \mu_{t,k} \quad (1.5.3)$$

We then test if the residuals $\mu_{t,k}$ are $I(1)$. We use the augmented Dickey-Fuller test on $\mu_{t,k}$. This test consists in estimating the following autoregressive model of the residuals:

$$\mu_t = \zeta_1 \Delta \mu_{t-1} + \zeta_2 \Delta \mu_{t-2} + \dots + \zeta_{p-1} \Delta \mu_{t-p+1} + \alpha + \rho \mu_{t-1} + \epsilon_t \quad (1.5.4)$$

and testing whether ρ is equal to one. The augmented Dickey-Fuller t-test for the null hypothesis that the two series are not cointegrated is then

$$t = \frac{\hat{\rho} - 1}{\hat{\sigma}_\rho} \quad (1.5.5)$$

assuming the true process for y_t is:

$$\Delta y_t = \sum_{s=0}^{\infty} \psi_s \epsilon_{t-s} \quad (1.5.6)$$

It is not possible to directly use the Dickey-Fuller tables to find the critical values since the residuals μ_t are generated from a fitting regression; one needs larger critical values than indicated by the standard Dickey-Fuller test. Appropriate values for this statistic are obtained by Monte Carlo simulations, and the critical values are tabulated (see e.g. Phillips and Ouillaris, *Econometrica* 1990 pp. 165-193).

The second approach, developed by Johansen (1988, 1991 and 1995), has some advantages over the previous procedure. First, it relaxes the assumption that the cointegrating vector is unique; second, it takes into account the short-run dynamics of the system when estimating the cointegrating vectors. The procedure is based on the reduced rank regression method. Suppose that an $(n \times 1)$ vector y_t can be characterized by a $VAR(p)$ in levels of the form:

$$y_t = \zeta_1 \Delta y_{t-1} + \zeta_2 \Delta y_{t-2} + \dots + \zeta_{p-1} \Delta y_{t-p+1} + \alpha + \rho y_{t-1} + \epsilon_t \quad (1.5.7)$$

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The Johansen algorithm can then be described as follows; first, estimate a $(p - 1)^{th}$ -order VAR for Δy_t :

$$\Delta y_t = \pi_0 + \hat{\Pi}_1 \Delta y_{t-1} + \hat{\Pi}_2 \Delta y_{t-2} + \dots + \hat{\Pi}_{p-1} \Delta y_{t-p+1} + \hat{\mu}_t \quad (1.5.8)$$

where $\hat{\Pi}$ denotes an $(n \times n)$ matrix of OLS coefficient estimates and $\hat{\mu}_t$ denotes the $(n \times 1)$ vector of OLS residuals, and a second set of OLS regressions as:

$$y_t = \theta_0 + \hat{\kappa}_1 \Delta y_{t-1} + \hat{\kappa}_2 \Delta y_{t-2} + \dots + \hat{\kappa}_{p-1} \Delta y_{t-p+1} + \hat{\nu}_t \quad (1.5.9)$$

where $\hat{\nu}_t$ is the $(n \times 1)$ vector of residuals from the second regression.

Second, calculate the canonical correlations from the OLS residual:

$$\hat{\Sigma}_{\nu\nu} = \frac{1}{T} \sum_{t=1}^T \hat{\nu}_t \hat{\nu}_t' \quad (1.5.10)$$

$$\hat{\Sigma}_{\mu\mu} = \frac{1}{T} \sum_{t=1}^T \hat{\mu}_t \hat{\mu}_t' \quad (1.5.11)$$

$$\hat{\Sigma}_{\mu\nu} = \frac{1}{T} \sum_{t=1}^T \hat{\mu}_t \hat{\nu}_t' \quad (1.5.12)$$

$$\hat{\Sigma}_{\nu\mu} = \hat{\Sigma}_{\mu\nu}' \quad (1.5.13)$$

Then, compute the matrix:

$$\hat{\Sigma}_{\nu\nu}^{-1} \hat{\Sigma}_{\nu\mu} \hat{\Sigma}_{\mu\mu}^{-1} \hat{\Sigma}_{\mu\nu} \quad (1.5.14)$$

From this matrix we can easily find the associated eigenvalues ($\hat{\lambda}_1 > \hat{\lambda}_2 > \dots \hat{\lambda}_n$). The cointegrating vectors associated with the variables defined in y can be found as the eigenvector of the above matrix associated with the eigenvalues ($\hat{\lambda}_i$). Finally, Johansen proposed two statistics based on the likelihood ratio test:

- The trace statistic tests the null hypothesis of $h = r$ cointegrating relations against the general alternative of $h = n$ cointegrating relations.

1.6. CONCLUSIONS

The further the eigenvalues are far from zero the larger will be the statistics. It can be calculated as follows:

$$2(\mathcal{L}_A^* - \mathcal{L}_0^*) = -T \sum_{i=h+1}^n \log(1 - \hat{\lambda}_i) \quad (1.5.15)$$

- The maximum eigenvalue statistic instead tests the null hypothesis of r cointegrating vectors against the alternative of $r + 1$. This statistic can be computed using:

$$2(\mathcal{L}_A^* - \mathcal{L}_0^*) = -T \log(1 - \hat{\lambda}_{r+1}) \quad (1.5.16)$$

Critical values for both tests were tabulated by Osterwald-Lenum (1992) using Monte Carlo simulations. Their asymptotic distributions depend on the number of non stationary components under the null hypothesis ($n - r$) and on the form of the vector of deterministic components.

1.6 Conclusions

The cost of equity capital is of particular importance both in economics and finance. Reliable estimates are, in fact, needed for many applications, ranging from capital budgeting to portfolio optimization problems. Many studies have shown that the usual approach, based on realized returns, empirically performs poorly. For this reason, a new methodology based on accounting valuation formulas has begun to emerge with encouraging results. However, there are some drawbacks to this new approach linked to the choice of the appropriate model, to the specific parameter assumptions, and last but not least, on obtaining reliable analysts' estimates.

For these reasons, knowing the factors that drive the expected return on the equity becomes indispensable to building reliable estimates and assessing the validity of any approach. Many works in the area have suggested that market beta, leverage, firm size, B/M, analysts' coverage, and other factors are important in explaining the cross sectional difference in expected

1.6. CONCLUSIONS

returns. We claim that many of those elements are reflected in the cost of debt. A credit spread measure can be used as a valid and readily available proxy to estimate the cost of equity capital. We have shown that the premium on credit default swap is closely related to the implied discount rate used in the equity valuation formula. We have demonstrated the existence of a cointegrating relationship between these two variables. We have also shown weak Granger causality from CDS premium to the discount factor. We obtain similar results considering each time series individually. Our findings are robust to the choice of different parameter assumptions and model specifications. An important aspect left for future research is to assess if the findings presented in this paper are merely driven by the fact that many variables, even apparently uncorrelated, moved simultaneously during the financial crisis or, as we think, a real and long term equilibrium exists between equity expected return and risk premium on debt. Unfortunately, the limited availability of CDS data prevented us from verifying our theory over a longer time period. The studied time period should optimally include many different market conditions and several market crashes. Alternatively, one could include more companies in the analysis, taking into consideration the quality and reliability of the earnings and dividends forecasts.

1.7 Tables & Figures

Table 1.1: DJIA Constituent List

The table reports the stocks composing the DJIA index as of 01.03.2010.

Ticker	Name	Analyzed Period		Note
'T'	'AT&T INC'	15.12.2005	18.03.2010	
'AA'	'ALCOA INC.'	15.01.2004	18.03.2010	
'AXP'	'AMERN EXPRESS'	15.01.2004	18.03.2010	
'BAC'	'BANK OF AMERICA'	15.01.2004	18.03.2010	
'BA'	'BOEING CO'	15.01.2004	18.03.2010	
'CAT'	'CATERPILLAR INC'	15.01.2004	18.03.2010	
'CVX'	'CHEVRON'	15.01.2004	18.03.2010	
CSCO' *	'CISCO SYS INC'	15.01.2004	18.03.2010	No DPS data
'KO'	'COCA COLA CO'	15.01.2004	18.03.2010	
'DIS'	'DISNEY WALT CO'	15.01.2004	18.03.2010	
'DD'	'DUPONT & CO'	15.01.2004	18.03.2010	
'XOM'	'EXXON MOBIL CORP'	15.01.2004	18.03.2010	
'GE'	'GEN ELECTRIC US'	15.01.2004	14.06.2007	
'HPQ'	'HEWLETT-PACKARD'	15.01.2004	18.03.2010	
'HD'	'HOME DEPOT INC'	15.01.2004	18.03.2010	
INTC' **	'INTEL CP'	20.11.2008	18.03.2010	No CDS available
'IBM'	'INTL BUS MACH'	19.02.2004	18.03.2010	
'JPM'	'JP MORGAN CHASE'	15.01.2004	18.03.2010	
'JNJ'	'JOHNSON & JOHNSN'	15.01.2004	18.03.2010	
'KFT'	'KRAFT FOODS, INC'	15.01.2004	18.03.2010	
'MCD'	'MCDONALDS CP'	15.01.2004	18.03.2010	
'MRK'	'MERCK & CO'	15.01.2004	15.10.2009	
'MSFT'	'MICROSOFT'	19.10.2006	18.03.2010	
'PFE'	'PFIZER INC'	15.01.2004	18.03.2010	
'PG'	'PROCT & GAMBL'	15.01.2004	18.03.2010	
'MMM'	'3M CO'	15.01.2004	18.03.2010	
TRV' ***	'TRAVELERS COS IN'	-	-	No CDS available
'UTX'	'UTD TECH'	15.01.2004	18.03.2010	
'VZ'	'VERIZON COMM'	19.08.2004	18.03.2010	
'WMT'	'WAL-MART STRS'	15.01.2004	18.03.2010	

Table 1.2: Descriptive Statistics

The table reports the descriptive statistics for the pooled sample of the implied discount factor, the US government rates and the CDS premium. The risk premium is computed as the difference between the implied discount rate and the 10 year Treasury Rate.

	Discount Rate			Risk Premium			Risk-free Rate			CDS Premium		
	EPS	DPS	Gordon	EPS	DPS	Gordon	3M	10Y	1Y	5Y	10Y	10Y
Mean	6.33%	6.88%	7.79%	2.23%	2.77%	2.77%	2.37%	4.10%	26.32	43.37	54.49	
2004	5.92%	6.58%	6.35%	1.70%	2.37%	2.13%	1.36%	4.22%	9.16	27.70	42.68	
2005	6.14%	6.59%	7.09%	1.85%	2.31%	2.81%	3.12%	4.29%	5.92	20.28	37.13	
2006	6.20%	6.61%	7.39%	1.40%	1.81%	2.60%	4.73%	4.80%	3.62	14.77	27.27	
2007	6.15%	6.53%	7.26%	1.52%	1.90%	2.62%	4.24%	4.63%	6.01	18.51	30.39	
2008	6.74%	7.27%	9.10%	3.15%	3.68%	5.51%	1.23%	3.59%	53.23	80.40	87.98	
2009	6.82%	7.66%	9.40%	3.65%	4.49%	6.22%	0.14%	3.18%	79.59	95.14	96.56	
2010 (March)	6.47%	6.95%	8.33%	2.71%	3.19%	4.57%	0.10%	3.76%	27.83	56.98	74.23	

This table reports the descriptive statistics for the pooled sample of annual growth in forecasted earnings and dividends per share.

Table 1.3: EPS and DPS: Descriptive Statistics

	Growth in EPS forecasts			Growth in DPS forecasts			DPS/EPS		
	1 Year	2 Years	3 Years	1 Year	2 Years	3 Years	1 Year	2 Years	3 Years
2004	32.82%	26.31%	21.72%	34.50%	37.30%	34.81%	0.39	0.37	0.39
2005	4.58%	7.53%	7.99%	-1.75%	-2.47%	-3.68%	0.35	0.35	0.35
2006	9.52%	7.88%	9.37%	11.63%	13.03%	12.87%	0.33	0.32	0.32
2007	11.22%	12.95%	15.07%	10.50%	11.68%	12.72%	0.33	0.33	0.33
2008	-0.19%	-13.01%	-10.42%	7.82%	3.00%	0.10%	0.34	0.33	0.32
2009	-20.63%	2.11%	5.43%	-5.50%	-3.58%	-0.82%	0.43	0.39	0.37
Mean	11.37%	11.92%	11.81%	10.80%	11.43%	12.09%	0.36	0.35	0.35

Table 1.4: Correlation Matrix

This table reports the correlation coefficients of monthly changes (i.e. each variable is first differenced). The upper part of the matrix reports Spearman rank estimates while the lower part reports the standard correlation coefficients.

	$r(EPS)_t$	$r(DPS)_t$	$r(GOR)_t$	$CDS(1Y)_t$	$CDS(5Y)_t$	$CDS(10Y)_t$	T-Bill (3M)	T-Note (10Y)	EPS(1Y) _t	EPS(2Y) _t	EPS(3Y) _t	DPS(1Y) _t	DPS(2Y) _t	DPS(3Y) _t
$r(EPS)_t$	1	0.75	0.88	0.6	0.58	0.51	0.04	-0.08	0.21	0.24	0.33	0.15	0.12	0.14
$r(DPS)_t$	0.84	1	0.83	0.48	0.42	0.36	0.04	0.07	0.13	0.17	0.22	0.22	0.21	0.44
$r(GOR)_t$	0.98	0.88	1	0.59	0.59	0.53	0.04	-0.06	0.12	0.17	0.24	0.12	0.1	0.13
$CDS(1Y)_t$	0.59	0.52	0.61	1	0.86	0.78	-0.17	-0.27	0.06	0.01	0.15	0.01	0.02	-0.04
$CDS(5Y)_t$	0.54	0.55	0.58	0.91	1	0.97	-0.24	-0.32	0.19	0.17	0.15	0.01	-0.01	-0.12
$CDS(10Y)_t$	0.45	0.54	0.5	0.82	0.96	1	-0.26	-0.33	0.22	0.21	0.15	0.02	0.00	-0.13
T-Bill (3M)	-0.06	-0.09	-0.06	-0.23	-0.33	-0.34	1	0.33	0.13	0.16	0.16	0.02	0.03	-0.01
T-Note (10Y)	0.2	0.11	0.19	-0.16	-0.25	-0.28	0.39	1	0.07	0.05	0.09	0.06	0.1	0.16
EPS(1Y) _t	-0.01	0.05	0.00	-0.14	0.01	0.07	0.01	0.01	1	0.9	0.73	0.65	0.62	0.47
EPS(2Y) _t	0.1	-0.02	0.08	-0.1	-0.08	-0.08	0.07	0.23	0.8	1	0.8	0.63	0.58	0.53
EPS(3Y) _t	0.13	-0.04	0.09	-0.15	-0.17	-0.19	0.05	0.25	0.7	0.96	1	0.58	0.57	0.54
DPS(1Y) _t	0.12	0.18	0.13	0.00	0.03	0.01	-0.03	0.1	0.64	0.56	0.56	1	0.96	0.72
DPS(2Y) _t	0.11	0.15	0.12	-0.05	-0.04	-0.06	-0.01	0.14	0.63	0.59	0.59	0.97	1	0.74
DPS(3Y) _t	0.11	0.36	0.13	-0.04	-0.05	0.02	-0.01	0.07	0.47	0.49	0.49	0.59	0.6	1

Table 1.5: Individual Time Series Unit Root ADF t-test

This table reports the augmented Dickey Fuller t-statistics for unit root. The row 'EWP' refers to the cross sectional average of all the individual time series. Panel A reports the individual tests for the stocks composing the Dow Jones Industrial Average Index on 01.03.2010. Panel B reports the test for government interest rates series. * means that the null of a unit root is rejected at 10%, ** at 5% and *** at 1%.

Panel A (Individual Series)							
Ticker	CDS(1 Year) _t	$r(EPS)_{t,k}$	$r(DPS)_{t,k}$	Ticker	CDS(1 Year) _t	$r(EPS)_{t,k}$	$r(DPS)_{t,k}$
'T'	-1.67*	0.27	0.47	'INTC'	N/A	N/A	N/A
'AA'	-1.99**	-0.28	-0.68	'IBM'	-1.71*	0.44	0.57
'AXP'	-1.80*	-0.25	-0.13	'JPM'	-1.53	-0.03	-0.93
'BAC'	-1.51	-0.96	-0.79	'JNJ'	-1.02	0.62	0.87
'BA'	-1.23	-0.22	0.09	'KFT'	-1.35	0.35	0.42
'CAT'	-1.91*	-0.44	-0.02	'MCD'	-1.15	0.10	0.55
'CVX'	-1.39	0.52	0.04	'MRK'	-1.31	0.11	-0.42
'CSCO'	-1.27	0.17	N/A	'MSFT'	-2.14**	0.21	0.04
'KO'	-0.91	0.44	0.64	'PFE'	-1.61*	0.70	0.24
'DIS'	-1.37	0.16	-0.11	'PG'	-1.38	0.35	0.50
'DD'	-1.69*	0.08	-0.06	'MMM'	-1.30	0.35	0.30
'XOM'	-1.96**	0.76	-0.01	'UTX'	-1.30	0.23	0.20
'GE'	-2.19**	0.47	-0.21	'VZ'	-1.26	0.26	0.62
'HPQ'	-1.64*	0.21	-1.47	'WMT'	-1.29	0.53	1.19
'HD'	-1.51	0.09	0.53	'EWP'	-1.52	0.27	0.10
Panel B (Interest rates)							
T-bill (3 Months)	-0.57	T-notes(10 Years)	-0.43	TERM (10 Years - 3 Months)	-0.55		

1.7. TABLES & FIGURES

Table 1.6: Cointegration Relationship

The table reports the estimates for cointegration between the cross sectional average CDS premium and the implied discount rate computed using EPS and DPS forecasts.

The second, the third and the fourth columns report the estimates for the 1 year, 5 year and 10 year CDS premiums, respectively. Panel A and C show the estimated cointegration relationship computed using the Johansen procedure.

Panel B and D shows the estimates of the OLS regression. The standard errors of the estimates are in parenthesis,

* means significant at the 10%, ** at 5% and *** at 1%.

$DR_t(EPS) = \alpha + \beta CDS_t + \epsilon_t$			
Panel A: Johansen			
Maturity CDS	1 Year	5 Year	10 Year
Cointegrating vector $r(T)$	1	1	1
Cointegrating vector $CDS(T)$	-1.1162	-0.9363	-1.0910
Likelihood ratio test	19.30**	19.05**	16.30**
Panel B: OLS			
Maturity CDS	1 Year	5 Year	10 Year
α	0.0606*** (0.0002)	0.0591*** (0.0003)	0.0574*** (0.0004)
β	1.0393*** (0.0557)	0.9771*** (0.0532)	1.0844*** (0.0663)
Adj. R^2	0.8243	0.8196	0.7827
DW	0.7599	0.8090	0.7722
ADF t-statistic	-4.68***	-4.83***	-4.42***
Number of observations	75	75	75
$DR_t(DPS) = \alpha + \beta * CDS_t + \epsilon$			
Panel C: Johansen			
Maturity CDS	1 Year	5 Year	10 Year
Cointegrating vector $r(T)$	1	1	1
Cointegrating vector $CDS(T)$	-1.4711***	-1.3125***	-1.5075***
Likelihood ratio test	34.29***	30.38***	24.68***
Panel D: OLS			
Maturity CDS	1 Year	5 Year	10 Year
α	0.0651 (0.0003)	0.0631 (0.0003)	0.0608 (0.0004)
β	1.3793 (0.0619)	1.3081 (0.0559)	1.4699 (0.0682)
Adj. R^2	0.8700	0.8807	0.8625
DW	1.1184	1.1726	1.0367
ADF t-statistic	-5.93***	-6.06***	-5.14***
Number of observations	75	75	75

1.7. TABLES & FIGURES

Table 1.7:

Cointegrating Relationship $DR_t = \alpha + \beta CDS_t + \gamma RF_t + \epsilon_t$

The table reports the estimated cointegration relation between the cross sectional average CDS premium, the risk-free rate and the implied discount rate computed using EPS forecasts.

Panel A shows the estimation using the Johansen procedure. Panel B shows the results of the OLS regression. RF can be the 3 Month T-bill rate (TB3M), the 10 year T-note yield (TN10Y) or the difference between the 10 year and the 3 month yield (TERM).

Standard errors are reported in parentheses, *** means significant at the 1%, ** at the 5%, and * at the 10%.

$DR_t(EPS) = \alpha + \beta CDS_t + \gamma RF_t + \epsilon$						
Panel A: Johansen						
Maturity CDS	1 Year CDS			5 Years CDS		
RF_t	TB3M	TN10Y	TERM	TB3M	TN10Y	TERM
Coint. vector r_t	1	1	1	1	1	1
Coint. vector CDS_t	-2.7439	0.2983	-1.4196	-1.9476***	-0.2612	-1.7942
Coint. vector (RF)	-0.2506	0.7325	0.1028	-0.1956	0.3868	0.2447
Likelihood ratio test	32.47**	37.83***	35.27**	41.91***	40.22***	41.80***
Panel B: OLS						
Maturity CDS	1 Year CDS			5 Years CDS		
RF_t	TB3M	TN10Y	TERM	TB3M	TN10Y	TERM
α	0.0592*** (0.0005)	0.0550*** (0.0024)	0.0612*** (0.0003)	0.0557*** (0.0006)	0.0483*** (0.0026)	0.0599*** (0.0003)
β	1.1825*** (0.0695)	1.2271*** (0.0964)	1.1233*** (0.0605)	1.2775*** (0.0618)	1.3179*** (0.0957)	1.1527*** (0.0537)
γ	0.0437*** (0.0139)	0.1238*** (0.0526)	-0.0478*** (0.0165)	0.0870 (0.0131)	0.2283 (0.0554)	-0.0896 (0.0155)
Adj. R^2	0.8434	0.8345	0.8405	0.8867	0.8520	0.8751
DW	0.8569	0.7219	0.8987	1.3050	0.8549	1.3321
ADF t-statistic	-4.79***	-4.44***	-4.95***	-6.20***	-4.83***	-6.34***
Number of observations	75	75	75	75	75	75
$DR_t(DPS) = \alpha + \beta CDS_t + \gamma RF_t + \epsilon$						
Panel C: Johansen						
Maturity CDS	1 Year CDS			5 Years CDS		
RF_t	TB3M	TN10Y	TERM	TB3M	TN10Y	TERM
Coint. vector r_t	1	1	1	1	1	1
Coint. vector CDS_t	-1.7359	-1.1221	-1.7395	-1.7720	-1.2926	-1.6829
Coint. vector RF_t	-0.0259	0.1740	0.0463	-0.0838	0.0140	0.0986
Likelihood ratio test	49.06***	45.00***	45.39***	67.54***	47.83***	46.66***
Panel D: OLS						
Maturity CDS	1 Year CDS			5 Years CDS		
RF_t	TB3M	TN10Y	TERM	TB3M	TN10Y	TERM
α	0.0657*** (0.0006)	0.0643*** (0.0027)	0.0648*** (0.0004)	0.0620*** (0.0007)	0.0562*** (0.0030)	0.0633*** (0.0004)
β	1.3247*** (0.0818)	1.4077*** (0.1111)	1.3354*** (0.0702)	1.4033*** (0.0811)	1.5250*** (0.1078)	1.3505*** (0.0677)
γ	-0.0167 (0.0163)	0.0188 (0.0606)	0.0249 (0.0191)	0.0276 (0.0172)	0.1453** (0.0624)	-0.0216 (0.0196)
Adj. R^2	0.8701	0.8684	0.8712	0.8833	0.8875	0.8811
DW	1.1354	1.1087	1.1302	1.2069	1.1696	1.2068
ADF t-statistic	-6.09***	-5.88***	-6.10***	-6.06***	-5.93***	-6.11***
Number of observations	75	75	75	75	75	75

1.7. TABLES & FIGURES

Table 1.8: Cointegration: $DR_t = \alpha + \beta CDS_t + \epsilon_t$

The tables report the cointegration tests for the cross sectional average CDS premium and the implied discount rate computed under different model assumptions.

Panel A, C, E and G show the estimated cointegration relationship computed using the Johansen procedure.

Panel B, D, F and H show the results of the OLS regression.

The standard errors of the estimates are reported in parentheses.

* means significant at the 10% level, ** at the 5% and *** at the 1%.

$DR_t(EPS) = \alpha + \beta CDS_t + \epsilon$ ($k = 0.3$)				$DR_t(DPS) = \alpha + \beta * CDS_t + \epsilon$			
Panel A: Johansen				Panel C: Johansen			
Growth Rate	$g = 0.02$	$g = 0.06$	$g = 0.12$	Growth Rate	$g = 0.02$	$g = 0.06$	$g = 0.12$
Coint. vector r_t	1	1	1	Coint. vector r_t	1	1	1
Coint. vector CDS_t	-1.0405	-0.9727	-0.8818	Coint. vector CDS_t	-1.3966	-1.3036	-1.1788
Likelihood ratio test	22.31***	22.49***	22.74***	Likelihood ratio test	31.78***	31.81***	31.85***
Panel B: OLS				Panel D: OLS			
Growth Rate	$g = 0.02$	$g = 0.06$	$g = 0.12$	Growth Rate	$g = 0.02$	$g = 0.06$	$g = 0.12$
α	0.0398*** (0.0003)	0.0784*** (0.0003)	0.1365*** (0.0002)	α	0.0441*** (0.0003)	0.0824*** (0.0003)	0.1401*** (0.0003)
β	1.0867*** (0.0523)	1.0156*** (0.0489)	0.9203*** (0.0444)	β	1.4038*** (0.0564)	1.3105*** (0.0527)	1.1852*** (0.0478)
Adj. R^2	0.8532	0.8531	0.8528	Adj. R^2	0.8933	0.8929	0.8924
DW	0.8824	0.8954	0.9129	DW	1.1385	1.1422	1.1469
ADF t-statistic	-5.14***	-5.18***	-5.22***	ADF t-statistic	-6.22***	-6.23***	-6.24***
Number of observations	75	75	75	Number of observations	75	75	75
$DR_t(EPS) = \alpha + \beta CDS_t + \epsilon$ ($g = 0.04$)				$DR_t(Gor) = \alpha + \beta CDS_t + \epsilon$			
Panel E: Johansen				Panel G: Johansen			
Payout Ratio	$k = 0.25$	$k = 0.5$	$k = 0.75$	Maturity CDS	1 Year	5 Year	10 Year
Coint. vector r_t	1	1	1	Coint. vector r_t	1	1	1
Coint. vector CDS_t	-0.8449	-1.6287	-2.3681	Coint. vector CDS_t	-3.7986	-2.6802	-3.7557
Likelihood ratio test	22.65***	21.66***	21.08***	Likelihood ratio test	19.10**	17.96**	16.85**
Panel F: OLS				Panel H: OLS			
Payout Ratio	$k = 0.25$	$k = 0.5$	$k = 0.75$	Maturity CDS	1 Year	5 Year	10 Year
α	0.0559*** (0.0002)	0.0718*** (0.0005)	0.0878*** (0.0007)	α	0.0695*** (0.0008)	0.0644*** (0.0009)	0.0593*** (0.0011)
β	0.8815*** (0.0425)	1.7072*** (0.0825)	2.4942*** (0.1217)	β	3.4033*** (0.1771)	3.2403*** (0.1690)	3.6340*** (0.1808)
Adj. R^2	0.8531	0.8522	0.8499	Adj. R^2	0.8328	0.8320	0.8449
DW	0.9076	0.8284	0.7723	DW	0.6648	0.6345	0.8293
ADF t-statistic	-5.21***	-4.99***	-4.83***	ADF t-statistic	-4.40***	-4.49***	-4.59***
Number of observations	75	75	75	Number of observations	75	75	75

Table 1.9: Individual stocks: Cointegration Johansen procedure (EPS)

This table reports the estimated cointegration relationship for the individual stocks between the implied discount rate $r_{t,k}$ and the premium on the corresponding $CDS_{t,k}$. The Implied discount rate is computed using EPS forecasts, assuming $1 - k = 0.3$, $g = 0.04$ and $T = 3$.

* indicates that the null of no cointegration relationship is rejected at the 10%, ** at 5% and *** at 1%.

Panel A: 1 Year CDS														
Ticker	'T'	'AA'	'AXP'	'BAC'	'BA'	'CAT'	'CVX'	'CSCO'	'KO'	'DIS'	'DD'	'XOM'	'GE'	'HPQ'
Cointegrating vector r_t	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Cointegrating vector CDS_t	-2.0507	-0.4219	-0.3665	-2.0186	-1.7624	0.0014	-4.3401	-1.7268	-1.1161	-2.4172	-1.0610	-5.3368	6.2908	-2.6541
Likelihood ratio test	32.78***	67.98***	51.39***	55.81***	32.02***	41.96***	18.10**	25.78***	31.11***	43.39***	34.55***	23.22***	21.44***	26.14***
Number of observations	52	70	70	75	75	71	74	50	68	73	75	75	42	73
Ticker	'HD'	'IBM'	'JPM'	'JNJ'	'KFT'	'MCD'	'MRK'	'MSFT'	'PFE'	'PG'	'MMM'	'UTX'	'VZ'	'WMT'
Cointegrating vector r_t	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Cointegrating vector CDS_t	0.1538	-1.2699	-0.7415	-1.9731	-0.7334	-2.1218	-4.5050	-6.7433	-3.0973	-0.8608	-1.1227	-1.2093	-0.5492	-0.8062
Likelihood ratio test	17.00**	12.3673	37.15***	22.18***	13.92*	22.00***	20.91***	25.67***	21.66***	36.58***	22.21***	34.20***	16.19**	10.6861
Number of observations	75	73	75	75	75	75	70	41	75	75	75	75	68	75

Panel B: 5 Years CDS														
Ticker	'T'	'AA'	'AXP'	'BAC'	'BA'	'CAT'	'CVX'	'CSCO'	'KO'	'DIS'	'DD'	'XOM'	'GE'	'HPQ'
Cointegrating vector r_t	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Cointegrating vector CDS_t	0.1684	-1.7064	-0.7778	-2.8276	-0.8401	-0.5976	-4.9497	-18.8418	-4.6721	-1.0627	-3.7787	-1.6071	-0.7052	-0.1796
Likelihood ratio test	16.97**	12.689	39.50***	31.31***	17.90**	18.38**	34.21***	61.02***	30.63***	35.12***	22.69***	33.28***	14.29*	13.62*
Number of observations	75	70	75	75	69	66	60	41	75	75	75	75	68	62

Table 1.10: Individual Stocks: Cointegration Johansen Procedure (DPS)

This table reports the estimated cointegration relationship for the individual stocks between the implied discount rate $r_{t,k}$ and the premium on the corresponding $CDS_{t,k}$. The Implied discount rate is computed using DPS forecasts, assuming $g = 0.04$. * indicates that the null of no cointegration relationship is rejected at the 10%, ** at 5% and *** at 1%.

Panel A: 1 Year CDS															
Ticker	'T'	'AA'	'JPM'	'JNJ'	'KFT'	'BA'	'CAT'	'CVX'	'CSCO'	'KO'	'DIS'	'DD'	'XOM'	'GE'	'HPQ'
Cointegrating vector r_t	1	1	1	1	1	1	1	1	0	1	1	1	1	1	1
Cointegrating vector CDS_t	-10.8454	-0.5883	-0.5523	-1.3592	-2.0921	-1.3173	-1.8939	0.0000	-1.7599	-1.7317	-3.2734	-2.0658	8.1414	-0.3439	-0.3439
Likelihood ratio test	31.743***	67.083***	35.493***	37.273***	18.073***	32.173***	20.633***	0.000*	24.023***	32.403***	27.123***	17.603***	23.683***	55.693***	55.693***
Number of observations	52	70	59	65	67	49	75	0	66	73	72	75	37	59	59
Ticker	'HD'	'TBM'	'JPM'	'JNJ'	'KFT'	'BA'	'MCD'	'MRK'	'MSFT'	'PFE'	'PG'	'MMM'	'UTX'	'VZ'	'WMT'
Cointegrating vector r_t	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Cointegrating vector CDS_t	-1.9749	-1.5576	0.5040	-4.8980	-2.3679	-9.0146	-9.5126	-10.7880	-14.4520	-2.4127	-1.1202	-7.2583	-4.8960	-1.8660	-1.8660
Likelihood ratio test	15.983***	17.513***	21.043***	21.373***	20.313***	19.903***	14.943***	59.553***	26.643***	21.863***	16.783***	20.773***	14.453***	7.613***	7.613***
Number of observations	61	53	74	69	65	56	60	39	75	72	62	55	68	61	61
Panel B: 5 Years CDS															
Ticker	'T'	'AA'	'JPM'	'JNJ'	'KFT'	'BA'	'CAT'	'CVX'	'CSCO'	'KO'	'DIS'	'DD'	'XOM'	'GE'	'HPQ'
Cointegrating vector r_t	1	1	1	1	1	1	1	1	0	1	1	1	1	1	1
Cointegrating vector CDS_t	-9.1732	-0.4026	-0.7149	-0.8889	-1.5069	-1.1920	-0.9283	0.0000	-2.0989	-1.7863	-2.4943	-5.1540	92.9129	-0.3232	-0.3232
Likelihood ratio test	29.483***	48.923***	44.303***	32.403***	23.723***	24.433***	20.273***	0.000*	15.053***	18.483***	20.103***	18.273***	45.093***	46.783***	46.783***
Number of observations	52	75	60	65	67	50	75	0	72	75	72	75	37	59	59
Ticker	'HD'	'TBM'	'JPM'	'JNJ'	'KFT'	'BA'	'MCD'	'MRK'	'MSFT'	'PFE'	'PG'	'MMM'	'UTX'	'VZ'	'WMT'
Cointegrating vector r_t	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Cointegrating vector CDS_t	-1.4333	-1.2071	0.6095	-3.3621	-2.5663	-9.2104	0.1985	-4.6095	-10.2145	-1.9425	-2.0265	-1.9298	-3.6042	-1.1042	-1.1042
Likelihood ratio test	17.223***	15.773***	20.723***	17.653***	12.633***	17.073***	20.553***	17.543***	16.023***	25.903***	14.753***	22.633***	11.363***	12.913***	12.913***
Number of observations	61	53	74	69	70	57	70	39	75	72	62	55	68	66	66

1.7. TABLES & FIGURES

Table 1.11: Individual stocks cointegration Johansen procedure (EPS, RF)

This table reports the estimated cointegration relationship for the individual stocks between the implied discount rate $r_{t,k}$, the premium on individual CDS $CDS_{t,k}$, and the risk-free rate. Panel A considers the 3 month US T-bill rate (3MTB), while Panel B considers the difference between yield on the 10 year US T-Notes and the 3 month US T-bill (TERM).

The Implied discount rate is computed using EPS forecasts, assuming $1 - k = 0.3$, $g = 0.04$ and $T = 3$.

* indicates that the null of no cointegration relationship is rejected at the 10%, ** at 5% and *** at 1%.

Panel A: 1 Year CDS, 3 Month T-Bill														
Ticker	'T'	'AA'	'AXP'	'BAC'	'BA'	'CAT'	'CVX'	'CSGO'	'KO'	'DIS'	'DD'	'XOM'	'GE'	'HPQ'
Cointegrating vector r_t	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Cointegrating vector CDS_t	-2.4241	-0.5654	-0.3503	-2.3139	-1.9240	-0.4681	-7.3698	-1.4029	-0.7132	-2.9175	-1.4740	-6.6004	3.8769	-1.9996
Cointegrating vector (3MTB)	-0.0147	-0.1793	0.0362	-0.1542	-0.0830	-0.1227	-0.4006	0.0285	0.0145	-0.0682	-0.0500	-0.1895	-0.1383	0.0819
Likelihood ratio test	38.756***	85.664***	60.793***	79.391***	67.479***	53.225***	32.933**	48.194***	50.432***	60.556***	47.461***	36.419***	70.201***	42.457***
Number of observation	52	70	70	75	75	71	74	50	68	73	75	75	42	73
Ticker	'HD'	'IBM'	'JPM'	'JNJ'	'KFT'	'MCD'	'MRK'	'MSFT'	'PFE'	'PG'	'MMM'	'UTX'	'VZ'	'WMT'
Cointegrating vector r_t	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Cointegrating vector CDS_t	-0.0627	-4.8250	-0.5583	-3.3585	-0.3728	-1.7883	-4.9835	-3.7762	-6.5087	-1.0961	-4.1377	-1.9124	-1.1623	1.1498
Cointegrating vector (3MTB)	-0.1151	-0.3984	0.0416	-0.0612	-0.0818	-0.0092	0.0062	0.1928	-0.11723	-0.0149	-0.2039	-0.0463	-0.0289	0.1252
Likelihood ratio test	40.867***	33.033**	49.275***	64.813***	38.454***	41.857***	66.006***	78.458***	47.311***	48.179***	52.469***	45.281***	32.403**	28.295*
Number of observation	75	70	75	75	69	66	60	41	75	75	75	75	68	62
Panel B: 1 Year CDS, (10 Year T-Note - 3 Month T-Bill)														
Ticker	'T'	'AA'	'AXP'	'BAC'	'BA'	'CAT'	'CVX'	'CSGO'	'KO'	'DIS'	'DD'	'XOM'	'GE'	'HPQ'
Cointegrating vector r_t	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Cointegrating vector CDS_t	-2.1811	-0.5415	-0.3498	-2.2108	-1.6596	-0.5178	-6.0079	-1.2944	-2.0550	-2.7354	-1.2424	-8.6552	2.3864	2.8743
Cointegrating vector (TERM)	0.0135	0.2421	-0.0585	0.1649	0.0508	0.1946	0.4470	-0.0537	0.0731	0.0805	0.0323	0.4064	0.1570	-0.7676
Likelihood ratio test	35.618***	90.488***	56.450***	64.903***	72.421***	54.850***	38.712***	33.563**	68.778***	57.655***	44.125***	37.706***	48.079***	40.010***
Number of observation	52	70	70	75	75	71	74	50	68	73	75	75	42	73
Ticker	'HD'	'IBM'	'JPM'	'JNJ'	'KFT'	'MCD'	'MRK'	'MSFT'	'PFE'	'PG'	'MMM'	'UTX'	'VZ'	'WMT'
Cointegrating vector r_t	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Cointegrating vector CDS_t	-0.0215	-5.2770	-0.5814	-3.0526	-0.8348	-2.4467	-6.1391	-18.9180	-4.7411	-1.3052	-3.4810	-1.8251	-1.9003	1.4049
Cointegrating vector (TERM)	0.1457	0.5421	-0.0644	0.0669	-0.1234	0.0457	0.1403	-0.0064	0.1053	0.0404	0.2369	0.0553	0.1605	-0.2315
Likelihood ratio test	45.125***	32.163**	49.332***	67.114***	34.133*	43.140***	51.857***	81.678***	54.941***	45.772***	58.365***	46.309***	25.8756	30.813**
Number of observation	75	70	75	75	69	66	60	41	75	75	75	75	68	62

1.7. TABLES & FIGURES

Table 1.12: Individual Stocks: Cointegration Johansen Procedure (DPS, RF)

This table reports the estimated cointegration relationship for the individual stocks between the implied discount rate $r_{t,k}$, the premium on individual CDS $CDS_{t,k}$, and the risk-free rate. Panel A considers the 3 month US T-bill rate (3MTB), while Panel B considers the 3MTB and the difference between yield on the 10 year US T-Note and the 3 month US T-bill (TERM). The Implied discount rate is computed using DPS forecasts, assuming $g = 0.04$ and $T = 3$.

* indicates that the null of no cointegration relationship is rejected at the 10%, ** at 5% and *** at 1%.

Panel A: 1 Year CDS, 3 Month T-Bill														
Ticker	'T'	'AA'	'AXP'	'BAC'	'BA'	'CAT'	'CVX'	'CSCO'	'KO'	'DIS'	'DD'	'XOM'	'GE'	'HPQ'
Cointegrating vector $r(T)$	1	1	1	1	1	1	1	-	1	1	1	1	1	1
Cointegrating vector CDS(T)	-2.6500	-0.7707	-0.3938	-27.5027	-2.0155	-2.1561	-3.1637	-	-7.6101	-2.0859	-4.1476	-1.1940	19.3726	-0.6159
Cointegrating vector (10Y - 3 M)	0.4328	-0.2217	0.1354	-7.1319	-0.0028	-0.2211	-0.1090	-	-0.2532	-0.0487	-0.0452	0.0383	-0.3572	-0.0490
Likelihood ratio test	87.187***	99.549***	45.195***	62.091***	27.982*	48.434***	39.396***	-	54.431***	43.353***	56.934***	38.752***	121.136***	86.521***
Number of observations	52	70	59	65	67	49	75	-	66	73	72	75	37	59
Panel B: 1 Year CDS, (10 Years T-Notes - 3 Month T-Bill)														
Ticker	'T'	'AA'	'AXP'	'BAC'	'BA'	'CAT'	'CVX'	'CSCO'	'KO'	'DIS'	'DD'	'XOM'	'GE'	'HPQ'
Cointegrating vector $r(T)$	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Cointegrating vector CDS(T)	-0.5176	0.3238	2.1860	-6.4260	-0.8607	-4.4255	-3.2663	-10.4143	-11.9409	-2.1578	-6.0806	-1.4637	-1.9737	0.7276
Cointegrating vector (10Y - 3 M)	0.1302	0.2230	0.4526	-0.1496	0.0150	0.0890	0.2602	-0.0019	-0.4072	-0.0112	-0.3080	0.1464	0.2397	0.1680
Likelihood ratio test	55.737***	23.4795	41.048***	51.303***	38.710***	50.537***	115.430***	76.946***	47.529***	31.993**	32.723**	44.169***	38.560***	38.728***
Number of observations	61	53	74	69	65	56	60	39	75	72	62	55	68	61
Panel B: 1 Year CDS, (10 Years T-Notes - 3 Month T-Bill)														
Ticker	'T'	'AA'	'AXP'	'BAC'	'BA'	'CAT'	'CVX'	'CSCO'	'KO'	'DIS'	'DD'	'XOM'	'GE'	'HPQ'
Cointegrating vector $r(T)$	1	1	1	1	1	1	1	-	1	1	1	1	1	1
Cointegrating vector CDS(T)	-4.1555	-0.7485	-0.4365	-13.9608	-26.4920	-1.9695	-3.1833	-	-5.0603	-4.7651	-4.2765	-1.4695	1.6262	-0.5701
Cointegrating vector (10Y - 3 M)	-0.5019	0.3017	-0.1929	5.4239	5.7475	0.2402	0.1675	-	0.2890	0.3655	0.0836	-0.0091	0.2521	0.0709
Likelihood ratio test	77.515***	92.717***	55.097***	62.273***	27.355*	54.960***	43.131***	-	59.954***	41.263***	51.128***	46.562***	80.749***	86.786***
Number of observations	52	70	59	65	67	49	75	-	66	73	72	75	37	59
Panel B: 1 Year CDS, (10 Years T-Notes - 3 Month T-Bill)														
Ticker	'HD'	'IBM'	'JPM'	'JNJ'	'KFT'	'MCD'	'MRK'	'MSFT'	'PFE'	'PG'	'MMM'	'UTX'	'VZ'	'WMT'
Cointegrating vector $r(T)$	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Cointegrating vector CDS(T)	-1.0202	-4.8302	1.0810	-5.8105	-2.6567	-5.7865	1.2406	-8.2886	-9.0750	-3.6999	-5.3123	-1.4802	-2.2346	1.1566
Cointegrating vector (10Y - 3 M)	0.0045	0.4621	-0.3794	0.1727	0.0231	-0.0817	-1.0255	-0.0293	0.4139	0.1857	0.3726	-0.1356	-0.2787	-0.3235
Likelihood ratio test	48.443***	30.903**	45.751***	52.152***	33.003**	52.580***	77.970***	79.127***	60.756***	33.373**	37.267***	51.679***	29.147*	33.243**
Number of observations	61	53	74	69	65	56	60	39	75	72	62	55	68	61

1.7. TABLES & FIGURES

Table 1.13: Individual Stock Cointegration OLS Regressions (EPS)

This table reports the estimated cointegration relationship for the individual stocks between the implied discount rate $r_{k,t}$ and the premium on the corresponding 1 year maturity CDS $CD S_{t,k}$.

The Implied discount rate is computed using EPS forecasts, assuming $1 - k = 0.3$, $g = 0.04$ and $T = 3$.

* indicates significant at the 10%, ** at 5% and *** at 1%. Standard errors are reported in parentheses.

Ticker	'T'	'AA'	'AAP'	'BAC'	'BA'	'CAT'	'CVX'	'CSCO'	'KO'	'DIS'	'DU'	'XOM'	'GE'	'HPQ'
α	0.0638*** (0.0005)	0.0630*** (0.0012)	0.0598*** (0.0006)	0.0673*** (0.0021)	0.0576*** (0.0006)	0.0670*** (0.0007)	0.0663*** (0.0010)	0.0580*** (0.0003)	0.0559*** (0.0002)	0.0569*** (0.0004)	0.0599*** (0.0003)	0.0623*** (0.0008)	0.0589*** (0.0005)	0.0621*** (0.0004)
β	1.3327*** (0.1993)	0.2699*** (0.0499)	0.3606*** (0.0303)	2.0888*** (0.2048)	1.5560*** (0.1228)	-0.1698* (0.0941)	2.5036*** (0.4120)	1.5157*** (0.0994)	1.3374*** (0.1243)	2.3087*** (0.1797)	1.1914*** (0.0884)	2.4846*** (0.4788)	-0.4663 (0.3905)	1.9288*** (0.1465)
Adj. R^2	0.462	0.291	0.671	0.582	0.683	0.031	0.330	0.825	0.631	0.695	0.710	0.259	0.010	0.705
DW	0.4195	0.2954	1.4844	1.5473	0.3900	0.3748	0.2752	0.9991	0.4374	0.6056	1.0509	0.2618	0.2513	0.7422
ADF t-statistic	-3.3034*	-3.2013*	-6.4330***	-6.7863***	-3.1257*	-3.3926*	-2.8082	-4.0238**	-2.3878	-4.4787***	-5.4388***	-3.1273*	-2.0789	-4.0047**
Number of observations	52	70	70	75	75	71	74	50	68	73	75	75	42	73
Ticker	'HD'	'IBM'	'JPM'	'JNJ'	'KFT'	'MCD'	'MRK'	'MSFT'	'PFE'	'PG'	'MMM'	'UTX'	'VZ'	'WMT'
α	0.0629*** (0.0004)	0.0615*** (0.0003)	0.0682*** (0.0006)	0.0583*** (0.0002)	0.0581*** (0.0003)	0.0588*** (0.0003)	0.0596*** (0.0006)	0.0633*** (0.0011)	0.0658*** (0.0006)	0.0565*** (0.0002)	0.0581*** (0.0004)	0.0593*** (0.0002)	0.0614*** (0.0003)	0.0612*** (0.0003)
β	0.0165 (0.0594)	1.3606*** (0.1139)	0.8415*** (0.0982)	2.2278*** (0.1575)	0.7950*** (0.0896)	0.7665*** (0.1662)	3.7698*** (0.2753)	0.7831 (1.2392)	3.0070*** (0.2503)	0.9006*** (0.0633)	1.3311*** (0.1648)	1.5208*** (0.0933)	0.6696*** (0.0914)	0.2207*** (0.0830)
Adj. R^2	-0.013	0.672	0.495	0.729	0.533	0.238	0.760	-0.015	0.659	0.731	0.465	0.782	0.440	0.090
DW	0.4359	0.4502	1.6325	0.6178	0.4919	0.4188	0.6181	0.1691	0.2491	0.8219	0.4284	1.1235	0.4723	0.4927
ADF t-statistic	-3.2453*	-3.1647*	-7.1642***	-3.6289**	-2.4281	-2.6630	-4.1992***	-1.9236	-3.0176	-4.3321***	-3.5257**	-5.7338***	-3.1114*	-3.0897*
Number of observations	75	70	75	75	69	66	60	41	75	75	75	75	68	62

1.7. TABLES & FIGURES

Table 1.14: Individual Stocks: Cointegration OLS Regressions (DPS)

This table reports the estimated cointegration relationship for the individual stocks between the implied discount rate $r_{k,t}$ and the premium on the corresponding 1 year maturity CDS $CD S_{t,k}$.

The Implied discount rate is computed using DPS forecasts, assuming $g = 0.04$ and $T = 3$.

* indicates significant at the 10%, ** at 5% and *** at 1%. Standard errors are reported in parenthesis.

Ticker	'T'	'AA'	'AXP'	'BAC'	'BA'	'CAT'	'CVX'	'CSCO'	'KO'	'DIS'	'DD'	'XOM'	'GE'	'HPQ'
α	0.0836*** (0.0017)	0.0577*** (0.0015)	0.0510*** (0.0010)	0.0915*** (0.0035)	0.0553*** (0.0004)	0.0598*** (0.0007)	0.0695*** (0.0004)	-	0.0672*** (0.0006)	0.0495*** (0.0003)	0.0709*** (0.0007)	0.0608*** (0.0003)	0.0698*** (0.0013)	0.0486*** (0.0005)
β	4.1234*** (0.6769)	0.5322*** (0.0622)	0.4614*** (0.0423)	0.1645 (0.3194)	1.9999*** (0.0742)	1.1548*** (0.0801)	1.9060*** (0.1543)	-	2.2797*** (0.2969)	1.6222*** (0.1159)	3.3380*** (0.1902)	0.8449*** (0.1920)	0.3439 (1.2106)	-0.0411 (0.1565)
Adj. R^2	0.415	0.511	0.670	-0.012	0.917	0.812	0.672	-	0.471	0.730	0.812	0.199	-0.026	-0.016
DW	0.3178	0.5445	0.8404	0.6098	1.0574	0.7349	0.9147	-	0.2466	0.9904	0.5210	0.4053	0.7627	0.1293
ADF t-statistic	-1.9303	-4.2758***	-4.0521***	-3.3619*	-5.4061***	-4.2342***	-4.6050***	-	-1.8857	-5.7498***	-3.3479*	-2.8411	-3.2748*	-4.2623***
Number of observations	52	70	59	65	67	49	75	-	66	73	72	75	37	59

Ticker	'HD'	'IBM'	'JPM'	'JNJ'	'KFT'	'MCD'	'MRK'	'MSFT'	'PFE'	'PG'	'MMM'	'UTX'	'VZ'	'WMT'
α	0.0584*** (0.0010)	0.0519*** (0.0004)	0.0832*** (0.0019)	0.0635*** (0.0005)	0.0700*** (0.0010)	0.0659*** (0.0013)	0.0766*** (0.0012)	0.0556*** (0.0008)	0.0800*** (0.0019)	0.0627*** (0.0005)	0.0623*** (0.0006)	0.0562*** (0.0006)	0.0842*** (0.0011)	0.0574*** (0.0005)
β	1.2908*** (0.1272)	1.3359*** (0.1363)	-0.8069** (0.3237)	3.7881*** (0.2886)	2.1020*** (0.2553)	5.1075*** (0.7117)	3.9576*** (0.5305)	2.0160** (0.8376)	5.6556*** (0.7583)	1.7431*** (0.1498)	2.7024*** (0.2353)	2.0084*** (0.1852)	1.9771*** (0.2909)	0.7637*** (0.1588)
Adj. R^2	0.630	0.646	0.067	0.716	0.511	0.479	0.481	0.112	0.425	0.654	0.682	0.683	0.403	0.269
DW	0.2053	0.2950	0.6880	0.5738	0.3014	0.2579	0.2733	0.2906	0.2027	0.5310	0.3984	0.7305	0.2402	0.1958
ADF t-statistic	-2.4842	-2.3639	-3.9009**	-3.5269**	-2.5010	-2.6496	-2.3298	-1.8642	-2.5960	-3.1200*	-3.2503*	-3.2588*	-1.9317	-1.5015
Number of observations	61	53	74	69	65	56	60	39	75	72	62	55	68	61

Table 1.15: Cross Sectional: Cointegration Between CDS Premium and Risk-Free Rates

This table reports the estimated cointegration relationship between the cross sectional average of the CDS premiums (1 year and 5 year maturity) and the US government interest rates (RF). Panel A reports the results obtained following the Johansen procedure, while Panel B reports the OLS estimates.

* means significant at the 10%, ** at 5% and *** at 1%. Standard errors are reported in parenthesis.

Panel A: Johansen procedure						
Maturity CDS	1 Year CDS			5 Years CDS		
Ind. variable	TB3M	TN10Y	TERM	TB3M	TN10Y	TERM
Coint. vector CDS_t	1	1	1	1	1	1
Coint. vector RF_t	0.1246	0.5565	-0.1884	0.1466	0.6085	-0.2211
Likelihood ratio test	22.72***	21.95***	22.88***	18.09**	21.46***	19.78***
Panel B: OLS $CDS_t = \alpha + \beta RF_t$						
Maturity CDS	1 Year CDS			5 Years CDS		
Ind. Variable	TB3M	TN10Y	TERM	TB3M	TN10Y	TERM
α	0.0057*** (0.0005)	0.0212*** (0.0015)	0.0004 (0.0006)	0.0080*** (0.0005)	0.0248*** (0.0014)	0.0015** (0.0006)
β	-0.1306*** (0.0177)	-0.4518*** (0.0358)	0.1304*** (0.0280)	-0.1548*** (0.0169)	-0.5000*** (0.0341)	0.1634*** (0.0279)
Adj. R^2	0.4200	0.6811	0.2187	0.5279	0.7427	0.3107
DW	0.1354	0.5645	0.1129	0.1457	0.6610	0.1258
ADF t-stat.	-3.62**	-3.98**	-3.55**	-3.11*	-4.37***	-3.14*
N. obs.	75	75	75	75	75	75

Table 1.16: Individual Stocks: Cointegration Between CDS Premium and Interest Rates

This table reports the estimated cointegration relationship using Johansen procedure between the individual CDS premiums (1 year maturity) and the 3 month T-Bill (Panel A), the 10 year T-notes (Panel B) and the difference between the 10 year and the 3 month yield (Panel C).

* indicates that the null of no cointegration is rejected at the 10%, ** at 5% and *** at 1%.

Panel A: 1 Year CDS 3 M Tbill														
Ticker	'T'	'AA'	'JPM'	'JNJ'	'KFT'	'MCD'	'MRK'	'MSFT'	'PFE'	'PG'	'MMM'	'UTX'	'VZ'	'WMT'
Cointegrating vector (CDS)	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Cointegrating vector (3MTB)	0.0537	0.6808	0.4358	0.2453	0.1482	0.1929	0.0683	0.0952	0.0518	0.0703	0.0916	0.0628	-0.0069	0.0923
Likelihood ratio test	12.1230	16.48**	11.4545	17.10**	15.06*	17.81**	12.6600	16.35**	16.85**	24.72***	17.11**	12.5876	34.45***	17.64**
Number of observation	52	70	70	75	75	71	74	50	68	73	75	75	42	73
Panel B: 1 Year CDS, 10 Y Tnotes														
Ticker	'T'	'AA'	'JPM'	'JNJ'	'KFT'	'MCD'	'MRK'	'MSFT'	'PFE'	'PG'	'MMM'	'UTX'	'VZ'	'WMT'
Cointegrating vector (CDS)	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Cointegrating vector (3MTB)	0.1264	0.0991	0.1358	0.0483	-0.0106	0.0423	0.0733	0.0062	0.0766	0.0794	0.0555	0.0650	0.0834	0.1000
Likelihood ratio test	18.07**	14.61*	20.62***	11.8095	18.24**	23.32***	20.64***	22.48***	16.79**	14.52*	15.49**	15.09*	10.9576	15.76**
Number of observation	75	70	75	75	69	66	60	41	75	75	75	75	68	62
Panel C: 1 Year CDS; 10 Y Tnote - 3 M Tbill														
Ticker	'T'	'AA'	'JPM'	'JNJ'	'KFT'	'MCD'	'MRK'	'MSFT'	'PFE'	'PG'	'MMM'	'UTX'	'VZ'	'WMT'
Cointegrating vector (CDS)	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Cointegrating vector (10YTN)	0.9326	0.2660	0.7167	0.1918	0.4333	0.1392	0.2475	0.0535	0.3286	0.3974	0.2926	0.3225	0.3966	0.3319
Likelihood ratio test	19.23**	14.17*	21.49***	18.09**	20.92***	24.85***	26.47***	34.88***	30.55***	13.84*	16.15**	19.37***	22.90***	17.05**
Number of observation	75	70	75	75	69	66	60	41	75	75	75	75	68	62
Panel C: 1 Year CDS; 10 Y Tnote - 3 M Tbill														
Ticker	'T'	'AA'	'JPM'	'JNJ'	'KFT'	'MCD'	'MRK'	'MSFT'	'PFE'	'PG'	'MMM'	'UTX'	'VZ'	'WMT'
Cointegrating vector (CDS)	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Cointegrating vector (TERM)	-0.2679	-0.1277	-0.2545	-0.0735	-0.1487	-0.0624	-0.1261	-0.0410	-0.1181	-0.1291	-0.0908	-0.1253	-0.1349	-0.1370
Likelihood ratio test	17.10**	17.18**	21.77***	16.01**	13.0922	22.07***	25.64***	16.62**	15.24**	17.67**	17.47**	17.12**	13.48*	15.37**
Number of observation	75	70	75	75	69	66	60	41	75	75	75	75	68	62

1.7. TABLES & FIGURES

Table 1.17: Vector Autoregressive Model (DPS and CDS)

This table reports the estimates for a $VAR(2)$ model. The variables included are the cross section average of the implied discount factor $r(DPS)_t$ and the cross section average of CDS premiums $CDS(T)_t$ for the stocks composing the DJIA (at 31.12.2010). The implied discount rate is computed according to the DPS model. Panel A considers the 1 year CDS, while Panel B considers the 5 year CDS.

* denotes significance at 10%, ** at 5%, *** at 1%. The 5% critical value for the Ljung-Box Q statistics is 5.99.

Panel A: $r(DPS)_t$, CDS(1 Year) $_t$					
Dependent Variable: $r(DPS)_t$			Dependent Variable: CDS(1 Year) $_t$		
R^2	0.8240		R^2	0.9440	
Adj. R^2	0.8137		Adj. R^2	0.9407	
Q-stat.	0.8978		Q-stat.	3.3963	
N.obs.	73		N.obs.	73	
N.vars.	5		N.vars.	5	
Variable	Coefficient	t-statistic	Variable	Coefficient	t-statistic
DR lag1	0.5511***	3.33	DR lag1	0.1159*	1.80
DR lag2	-0.0268	-0.16	DR lag2	-0.0261	-0.41
CDS lag1	0.7849**	2.11	CDS lag1	1.2295***	8.49
CDS lag2	-0.2316	-0.72	CDS lag2	-0.4076***	-3.27
constant	0.0313***	2.72	constant	-0.0057	-1.27

Panel B: $r(DPS)_t$, CDS(5 Year) $_t$					
Dependent Variable: $r(DPS)_t$			Dependent Variable: CDS(5 Year) $_t$		
R^2	0.8488		R^2	0.9440	
Adj. R^2	0.8399		Adj. R^2	0.9407	
Q-stat.	1.0596		Q-stat.	1.0235	
N.obs.	73		N.obs.	73	
N.vars.	5		N.vars.	5	
Variable	Coefficient	t-statistic	Variable	Coefficient	t-statistic
DR lag1	0.3327**	2.05	DR lag1	0.0282	0.37
DR lag2	-0.0691	-0.45	DR lag2	-0.0330	-0.47
CDS lag1	0.9928***	3.19	CDS lag1	1.2969***	8.99
CDS lag2	-0.0943	-0.30	CDS lag2	-0.3406**	-2.36
constant	0.0469***	4.29	constant	0.0005	0.11

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Table 1.18: Vector Autoregressive Model (EPS and CDS)

This table reports the estimates for a $VAR(3)$ model. The variables included are the cross section average of the implied discount factor $r(EPS)_t$ and the cross section average of CDS premiums $CDS(T)_t$ for the stocks composing the DJIA (at 31.12.2010). The implied discount rate is computed according to the EPS model. Panel A considers the 1 year CDS, while Panel B considers the 5 year CDS.

* denotes significance at 10%, ** at 5%, *** at 1%. The 5% critical value for the Ljung-Box Q statistics is 7.8147.

Panel A: $r(EPS)_t$, CDS(1 Year) $_t$					
Dependent Variable: $r(EPS)_t$			Dependent Variable: CDS(1 Year) $_t$		
R^2	0.8891		R^2	0.9540	
Adj. R^2	0.8788		Adj. R^2	0.9498	
Q-statistics	3.1568		Q-statistics	0.2223	
N.obs.	72		N.obs.	72	
N.vars.	7		N.vars.	7	
Variable	Coefficient	t-statistic	Variable	Coefficient	t-statistic
DR lag1	0.3819***	2.75	DR lag1	0.1257	1.55
DR lag2	-0.2057	-1.37	DR lag2	-0.1762**	-2.01
DR lag3	0.8535***	6.42	DR lag3	0.2423***	3.13
CDS lag1	1.4030***	4.75	CDS lag1	1.3536***	7.87
CDS lag2	-1.6537***	-4.28	CDS lag2	-0.5937**	-2.64
CDS lag3	0.0908	0.42	CDS lag3	-0.0093	-0.07
constant	-0.0013	-0.15	constant	-0.0115**	-2.37

Panel B: $r(EPS)_t$, CDS(5 Year) $_t$					
Dependent Variable: $r(EPS)_t$			Dependent Variable: CDS(5 Year) $_t$		
R^2	0.8678		R^2	0.9439	
Adj. R^2	0.8556		Adj. R^2	0.9388	
Q-statistics	0.6985		Q-statistics	0.0051	
N.obs.	72		N.obs.	72	
N.vars.	7		N.vars.	7	
Variable	Coefficient	t-statistic	Variable	Coefficient	t-statistic
DR lag1	0.5024***	3.66	DR lag1	0.1500*	1.75
DR lag2	-0.3284**	-2.15	DR lag2	0.1616*	-1.69
DR lag3	0.6399***	4.77	DR lag3	0.1047	1.25
CDS lag1	1.039***	4.04	CDS lag1	1.2124***	7.54
CDS lag2	-0.9016**	-2.60	CDS lag2	-0.3121	-1.44
CDS lag3	-0.0316	-0.15	CDS lag3	-0.0364	-0.27
constant	0.0115	1.43	constant	-0.0053	-1.05

Table 1.19: Granger Causality

This table reports the Granger causality test between the cross section average implied discount factor and the cross sectional average of CDS premium of the stocks composing the DJIA. Panel A and B consider the implied discount rate computed from the EPS model, while Panel C and D considers estimates from the DPS model. The format of the output of the third table "Granger Causality Probabilities" is such that the columns reflect the Granger casual impact of the columns-variable on the row variable.

Panel A: $r(EPS)_t$ CDS(1 Year) $_t$					
Granger test (Eq. $r(EPS)_t$)		Granger test (Eq. CDS(1 Year) $_t$)		Granger Probabilities	
F-Value	F-Probability	F-Value	F-Probability	$r(EPS)_t$	CDS(1 Year) $_t$
DR	27.22	0.00%	5.32	0.24%	0.00%
CDS	11.15	0.00%	33.65	0.00%	0.24%
Panel B: $r(EPS)_t$ CDS(5 Year) $_t$					
Granger test (Eq. $r(EPS)_t$)		Granger test (Eq. CDS(5 Years) $_t$)		Granger Probabilities	
F-Value	F-Probability	F-Value	F-Probability	$r(EPS)_t$	CDS(5 Years) $_t$
DR	16.80	0.00%	1.77	16.22%	0.00%
CDS	5.87	0.13%	40.54	0.00%	16.22%
Panel C: $r(DPS)_t$ CDS(1 Year) $_t$					
Granger test (Eq. $r(DPS)_t$)		Granger test (Eq. CDS(1 Year) $_t$)		Granger Probabilities	
F-Value	F-Probability	F-Value	F-Probability	$r(DPS)_t$	CDS(1 Year) $_t$
DR	6.46	0.27%	1.68	19.32%	0.27%
CDS	3.00	5.66%	45.91	0.00%	19.32%
Panel D: $r(DPS)_t$ CDS(5 Years) $_t$					
Granger test (Eq. $r(DPS)_t$)		Granger test (Eq. CDS(5 Years) $_t$)		Granger Probabilities	
F-Value	F-Probability	F-Value	F-Probability	$r(DPS)_t$	CDS(5 Years) $_t$
DR	2.18	12.03%	0.13	87.75%	12.03%
CDS	9.05	0.03%	57.08	0.00%	87.75%

1.7. TABLES & FIGURES

Figure 1.1: Dow Jones Industrial Average Index (2004-2010)

This figure reports the closing price for the Dow Jones Industrial Average Index for the period January 2004-December 2010.

Source: Yahoo Finance



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Figure 1.2: Government Bond Yield (2004-2010)

The first figure represents the 10 year constant maturity yield, the second one is the yield on a 3 month treasury-bill and the last one is the difference between the 10 year and the 3 month yield.

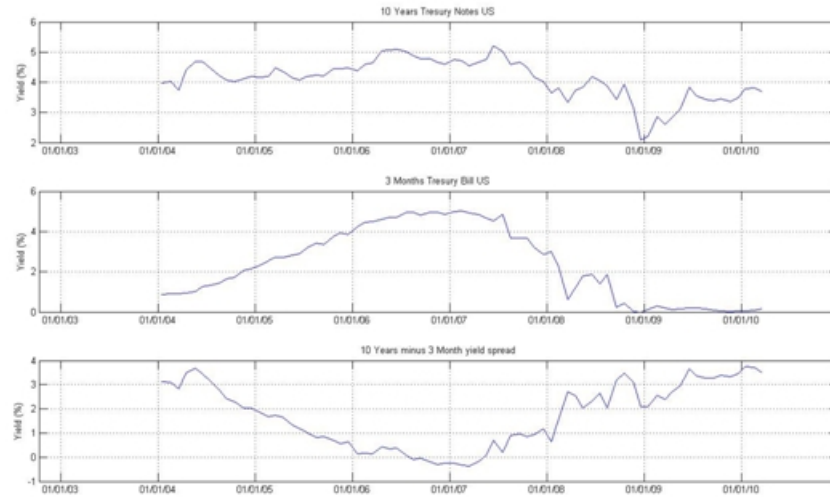
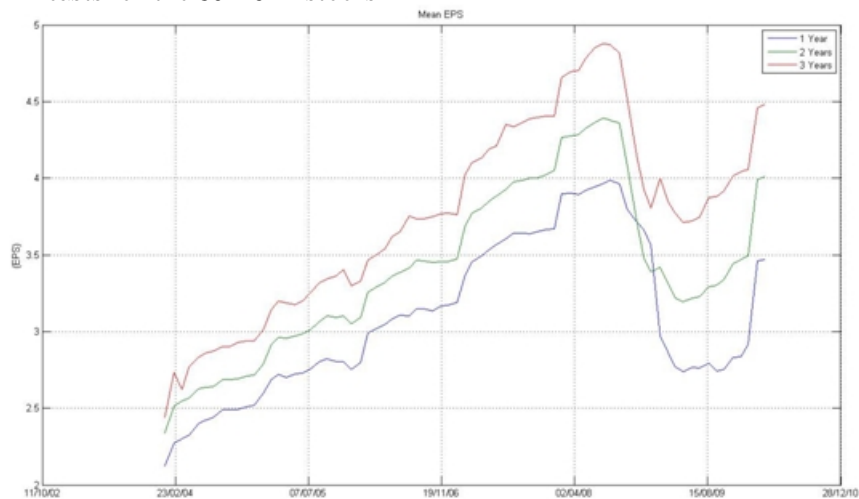


Figure 1.3: Analysts Earning per Share Forecasts (2004-2010)

The figure reports the cross sectional average of EPS analysts' forecasts for the 30 DJIA stocks.



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Figure 1.4:

Analysts' Dividend per Share Forecasts (2004-2010)

The figure reports the cross sectional average of DPS analysts' forecasts for the 30 DJIA stocks.

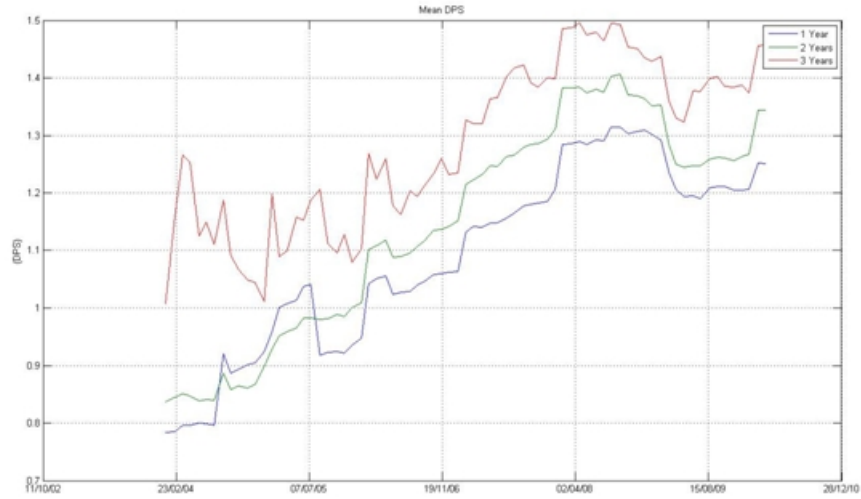
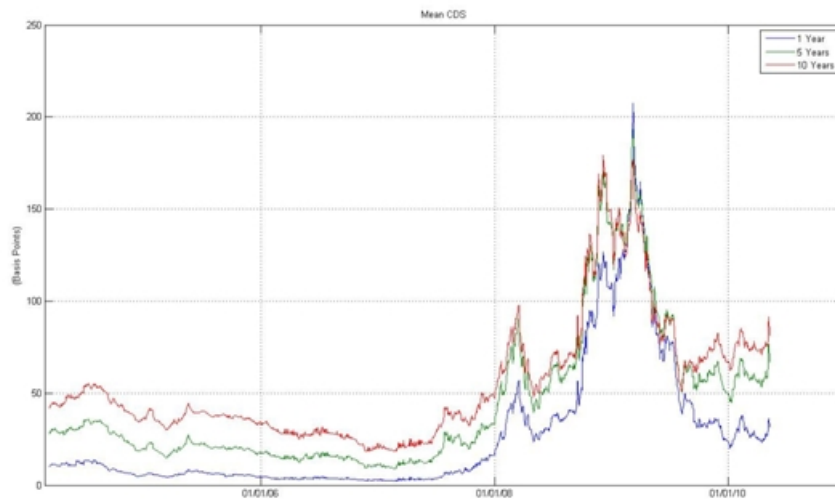


Figure 1.5: Mean CDS Premium (2004-2010)

The figure reports the cross sectional average of the premium on the CDS for the stocks composing the DJIA.



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Figure 1.6: Mean Discount rate (Different models)

The figure reports the cross sectional average of the implied discount rate $r_{t,k}$ derived using different models using $T = 3$, $k = 0.3$ and $g = 0.04$.

EPS refers to:

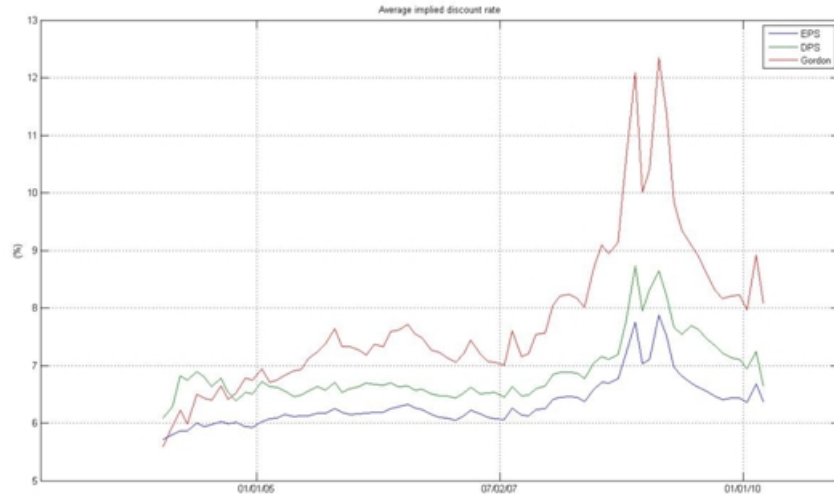
$$P_{t,k} = \sum_{s=1}^T \frac{(1-k) E_t [EPS_{t+s,k}]}{(1+r_{t,k})^s} + \frac{(1-k) E_t [EPS_{t+T+1,k}]}{(r_{t,k} - g_k) (1+r_{t,k})^T}$$

DPS refers to:

$$P_{t,k} = \sum_{s=1}^T \frac{E_t [DPS_{t+s,k}]}{(1+r_{t,k})^s} + \frac{E_t [DPS_{t+T+1,k}]}{(r_{t,k} - g_k) (1+r_{t,k})^T}$$

Gordon refers to:

$$P_{t,k} = \sum_{s=1}^T \frac{E_t(DPS_{t+s,k})}{[1+r_{t,k}]^s} + \frac{E_t(EPS_{t+T+1,k})}{r_{t,k} [1+r_{t,k}]^T}$$



1.7. TABLES & FIGURES

Figure 1.7: Mean Discount Rate (DPS)

The figure shows the cross sectional average of the implied discount rate computed on the basis of DPS forecasts with different assumptions on the long term growth rate g .

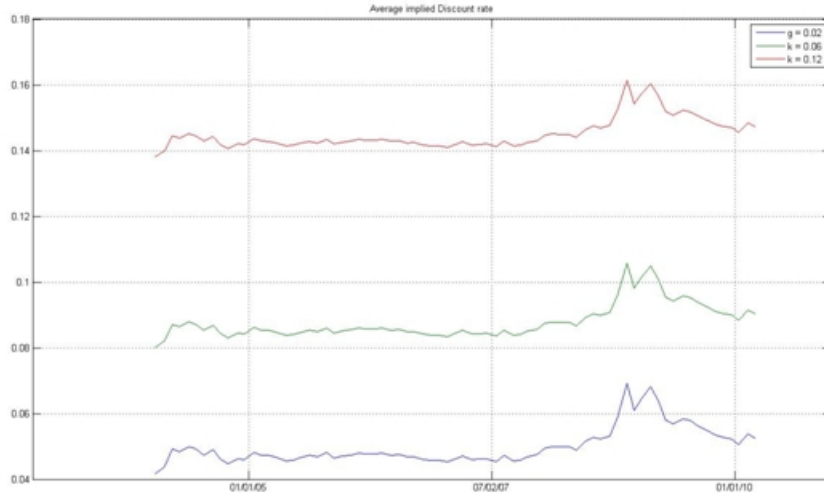
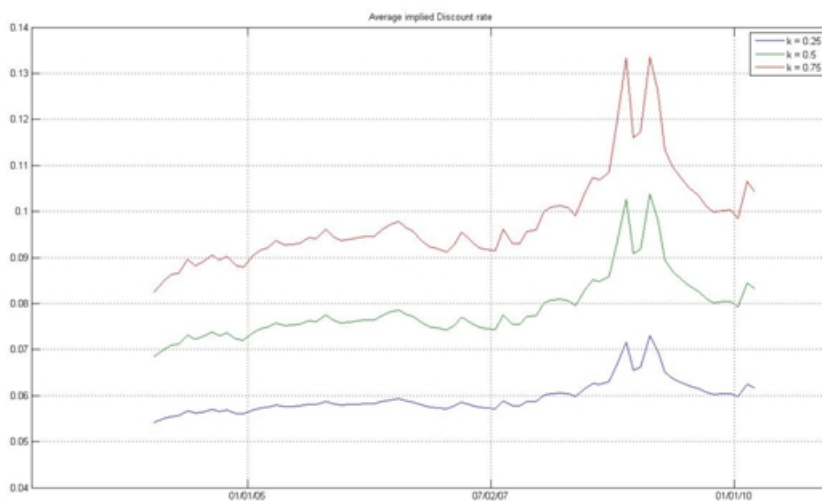


Figure 1.8: Mean Discount Rate (EPS)

The figure shows the cross sectional average of the implied discount rate computed on the basis of EPS forecasts with different assumptions on the payout rate k .



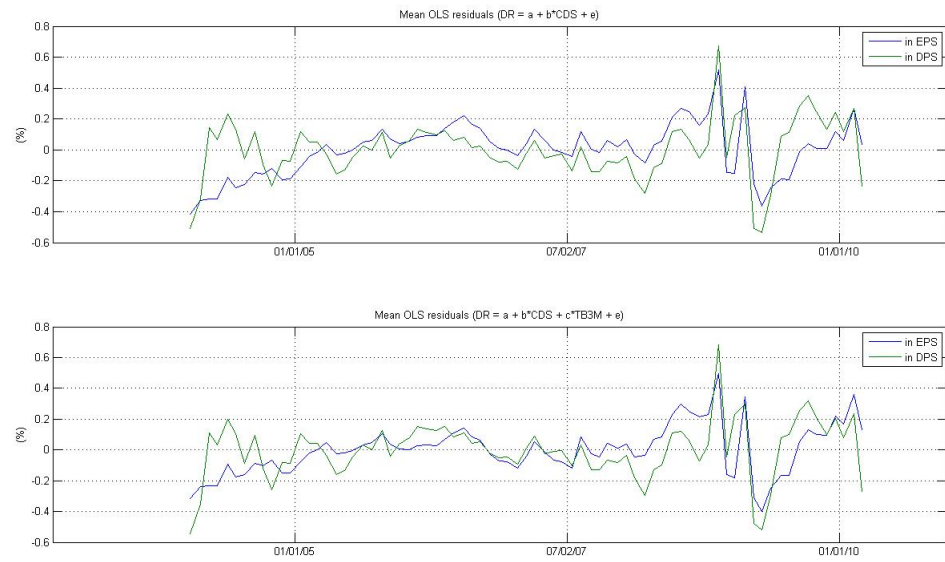
1.7. TABLES & FIGURES

Figure 1.9: Cross Section: OLS Residuals

The figures reports the OLS residuals of a regression between the cross sectional average implied discount rate and the CDS premium:

Panel 1: $r_t = \alpha + \beta CDS(5Y)_t + \epsilon$

Panel 2: $r_t = \alpha + \beta CDS(5Y)_t + \gamma T - Bill + \epsilon$

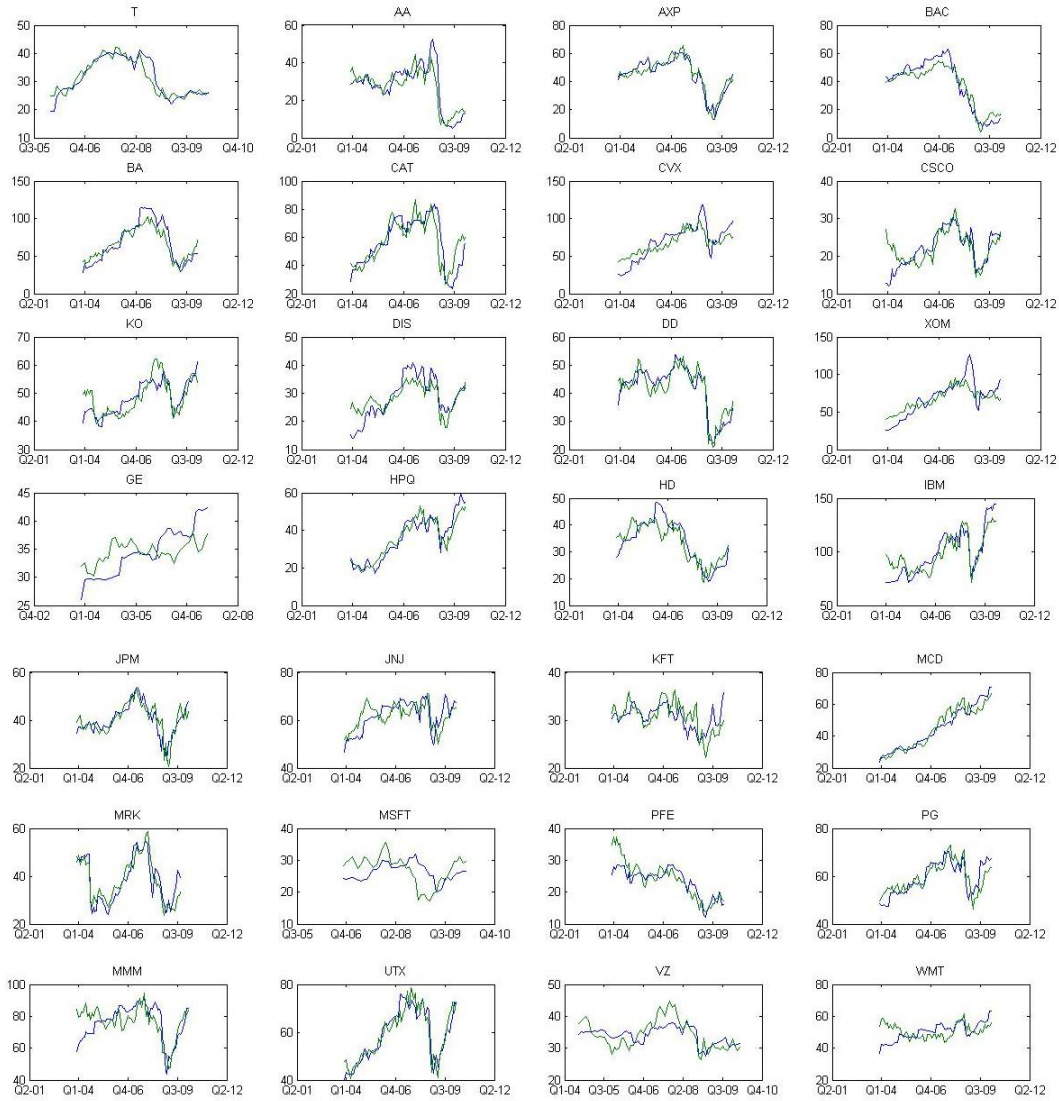


1.7. TABLES & FIGURES

Figure 1.10: Actual Price vs. Fitted Price

The following figures show the actual market prices (green lines) compared to the fitted prices (blue lines). The latter are computed using the DDM as in equation 1.2.3, the discount rates come from the in-sample OLS regression:

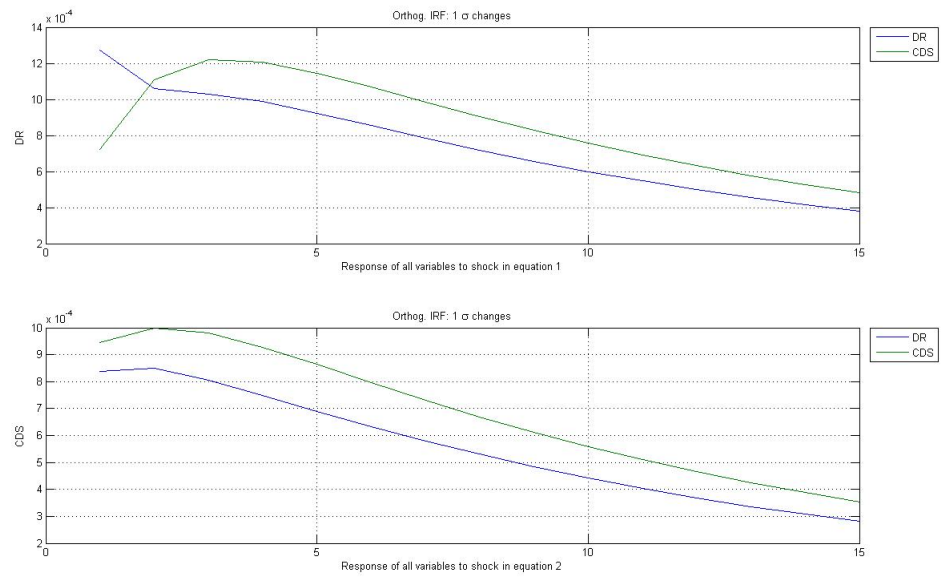
$$r(EPS)_{t,k} = \alpha + \beta CDS(5Y)_{t,k} + \epsilon$$



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Figure 1.11: $r(DPS)_t$: Impulse Response Function (IRF)

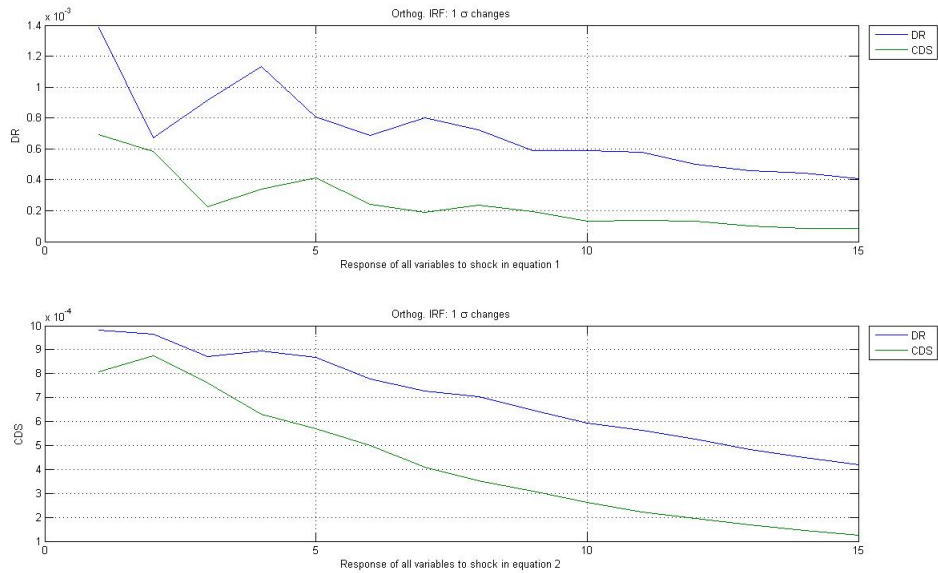
The following figures show the IRF function of a VAR(2) in levels computed using the cross sectional average 5 year CDS premium and the implied discount rate computed using DPS



1.7. TABLES & FIGURES

Figure 1.12: $r(EPS)_t$: Impulse Response Function (IRF)

The following figures show the IRF function of a VAR(3) in levels computed using the cross sectional average 5 year CDS premium and the implied discount rate computed using EPS



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Chapter 2

Promised Yield, Implied Discount Factor, and Return Predictability

Through this paper, the relationship between the implied discount factor and the promised yield under risk neutral probability (PYRN) is verified. The implied discount factor is determined using the Finite Horizon Expected Return Model (FHERM), equating stock prices and analysts' forecasts for future earnings per share (EPS) and dividends per share (DPS). The PYRN is derived from corporate bond yield. We demonstrated that these two measures are indeed cointegrated, and that any deviation from the parity will be only slowly corrected, implying that market returns are at least partially predictable. We also found evidence of Granger causality from PYRN to the implied discount factor. We further showed that incorporating this information into a trading strategy may yield superior performance. Finally, we demonstrated that most of the observed variance in market returns is due to changes in the discount factor, with only a tiny fraction attributed to unexpected revisions in earnings perspectives.

2.1 Introduction

One of the most critical aspects of equity valuation is the determination of the appropriate expected return to use in order to properly discount future cash flows. Although much effort has been spent in estimating the cost of capital for individual stocks, the method to correctly determine the market risk premium still remains controversial. All economists agree that the expected return on any investment is always determined by the sum of the yield on a comparable risk-less asset and an extra return to compensate for the risk. Although the first is broadly, but not unanimously, identified by the yield on a government bond, the determination of the second component remains controversial. From a theoretical point of view, determining the risk premium requires the correct identification and measurement of all elements that determine an asset to be “risky”. Most existing risk-return models agree that risk can be identified in terms of the variance between expected and realized return and that the only risk that has to be compensated is the non diversifiable one. The most commonly used approaches are the capital asset pricing model (CAPM), the arbitrage pricing model (APM), and the multi-factors model. In all those models, the expected return on any asset $E_t(r)$ can be written as: the sum of the risk free rate (r_f) and the risk premium associated with the i -th risk factor (RP_i).

$$E_t(r) = r_f + \sum_{i=1}^N \beta_i RP_i \quad (2.1.1)$$

where r_f is the risk free asset, β_i is the sensitivity of the asset at the risk factor i , and RP_i is the associated risk premium. The problem arises in how to measure and identify the risk premiums. The standard approach is to rely on historical returns, taking the average (or more sophisticated measures) of the difference between the return on a market index (or on some portfolio that can be seen as proxy for the risk factor) and the yield on some treasury bond. The rationale is that historical return is the best estimate for expected return. However such an approach has some severe limitations: in particular, one needs to assume that the risk premium remains fairly constant over

2.1. INTRODUCTION

time. Even assuming that is true, given the noise inherent in the data, a long and proper time series is needed to make correct inference. Additional problems arise in the choices of the risk-free asset, of the optimal time-frame, and of the appropriate time-horizon. All these variables substantially affect the estimate of the risk premium.

Given all these issues, an alternative approach has been developed in the literature. The required expected return is directly inferred from market prices and from analysts' forecasts of earnings and dividends. This methodology requires an appropriate equity valuation formula and some restrictive assumptions about future long term growth of the firm. The procedure solves many of the problems presented above, but others emerge. In particular, the choice of the valuation formula and the assumptions relative to future long term growth are somewhat subjective and can alter the results substantially. Also, there is no clear framework to analyse the determinant of the expected return.

Alternatively, the cost of equity capital can also be determined, similarly to the yield of a bond, through a non arbitrage argument. Following the works of Bierman and Hass (1975, 1990), Cheung (1999) developed a model to evaluate the cost of capital for small firms for which the CAPM cannot be used. The expected return on equity are strictly related to the yield of a corporate bond. Applying this idea and using data on the corporate bond index spread, it is possible to derive the risk premium.

In this paper, we intend to verify that the cost of capital derived by the reverse engineering of equity valuation formulas and the cost derived by the credit spread on corporate bond are in some way related, and to test the predictability of returns and changes in the risk premium. Additionally, we aim to provide a link relating implied discount factor, required return on equity, and observed return.

This paper is organized as follows. Section one is a review of the related literature and of the most used equity valuation models. Section two presents a simple model useful to derive the cost of equity capital from the cost of debt. Section three discusses the methodology used in this paper and reviews the summary statistics. Section four discusses the empirical relationship

between implied discount factor and the cost of equity capital, while section five discusses the determinants of observed market returns and evidence of predictability. Finally, the paper concludes in section six.

2.2 Equity Valuation Models: Literature review

Many equity valuation models have been developed in the financial literature. The starting point of the vast majority of them is the dividend discount model (DDM), which can be traced back to Williams (1938). The DDM relates the price of the security at time t , P_t , to the expected cost of equity capital, $E_t(r)$, and the value of dividends DPS_t :

$$P_t = \sum_{\tau=1}^{\infty} \frac{E_t(DPS_{t+\tau})}{(1 + E_t(r))^{\tau}} \quad (2.2.1)$$

This model states that the price of any security can be defined as the discounted sum of all future cash flows. The problem with this approach is that such a stream of cash flows is not known and some restrictive assumptions have to be made. The simplest is to assume that dividends can be expected to grow at a constant rate g . In this case, the price can be expressed as a growing perpetuity. This specification is often referred as the Gordon model (1959):

$$P_t = \frac{E_t(DPS_{t+1})}{E_t(r) - g} \quad (2.2.2)$$

Unfortunately, estimates are very sensitive to the choice of the long term growth rate. More realistic assumptions are imposed in the Ohlson and Juettner (2005) model. This representation relates current price with the next two years' earning per share (EPS) forecasts, the next year's dividend per share (DPS) analysts' estimate, and a long term growth rate γ :

$$P_t = \frac{EPS_1}{E_t(r)} + \frac{EPS_2 - EPS_1 - E_t(r)(EPS_1 - DPS_1)}{E_t(r)(E_t(r) - (\gamma - 1))} \quad (2.2.3)$$

2.2. EQUITY VALUATION MODELS: LITERATURE REVIEW

Residual income valuation model, whose theoretical foundation can be found in the works of Preinreich (1938), Edwards and Bell (1961), Ohlson (1995), and others, are less sensitive to errors in the estimate of the inputs. This procedure, often referred to as the Edward-Bell-Ohlson (EBO) valuation model, states that the price of a given security is determined by the sum of the book value at time t , B_t , plus the discounted sum of all future residual income. Formally it can be written as:

$$P_t = B_t + \sum_{i=1}^{\infty} \frac{E_t [ROE_{t+1} - E_t(r)] B_{t+i-1}}{(1 + E_t(r))^i} \quad (2.2.4)$$

where ROE_{t+1} is the after tax return on book equity for the period $t + 1$. Finally, Gordon (1997) developed a parsimonious model, the finite horizon expected return model (FHERM), in which he allows abnormal performance over a finite horizon N . Starting from year $N + 1$ the corporation's return on equity investment (ROE) is assumed to be equal to the expected return.

In the last years, many authors have started to use equity valuation formulas to estimate the market expected return. In particular, Botosan (1997), using an accounting based valuation formula, analysed the association of the implied cost of equity capital with market beta, firm size, and a measure of disclosure level. She demonstrated that the expected rate of return is negatively associated with disclosure level, in particular for firms with low analyst following; furthermore, it is increasing in beta and decreasing in firm size. Gordon (1997) found that the cross-sectional differences in the implied discount factor estimated through the Finite Horizon Expected Return Model (FHERM) are in agreement with the predictions of the CAPM. Frenkel and Lee (1998) found that the firms' fundamental value (V) estimated using IBES consensus estimates and a residual income model is highly correlated with the contemporaneous market stock price. Furthermore, the V/P ratio offers predictive power for long term cross-sectional returns. Gode and Mohanram (2001) derived the implied cost of equity capital using the Ohlson and Juettner model. They found that the expected return is related to conventional risk factors such as earning volatility, systematic and unsystematic return

2.2. EQUITY VALUATION MODELS: LITERATURE REVIEW

volatility, and leverage. Gebhardt, Lee and Swaminathan (2001) estimated the implied cost-of-capital through the residual income model for a large sample of US stocks. Examining the firm characteristics that are systematically related to the derived cost of capital, they found book-to-market ratio (B/M), industry membership, forecasted long-term growth, and the dispersion of analyst earning forecasts explain around 60% of the cross sectional variation in future implied cost of capital.

Botosan and Plumlee (2001) wanted to verify whether the cost of capital estimated from the unrestricted dividend model is a valid proxy for expected cost of equity capital and if other valuation models correlate with it. They showed that the derived measure is associated with six risk proxies suggested by theory and prior researches in a consistent way. In particular, they found a positive and strong relationship between market beta and the derived rate of return. In the second part of their work, they analysed the extent to which the restricted form model correlates with the unrestricted form, finding that the EBO valuation model correlates the most. However, they noticed that there is no gain in using such a specification because of the need for forecasts of future stock prices. Among the other approaches with less need for data, the Gordon model showed the highest correlation. Conversely, the Ohlson and Juettner model and the Gebhardt, Lee and Swaminathan specification correlated less with the unrestricted dividend model, moreover the association between the derived expected return estimates and the risk factors are less consistent with the theory than the ones obtained using the previous ones. Easton et al. (2002) provided a method to simultaneously estimate the cost of equity capital and the growth in residual earnings. They found that the market expected return ranged from 11% to 16% between 1981 and 1998, while the equity premium average was 5.3%. In a survey of 150 textbooks, Fernández (2010) found an average required equity premium of 6.5%. Furthermore, the equity premium seemed to have decreased over time; the 5-year moving average declined from 8.4% in 1990 to 5.7% in 2009. In any case, there is a large heterogeneity in the estimates; the average recommendations range between 3% and 10%. He also argued the importance of distinguishing between historical (HEP), required (REP), expected (EEP)

and implied equity premium (IEP). The equivalence $EEP = REP = IEP$ is true only if all investors have the same expectations.

2.3 Cost of Equity Capital: The Model

Any security can in general be evaluated as the discounted sum of all the cash flows to investors. Assuming dividends to be the sole way to distribute value to shareholders, it can be shown that the current price of any stock is determined by the present value of all future dividends; this is the so called dividend discount models (Equation 3.7.2). Unfortunately, this model is not directly applicable because it requires knowledge of all the stream of future dividends. For this reason, many simplifying assumptions have to be made. In particular., by imposing dividends to grow at a constant rate, the intrinsic price can be expressed as a growing perpetuity (Constant-Growth DDM, Equation 2.2.2), however such an assumption may be unrealistic. An appealing and simple model trying to overcome this weakness is the finite horizon expected return model (FHERM), firstly developed by Gordon and Gordon (1997). The main assumptions required are that earnings are the sole source of funds for equity investment, that dividends are the sole means for distributing funds to investors, and that, beyond time N , the return on equity (ROE) will be equal to the expected return. Given the above conditions and relying on the DDM, the following equation can be derived:

$$P_t = \sum_{\tau=1}^T \frac{E_t(DPS_{t+\tau})}{[1 + E_t(r)]^\tau} + \frac{E_t(EPS_{t+1+T})}{E_t(r) [1 + E_t(r)]^T} \quad (2.3.1)$$

where P_t is the current share price, $E_t(r)$ is the expected return required by investors, $E_t(DPS_t)$ and $E_t(EPS_t)$ are respectively the expected dividend and earnings per share at time t . From this formula, it is possible to derive the expected rate of return implied by current market prices and forecasts about future earnings and dividends. Although the empirical literature often assumes that the constant discount rate is approximately equal to the expected rate of return, the two may differ for two reasons: first, the term

2.3. COST OF EQUITY CAPITAL: THE MODEL

structure of risk-free interest rates is generally not flat, leading to different expected rates of return at different horizons¹; and second, the expected rate of return will exceed the discount rate, if it is stochastic (see Ohlson (1990) and Samuelson (1965)).

An alternative approach to estimate the cost of equity capital is based on the cost of debt. The motivation behind this approach is that both are driven by the same factors that affect the health of the firm, while the main difference is given by the different priority of payment in case of default. The spread of a bond is mainly determined by the probability of default and the loss in case of default of the underlying company. Additionally, many researchers have shown that liquidity and other factors may also affect the credit spread. Given the risk neutral probability of default and the recovery rate, namely the amount of money that is recovered in case of default, it is possible through a non-arbitrage argument to determine the associated cost of debt. To keep things as simple as possible, a one period model is assumed. Also, investors are assumed to be risk-neutral and it is assumed that equity investors will receive nothing in case of default, while debt holders will be able to recover a fraction of the invested amount R . Finally, it is assumed there are no taxes and market imperfections. Relying on those assumptions and on a non-arbitrage argument, it is possible to express the risk neutral expected return on the debt as a function of the default probability and the recovery rate.

$$\tilde{E}_t [D(1 + r)] = pD(1 + y_d) + (1 - p)RD \quad (2.3.2)$$

where \tilde{E}_t is the expectation operator under the risk neutral probability, p is the survival probability, y_d is the yield on the risky bond, R is the recovery rate and D is the amount invested in the risky asset. The expected pay-off of a bond investment can be expressed as the pay-off in case of survival and in case of default, weighted by the respective probabilities. In the case of non

¹Empirically, the forward one-year rates flattens rather quickly. For this reason, assuming a constant interest rate for the first years has a small impact on the valuation since first years dividends represent a small proportion of the value of the company in comparison to the terminal value.

2.3. COST OF EQUITY CAPITAL: THE MODEL

default which occurs with probability p , the bond-holder will receive back the capital and interests at the end of the period. If there is a default event, which occurs with probability $1-p$, the investor will receive back a fraction R of the capital initially invested. To avoid any arbitrage, the expected return in a risk neutral world equates the return on a risk free asset in equilibrium; that is:

$$\tilde{E}_t [D(1+r)] = D(1+r_f) \quad (2.3.3)$$

Combining Equations 2.3.2 and 2.3.3, it is possible to express explicitly the cost of debt:

$$y_d = \frac{r_f + (1-R)}{p} - (1-R) \quad (2.3.4)$$

From the above expression, it is possible to estimate the market implied default probabilities starting from the observed credit spread. The following formula can be easily derived:

$$(1-p) = \frac{y_d - r_f}{1-R+y_d} \quad (2.3.5)$$

A similar reasoning can be applied in order to derive an analogous expression for the rate of return on an equity investment. Some additional assumptions are needed: in particular, the underlying default probability must be the same for the debt and the equity. This is a reasonable hypothesis, since default is a corporate event and thus it is natural to think that every stakeholder of the firm is affected. The principal difference between equity and bond investment is the pay-off in case of default. Since equity is a residual claim, it has the lowest repayment priority. For this reason the expected recovery rate for a shareholder is often zero. The expected return on equity under the risk neutral probability can be written as:

$$\tilde{E}_t [E(1+r_e)] = p [(D+E)(1+y_a) - D(1+y_d)] \quad (2.3.6)$$

where D and E are the amount invested in debt and equity, respectively, r_e is the return on the equity capital, and y_a is the weighted average cost of

capital (WACC).

$$y_a = \frac{D}{D+E}y_d + \frac{E}{D+E}r_e \quad (2.3.7)$$

The first term on the left is the pay-off to equity-holders in case of survival. Since they are residual claimers, they will receive the difference between the value of the assets of the firm and its debts. Conversely, in case of default they will lose all the invested capital. Under the risk neutral probability every asset must provide the same expected rate of return,

$$\tilde{E}_t [E(1 + r_e)] = E(1 + r_f) \quad (2.3.8)$$

In the real world this will be different from the risk-free rate because of the need to compensate equity investors for the possibility of default, since if there is default, their return is zero. In this paper we refer to it as the promised yield under risk neutral probability (PYRN).

Imposing $r_e = PYRN$ and substituting the definition of the WACC in Equations 2.3.6 and 2.3.8, the expected rate of return is:

$$E(1 + r_f) = pE(1 + PYRN) \quad (2.3.9)$$

Thus, the explicit expression for the PYRN is:

$$PYRN = \frac{1 + r_f}{p} - 1 \quad (2.3.10)$$

The spread between the promised yield and the cost of debt can thus be written simply as the difference between Equation 2.3.10 and Equation 2.3.4:

$$PYRN - y_d = \frac{Rh}{1 - h} \quad (2.3.11)$$

where $h = 1 - p$ is the risk neutral default probability.

Most of the literature considering the cost of debt agrees on the fact that there is a risk premium in the bond market. In other words, the spread over the risk free rate seems to be too high to be explained only by default probability and recovery rate. On the basis of this observation a very a

simple adjustment of the previous equation is proposed. Assuming that this risk premium is constant and independent on default probability, the part of the return on a corporate bond that is only related to the credit quality of the underlying firm is then:

$$y_d^* = y_d - c \quad (2.3.12)$$

where c is a constant risk premium and the superscript $*$ means risk premium adjusted. Since c is a positive constant, the cost of debt adjusted for the risk premium will be lower than the observed market rate. Consequently, the resulting implied default probability will be lower. The promised yield under risk neutral probability comprehensive of the risk premium ($PYRN^*$) can therefore be expressed as:

$$PYRN^* = y_d^* + \frac{Rh^*}{1 - h^*} \quad (2.3.13)$$

where

$$h^* = \frac{y_d^* - r_f}{1 - R + y_d^*} \quad (2.3.14)$$

Under the assumptions that the return required by investors in order to hold equity is equal to the promised yield and that the market is efficient, it follows that the implied discount rate derived from the FHERM $[E_t(r)]$ must be equal to the $PYRN^*$. In the light of this paper, the empirical relationship between those two variables will be investigated.

2.4 Methodology and Summary Statistics

The monthly data on analysts' forecasts of earnings and dividends over the period January 1986 - December 2009 are obtained from the IBES Summary Statistics database. Monthly data on prices, returns, market capitalization are obtained from the CRSP database. The CBOE volatility price index and the redemption yield on Barclays Bond index are obtained from DataStream. The data on the monthly government bond interest rates and yield on BBB seasoned corporate bonds are obtained from the Federal Reserve Statistical Release. Finally, data on the Standard & Poor's credit rating are

obtained from the Compustat Database. The implied discount rate is calculated from the finite horizon expected return model (FHERM), as discussed in the previous section. The empirical implementation requires determining the horizon (N) beyond which $E_t(r)$ will equate the ROE. According to the availability and reliability of data, N is set between one year and three years. Forecasts above the three years horizon do not provide much additional information as analysts usually base their estimates for longer horizon on the long term growth rate and on the two year earnings forecast. In addition, data over longer horizons are less reliable and are typically not available for most stocks. To deal with missing information, the following algorithm is used. If data on $DPS_{t+\tau}$ is not available but there is the information on $EPS_{t+\tau}$, we use as a proxy for dividends $DPS_{t+\tau} = kEPS_{t+\tau}$, where k is the payout ratio which is assumed to be 0.35, its historical long term average. In the case in which we have data on $DPS_{t+\tau+1}$ but not on $DPS_{t+\tau}$ we set $DPS_{t+\tau} = DPS_{t+\tau+1}/(1+g)$, where g is the long term growth rate. Similarly, in the case in which we have neither $DPS_{t+\tau}$ or $DPS_{t+\tau+1}$ but we have $EPS_{t+\tau+1}$, we use $DPS_{t+\tau} = kEPS_{t+\tau+1}/(1+g)$. If the preceding algorithm fails, we decrease the time horizon for the given stock, setting $T = T - 1$. This procedure is repeated for each date and for each stock available in the database. Stocks for which no realistic solutions for the discount rate are found are dropped from the sample, where a realistic rate is within the limits $0 < E_t(r) < 0.50$. In addition, we require a continuous coverage of the stock by analysts in the previous five years, in order to ensure a good quality of the estimates. This selection leads to a final sample constituted by an average of more than 1500 stocks, representing about 20% of the initial universe. Such a restrictive procedure is used because we want to avoid any possible problem related to bad data quality or insufficient analyst coverage. Nevertheless, one has to be aware that the final sample is strongly tilted towards big stocks. The average market capitalization of stocks composing our sample at 1 January 1986 was \$ 1248.8 million, while the average capitalization for the AMEX/NYSE was \$ 358.6 million. In 2007, the average capitalizations were 7846.7 and 3014 million dollars, respectively. All the statistics are presented in Table 2.1 and in Figure 2.1.

2.4. METHODOLOGY AND SUMMARY STATISTICS

Every month, an equally weighted index is built by aggregating each individual stock's implied discount rate $[E_t(r_i)]$ in a cross sectional arithmetical mean.

$$E_t(r_m) = \frac{1}{N} \sum_{i=1}^N E_t(r_i) \quad (2.4.1)$$

Summary statistics on the implied discount rate are presented in Table 2.2. The table reports the statistics relative to the end of January of every year for the period 1986-2009. The cross-sectional average discount rate has steadily declined from around 10% in 1986 to around 7% in 2007, following the general trend of long term US government interest rate. Conversely, in 2008 and 2009 discount rates strongly increased (8.07% and 11.37%, respectively), due to the deep financial crisis and the consequent increase of risk premiums that investors demanded in order to keep risky assets. The implied risk premium, defined as the difference between the implied discount factor and the 3-month T-Bill rates, seems to present quite regular cycles. These cycles correspond broadly with economic downturn and expansion: during periods of good economic activity the premium goes down, in bad times, it goes up. During the years 1986-2009, it ranged from a minimum of 1.87% (January 2007) to a maximum of 11.26% (January 2009). The discount factors of the individual stocks are quite heterogeneous. The standard deviation is, relative to the mean, generally high (time series average 3.83%). Additionally, the distribution is not symmetric, as summarized by the positive skewness (average 2.12 over the full sample period). This value indicates a right tilted distribution, probably as a consequence of the portfolio's bias towards big stocks, which are usually characterized by lower discount rates. Finally, the kurtosis (mean 13.58) indicates fat tails, which means that there are several extreme observations.

The average market return is computed taking the cross sectional arithmetical mean of individual stock returns. The data comes from the CRSP database and returns include the dividends.

$$r_{m,t} = \frac{1}{N} \sum_{i=1}^N r_{i,t} \quad (2.4.2)$$

2.4. METHODOLOGY AND SUMMARY STATISTICS

To check that our sample is representative of the market, we run the following market regression:

$$r_{m,t} - rf_t = \alpha + \beta (r_t^{ind} - rf_t) + \epsilon_t \quad (2.4.3)$$

where r_t^{ind} is the monthly gross log return on the benchmark market index and rf_t is the yield on the 3-month US T-Bill. Table 2.3 reports the estimates of the above market regression. The systematic risk associated with the sample is comparable to that associated with the usual value weighted index (CRSP value weighted index with and without dividends or the S&P500 index). The betas are in fact not statistically different from one. Interestingly, even if the sample index is built as an equally weighted index, the betas with respect to the CRSP equally weighted index are below one (around 0.86), indicating a lower level of systematic risk. This may be because the sample is strongly tilted towards big stocks, which usually are less risky than small stocks. The relative high value of the R^2 statistic (0.79-0.85) indicates a fairly good correlation between the sample and the benchmark index. On the basis of the above results, we confirm that the stocks considered are fairly representative of the overall market. However, we find the positive alpha with respect to all benchmarks considered puzzling. The excess return over the CRSP value weighted index (with dividends) is 0.26% on a monthly basis, corresponding to an annualized return of around 3.16%. The value is significant at the 5% level. Even against the CRSP equally weighted index, we find a positive alpha of 0.22% (monthly) but only at a significance of 10%. This apparent over-performance can be given by the fact that all stocks presenting negative expected earnings are dropped from the sample. However, even if all information is known ex-ante, it is impossible for investors to realize abnormal returns from this over-performance because a practical implementation of this strategy requires a continuous re-balancing of the portfolio. Additionally, every January the composition of the index may vary as many stocks are dropped or added. As a consequence, transaction costs may eliminate any abnormal profit.

The monthly average excess return including dividends of our sample was,

2.4. METHODOLOGY AND SUMMARY STATISTICS

during the years 1986-2009, around 0.85% with an associated standard deviation of 5.24% resulting in a monthly Sharpe ratio of 0.1617. The annual average return was 8.46% with a standard deviation of 20.01%. For comparison, the average excess return (with dividends) of the equally weighted CRSP index was 0.72% with a standard deviation of 5.63%, while the value weighted index yielded an average monthly return of 0.53% with 4.62% volatility.

In order to be able to compute the PYRN, the credit quality of the considered portfolio has to be assessed. The data on individual firm's ratings are obtained from the COMPUSTAT database and refer to Standard and Poor's assessment. Data on ratings are unfortunately not available for every stock composing our portfolio, but the data should still be representative of the overall portfolio. The distribution of ratings for some selected years is presented in Figure 2.3; the mass of the distribution is centred around the "BBB rating". The distribution presents a positive skewness. This means that "A grade" companies are more frequent than "C rated" firms. Again, this may be a consequence of the bias of the sample. Looking at the dynamic of rating distribution, one can observe that on average there is a deterioration of the ratings. This is most probably due to the fact, that moving to more recent years, many low rated companies were included in the portfolio. This is probably a direct consequence of increased analysts' coverage of small firms. In order to have a measurable quantity, an increasing numerical value is associated to every rating a score of one is associated with "AAA" while a score of 23 is assigned to "D" (Defaulted). The complete conversion scheme is presented in Table 2.4. The overall portfolio credit quality S_t^M , for every month during the period 1986-2009, is then estimated taking the simple arithmetic average of individual scores (S_t^i).

$$S_t^M = \frac{1}{N} \sum_{i=1}^N S_t^i \quad (2.4.4)$$

Summary statistics of the resulting time series are presented in Table 2.5. As previously discussed, the average credit quality deteriorated between 1986 and 2009, declining from a score of 7.33 (A-) to 9.63 (BBB-), while the

median rating decreased from A to BBB. The distribution also becomes more symmetric in more recent times, as indicated by the skewness. Conversely, neither the standard deviation nor the kurtosis appeared to have changed significantly over time.

2.5 Implied Discount Factor and PYRN

Cointegration Analysis

The goal of this section is to verify that the implied discount factor can be interpreted as the cost of equity capital. To do this, the empirical equivalence between the implied discount factor, determined by the FHERM, and the PYRN*, determined on the basis of market credit spread, will be verified. For this purpose, evidence of the strict relationship between the implied discount rate and the yield on an index of corporate bonds will be presented. The market implied discount factor $[E_t(r_m)]$, is computed as described in the second section. Individual stock's discount factors are firstly computed by Equation 2.3.1, then the individual observations are aggregated as the arithmetical average. The next step is to determine the appropriate theoretical cost of debt for the portfolio considered. Unfortunately, there is not a bond index that perfectly replicates the considered portfolio. However, it is possible to find several bond indices that replicate the yield of US corporate bonds; we have chosen from among these the “Barclays Aggregate Long Credit A” and the “Barclays Aggregate Long Credit BBB”. These indices are built in such a way as to replicate a basket of corporate bonds with maturity ranging from 7-10 years with a credit rating of A and BBB respectively. Assuming that the yield is proportional to the credit rating, it is possible to combine these two indexes to replicate the yield of the portfolio. The weight for the two components can be easily determined by solving the following equation:

$$S_t^M = w_{1,t}S_t^A + (1 - w_{1,t})S_t^{BBB} \quad (2.5.1)$$

where S_t^M is the credit score of the market portfolio (see Equation 2.4.4). S_t^A and S_t^{BBB} correspond to the credit score of the two bond indexes. According to the scoring methodology introduced in the previous section, we set S_t^A to 6 and S_t^{BBB} to 9. $w_{1,t}$ and $w_{2,t} = 1 - w_{1,t}$ are the proportion to be invested in the first and the second index at month t . Consequently, the cost of debt is approximated by the redemption yield of the following portfolio:

$$y_{d,t} = w_{1,t}y_{A,t} + (1 - w_{1,t})y_{BBB,t} \quad (2.5.2)$$

where $y_{A,t}$ and $y_{BBB,t}$ are the redemption yield on the Barclays Aggregate Long Credit A and the monthly yield on seasoned corporate bonds BBB, respectively. Comparing the time series of the implied discount rate and of the redemption yield on the bond index portfolio, as in Figure 2.5, we observe that the two series behave in a very similar way, with the second index generally less than the first. This is consistent with the model previously derived. The next step consists in deriving the PYRN*; for this purpose, an estimate of the implied default probabilities is needed. This task is achieved by numerically minimizing the following expression by changing the constant c :

$$e = \min_c \sum_{t=1}^T \left[E_t(r_m) - \left(y_{d,t}^* + \frac{Rh^*}{1 - h^*} \right) \right]^2 \quad (2.5.3)$$

The parameter R is set to 0.4, which corresponds to the historical recovery rate for BBB rated bonds. The bond spread over the risk-free rate is computed as the difference between the bond index yield and the yield on the 10-year US Treasury Notes. The above minimization procedure gives an estimate for the annualized risk premium c of 0.46%. This value is reasonable and comparable with the liquidity premium found in related literature on the bond market². Once c is estimated, the default probability, implied by the credit spread between the bond index and the 10-year Treasuries yield, can be easily derived. The resulting time series is plotted in Figure 2.4. The default probability remained relatively low during the years 1988-2000, mov-

²E.g. Chen, Lesmond, and Wei (2007) found a liquidity estimate for BBB rated bond over the period 1995-2003 of about 35-70 Bps depending on the maturity of the bond.

ing around the 2% level. The first significant spike took place in the years 2001-2002, corresponding to the bursting of the tech bubble. By mid 2002, it has reached the level of 5%. The last severe rise in default probability took place during the recent financial crisis, when in December 2008 it reached the record level of 8.37%. However, by end of 2009, it started to revert toward its long term average, reaching a value of 4.22%. Figure 2.5 shows the time series of the implied discount factor, the yield on the bond portfolio and the $PYRN^*$. The bond yield is, as expected, below the implied discount factor on average. The $PYRN^*$ and the implied discount factor tend to be closely related for most of the time. However, there are some periods in which the two rates diverge. Thus, if the model is sufficiently accurate, the bond and equity market may not be perfectly in equilibrium at all times. This issue will be investigated in more detail in the next sections.

A useful technique to detect long run dependencies between variables is the cointegration analysis. Two or more time series are said to be cointegrated if each of the series taken individually have a unit root, while some linear combination of them is stationary. The first step of the analysis is to check for the presence of a unit root in the two series of interest. Many statistical procedures to test for unit root have been proposed in the literature. The most known and widely used are probably the Augmented Dickey-Fuller (ADF), the Phillips-Perron (PP) and the Kwiatkowski-Phillips-Schmidt-Shin (KPSS). While the first two methods test the null hypothesis that the time series has a unit root, the KPSS procedure focuses on the null that the data is stationary. The above tests can be corrected in order to take into consideration different assumptions about the true data generating process, in particular the presence of a constant term or a time trend.

A priori, there is nothing in economic theory to suggest that discount rates should exhibit a deterministic time trend. So a natural null hypothesis is that the true process is a random walk without any trend.³ If these data

³Although it may appear that the two time series are slowly decreasing, this feature is mainly attributable to the relatively limited length of the time window considered. Looking at the yield on BAA corporate bonds starting from 1919, one observes that yields were generally increasing until the 80's, but decreasing afterwards. This leads us to the conclusion that any apparent trend is only a feature of the selected time period.

were to be described by a stationary process, surely the process would have a positive mean. This argues for including a constant term in the estimated regression, even though under the null hypothesis, the true process does not contain a constant term. Finally, the lag length of the ADF test is selected according to the AIC criterion. All the statistics are presented in Table 2.6. The KPSS test rejects the null of stationarity in both the time series of implied discount factors and PYRN*. Analogously, the ADF and the PP tests do not reject the null of a unit root in the time series of the *PYRN** at the 5% critical value, while they do not reject the null of an unit root in the discount rates only at the 1%. Given the relative low power of the ADF test and the results of the KPSS test, we can conclude that, on the basis of the previous numbers, the two time series are strongly persistent and eventually present a unit root⁴. Conversely, all the tests performed on the first differenced data clearly reject the null of a unit root.

Wrong conclusions about the order of integration of the variables may lead to bias in the estimates of the cointegrating vector as pointed out by Elliot (1998)⁵.

Having assumed that both time series present a unit root, tests for cointegration can be performed. The most widely used methodologies are the Engle-Granger test and the Johansen procedure. Simplifying, the first is

⁴From the economic point of view, this finding is problematic, since it will imply in the long run the variance of those two variables to tend towards infinite. The theory suggests that neither time series should have a unit root, as they are generally bounded above zero and are characterized by a slow mean reversion behaviour. This feature, however, cannot be easily identified because of the limited availability of data. Nevertheless, given their strong persistence, it is more reasonable from an econometric point of view to treat them as $I(1)$ processes.

⁵Elliot (1998) argues that if the roots are near but not one; although the point estimates of cointegrating vector remain consistent, commonly applied hypotheses no longer have the usual distribution. He assumes the following data generating process (dgp):

$$\begin{aligned} y_{1,t} &= d_{1,t} + Ay_{1,t-1} + \eta_{1,t} \\ y_{2,t} &= d_{2,t} + By_{1,t} + \eta_{2,t} \end{aligned} \tag{2.5.4}$$

He showed that the bigger the covariance between $\eta_{1,t}$ and $\eta_{2,t}$, the bigger the bias. Table 2.8 reports the sample variance-covariance matrix of the residuals of the previous system. y_1 is set to the PYRN* while y_2 is the implied discount rate. Given the relative low covariance between $\eta_{1,t}$ and $\eta_{2,t}$ (-3.64E-06), wrong assumptions about the order of integration of the variables are not expected to severely bias the results presented in this article.

based on the Augmented Dickey-Fuller test for unit root, checking for the stationarity in the residuals of an OLS regression between the variables. If this is so, the two series are said to be cointegrated. The second methodology relies on maximum likelihood, which is more generally applicable because it allows for more than one cointegrating relationship. Two statics are proposed: the trace and the eigenvalue statistics. The two differ on the null hypothesis. The first tests the null that there are less than n cointegration vectors ($r \leq n$), while the second tests the hypothesis that there are exactly r cointegrating vectors ($r = n$). A priori, the theory suggests that to price a security, all future cash flows should be discounted at the cost of capital. If this is true, the implied discount factor found by solving the FHERM should be equal to the $PYRN^*$ (as derived in the previous section). For this reason, the resulting cointegrating vector should be $[1, -1]'$. The ADF test is performed assuming no deterministic part in the time polynomial and including two lagged changes of the residuals in the regression (determined by the AIC). The ADF t-statistic on the residuals has a value of -5.49 that is statistically significant well above the 1% level. The null that the two time series are not cointegrated is largely rejected. As expected, the beta of the OLS regression between $E_t(r_m)$ and $PYRN_t^*$ is not statistically different from one. The Johansen procedure comes to the same conclusions. Both the trace and the eigenvalue statistics confirm the presence of one cointegrating relationship between the two variables. Both the statistics are significant at the 1% confidence level. The cointegrating vector, $[1, -1.0027]'$, is not statistically different from what was hypothesized. All the numbers are presented in Table 2.7. These results can be interpreted as evidence in favour of the hypothesis that the implied discount factor equals the promised yield under the risk neutral probability and in support of the validity of the simple models introduced in section two.

The residuals of the above cointegrating relationship are however quite strongly autocorrelated, as shown in Figure 2.7. A simple analysis of the sample autocorrelation function and of the sample partial autocorrelation function suggests the residuals follow an AR(1) model, with ρ equal to 0.8373; deviations from parity are quite persistent and it takes some time for equi-

librium to be restored. Possible explanations are slowly varying changes in the liquidity premium associated with the bond market, a missing transitory variable, or an overreaction to changes in the risk premium. All this creates the perception that an equity is too risky or too safe with respect to corporate bond market. Further investigations about the presence of short-run dynamics altering the equilibrium are presented in the next section. In conclusion, the yield on a comparable risky bond corrected for its seniority and for a constant liquidity premium almost equals the discount rate to be applied to stocks' valuation formula. This creates a strong link between equity and bond markets. An increase in the riskiness of the corporate bond will translate into a decrease of the market price of the share and vice versa. The proposed procedure allows direct inference of this relationship by eliminating any influence due to changes in earnings perspective.

One Step More: Vector Error Correction Model

In the previous section, the existence of a long run equilibrium level between the implied discount factor and the $PYRN_t^*$ was confirmed. In this section, the analysis is further extended by introducing short term dynamics into the model. An appealing procedure allowing this is the Vector Error Correction Model (VECM). This class of models essentially adds an error correction term to a simple VAR model. The advantage of doing this is that both the long-run and the short-run dynamics are considered. VECM model became popular after the work of Engel and Granger (1987). The error correction term is defined as the residuals of a cointegrating relationship and it can be formally expressed as:

$$\epsilon_t = y_t - \beta x_t \quad (2.5.5)$$

where the β is the cointegrating coefficient of the regression between two cointegrated variables. From the previous section, a unique cointegrating

vector was identified. The resulting VECM is thus defined as:

$$\begin{bmatrix} \Delta E_t(r) \\ \Delta PYRN_t^* \end{bmatrix} = \begin{bmatrix} c_1 \\ c_2 \end{bmatrix} + A_1 \begin{bmatrix} \Delta E_{t-1}(r) \\ \Delta PYRN_{t-1}^* \end{bmatrix} + \dots + A_{p-1} \begin{bmatrix} \Delta E_{t-p+1}(r) \\ \Delta PYRN_{t-p+1}^* \end{bmatrix} + \eta \epsilon_{t-1} + \mu_t \quad (2.5.6)$$

where β is the long-run coefficient,

$$A_l = \begin{bmatrix} A_{l,1,1} & A_{l,1,2} \\ A_{l,2,1} & A_{l,2,2} \end{bmatrix}, \eta = \begin{bmatrix} \eta_1 \\ \eta_2 \end{bmatrix}$$

are matrices of short-run coefficients, and

$$\epsilon_t = E_t(r) - \beta PYRN_t^*$$

is the error correction term which can be interpreted as a disequilibrium factor. If it is different from zero, the system is out of equilibrium; if η is negative, the error will be corrected and the system will tend to return to its long run equilibrium.

$$\begin{aligned} \Delta E_t(r) &= E_t(r) - E_{t-1}(r) \\ \Delta PYRN_t^* &= PYRN_t^* - PYRN_{t-1}^* \end{aligned}$$

are the one month changes in the discount rate and in the promised yield respectively and

$$\mu_t = \begin{bmatrix} \mu_{1,t} \\ \mu_{2,t} \end{bmatrix}$$

are i.i.d noise terms with zero mean. The optimal number of lagged variable can be determined as in a VAR model. The most used criteria are the Aikake information criterion, the Hannan-Quinn Criterion and the Schwarz Criterion. The AIC suggests that the optimal number of lags is two while the other two criteria recommend to use one lag. Considering that none of the parameters associated with the second lag is statistically significant, the number of lagged difference is set to one. According to the theory, the two variables express the same quantity, thus no time trend nor constant term is added to the cointegrating relation.

The output of the model is presented in Table 2.9. The likelihood of an increase in the discount rates in the following month is higher if a positive change is observed in the current month. This variable is also positively influenced by past changes in PYRN*. The error correction term coefficient (η) is negative and statistically significant at the 1% level. The estimate of $\eta = -0.13$ indicates that every period about 13% of the disequilibrium is “corrected”. This mean that when the $E_t(r)$ is above the promised yield by 1%, all other parameters unchanged, it will decrease by 0.13% in the next period. Notice that this driver tends to act in the opposite direction than the one described before. The adjusted r-square of the model is 15.78%. This value is relatively high and implies that next period change in the discount rate can be, at least partially, predicted. Conversely, monthly changes in the PYRN* seem not to be affected by past lagged changes in the implied discount factor nor by the error correction term; both the coefficients are not statistically different from zero; only the coefficient relative to past lagged changes in the variable itself is positive and statistically significant. The adjusted r-square for this model is significantly lower (1.65%), indicating that, in opposition to $\Delta E_t(r)$, $\Delta PYRN_t^*$ cannot be well predicted by the proposed specification. This can be interpreted as evidence that the promised yield is determined exogenously. This is not extremely surprising since PYRN* critically depends only on the default risk of the underlying entity and the overall level of interest rates.

The residuals appear not to be serially correlated. Both the Portmanteau test and the LM test do not reject the null hypothesis of no correlation for all lags up to 12 months. Granger causality Tests (Panel B of Table 2.9) indicate a causality that goes from the promised yield towards the implied discount factor. The null hypothesis that the discount rate does not Granger-cause the PYRN* cannot be rejected (p-value 74%). Instead the null hypothesis that PYRN* does not Granger-cause $E_t(r)$ is clearly rejected by this test (p-value 0%). Granger test also confirms causality between past and next month changes in $E_t(r)$ and between past and next month changes in PYRN*. All this confirms what was previously said.

The dynamics of the model can be analysed through the impulse response

function (IRF). An impulse response refers to the reaction of a given variable in response to a one standard deviation shock in a given variable. A ten period horizon is employed, in order to allow dynamics to work out. The Cholesky ordering used to compute IRF is PYRN*, implied discount rate. Qualitatively similar results are obtained also considering the alternative ordering scheme. Figure 2.9 shows the cumulated effect. A one standard deviation shock approximately corresponds to a 0.3% change in PYRN* and a 0.4% change in $E_t(r)$. Shocks in the discount rate will initially have a positive effect on the variable itself, explained by the positive sort-run $A_{1,1}$ coefficient. Starting from the second month, it begins to be reabsorbed, because of the error correction term. A shock on $E_t(r)$ will suddenly push the system out of equilibrium, but the equilibrium, through continuous adjustments of the $E_t(r)$ and, to a lower extent, the PYRN*, will be restored. For this reason, shocks affecting only the discount factor are transitory (although quite persistent) and in general limited to the discount factor itself. Conversely, shocks in the promised yield will have a deeper impact in the overall system. An impulse in the PYRN* affects in a significant way the $E_t(r)$ for several months. However, most of the action takes place in the first three months and the overall adjustment broadly correspond to the initial shock. This means that an increase of 1% of the PYRN* will cause $E_t(r)$ to broadly increase by 1% over the following three months. The impact on the variable itself, although positive, is quite limited.

We conclude our dynamic analysis of the system by considering the variance decomposition. This technique is useful to determine the amount of information each variable contributes to the other variables. It is possible to determine how much of the forecasted error variance of each variable can be explained by exogenous shocks in the other variable. The same Cholesky ordering as in the IRF analysis is chosen. Different ordering does not alter significantly the output. The time horizon considered is 24 months in order to capture the long-term relationship. Results are summarized in Figure 2.10. The analysis of the figures suggest that the promised yield is the leading variable, being the most exogenous. The variance of PYRN* is almost only due to the variable itself, even over the long horizon. Conversely, the

variance of $E_t(r)$ is at least partially caused by the other variable. The proportion of the variance that is due to PYRN* tends to increase with time. This is consistent with the fact that, in the long-run, those two variables tend to converge.

The stability of the model can be tested recursively. Specifically, the model is re-estimated on the basis of the first τ observations for $\tau = t_1, \dots, t_N$. A plot of the recursive estimate with the associated confidence interval is useful to get information on possible structural break. Figures 2.11 and 2.12 plot the recursive estimate of the parameter of the VECM model; the two panels of Figure 2.11 are the estimates relative to the long run parameters. The estimates remain fairly stable during the all sample periods, with the exception of the beginning of the period, which is due to the limited number of observations. The four panels in Figure 2.12 report the estimates for the short run parameters. Even those estimates appear to be relatively stable, although some instability near the year 2008 can be noticed, probably due to the high uncertainty and the high volatility due to the financial crisis. In any case, based on these statistics, the estimated parameters are fairly stable throughout the entire sample period.

The overall stability of the model can be determined through the recursive eigenvalues and the Tau statistics. The first is a recursive statistic for stability analysis proposed by Hansen & Johansen (1999). The second compares the eigenvalues obtained from the full sample and the eigenvalues estimated from the first t observation only. If the Tau statistics exceeds a given threshold, the stability of the model is rejected. Tau statistic remains well below the critical value during the entire sample periods, as shown in Figure 2.13; the same is also true for the recursive eigenvalues. This statistic remains (except from some instability at the beginning of the sample) fairly stable. Even if some minor activity can be observed around year 2002, no concern on the stability of the system emerges from the analysis of these two statistics.

Determinants of $E_t(r)$ and PYRN

In the previous section, we derived the time series of implied discount rate from analysts' earnings and dividends estimate and current prices and the series of PYRN* from bond market data. In this section, we want to show how those two measures relate to commonly used variables to predict stock returns, such as the difference between long and short term interest rates (*Term*), the difference between yield on BBB and AAA rated bond (*Spread*), the dividend yield (*Div*) and the variance of the stock market (σ^2). The last variable is obtained as the square of the VOX volatility index. *Div* is computed by applying the Hodrick-Prescott filter (power 2) to the monthly time series of CRSP dividend yield in order to reduce its noisiness. From an economic point of view, all these variables are expected to move with the economic cycle. $E_t(r)$ is the discount rate investors apply to discount risky cash flows; the higher the risk, the higher the discount factor. Risk, in general, is higher in periods of low economic activity, since firms may not generate enough cash to be able to fulfil all their obligations. This risk will be particularly high for low quality firms, since they do not usually have big reserves at their disposal. For this reason, *Spread* is expected to increase in bad times. Volatility is a measure of the uncertainty and it is natural to expect it to grow in bad times. For this reason, it is not surprising to observe a positive relationship between $E_t(r)$, *Spread*, *Term* and Volatility. Although not very precise at individual level, the dividend yield may give interesting information on the profitability of the firms at aggregate level. One may in fact expect firms to decrease dividends in periods of low activity and poor earning perspective and consequently, leading to poor expected returns. Since $E_t(r)$ can be interpreted also as the expected return on an equity investment, one expects a positive relationship even between these two variables. A similar reasoning also apply to PYRN*. Since all the variables tend to be highly persistent, to avoid any problem related to spurious regression we have taken first differenced variables, and estimated

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the following regressions.

$$\begin{aligned}\Delta E_t(r) &= \alpha + \beta_1 \Delta Term_t + \beta_2 \Delta Spread_t + \beta_3 \Delta Div_t + \beta_4 \Delta \sigma^2 + \epsilon_t \\ \Delta PYRN_t^* &= \alpha + \beta_1 \Delta Term_t + \beta_2 \Delta Spread_t + \beta_3 \Delta Div_t + \beta_4 \Delta \sigma^2 + \epsilon_t\end{aligned}\tag{2.5.7}$$

Results are presented in Table 2.10. $PYRN^*$ is positively related only with *Term* and *Spread*. All other coefficients are in fact not statistically significant. The proportion of variability that is explained solely by those two variables is around 34%. Thus, $PYRN^*$ depends on the information regarding default spread and the business cycle. $E_t(r)$, in contrast, is statistically related to more variables: only *Term* is not statistically significant (although positive). As expected, $E_t(r)$ is positively related to *Spread*, Volatility and dividend yield. All the numbers are in line with what was said previously. The explanatory power of the model is around 25%. These numbers are consistent with other studies, which found dividend yield, term, and spread to be positively related to expected return. This may suggest $E_t(r)$ to be a readily available proxy for stock expected return, since it relates in a consistent way to variables commonly used in the literature to explain future returns. Furthermore, its computation is relatively easy.

2.6 Implied discount factor and realized market return

A return decomposition: earnings and discount rates

In the following sections, the observed market return will be analysed. In particular, the relationship between market returns, discount factors, and deviations from parity with respect to the cost of capital will be investigated. For this purpose, it is useful to distinguish between the part of returns that is due to changes in the discount factor and the part that is instead due to changes in earnings. In order to simplify the overall analysis, a simplified version of the FHERM is considered. Assuming that ROE is equal to the expected cost of equity and that EPS is due to growth in the first year

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at ROE, the stock market price can be expressed as a perpetuity (see the technical appendix for a more detailed derivation):

$$P_t = \frac{E_t(EPSt_{+1})}{E_t(r)} \iff E_t(r) = \frac{E_t(EPSt_{+1})}{P_t} \quad (2.6.1)$$

Using the definition of the return, the return comprehensive of dividends is:

$$ret_t = \frac{P_t - P_{t-1}}{P_{t-1}} + div_t \quad (2.6.2)$$

where P_t is the price of the security and div_t is the dividend yield at time t . Combining Equations 2.6.1 and 2.6.2 and taking the logarithm, the following relation is derived:

$$\log(1 + ret_t - div_t) = \log \left[\frac{E_t(EPSt_{+1})}{E_{t-1}(EPSt)} \right] + \log \left[\frac{E_{t-1}(r)}{E_t(r)} \right] \quad (2.6.3)$$

The observed market return can be decomposed in two components, one that is due to earnings growth and the other that is due to change in the discount rate. The first component depends on the expectations about future performance of the firm, while the second term depends on changes in the riskiness of the firm and on changes in the general level of interest rates. Next month's expectations for future earnings can be expressed as a combination of two factors:

$$E_t(EPSt_{+1}) = E_{t-1}(EPSt)[1 + E_{t-1}(r)][1 + \xi_t] \quad (2.6.4)$$

where the first factor $[1 + E_{t-1}(r)]$ is the expected gross growth in earnings. This factor comes directly from the assumption that earnings will grow at the same rate as the cost of equity capital. The second factor $[1 + \xi_t]$ is the unexpected growth in earnings, assumed to be i.i.d. and to have zero mean. Substituting Equation 2.6.4 into the first term of Equation 2.6.3, one obtains:

$$\log(1 + ret_t - div_t) = \log[1 + E_{t-1}(r)] + \log \left[\frac{E_{t-1}(r)}{E_t(r)} \right] + \log[1 + \xi_t] \quad (2.6.5)$$

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Returns are divided into three main components. The first is the expected return, which can be interpreted as the return that investors require in order to keep the risky investment. The last two terms can be interpreted as the unexpected part of returns. The second term refers to changes in the discount rate and thus to changes in the riskiness of the firm, while the third refers to unexpected earnings revisions. $E_t(EPSt_{+1})$ is computed in such a way that, given $E_t(r)$ and P_t , the above equation is verified. This procedure is used because $E_t(EPSt_{+1})$ is not directly observable, as it refers to a theoretical perpetuity, long term earning level. However, this measure is strongly correlated with analysts' long term earning expectation.

Summary statistics relative to the proposed decomposition are presented in Table 2.11. The average monthly log return over the period 1986-2009 of the considered portfolio was around 1.02% with a standard deviation of 5.35%. Dividends account for 0.19%, while capital gain accounts for the remaining 0.83%. The biggest part of the observed positive mean in returns comes from the earnings growth, accounting for about 90% (0.76%). Out of this, 90% (or 0.69%) comes from the expected increase in earnings ($\Delta EPSt_t$), and unexpected earnings (namely the part of earnings exceeding the ROE) accounts only for 0.07%. This is consistent with the hypothesis that earnings tend to grow, on average, at the same rate as the equity cost of capital. Changes in the discount factor ($\Delta E_t(r)$) accounts for another 0.07% of the observed average returns. This positive number comes from the fact that the average discount factor has declined over the sample period. The average discount factor has decreased from around 10% in 1986 to around 8% in 2009. This is a consequence of the reduction of US long term interest rates. However, this effect was partly compensated by the lowering in the credit quality of the stocks composing the index. Considering an average duration implied by the pricing formula of 11.7, this decline in the cost of equity capital roughly corresponds to a positive cumulative return of 23.4%, which is approximately equal to the 0.07% on a monthly basis reported in the table.

Although accounting for only a small proportion of the expected return, changes in the discount factor account for roughly 80% of the observed variance of returns, with only 20% due to revisions in earnings. The variance

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attributable to $\Delta E_t(r)$ is 0.2079% (corresponding to a standard deviation of 4.56%) while the variance attributable to ΔEPS is 0.0313% (standard deviation 1.77%). This means that the biggest part of monthly price movements are due to changes in the perception of the riskiness of the equity investment, and only a relative tiny fraction to fundamentals. This is in agreement with the excess volatility concept introduced by Shiller (1981), in which the volatility of stock is 5-10 times higher than what would be expected if all the uncertainty comes from future dividends.

The positive correlation (0.28) between $\Delta E_t(r)$ and unexpected ΔEPS is noteworthy. It indicates that negative (positive) surprises in aggregate earnings are often associated with an increase (decrease) in the perceived riskiness of equity. Finally, the correlation between unexpected and expected ΔEPS is negative (-0.24), indicating that when the expectation for future growth is relatively high (or low), the probability of having a negative surprise increases (decreases). This may be the consequence of investors' over-optimism (over-pessimism) about the real growing opportunity of the economy. Returns without dividends are, not surprisingly, highly correlated with changes in the discount rate (0.95) and with unexpected earnings growth. This shows that stock price movements are mainly a consequence of changes in the risk aversion and of surprises in earnings announcements. The dividends correlate with expected ΔEPS the most, as the dividends are mainly determined in advance according to earnings forecasts.

The sensitivity of returns to changes in the discount rate can be, similarly to the bond market, approximated by the duration. Assuming prices are determined by the previously introduced perpetuity (Equation 2.6.1), and taking the first derivatives of P with respect to $E_t(r)$ and dividing by P , we derive:

$$D = \frac{\delta P}{\delta E_t(r)} \frac{1}{P} = -\frac{1}{E_t(r)} \quad (2.6.6)$$

An interesting feature of this specification is that the duration does not depend on the level of earnings. If one wants to have a better approximation, the convexity must also be taken into consideration. The convexity is defined

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as:

$$C = \frac{\delta^2 P}{\delta E_t(r)^2} \frac{1}{P} = \frac{2}{E_t(r)^2} \quad (2.6.7)$$

Taking a second order Taylor expansion, returns can thus be approximated by:

$$\tilde{r}_t(E_t(r)) = -D\Delta E_t(r) + \frac{1}{2}C(\Delta E_t(r))^2 \quad (2.6.8)$$

Considering an average $E_t(r)$ of 8.76%, a 1% positive shock in the discount rate translates into a negative stock return of 10.27%. This simple approximation is useful to explain why return volatility seems to be mainly attributable to shock in the discount rate.

Earnings and implied discount rate

Using the relation derived in Equation 2.6.3, monthly changes in the earnings estimates can be derived for individual stocks. The cross-sectional average is reported in Figure 2.6. The existence of a link between changes in the earnings forecasts and changes in the implied discount rate for the individual time series, can be verified by means of the following regressions:

$$\left. \begin{aligned} \log\left(\frac{EPS_{i,t}}{EPS_{i,t-1}}\right) - \frac{1}{12}\log(1 + E_{t-1}(r_i)) &= \alpha + \beta \log\left(\frac{E_t(r_i)}{E_{t-1}(r_i)}\right) \\ \log\left(\frac{E_t(r_i)}{E_{t-1}(r_i)}\right) + \frac{1}{12}\log(1 + E_{t-1}(r_i)) &= \alpha + \beta \log\left(\frac{EPS_{i,t}}{EPS_{i,t-1}}\right) \end{aligned} \right\} \quad (2.6.9)$$

Estimates are performed by FGLS using panel regression; the results are presented in Table 2.12. The two variables appear quite strongly correlated as indicated by the relatively high R^2 statistics. The common intercept is not statistically different from zero, indicating that the positive drift in the changes in earnings estimate is captured by the term $\log(1 + E_{t-1}(r_i))$. Thus, earnings grow in expectation at the cost of equity capital, in agreement with the assumption of the FHERM stating that in the long run $E_t(r_i) = ROE_{t,i}$, and with the return decomposition presented in Table 2.11, for the aggregate case.

The β estimates indicate a positive relation between $\log\left(\frac{EPS_{i,t}}{EPS_{i,t-1}}\right)$ and

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$\log \left(\frac{E_t(r_i)}{E_{t-1}(r_i)} \right)$. Thus, a decrease in earnings forecasts will accompany a decrease in the expected return for equity capital. As a consequence, the two forces will partly offset each other and thus the impact on returns will be lower. This findings is in contrast with what was found at the aggregate level, in which the two variables were negatively correlated (see Table 2.13).

Return predictability

This section investigates the predictability of returns. More particularly, we assess if there is any relationship between the return during the following months and the current disequilibrium between the implied discount factor and $PYRN^*$, which is the residuals of the cointegration relationship introduced in section two ($\epsilon_t = E_t(r) - PYRN_t^*$).

This issue is introduced by a quick graphical inspection of the behaviour of ϵ_t in correspondence to the five biggest drops in the S&P500 index and of the three recessions as defined by the NBER over the years 1986-2009. The data is plotted in Figure 2.14. The first panel plots the time series of the residuals of the cointegration, while the second reports the log of the level of the S&P500 index. The vertical green lines identify the NBER recessions while the red lines indicate the five most severe monthly drawbacks of the index. During the first phase of the downturn preceding the crisis of the nineties, the ϵ_t becomes positive, suggesting that the market was driven too low. A support for this claim is that despite the crisis, which was not terminated officially, the stock market experienced a strong recovery in the valuations.

The picture appears completely different during the crisis of 2001; this time ϵ_t became negative. This is a symptom of too high valuations. The relative over-valuation seemed to last for several months despite the strong decline in market prices. Equilibrium was restored only after September 2002, after which the market started to recover.

Before the financial crisis of 2008 and 2009, valuations seemed not to be too high; ϵ_t was in fact near zero. Interestingly, during the crisis and despite the strong decline in market prices, ϵ_t became negative, indicating that the

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prices could still be too high given the strong risk aversion and the severe downgrade revision of earnings perspectives. The situation began to slowly normalize after March 2009.

We conclude this rapid overview with some remarks on the crash of October 1987 and August 1998. On the so called black Monday (the 19th October 1987), the S&P500 lost in a single day more than the 20% of its value. The debate over the causes of the crash lasted for many years, but no clear conclusions were found. Some traders attributed the crash to program trading and to portfolio insurance derivatives; others instead believed that the crash was caused by macroeconomics variable such as disputes in foreign exchange markets and fears of inflation. Some analysts claimed that the cause was as a result of the collapse of the US and European bond markets, which caused interest-sensitive stock groups to start the market draw-down. Without entering into any consideration of the causes, we limit ourselves to notice that in those periods, the implied cost of capital was below the theoretical by more than 2.5%, indicating a possible strong over-valuation of the stock market relative to the bond market. The big drop in the quotation seemed to re-establish the equilibrium, leading ϵ_t near to the zero level. Stock markets took more than a year and a half to reach the pre-crisis level, supporting the view that the market was overvalued.

The August 1998 crash was caused by the deep financial crisis in Russia, following the Asian crisis and a sharp decline in commodities prices. This instability caused the index to decline more than 10% during that month. Losses were rapidly recovered and, by the end of November, the index was trading at new highs. At that time, ϵ_t was near zero, indicating that equities were not overvalued in comparison to the bond market. The drop was caused by a loss of confidence and a relative increase in risk aversion. After the drop, equity appeared under-valued. This may explain the rapid recovery of the stock market.

This simple analysis of Figure 2.14 suggests a forecasting power of the disequilibrium between the implied cost of equity capitals estimated from prices and analysts forecasts and the promised yield derived from the cost of debt. When this difference is positive, meaning that the earnings are ex-

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cessively discounted, a positive trend in the market in the following months may eventually emerge. Conversely, when the difference is negative, indicating that prices are too high, the market seems not to perform particularly well in the following times. This is also confirmed by the statistically significant negative error correction term found in the VECM analysis of section two. To formally study the assumed predictability, the realized market return (without dividends) is regressed against the residuals of the cointegrating relationship and against the monthly changes in the implied discount rate and in the $PYRN^*$, that is:

$$\begin{aligned} \log(1 + ret_{t+s} - div_{t+s}) = \\ \alpha + \frac{1}{12} \log [1 + E_t(r)] + \beta_1 \epsilon_t + \beta_2 \Delta E_t(r) + \beta_3 \Delta PYRN_t^* + \nu_t \end{aligned} \quad (2.6.10)$$

where ret_{t+s} and div_{t+s} are the monthly return and the dividend yield on the market portfolio s months ahead, respectively.

As a robustness check, some variables commonly used in the literature to predict market returns, the dividend yield (Div_t), the difference between long term and short term interest rates ($Term_t$), the difference between the yield on AAA and BBB rated bonds ($Spread_t$), and the variance of the stock market (σ^2), are added to the previous regression.

$$\begin{aligned} \log(1 + ret_{t+s} - div_{t+s}) = \\ \alpha + \frac{1}{12} \log [1 + E_t(r)] + \beta_1 \epsilon_t + \beta_2 \Delta E_t(r) + \beta_3 \Delta PYRN_t^* \\ + \beta_4 \Delta \sigma_t^2 + \beta_5 \Delta Spread_t + \beta_6 \Delta Term_t + \beta_7 \Delta Div_t + \nu_t \end{aligned} \quad (2.6.11)$$

The results of the above regression are presented in Table 2.15, model 1 refers to the unrestricted regression 2.6.11; neither $Spread$, $Term$ nor Div are significant in predicting returns. For this reason we repeat the regression without considering those variables (Model 2). As expected, the β_1 is positive and highly statistically significant, meaning a deviation of 1% from the long run equilibrium will lead to a 1.51% return adjustment in the following month. A possible explanation for this is that when $\epsilon_t > 0$ the implied discount rate is too high relative to the theoretical cost of capital, the cash

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flows are discounted too much and prices are too low. For this reason, prices are expected to increase in the following months until the equilibrium is re-established. When this variable is taken alone, it can explain around 5% of future return volatility (Model 7). This is consistent with the estimate of the VECM model presented in the previous section, where around 0.13% of current disequilibrium in $E_t(r)$ is corrected in the following month. Considering an average duration of 11.7, this adjustment translates approximately into a 1.52% price change that is close to the value presented here. Short run parameters (β_2 and β_3) are negative and significant at the 99% confidence level. Those variables taken alone (Model 4) are able to explain around 11.43% of next month return volatility, indicating that a negative (positive) change in the discount factor and in the cost of capital will lead to a negative (positive) return in the following month. In model 5 and 6, $\Delta E_t(r)$ and $\Delta PYRN_t^*$ are taken individually; the parameter estimates are similar to the case in which they are considered jointly, but the adjusted R^2 of the model is only 5.79% and 8.79%, indicating that both the variables contain useful, independent information for predicting returns. This is again consistent with our previous VECM analysis. β_4 is positive and statistically significant, meaning that an increase in the volatility will lead to a higher market return next month. Interestingly, when only the variance is taken, it shows that there is no predicting power for next month returns (Model 8). Considering all the statistically significant variables, the explanatory power of the model is 18.26%, quite high for the predictability of returns.

Finally, the alpha is not statistically different from zero for all the specifications considered, indicating that any deterministic component of returns is left. The numbers presented so far suggests that while the β_1 captures a long term reversal in returns, β_2 and β_3 capture a short term continuation. The fact that those effects act in opposite directions helps to explain why the evidence on return predictability is so controversial and why there is little, if any, autocorrelation in observed market return even if $\Delta E_t(r)$ is positively autocorrelated. The correlation between the variables used in the regression is relatively low (except between $\Delta E_t(r)$ and $\Delta \sigma^2$), reducing any concern about collinearity in parameter estimation. The correlation matrix

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is presented in Table 2.14.

In the following, predictability over a longer time horizon is assessed. The same procedure is used as before, but different leads for return are used. The results are presented in Table 2.16. The betas remain positive and statistically significant at the 1% level up to the three months horizon, and up to four months at the 5%. This means that disequilibrium takes some time to be corrected. The short term coefficients instead become quickly statistically not significant. At a lead two, only the $PYRN^*$ coefficient is still negative and significant at the 10% level. Starting from lead three, both the coefficients become statistically equal to zero. The explanatory power of the model, not surprisingly, decreases quickly as the number of leads increases. The variability of returns explained by the model quickly decreases from 16.51% at lead one to 6.96% at lead two. At lead three and four the explanatory power of the model is only 2% and 1.67% respectively, and at higher leads the power is practically zero. Although past values of $\Delta E_t(r)$ and $\Delta PYRN^*$ seem to contribute the most in predicting next month returns, ϵ_t continues to remain significant for a longer time.

Out-of-sample and Market performance

In this section, we verify the performance of our model out-of-sample. The regression in Equation 2.6.10 is re-estimated every month in order to consider only the information available to the investor. On the basis of those estimates, predictions for next month's excess return are made:

$$\begin{aligned} & \log(1 + ret_{t+1} - div_{t+1}) - \log(1 + rf_{t+1}) = \\ & \hat{\alpha} + \frac{1}{12} \log[1 + E_t(r)] + \hat{\beta}_1 \epsilon_t + \hat{\beta}_2 \Delta E_t(r) + \hat{\beta}_3 \Delta PYRN_t^* - \log(1 + rf_t) \end{aligned} \quad (2.6.12)$$

Finally, we compare them to the realized market excess return. The first 5 years of data are used to estimate the first set of parameters. In Table 2.17 the root mean square error (RMSE), the mean absolute error (MAE) and the R^2 of the in-sample (IS) and the out-of-sample model (OOS) are reported. Not

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surprisingly, OOS presents higher RMSE and MAE and lower R^2 compared to IS. However, one still observes a relatively high value of the R^2 (11.82%), and both RMSE and MAE are significantly smaller than the ones obtained with a constant equity premium. This shows that the proposed model for forecasting returns holds well even out-of-sample, meaning that an investor can practically exploit it for real time trading. In Table 2.18, one proposes a trading strategy trying to exploit this predictability. The strategy consists in buying the market index when the forecasted return (from Equation 2.6.12) is higher than the implied discount rate:

$$\log(1 + ret_{t+1} - div_{t+1}) - \frac{1}{12} \log[1 + E_t(r)] > 0 \quad (2.6.13)$$

and going short otherwise. The monthly excess return (over the 3-month T-bill) was 1.49%, with a standard deviation of 4.95%, resulting in a Sharpe Ratio of 0.30. The performance of this strategy is sensibly higher than the simple buy and hold, which yielded an average monthly return of only 0.66% with a slightly higher standard deviation (5.13%). The cumulative excess return of such a strategy is presented in Figure 2.15. The numbers refer to cumulated excess return without reinvestment. As the figure shows, both the in- and the out-of-sample strategies outperform for all of the sample period the naive buy-and-hold strategy. Furthermore, there is not a big difference between the in- and out-of-sample.

An alternative trading strategy based solely on the difference between $E_t(r)$ and $PYRN^*$ is also proposed. The advantage of this setting is that no estimation or regression is needed to implement it. The strategy consists of buying a fund that replicates the index when $E_t(r) - PYRN_t^*$ is above a given threshold C : $\epsilon_{t-1} > C$ (Strategy 1). The performance of this strategy will be compared with the return on three alternatives: first, simple buy and hold strategy (Alternative 1); second, going long in the index when $\epsilon_{t-1} < -C$ (Alternative 2); and third, buying when $-C < \epsilon_{t-1} < C$ (Alternative 3). All the positions will be kept as long as the corresponding initial enter conditions are satisfied. Three different values for C are tested: $C = 0$; $C = 0.5\%$ and $C = 1\%$. Results of the above variants are presented in table 2.19. “Strategy

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1” presents the highest return and the lowest volatility, for any choice of the threshold parameter C . Conversely “Alternative 2” offers the worst return and the highest standard deviation, while the performance of “Alternative 3” is comparable to the buy and hold strategy. Buying the stock market index when the $\epsilon_{t-1} > C$ would have provided a monthly positive excess return (over the 3-month T-Bill) of 1.44% with a volatility of 4.37%. The resulting Sharpe ratio, 0.32, is considerably higher than the one of the buy and hold strategy (0.16). During the period 1986-2009, positions will be kept for a total of 165 months over 287. The opposite strategy, that is buy when $\epsilon_{t-1} < -C$ instead, would have yielded no excess return with a considerably higher volatility (6.17%), with considerably low risk-reward ratio. Better risk-rewards ratio can be obtained by increasing the threshold level C . Setting it to 0.5% the monthly excess return would have been equal to 2.31%, with a standard deviation of only 3.86%, resulting in a Sharpe ratio of 0.59 that is more than three times larger than the one corresponding to the naive buy and hold alternative. Obviously, the trading opportunities are sensibly less, only in 67 months were trading conditions satisfied. Buying when $\epsilon_{t-1} < -0.5\%$ would not have been a good idea since it would have provided a negative excess return of 0.81% monthly, with a substantial higher volatility of 7.44%. At all other times, the average excess return would have been 0.7% with a standard deviation of 4.7%. This performance is practically equivalent to the buy and hold strategy. However, the best risk-reward ratio can be attained by moving the entry level even higher. Imposing C to be 1% would have provided an excess return of 2.7% with a volatility of only 3.25%. The resulting Sharpe ratio is 0.82, which is more than five times larger than the benchmark. Trading opportunities were however very few, only 17 months. The opposite strategy would have provided a negative excess return of 0.9% with 7.24% standard deviation.

To conclude the analysis, a formal test to check if the different alternatives provide statistically different performances is introduced. To test the null that the average return of two strategies is equal the following statistic can

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be used:

$$t = \frac{\bar{r}_1 - \bar{r}_2}{\sqrt{\frac{\sigma_1^2}{T_1} + \frac{\sigma_2^2}{T_2}}} \quad (2.6.14)$$

where \bar{r}_1 and \bar{r}_2 are the average return of the two strategies, σ_1^2 and σ_2^2 are the corresponding variances and T_1 and T_2 are the number of observations for the two groups. The t-statistics will be compared with the critical value of the student-t distribution with $T_1 + T_2 - 2$ degrees of freedom. To test the null that the two Sharpe ratios are equal, the following t-statistics is instead proposed:

$$t = \frac{\hat{S}R_1 - \hat{S}R_2}{\sqrt{\frac{1 + \frac{1}{2}\hat{S}R_1^2}{T_1} + \frac{1 + \frac{1}{2}\hat{S}R_2^2}{T_2}}} \quad (2.6.15)$$

where $\hat{S}R_1$ and $\hat{S}R_2$ are the estimated Sharpe ratios for the two strategies, respectively. The degrees of freedom are the number of independent estimates of variance on which mean square error (MSE) is based. This is equal to $(T_1 - 1) + (T_2 - 1)$, where T_1 and T_2 are the sample size of the two groups, respectively.

Results relative to the above t-test are reported in Table 2.20. The null that the first strategy performs equally better than “Alternative 2” is in general largely rejected by both tests. All p-values for the null that the two Sharpe ratios are equal, as well as the p-values relative to the null that the average returns are equals are all below the 1% probability. The null that the average return of “Strategy 1” is equal to the average return of the buy and hold strategy in favour of the alternative that it is larger is rejected at the 10% level, if $C = 0$, and at 5%, for the others cases. The null hypothesis that “Alternative 2” performs equally well as the benchmark against the alternative that it performs worse is rejected at the 10% level for $C \leq 0.5\%$. The hypothesis of equal Sharpe ratios between “Strategy 1” and “Alternative 3” as well as between “Alternative 2” and “Alternative 3” are largely rejected for any threshold level C . In other words, a strategy based on the relative disequilibrium between the implied discount rate and the PYRN* is able to

statistically perform better than a naive passive strategy.

To summarize, we have provided evidence that previous changes in discount rate cost of equity capital and the “disequilibrium” between the level of those two variables are useful in predicting returns. A simple trading strategy based solely on the last term is able to produce significant superior performance than a naive buy and hold strategy.

2.7 Conclusions

In this paper, two different methodologies to estimate the cost of equity capital have been proposed. The first relies on the determination of the implied discount factor $[E_t(r)]$ by equating the stock market price with the firm’s intrinsic value obtained through an equity valuation model. $E_t(r)$ can be interpreted as the implied expected return (IER). The second, instead, estimates the promised yield under the risk neutral probability (PYRN*) starting from the credit spread on the bond market. PYRN* can be interpreted as the required expected return (RER). We showed that those two variables are related by a one to one relationship. This means that in the long run the two rates move together and are equivalent, consistent with the hypothesis that over the long horizon all investors share the same expectations. The average implied discount factor was around 8.76% during the period 1986-2009; the risk premium over the 3-month T-bill rate was instead around 4.4%, with a minimum of 1.84% in 2007 and a maximum of 11.86% in 2009. Both $E_t(r)$ and PYRN* relate in a consistent way with commonly used variables to explain future returns, such as spread, term and dividend yield.

We have also provided a subdivision of the realized returns (without dividends) into three main components: the expected part (that equals the $E_t(r)$), the unexpected part due to change in the implied cost of equity, and the unexpected part due to abnormal earnings (namely the growth in earnings exceeding the $E_t(r)$). According to this scheme, most of the variability observed in market returns comes from changes in the implied discount factor, accounting for more than 80% of realized variance. The positive average

2.7. CONCLUSIONS

observed in the market returns comes mainly from the growth of the firm (assumed to be equal to $[1 + E_t(r)]$), accounting for around 83% of the monthly average market return. The remaining 17% is equally explained by the downward trend in the $E_t(r)$ and by abnormal earnings. This indicates $E_t(r)$ to be a good proxy for the expected return.

In the last part, we have shown, using a vector error correction model, that changes in the implied discount factor are somewhat predictable, considering past changes in the variable itself, past changes in the PYRN* and the level of the “disequilibrium” between this two variables. Conversely, the PYRN* is less predictable and depends substantially only on its own past changes. This predictability translates also into the returns. In fact, about 16% of variability in observed market returns can be explained by the same factor that explains the implied discount factor. The predictability survive even out-of-sample. Both a simple trading strategy exploiting just the deviations from the parity between $E_t(r)$ and PYRN* and a more complex one that considers also past changes in $E_t(r)$ and PYRN* would have provided superior risk-reward ratio than a naive passive strategy.

2.8 Technical Appendix

The Finite Horizon Expected return Model (FEHRM), Gordon and Gordon (1997)

By definition, the expected return on any securities is given by the expected dividend $E(DPS_1)$ plus the expected price appreciation $[E(P_1) - P_0]$ divided by the initial price P_0 :

$$E(r) = \frac{E(DPS_1) + [E(P_1) - P_0]}{P_0} \quad (2.8.1)$$

Rearranging the terms of the previous equation, today's stock price can be expressed as:

$$P_0 = \frac{E(DPS_1) + E(P_1)}{1 + E(r)} \quad (2.8.2)$$

Similarly, the next period stock price is given by:

$$P_1 = \frac{E(DPS_2) + E(P_2)}{1 + E(r)} \quad (2.8.3)$$

Substituting Equation 2.8.3 into Equation 2.8.2, one obtains:

$$P_0 = \frac{E(DPS_1)}{1 + E(r)} + \frac{E(DPS_2) + E(P_2)}{[1 + E(r)]^2} \quad (2.8.4)$$

Reiterating infinitely, the preceding reasoning gives the dividend discount model (DDM) of stock prices:

$$P_0 = \sum_{\tau=1}^{\infty} \frac{E(DPS_{\tau})}{[1 + E(r)]^{\tau}} \quad (2.8.5)$$

This equation states that the stock price P_0 should be equal to the present value of all expected future dividends. Unfortunately, DDM is not practically implemented because it requires dividend forecasts for every period into the future. Some simplifying assumptions need to be made. If a constant rate of growth g in dividends for all time is assumed, the Equation 2.8.5 can be

simplified as:

$$P_0 = \frac{E(DPS_1)}{E(r) - g} \iff E(r) = \frac{E(DPS_1)}{P_0} + g \quad (2.8.6)$$

A weakness of this model is the assumption of a constant perpetual growth in dividends. Gordon and Gordon (1997) attempt to overcome this weakness. Assuming that earnings are the sole source of funds for equity investment, and dividends are the sole means for distributing funds to investors, they re-specify the previous equation in term of earning per share EPS_{t+1} , earnings retention rate RTR and return on equity ROE .

$$E_t(r) = \frac{E(EPS_{t+1})(1 - RTR)}{P_t} + (ROE \cdot RTR) \quad (2.8.7)$$

The works of Holt (1962) and Pappas (1966) and others have shown that a corporation cannot be expected to have abnormally high or low growth rates forever. For this reason, the expected return that investors require and the return on equity have to be the same in the long run. Under the assumption that ROE is equal to the rate of return that investors require on its shares, the previous formula reduces to:

$$E_t(r) = \frac{E(EPS_{t+1})}{P_t} \iff P_t = \frac{E(EPS_{t+1})}{E(r)} \quad (2.8.8)$$

Gordon and Gordon (1997) considered the case in which abnormal performances can be forecasted up to a finite horizon N . Beyond this time, ROE and $E(r)$ will coincide.

$$E_t(r) = ROE, T > N \quad (2.8.9)$$

Finally, combining Equations 2.8.5, 2.8.8 with condition 2.8.9 the final expression for the FHERM can be written as follow:

$$P_t = \sum_{\tau=1}^N \frac{E_t(DPS_{t+\tau})}{[1 + E_t(r)]^\tau} + \frac{E_t(EPS_{t+N+1})}{E_t(r) [1 + E_t(r)]^N} \quad (2.8.10)$$

Sharpe Ratio t-Test

The statistics of Sharpe ratio are derived from the work of A.W. Lo (2002). Given a sample of returns, the sample estimator for the mean and the variance are given respectively by:

$$\hat{\mu} = \frac{1}{T} \sum_{t=1}^T r_t \quad (2.8.11)$$

and

$$\hat{\sigma}^2 = \frac{1}{T} \sum_{t=1}^T (r_t - \hat{\mu})^2 \quad (2.8.12)$$

A natural estimator of the Sharpe ratio will therefore be:

$$\hat{SR} = \frac{\hat{\mu} - r_f}{\hat{\sigma}} \quad (2.8.13)$$

Assuming returns to be i.i.d. with finite mean and variance, the estimators for the mean (2.8.11) and the variance (2.8.12), due to central limit theorem, are asymptotically normally distributed:

$$\sqrt{T}(\hat{\mu} - \mu) \xrightarrow{a} N\left(0, \frac{\sigma^2}{T}\right) \quad (2.8.14)$$

$$\sqrt{T}(\hat{\sigma}^2 - \sigma^2) \xrightarrow{a} N\left(0, 2\frac{\sigma^4}{T}\right) \quad (2.8.15)$$

The joint distribution of $\hat{\mu}$ and $\hat{\sigma}^2$ can be obtained as follows. Let us denote $\hat{\theta} = (\hat{\mu}, \hat{\sigma}^2)'$ and $\theta = (\mu, \sigma^2)'$ as the corresponding vector of population values. Using the central limit theorem, the asymptotic distribution of $\hat{\theta}$ is:

$$\sqrt{T}(\hat{\theta} - \theta) \xrightarrow{a} N(0, V_\theta) \quad (2.8.16)$$

where

$$V_\theta = \begin{bmatrix} \sigma^2 & 0 \\ 0 & 2\sigma^4 \end{bmatrix} \quad (2.8.17)$$

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The Sharpe ratio can be defined as a function $g(\hat{\theta})$. Its asymptotic distribution can be derived from Taylor's theorem or the so called delta method.

$$\sqrt{T} \left(g(\hat{\theta}) - g(\theta) \right) \xrightarrow{a} N(0, V_g) \quad (2.8.18)$$

where

$$V_g = \frac{\delta g}{\delta \theta} V_{\theta} \frac{\delta g}{\delta \theta'} \quad (2.8.19)$$

Since $g(\cdot)$ is given by equation 2.8.13:

$$\frac{\delta g}{\delta \theta'} = \begin{bmatrix} \frac{1}{\sigma} \\ -\frac{\mu - r_f}{2\sigma^3} \end{bmatrix} \quad (2.8.20)$$

which yields the following asymptotic distribution of SR:

$$\sqrt{T} \left(\hat{SR} - SR \right) \xrightarrow{a} N(0, V_{IID}) \quad (2.8.21)$$

where

$$V_{IID} = 1 + \frac{1}{2} \left(\frac{\mu - r_f}{\sigma} \right)^2 = 1 + \frac{1}{2} SR^2 \quad (2.8.22)$$

The standard error of the SR estimator can thus be computed as:

$$\sigma_{\hat{SR}} = \sqrt{\frac{1 + \frac{1}{2} \hat{SR}^2}{T}} \quad (2.8.23)$$

An obvious choice of the test statistics for the null hypothesis $H_0 : SR_1 - SR_2 = 0$ is the sample difference $(\hat{SR}_1 - \hat{SR}_2)$. In the special case in which the two measures are independent, the variance of this statistics will be:

$$var \left(\hat{SR}_1 - \hat{SR}_2 \right) = \frac{1 + \frac{1}{2} \hat{SR}_1^2}{T_1} + \frac{1 + \frac{1}{2} \hat{SR}_2^2}{T_2} \quad (2.8.24)$$

Therefore, the t-statistics will be given by:

$$t = \frac{\hat{S}R_1 - \hat{S}R_2}{\sqrt{\frac{1 + \frac{1}{2}\hat{S}R_1^2}{T_1} + \frac{1 + \frac{1}{2}\hat{S}R_2^2}{T_2}}} \quad (2.8.25)$$

which follows a student-t distribution with degrees of freedom equal to the number of independent estimates of variance on which the MSE is based. In this case it is equal to $(T_1 - 1) + (T_2 - 1)$, where T_1 is the sample size for the first group and T_2 is the sample size of the second group.

2.9 Tables & Figures

Table 2.1: Market Capitalization Summary Statistics

This table reports the summary statistics relative to market capitalization (at 1st January of every year) of the CRSP database (benchmark) and of the considered sample. #Stocks is the number of stocks composing the sample, Avg. mkt capitalization, 20%, 50% and 80% quantile refer to the average market capitalization of the full sample and of the 20%, 50% and 80% smallest stocks, respectively.

Year	Market Capitalization (millions) Summary statistics									
	# Stocks		Avg mkt capitalization		20 % Quantile		50% Quantile		80 % Quantile	
	Sample	Benchmark	Sample	Benchmark	Sample	Benchmark	Sample	Benchmark	Sample	Benchmark
1986	1266	6531	1244.8	358.6	115.1	8.4	426.5	40.4	1541.1	236.8
1987	1223	6970	1630.8	425.2	130.8	9.4	510.0	43.2	1987.5	257.5
1988	1127	7336	1617.1	369.3	134.9	7.0	510.2	32.3	2036.8	198.4
1989	1147	7152	1791.1	419.8	159.9	7.5	555.8	37.0	2173.9	232.2
1990	1241	6986	1794.9	455.7	128.1	7.0	502.4	36.3	2115.3	239.2
1991	1298	6846	1896.0	474.5	115.9	5.2	458.6	30.2	2009.1	225.6
1992	1328	7005	2355.6	596.4	158.0	9.3	626.3	53.2	2544.9	347.6
1993	1419	7198	2481.2	649.2	171.2	14.2	690.3	69.5	2904.9	385.5
1994	1568	8035	2571.4	685.9	177.6	19.4	728.3	84.2	2929.1	432.6
1995	1612	8412	2395.2	635.6	163.7	17.8	624.4	74.8	2694.0	382.3
1996	1605	8712	3243.2	845.9	198.0	21.2	775.2	95.6	3336.9	490.8
1997	1607	9261	4072.3	988.7	251.2	25.1	887.7	108.2	3865.1	552.5
1998	1611	9312	5131.4	1220.5	290.2	26.0	1061.9	120.5	4747.2	656.0
1999	1691	8885	6199.3	1617.9	203.1	25.7	868.2	114.0	4620.3	671.9
2000	1721	8618	6803.1	2044.2	182.0	31.7	778.6	146.6	4489.9	885.0
2001	1731	8298	7075.7	2069.5	176.5	25.8	905.8	132.0	4854.1	857.7
2002	1697	7620	6406.2	1889.4	245.1	26.0	976.3	138.8	4844.1	853.5
2003	1742	7208	4814.9	1580.9	207.4	25.1	821.5	129.3	3932.0	792.7
2004	1851	6923	6156.2	2293.8	374.2	56.5	1206.2	263.6	5214.3	1341.5
2005	1885	6919	6429.2	2455.2	415.2	65.2	1398.0	294.0	5804.5	1498.1
2006	1938	6901	7161.0	2780.0	483.3	76.5	1617.8	344.9	6791.6	1739.8
2007	1974	7051	7846.7	3014.0	479.6	80.2	1684.8	365.6	7431.6	1897.1
2008	1897	7095	7819.4	2822.8	371.1	61.4	1549.7	290.5	7257.6	1634.4
2009	2122	6816	4412.4	1718.8	155.8	28.0	799.3	153.6	3497.5	959.6
Average	1595.88	7587.08	4306.22	1350.49	228.65	28.32	873.49	133.27	3900.99	740.34

2.9. TABLES & FIGURES

Table 2.2:

Implied Discount Factor: Summary Statistics (1986-2009)

This table reports the summary statistics relative to implied discount factor at 1st January of every year. The individual stock implied discount factor (IDF) $E_t(r_i)$ is derived from the FHERM. All the statistics are computed on the cross-sectional of individual observations. The implied risk premium (IRP) is computed as the difference between the cross-sectional mean of the individual IDF and the 3-month US T-Bill rate. All rates considered are expressed in a yearly basis.

Implied discount factor summary statistics (as 31 January)								
Year	T-bill	Mean	IRP	Median	Std.	Skew.	Kurt.	No. Stocks
1986	0.0697	0.1007	0.0310	0.0948	0.0440	1.9772	10.9330	1266
1987	0.0567	0.0888	0.0321	0.0823	0.0402	2.0646	10.4560	1223
1988	0.0568	0.1110	0.0542	0.1029	0.0481	1.9832	11.0580	1127
1989	0.081	0.1047	0.0237	0.0982	0.0431	2.1572	12.3480	1147
1990	0.0755	0.1101	0.0346	0.1021	0.0459	1.4930	7.0563	1241
1991	0.0644	0.1075	0.0431	0.0991	0.0468	1.8949	10.5880	1298
1992	0.0388	0.0878	0.0490	0.0828	0.0383	2.2861	15.3750	1328
1993	0.0308	0.0871	0.0563	0.0806	0.0364	2.4499	15.0000	1419
1994	0.0301	0.0838	0.0537	0.0786	0.0350	2.7232	18.5160	1568
1995	0.0553	0.0972	0.0419	0.0895	0.0397	2.2367	13.3610	1612
1996	0.0496	0.0880	0.0384	0.0828	0.0372	2.5162	16.1830	1605
1997	0.0507	0.0803	0.0296	0.0771	0.0327	3.0845	22.1110	1607
1998	0.0522	0.0767	0.0245	0.0714	0.0354	3.3597	22.5530	1611
1999	0.0437	0.0814	0.0377	0.0756	0.0423	2.2538	12.8740	1691
2000	0.0517	0.0935	0.0418	0.0885	0.0494	1.2573	6.8615	1721
2001	0.0573	0.0844	0.0271	0.0780	0.0467	2.2336	12.7080	1731
2002	0.0171	0.0711	0.0540	0.0673	0.0350	2.0083	12.9550	1697
2003	0.012	0.0857	0.0737	0.0806	0.0399	1.9342	11.2710	1742
2004	0.0093	0.0661	0.0568	0.0648	0.0272	1.8406	13.6070	1851
2005	0.0218	0.0686	0.0468	0.0667	0.0235	1.3748	9.1925	1885
2006	0.0399	0.0673	0.0274	0.0658	0.0247	1.8539	14.0360	1938
2007	0.0489	0.0673	0.0184	0.0652	0.0230	2.3837	24.3980	1974
2008	0.0329	0.0807	0.0478	0.0776	0.0292	2.0550	15.5870	1897
2009	0.0011	0.1137	0.1126	0.1025	0.0562	1.5306	7.0488	2122
Average	0.0436	0.0876	0.0440	0.0823	0.0383	2.1230	13.5865	1595.875

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Table 2.3: Market Model: OLS (1986- 2009)

This table reports the OLS estimate of the regression between the cross sectional arithmetic average of the returns (including dividends) of the stocks composing the sample (\bar{r}_i) and five commonly used benchmark returns (\bar{r}_m). $\bar{r}_i - r_f = \alpha + \beta(\bar{r}_m - r_f) + \epsilon_i$

r_f is the yield on the 3-month US T- Bill. Every column reports the results relative to the five different benchmark used: vwretld and vwretx refer to the CRSP value weighted index with and without dividends, respectively, ewretld and ewretx refer to CRSP equally weighted index (with and without dividends) and sprtn refers to the return on the S&P500 index. All the returns are expressed on a monthly basis.

Standard errors are reported in parenthesis.

*, **, *** indicate significance at 10%, 5% and 1%, respectively.

Index	vwretld	vwretx	ewretld	ewretx	sprtn
α	0.0026 (0.0012)	0.0047 (0.0012)	0.0022 (0.0012)	0.0035 (0.0012)	0.0046 (0.0014)
β	1.0467 (0.0255)	1.0467 (0.0254)	0.8637 (0.0212)	0.8622 (0.0213)	1.0339 (0.0313)
R^2	0.8546	0.8549	0.8523	0.8514	0.7915
DW	1.5749	1.5897	1.8941	1.9011	1.7133
N. obs.	288	288	288	288	288

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Table 2.4: Credit Rating Frequency: 1986-2009

This table reports the average frequency and the average number of firms having a given rating during the period 1986-2009. Those statistics are computed as time series arithmetical averages. The Score is an increasing numerical value that uniquely identifies the credit rating of a company.

Rating	Score	Freq.	No. Firms (N)	Rating	Score	Freq.	No. Firms
AAA	1	3.47%	26.83	BB-	13	8.31%	71.63
AA+	2	1.59%	12.29	B+	14	4.71%	37.50
AA	3	3.53%	23.42	B	15	0.87%	7.46
AA-	4	9.16%	70.63	B-	16	0.71%	5.88
A+	5	7.39%	54.38	CCC+	17	1.38%	11.79
A	6	4.74%	33.00	CCC	18	0.36%	2.92
A-	7	5.37%	40.50	CCC-	19	0.28%	2.17
BBB+	8	22.47%	187.92	CC	20	0.11%	1.04
BBB	9	6.72%	52.08	C	21	0.00%	0.00
BBB-	10	11.05%	93.88	SD	22	0.03%	0.33
BB+	11	4.19%	35.13	D	23	0.85%	6.79
BB	12	2.72%	21.38				

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Table 2.5: Market Credit Rating: Summary Statistics

This table reports the summary statistics relative to the cross-sectional average of the credit score for the period 1986-2009. The numbers refer to January of every year.

Year	Mean	Median	Std.	Skew.	Kurt.	N. Obs.
1986	7.33	6	3.88	0.87	3.86	499
1987	7.71	7	4.23	0.91	3.94	541
1988	7.64	7	4.12	0.89	4.22	556
1989	7.64	8	4.10	0.88	4.24	569
1990	7.73	8	3.97	0.75	3.93	593
1991	7.86	8	3.98	0.70	3.86	620
1992	7.75	8	3.80	0.66	3.93	647
1993	7.76	8	3.71	0.58	3.76	673
1994	7.92	8	3.67	0.48	3.64	737
1995	8.08	8	3.68	0.50	3.83	763
1996	8.11	8	3.74	0.56	3.97	771
1997	8.21	8	3.75	0.56	4.06	802
1998	8.18	8	3.75	0.58	4.31	815
1999	8.33	8	3.81	0.58	4.39	874
2000	8.59	8	3.95	0.69	4.57	874
2001	8.77	8	3.91	0.59	4.36	883
2002	8.89	8	3.94	0.66	4.46	883
2003	9.03	8	3.79	0.44	4.05	901
2004	9.27	9	3.78	0.34	3.83	969
2005	9.43	9	3.75	0.28	3.79	1005
2006	9.39	9	3.68	0.26	3.76	1032
2007	9.43	9	3.71	0.24	3.70	1037
2008	9.49	9	3.73	0.29	3.79	1031
2009	9.63	9	3.82	0.33	3.92	1099

Table 2.6: Unit Root Tests (1986-2009)

This table reports different test statistics for the presence of a unit root. Panel A tests for unit roots in the cross sectional average of implied discount factors ($E_t(r_m)$), Panel B in the PYRN*, Panel C in the square CBOE volatility index, and finally, Panel D in the implied risk premium defined as the difference between $E_t(r_m)$ and the 10-year US T-note rate.

The following tests are performed:

Augmented-Dickey-Fuller test statistic (ADF), Phillips-Perron test statistic (PP)

Estimated regression: $y_t = \alpha + \rho y_{t-1} + u_t$

True process: $y_t = y_{t-1} + u_t$, $u_t \sim \mathcal{N}(0, \sigma^2)$

Kwiatkowski-Phillips-Schmidt-Shin test statistic (KPSS) (null the time series is stationary)

Panel A.1: Implied Discount rate $E_t(r_m)$ (ADF)						Panel B.1: PYRN* (ADF)					
Level		First difference				Level		First difference			
N.lags	T-stat	Prob.	N.lags	T-stat	Prob.	N.lags	T-stat	Prob.	N.lags	T-stat	Prob.
2	-2.9251	0.04	1	-12.5930	0.00	1	-2.7261	0.07	0	-9.0464	0.00
Panel A.2: Implied Discount rate $E_t(r_m)$ (PP)						Panel B.2: PYRN* (PP)					
Bandwidth	T-stat	Prob.	Bandwidth	T-stat	Prob.	Bandwidth	T-stat	Prob.	Bandwidth	T-stat	Prob.
8	-2.9057	0.05	16	-13.8769	0.00	6	-2.5187	0.11	0	-12.1905	0.00
Panel A.3: Implied Discount rate $E_t(r_m)$ (KPSS)						Panel B.3: PYRN* (KPSS)					
Bandwidth	LM-Stat.	1%level	Bandwidth	LM-Stat.	1%level	Bandwidth	LM-Stat.	1%level	Bandwidth	LM-Stat.	1%level
14	1.1708	0.74	14	0.0398	0.74	14	1.0336	0.74	5	0.0530	0.74
Panel C.1: Variance (ADF)						Panel D.1: Implied Risk premium (ADF)					
Level		First difference				Level		First difference			
N.lags	T-stat	Prob.	N.lags	T-stat	Prob.	N.lags	T-stat	Prob.	N.lags	T-stat	Prob.
0	-6.1478	0.00	1	-13.1313	0.00	1	-4.12461	0.00	0	-13.7559	0.00
Panel C.2: Variance (PP)						Panel D.2: Implied Risk premium (PP)					
Bandwidth	Tstat	Prob.	Bandwidth	Tstat	Prob.	Bandwidth	T-stat	Prob.	Bandwidth	T-stat	Prob.
4	-5.9937	0.00	24	-26.0836	0.00	3	-3.3963	0.01	8	-13.9817	0.00
Panel C.3: Variance (KPSS)						Panel D.3: Implied Risk premium (KPSS)					
Bandwidth	LM-Stat.	1%level	Bandwidth	LM-Stat.	1%level	Bandwidth	LM-Stat.	1%level	Bandwidth	LM-Stat.	1%level
12	0.2109	0.74	26	0.0488	0.74	14	0.9754	0.74	7	0.0316	0.74

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Table 2.7:
*PYRN** and Implied Discount Factor: Cointegration Analysis

This table reports the estimate of the cointegration between the *PYRN** and the implied discount factor $E_t(r_m)$. Panel A reports the results relative to the Johansen Maximum Likelihood methodology, while panel B refers to the Engle-Granger procedure.

*, **, *** mean significant at the 10%, 5% and 1%, respectively.

Standard errors are reported in parenthesis.

Panel A: Johansen Cointegration Test				
No deterministic trend, optimal number of lags: 2				
Unrestricted Cointegration Rank Test (Trace)				
No.of CE(s)	Eigenvalue	Stat.	Crit. Value	Prob.
None	0.0706***	21.4985	12.3209	0.00
At most 1	0.0025	0.7060	4.1299	0.46
Unrestricted Cointegration Rank Test (Maximum Eigenvalue)				
No.of CE(s)	Eigenvalue	Stat.	Crit. Value	Prob.
None	0.0706***	20.7925	11.2248	0.00
At most 1	0.0025	0.7060	4.1299	0.46
1 Cointegrating Equation(s): Log likelihood				2477.969
Normalized cointegrating coeff.			Adjustment coefficients	
DR	PYRN*		DR	PYRN*
1	-1.0027***		-0.1245***	0.0182
(-)	-(0.0183)		-(0.0309)	-(0.0212)
Panel B: Augmented DF test for cointegration				
No deterministic trend, optimal number of lags: 2				
AR(1)	CADF t-stat.	1% Crit. Value	Beta	t-stat
-0.1720	-5.4395***	-4.4817	0.9942	185.39

Table 2.8: Cointegration Residuals: Var-cov matrix

This table reports the var-cov matrix of the residuals of the following regression:

$$\begin{aligned} PYRN_t^* &= d_{1,t} + A * PYRN_{t-1}^* + \eta_{1,t} \\ E_t(r_m) &= d_{2,t} + B * PYRN_t^* + \eta_{2,t} \end{aligned}$$

	η_1	η_2
η_1	9.33E-06	-3.64E-06
η_2	-3.64E-06	5.77E-05

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Table 2.9: Vector Error Correction Model (VECM)

Panel A reports the estimate of the VECM between monthly changes in the implied discount factor $[\Delta E_t(r_m)]$ and in the $[\Delta PYRN_t^*]$. The error correction term is the residual of the cointegration between $E_t(r_m)$ and $PYRN_t^*$. The number of observations is 285. The considered lag is one month.

*, **, *** mean significant at the 10%, 5% and 1%, respectively.

Panel B reports the estimated Granger probabilities, which refer to the null hypothesis that the variable in the column Granger causes the variable in the row.

Panel A Vector Error Correction Model (1 lag)				
Cointegrating Equation:				
	Coef.	t-stat	Prob.	
$E_{t-1}(r_m)$	1	-	-	
$PYRN^*_{t-1}$	-1.0013***	-58.9722	0.0000	
Equation 1: $\Delta E_t(r_m)$				
	Coef.	t-stat	Prob.	
$\Delta E_{t-1}(r_m)$	0.1781***	3.0916	0.0022	
$\Delta PYRN^*_{t-1}$	0.3056***	3.8572	0.0001	
Error Correction	-0.1300***	-4.4162	0.0000	
Constant	0.0000	-0.1221	0.9029	
Adj. R^2		0.1578		
Sum error ²		0.0000		
Box Q-stat		0.1848		
Equation 2: $\Delta PYRN^*_t$				
	Coef.	t-stat	Prob.	
$\Delta E_{t-1}(r_m)$	-0.0150	-0.3322	0.7400	
$\Delta PYRN^*_{t-1}$	0.1536***	2.4746	0.0139	
Error Correction	0.0003	1.6888	0.0924	
Constant	-0.0001	-0.5658	0.5720	
Adj. R^2		0.0165		
Sum error ²		0.0000		
Box Q-stat		-0.0042		
Panel B Granger Casuality Tests				
	Equation 1: $E_t(r_m)$		Equation 2: $PYRN^*_t$	
	F-Value	Prob.	F-Value	Prob.
$E_t(r_m)$	9.56	0.00	0.11	0.74
$PYRN^*_t$	14.88	0.00	6.12	0.01

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Table 2.10: Determinants of DR and PYRN

Column $E_t(r_m)$ refers to:
 $\Delta E_t(r_m) = \alpha + \beta_1 \Delta Term_t + \beta_2 \Delta Spread_t + \beta_3 \Delta DIV_t + \beta_4 \Delta \sigma_t^2 + \epsilon_t$
Column $PYRN^*$ refers to:
 $\Delta PYRN_t^* = \alpha + \beta_1 \Delta Term_t + \beta_2 \Delta Spread_t + \beta_3 \Delta DIV_t + \beta_4 \Delta \sigma_t^2 + \epsilon_t$
Standard errors are reported in parenthesis.
*, **, *** mean significant at the 10%, 5% and 1%, respectively.

	$E_t(r_m)$		$PYRN^*$	
	Value	Std. error	Value	Std. error
α	0.0000	(0.0002)	-0.0001	(0.0001)
β_1	0.1151**	(0.0702)	0.0922*	(0.0479)
β_2	0.5087**	(0.2204)	1.5169***	(0.1506)
β_3	0.0466***	(0.0067)	0.0043	(0.0046)
β_4	1.7396***	(0.6492)	0.4115	(0.4435)
R^2	0.27		0.35	
Adj. R^2	0.25		0.34	
DW	1.81		2.19	

Table 2.11: Market Return: A Decomposition

This table shows the decomposition of returns in its components. Values in parentheses are the standard deviations while all others values are arithmetical averages. All values are expressed in a monthly basis.

Log Returns	
0.0102 (0.0535)	
Dividends	Capital gain
0.0019 (0.0009)	0.0083 (0.0535)
ΔEPS	
0.0076 (0.0177)	
ΔDR	
0.0007 (0.0456)	
Expected	Unexpected
0.0069 (0.0010)	0.0007 (0.0179)

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Table 2.12: Earnings vs. Implied Discount Rates

Panel A: reports the GLS estimates of the regression:

$$\log\left(\frac{EPS_{i,t}}{EPS_{i,t-1}}\right) - \frac{1}{12}\log(1 + E_{t-1}(r_i)) = \alpha + \beta\log\left(\frac{E_t(r_i)}{E_{t-1}(r_i)}\right)$$

while Panel B of the regression:

$$\log\left(\frac{E_t(r_i)}{E_{t-1}(r_i)}\right) + \frac{1}{12}\log(1 + E_{t-1}(r_i)) = \alpha + \beta\log\left(\frac{EPS_{i,t}}{EPS_{i,t-1}}\right)$$

Method: Pooled EGLS (Cross-section weights) White cross-sectional standard errors & covariance (d.f. corrected)

*, **, *** mean significant at the 10%, 5% and 1%, respectively.

Panel A: GLS estimates (log(DR) vs Earn)				
	Coeff.	Std. Error	t-Stat.	Prob.
α	0.0006	(0.0012)	0.46	0.63
β	0.4690***	(0.0153)	29.56	0
Weighted Statistics				
R^2	0.3789	Mean dependent var.	-0.0014	
$Adj.R^2$	0.3789	S.D. dependent var.	0.1180	
S.E. of regression	0.0930	Sum squared resid.	3434.66	
F-statistic	242253	Durbin-Watson stat.	1.9356	
Prob(F-statistic)	0			
Unweighted Statistics				
R^2	0.4852	Mean dependent var.	-0.0300	
Sum squared resid.	3884.08	Durbin-Watson stat.	1.9112	
Panel B: GLS estimates (log(Earn) vs DR)				
	Coeff.	Std. Error	t-Stat.	Prob.
α	-0.0009	(0.0023)	-0.41	0.69
β	0.8694***	(0.0088)	98.83	0.00
Weighted Statistics				
R^2	0.4822	Mean dependent var.	-0.0023	
$Adj.R^2$	0.4822	S.D. dependent var.	0.1609	
S.E. of regression	0.0930	Sum squared resid.	5326.06	
F-statistic	369842.2	Durbin-Watson stat.	2.048	
Prob(F-statistic)	0			
Unweighted Statistics				
R^2	0.5179	Mean dependent var.	-0.0016	
Sum squared resid.	5332.15	Durbin-Watson stat.	2.0225	

Table 2.13:
Returns Components' Variance, Covariance and Correlation

The considered variables are defined as follows: (Ret) is the market return comprehensive of the dividends, (Div) is the dividend yield, (Capital gain) is the change in stock prices, this is defined as $\log[P_t/P_{t-1}]$. The last term is subdivided in two components: $(-\Delta E_t(r_m))$ that is the change in the implied discount rate, defined as $\log(E_{t-1}(r_m))/E_t(r_m)$, and (ΔEPS) the change in the earnings per share, defined as $\log(EPS_t/EPS_{t-1})$. The last one is again subdivided in two parts: the expected change in earnings (ΔEPS expected) defined as $\log(1 + E_t(r_m))$, and the unexpected one (ΔEPS unexpected) that is defined as the difference [$\Delta EPS - \Delta$ expected]. Panel A reports the estimated correlation coefficients, while panel B reports the variance covariance matrix. All the variables are defined on a monthly basis.

Panel A: Correlation Matrix (logs)							
	Ret	Div	Capital Gain	$-\Delta E_t(r_m)$	ΔEPS	ΔEPS Expected	ΔEPS Unexpected
Ret	1.00	0.10	1.00	0.95	0.58	0.09	0.57
Div	0.10	1.00	0.08	0.13	-0.10	0.58	-0.13
Capital Gain	1.00	0.08	1.00	0.95	0.58	0.08	0.57
$-\Delta E_t(r_m)$	0.95	0.13	0.95	1.00	0.29	0.16	0.28
ΔEPS	0.58	-0.10	0.58	0.29	1.00	-0.18	1.00
ΔEPS Expected	0.09	0.58	0.08	0.16	-0.18	1.00	-0.24
ΔEPS Unexpected	0.57	-0.13	0.57	0.28	1.00	-0.24	1.00

Panel B: Variance-Covariance Matrix							
	Ret	Div	Capital Gain	$-\Delta E_t(r_m)$	ΔEPS	ΔEPS Expected	ΔEPS Unexpected
Ret	0.2864%	0.0005%	0.2865%	0.2318%	0.0547%	0.0005%	0.0542%
Div	0.0005%	0.0001%	0.0004%	0.0005%	-0.0002%	0.0001%	-0.0002%
Capital Gain	0.2865%	0.0004%	0.2867%	0.2317%	0.0550%	0.0004%	0.0545%
$-\Delta E_t(r_m)$	0.2318%	0.0005%	0.2317%	0.2080%	0.0237%	0.0007%	0.0230%
ΔEPS	0.0547%	-0.0002%	0.0550%	0.0237%	0.0312%	-0.0003%	0.0315%
ΔEPS Expected	0.0005%	0.0001%	0.0004%	0.0007%	-0.0003%	0.0001%	-0.0004%
ΔEPS Unexpected	0.0542%	-0.0002%	0.0545%	0.0230%	0.0315%	-0.0004%	0.0320%

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Table 2.14: Correlation Matrix

The table reports the correlation between the change in the implied discount rate ($\Delta E_t(r_m)$), the change in the promised yield ($\Delta PYRN_t^*$), the difference between $\Delta E_t(r_m)$ and $\Delta PYRN_t^*$ (ϵ_t), change in the variance of returns ($\Delta \sigma_t^2$), the difference between the yield on a BBB and a AAA rated bond ($Spread_t$), the difference between the yield on 10-year treasury notes and on 3-month treasury bill ($Term_t$), and the CRSP dividend yield (Div).

	$\Delta E_t(r_m)$	$\Delta PYRN_t^*$	ϵ_t	$\Delta \sigma_t^2$	$Spread_t$	$Term_t$	Div.
$\Delta E_t(r_m)$	1.0000	0.2321	0.1720	0.4615	0.0174	0.0485	-0.1373
$\Delta PYRN_t^*$	0.2321	1.0000	-0.1820	0.2621	0.0506	-0.1050	-0.0465
ϵ_t	0.1720	-0.1820	1.0000	0.0284	-0.3828	-0.2204	-0.0156
$\Delta \sigma_t^2$	0.4615	0.2621	0.0284	1.0000	0.0420	0.0114	-0.0532
$Spread_t$	0.0174	0.0506	-0.3828	0.0420	1.0000	0.2673	0.2208
$Term_t$	0.0485	-0.1050	-0.2204	0.0114	0.2673	1.0000	0.1476
Div.	-0.1373	-0.0465	-0.0156	-0.0532	0.2208	0.1476	1.0000

Table 2.15: Return Predictability (1986-2009)
$$\ln(1 + r_{t+1} - div_{t+1}) = \frac{1}{12} \ln(1 + E_t(r_m)) + \alpha + \beta_1 \epsilon_t + \beta_2 \Delta E_t(r_m) + \beta_3 \Delta PY RN_t^* + \beta_4 \Delta \sigma_t^2 + \beta_5 Spread_t + \beta_6 Term + \beta_7 Div_t + \nu_t$$

The left hand side refers to next month's realized market return without dividends. ϵ_t is the difference between the implied discount factor ($E_t(r_m)$) and the $PY RN_t^*$. The regression refers to monthly returns. Different models differ only on the variables used in the regression. Standard errors are reported in parenthesis. *, **, *** mean significant at the 10%, 5% and 1%, respectively.

	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8
α	0.0005 (0.0029)	0.0004 (0.0029)	0.0005 (0.0029)	0.0005 (0.0030)	0.0010 (0.0031)	0.0006 (0.0030)	0.0014 (0.0031)	0.0012 (0.0032)
β_1	1.6969*** (0.3779)	1.6052*** (0.3669)	1.5895*** (0.3701)				1.5026*** (0.3773)	
β_2	-3.8092*** (0.8024)	-3.8801*** (0.7851)	-3.0694*** (0.7186)	-2.3759*** (0.7215)	-3.1079*** (0.7238)			
β_3	-2.9654*** (1.1876)	-3.7663*** (0.9992)	-3.3476*** (0.9933)	-4.3439*** (0.9953)		-5.1058*** (0.9847)		
β_4	0.2502*** (0.0958)	0.2296*** (0.0936)						-0.0630 (0.0903)
β_5	-4.3997 (3.3890)							
β_6	0.5180 (0.9691)							
β_7	0.2891 (2.9994)							
R^2	0.1980	0.1980	0.1747	0.1206	0.0612	0.0868	0.0529	0.0017
Adj. R^2	0.1777	0.1777	0.1659	0.1143	0.0579	0.0835	0.0496	-0.0018
DW	2.0764	2.0764	2.0303	2.0305	1.9578	1.7465	1.4650	1.5782
N.obs.	286	286	286	286	286	286	286	286

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Table 2.16: Return Predictability at Different Leads

$$\ln(1 + r_{t+\tau} - \text{div}_{t+\tau}) - \frac{1}{12}\ln(1 + E_t(r_m)) = \alpha + \beta_1\epsilon_t + \beta_2\Delta E_t(r_m) + \beta_3\Delta PYRN_t^* + \nu_t$$

The left hand side refers to n-months ahead unexpected return and it is defined as the difference between the market return without dividends and the expected return, (assumed to be proxied by the implied discount factor). ϵ_t is the difference between $\Delta E_t(r_m)$ and $\Delta PYRN_t^*$. The regression refers to monthly returns. Standard errors are reported in parenthesis. *, **, *** mean significant at the 10%, 5% and 1%, respectively.

Leads	r_{t+1}	r_{t+2}	r_{t+3}	r_{t+4}	r_{t+5}	r_{t+6}
α	0.0008 (0.0029)	0.0010 (0.0031)	0.0012 (0.0031)	0.0010 (0.0032)	0.0011 (0.0032)	0.0016 (0.0032)
β_1	1.6094*** (0.3701)	1.5115*** (0.3907)	1.0942*** (0.4019)	0.8272** (0.4032)	0.4866 (0.4057)	0.1038 (0.4059)
β_2	-3.0902*** (0.7190)	0.5603 (0.7585)	-0.0880 (0.7819)	-0.0079 (0.7851)	0.4087 (0.7898)	1.3599* (0.7908)
β_3	-3.2758*** (0.9925)	-1.9789* (1.0486)	-0.5210 (1.0784)	-1.4692 (1.0823)	-1.7489 (1.0911)	-0.2868 (1.1038)
R^2	0.1738	0.0794	0.0304	0.0271	0.0187	0.0121
Adj. R^2	0.1651	0.0696	0.0201	0.0167	0.0081	0.0014
DW	2.0190	1.6901	1.6388	1.6091	1.5795	1.5309
N.obs.	286	285	284	283	282	281

Table 2.17: Forecasts Errors (1991-2009)

The table presents the statistics on forecast errors for return predictability at monthly frequency. Out-of sample statistics are computed by updating the parameter estimates on the basis of the preceding 5 years. The historical mean refers to the random walk. RMSE is the root mean square error while MAE is the mean absolute error. Correct sign is the number of months for which we predict the right sign in returns

	Forecasts Excess returns		
	In-Sample	Out-of-sample	Historical Mean
MAE	0.0336	0.0352	0.0368
RMSE	0.0463	0.0480	0.0513
R^2	0.1795	0.1182	-0.0023
Correct sign	151	143	142
Correct sign in %	66.52%	63.00%	62.56%
N.Obs.	227	227	227

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Table 2.18: Trading Strategy (1991-2009)

The table presents the performance of a trading strategy exploiting the predictability of returns. The strategy consists in buying the market index when:

$$\beta_1 \epsilon_t + \beta_2 \Delta E_t(r_m) + \beta_3 \Delta PYRN_t^* - \frac{1}{12} \ln(1 + E_r(r_m)) > 0$$

and selling the index otherwise. The numbers refer to excess return with respect to the 3-month US T-Bill. The Out-of-sample parameters are updated monthly on the basis of the previous 5 years.

Strategy: Buy when Return forecasts is positive sell otherwise			
	In-Sample	Out-of-sample	Buy-and-hold
Monthly Excess Returns	0.0155	0.0149	0.0066
Standard deviation	0.0493	0.0495	0.0513
Sharpe Ratio	0.3134	0.3016	0.1290

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Table 2.19: Trading Strategy ϵ_t (1986-2009)

The table reports the performance of different trading strategies exploiting the difference between the implied discount factor $E_t(r_m)$ and the $PYRN_t^*$ (ϵ_t). Strategy 1 consists in buying the market index when $[\epsilon_t > C]$. Alternative 2 refers to the opposite strategy, namely buy when $[\epsilon_t < C]$. Alternative 3 is to buy when $[-C < \epsilon_t < C]$. Where C is a positive constant. All positions will be kept until the above trading conditions are satisfied. All the numbers refer to monthly returns.

Monthly returns: return of the following months						
	Strategy 1		Alternative 2		Alternative 3	
	Ret	Exc. Ret	Ret	Exc. Ret	Ret	Exc. Ret
Holding condition	$\epsilon_t > 0\%$		$\epsilon_t < 0\%$		$-\infty < \epsilon_t < \infty$	
Mean	0.0181	0.0144	0.0036	0.0004	0.0119	0.0084
Std.	0.0437	0.0439	0.0617	0.0617	0.0524	0.0525
Sharpe Ratio	0.3272		0.0058		0.1603	
Trading Months	165		122		287	
Holding condition	$\epsilon_t > 0.5\%$		$\epsilon_t < -0.5\%$		$-0.5\% < \epsilon_t < 0.5\%$	
Mean	0.0268	0.0231	-0.0052	-0.0081	0.0113	0.0077
Std.	0.0386	0.0388	0.0746	0.0744	0.0474	0.0477
Sharpe Ratio	0.5970		-0.1088		0.1619	
Trading Months	67		52		168	
Holding condition	$\epsilon_t > 1.0\%$		$\epsilon_t < -1.0\%$		$-1.0\% < \epsilon_t < 1.0\%$	
Mean	0.0310	0.0270	-0.0056	-0.0090	0.0132	0.0097
Std.	0.0327	0.0325	0.0726	0.0724	0.0494	0.0496
Sharpe Ratio	0.8247		-0.1236		0.1969	
Trading Months	17		36		234	

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Table 2.20: Trading Strategy ϵ_t : t-test

The table reports the t-test relative to the statistical significance of the difference between the performances of the trading strategies. In Panel A, the statistical significance of the differences in average returns are tested, while in Panel B, the statistical significance of the differences in Sharpe ratios are tested. *, **, *** mean significant at the 10%, 5% and 1%, respectively.

Panel A: Average returns			
Null Hypothesis: Average returns Strategy one equals Buy and hold			
	t-stat	DF	Prob.
$\epsilon_t > 0\%$	1.2948*	450	0.0980
$\epsilon_t > 0.5\%$	2.5984***	352	0.0049
$\epsilon_t > 1.0\%$	2.1814**	302	0.0150
Null Hypothesis: Average returns Alternative 2 one equals Buy and hold			
	t-stat	DF	Prob.
$\epsilon_t < 0\%$	-1.2594	407	0.1043
$\epsilon_t < -0.5\%$	-1.5293*	337	0.0636
$\epsilon_t < -1.0\%$	-1.3906*	321	0.0827
Null Hypothesis: Average returns Strategy one equals Alternative 2			
	t-stat	DF	Prob.
$\epsilon_t < 0\% \text{ vs } \epsilon_t > 0\%$	2.1401**	285	0.0166
$\epsilon_t < -0.5\% \text{ vs } \epsilon_t > 0.5\%$	2.7414***	117	0.0035
$\epsilon_t < -1.0\% \text{ vs } \epsilon_t > 1.0\%$	2.4838***	51	0.0082
Panel B: Sharpe ratio			
Null Hypothesis: Sharpe ratio Strategy one equals Alternative 3			
	t-stat	DF	Prob.
$\epsilon_t > 0\%$	-	-	-
$\epsilon_t > 0.5\%$	2.8313***	233	0.0025
$\epsilon_t > 1.0\%$	2.1769**	249	0.0152
Null Hypothesis: Sharpe ratio Alternative 2 one equals Alternative 3			
	t-stat	DF	Prob.
$\epsilon_t < 0\%$	-	-	-
$\epsilon_t < -0.5\%$	-1.6992**	218	0.0454
$\epsilon_t < -1.0\%$	-1.7818**	268	0.0380
Null Hypothesis: Sharpe ratio Strategy one equals Alternative 2			
	t-stat	DF	Prob.
$\epsilon_t < 0\%$	2.6611***	285	0.0041
$\epsilon_t < -0.5\%$	3.6726***	117	0.0002
$\epsilon_t < -1.0\%$	2.9015***	51	0.0027

2.9. TABLES & FIGURES

Figure 2.1:
Average Market Capitalization for Years 1986-2009

This figure reports the quantile of the average market capitalization for all the CRPS database (benchmark) and for the sample used in the paper (sample). This statistic is computed by taking the cross-sectional average of the market capitalization of all the considered stocks at the 1st of January of every year and then by taking the time-series average.

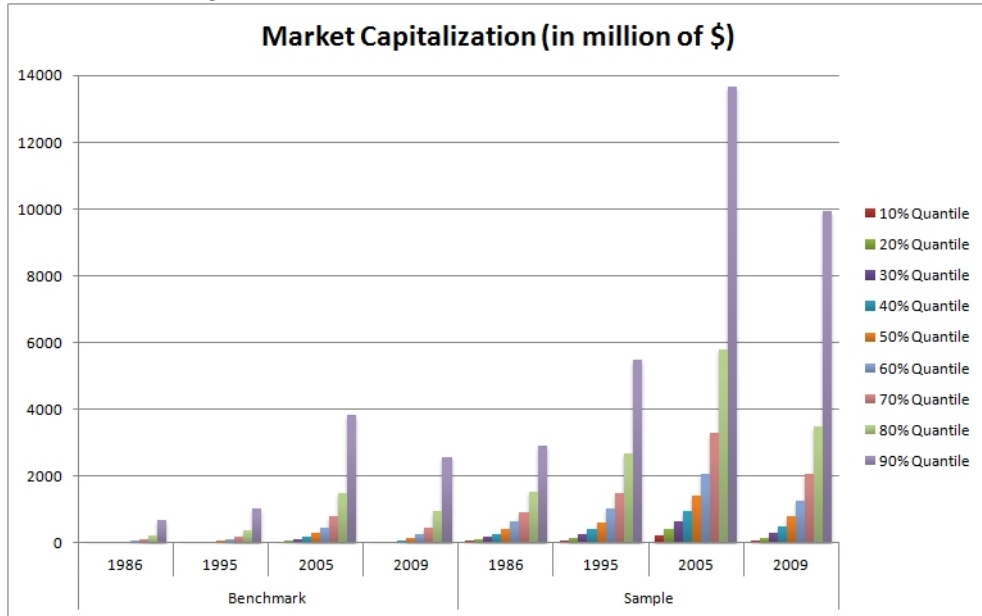
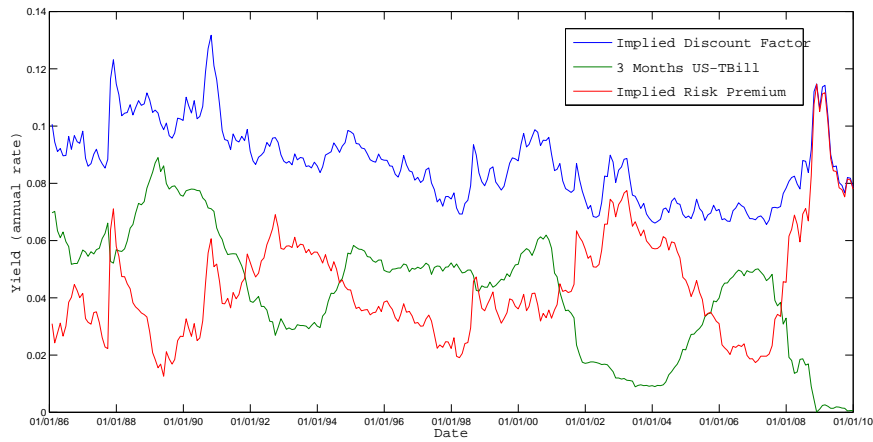


Figure 2.2: Cross Sectional Average IDF, IRP and 3MTB

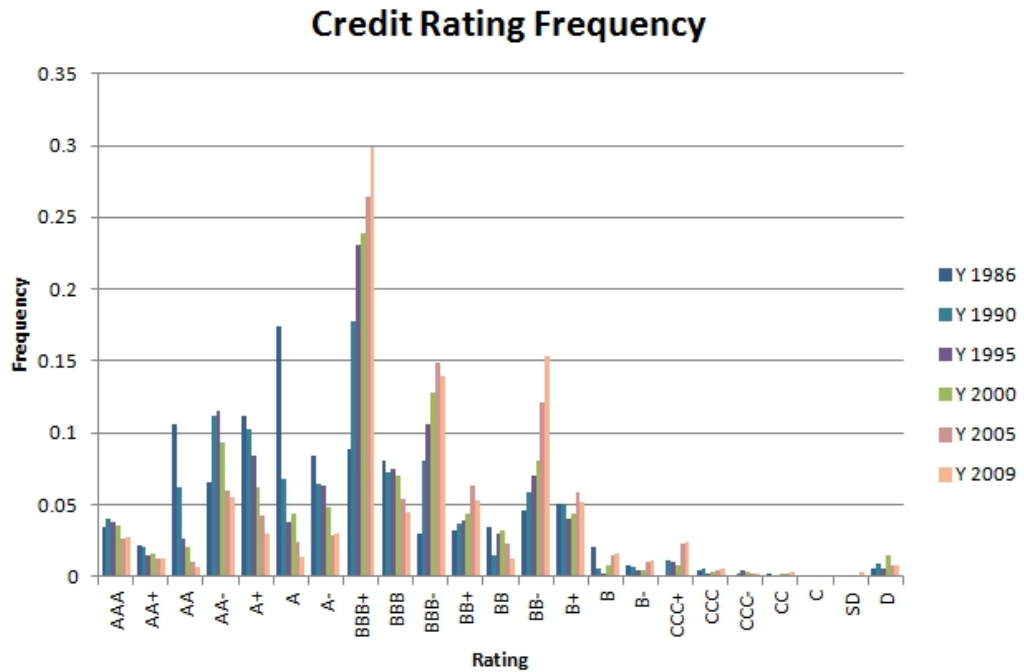
This figure plots the time series of the implied discount factor (IDF), the 3-month US T-Bill rate (3MTB), and the implied risk premium (IRP). IDF is obtained by taking the cross-sectional arithmetical mean of the individual stock implied discount factor (using the FHERM). IRP is defined as the difference between IDF and 3MTB. All data refer to the last trading day of every month. All rates are expressed in a yearly basis.



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Figure 2.3: Credit Rating Frequency

This figure reports the distribution of credit rating relative to January for the years 1986,1990,1995,2000,2005 and 2009. It refers to Standard & Poor's long term credit rating



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Figure 2.4: Implied One Year Default Probability (1986-2009)

This figure shows the one year implied default probability computed on the basis of the credit spread of a bond portfolio tracking A and BBB rated companies. The spread is computed relatively to the yield on 10 years US Treasury bond.

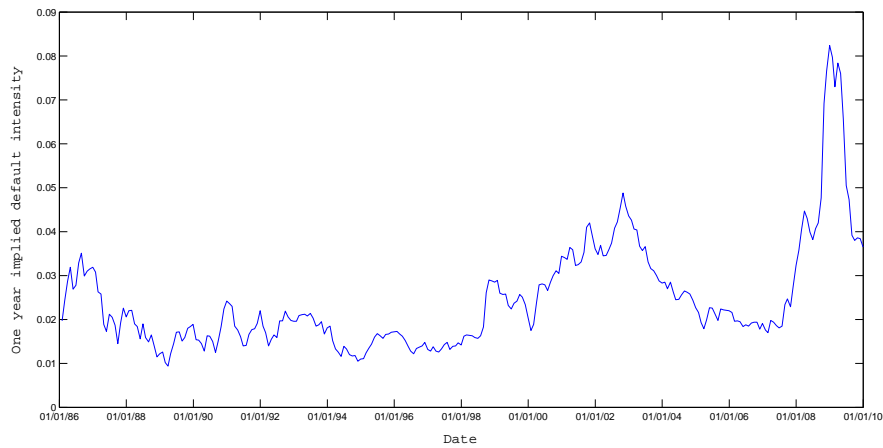


Figure 2.5:
Cost of Debt, Implied Discount Factor and PYRN*

This figure plots the time series of the implied discount factor (obtained from FHERM), the yield on a bond portfolio tracking A and BBB rated companies, finally the PYRN* is derived from the credit spread.

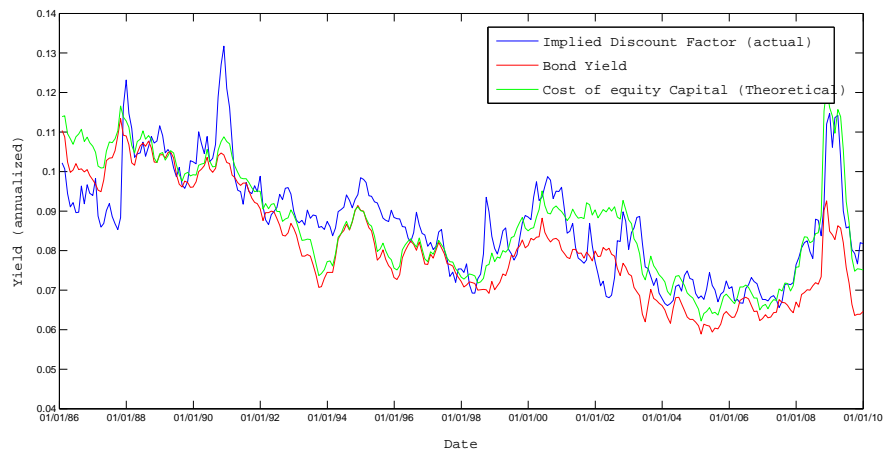


Figure 2.6:

Monthly Changes in Long Term Earnings Forecasts

This figure plots the time cross-sectional average of the long term monthly changes in earnings forecasts.

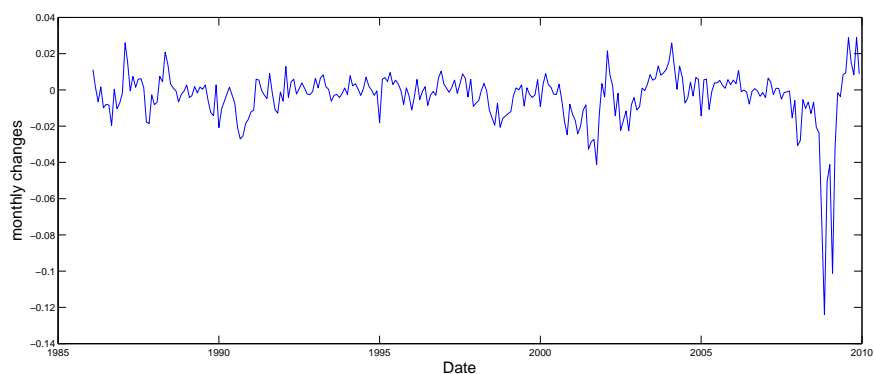


Figure 2.7: Autocorrelation
Function and Partial Autocorrelation Function (1986-2009)

The two figures report respectively the sample autocorrelation function (ACF) and the sample partial autocorrelation function (PACF) of the monthly residuals of the cointegration relationship between the PYRN* and the implied discount factor. The considered lag is 20 months.

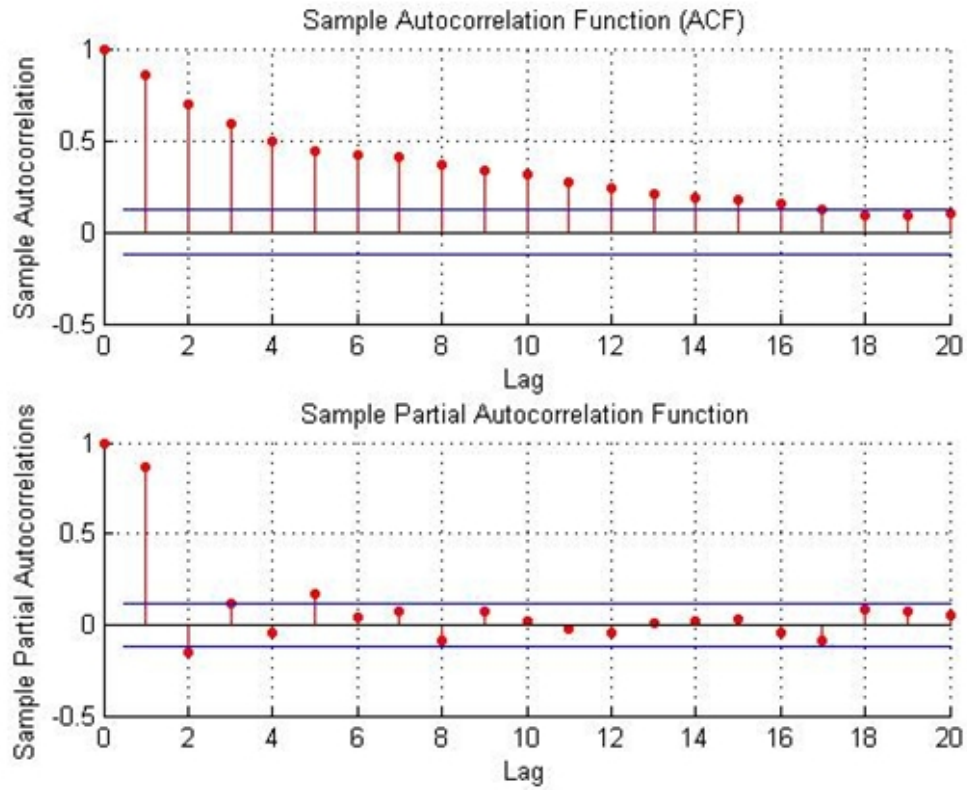


Figure 2.8: VECM: Residuals (1986-2009)

The two figures report the residuals of the VECM model.

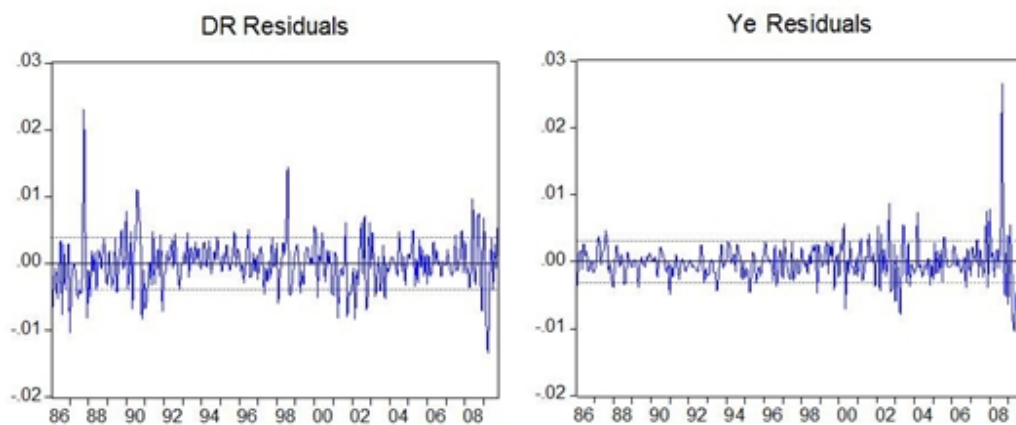
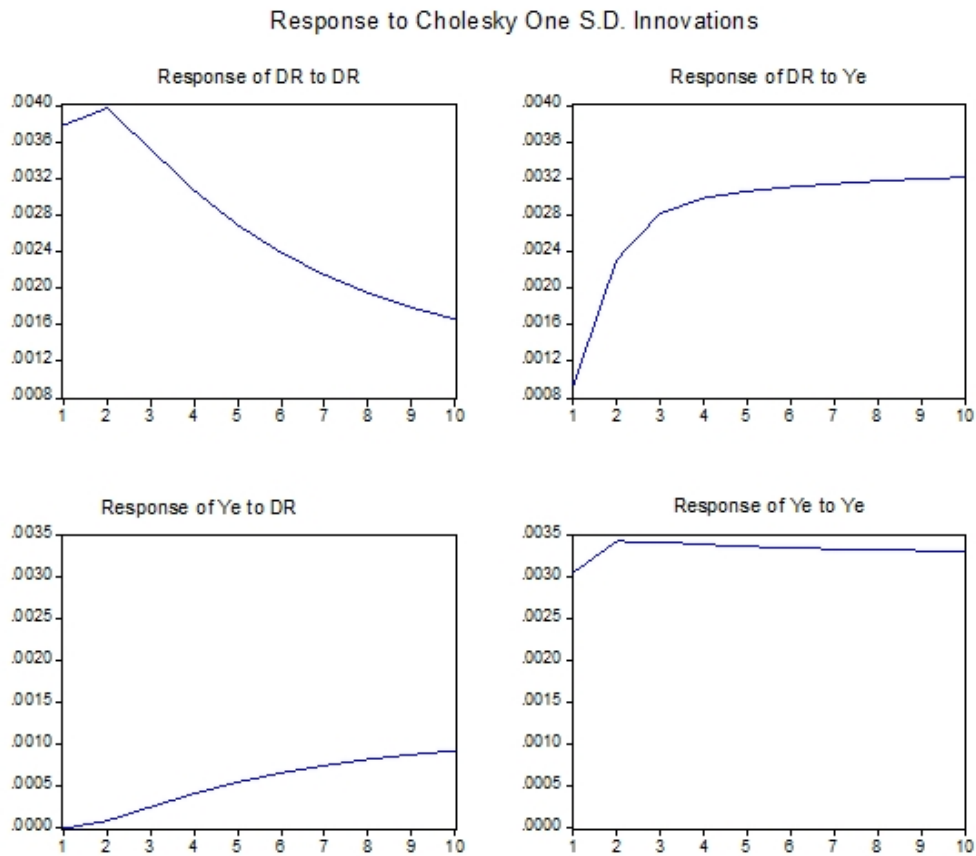


Figure 2.9: VECM: Impulse Response Function (IRF)

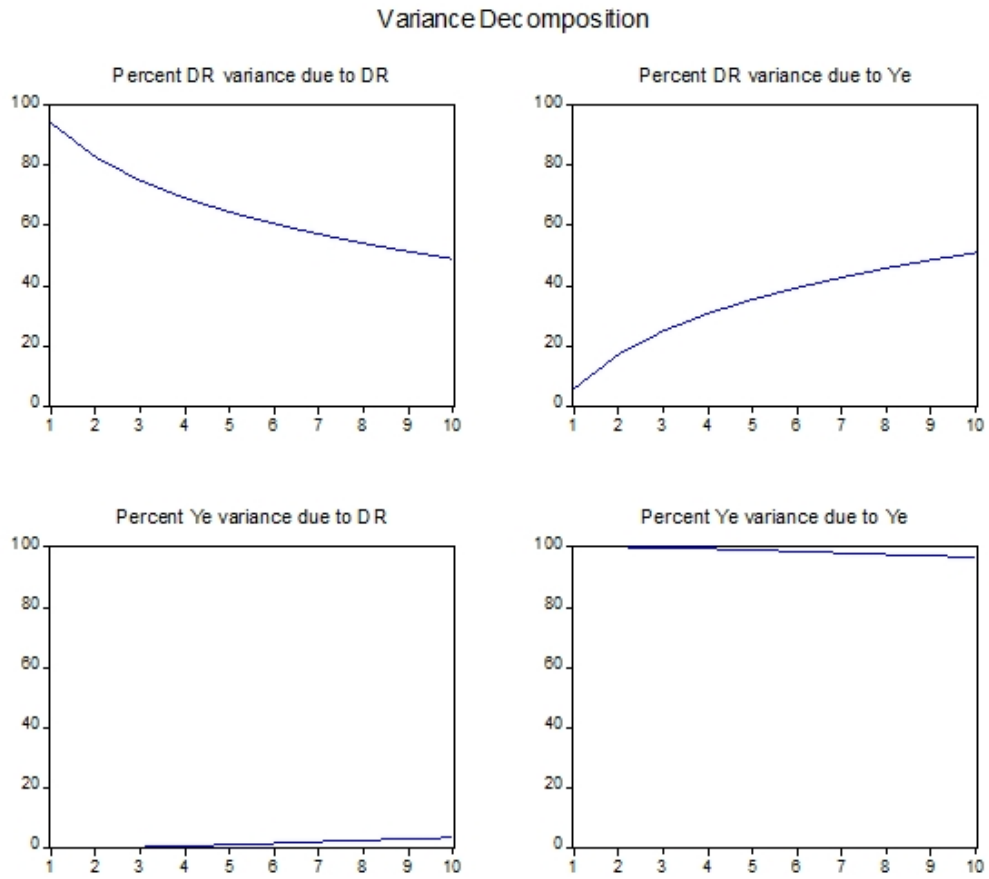
The following figures show the cumulative impulse response function from the estimates of the VECM between Implied discount factor $E_r(r_m)$ (DR) and PYRN* (Y_e). The output refers to the impact on the level of the variable as a result of a one standard error shock in a given variable. The horizon considered is 10 months.



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Figure 2.10: VECM: Variance Decomposition

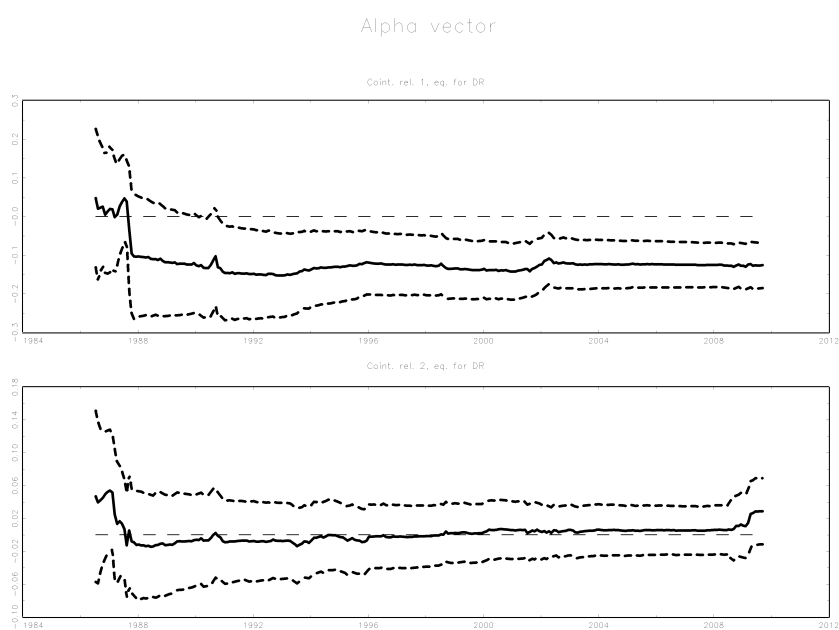
The following figures show the percentage of the variance that is due to the variable itself or to the other variable. The Cholesky ordering considered is $PYRN_t^* - E_t(r_m)$. In the figure, Y_e corresponds to $PYRN_t^*$ and DR to $E_t(r_m)$.



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Figure 2.11: VECM: Recursive Estimates (1986-2009)

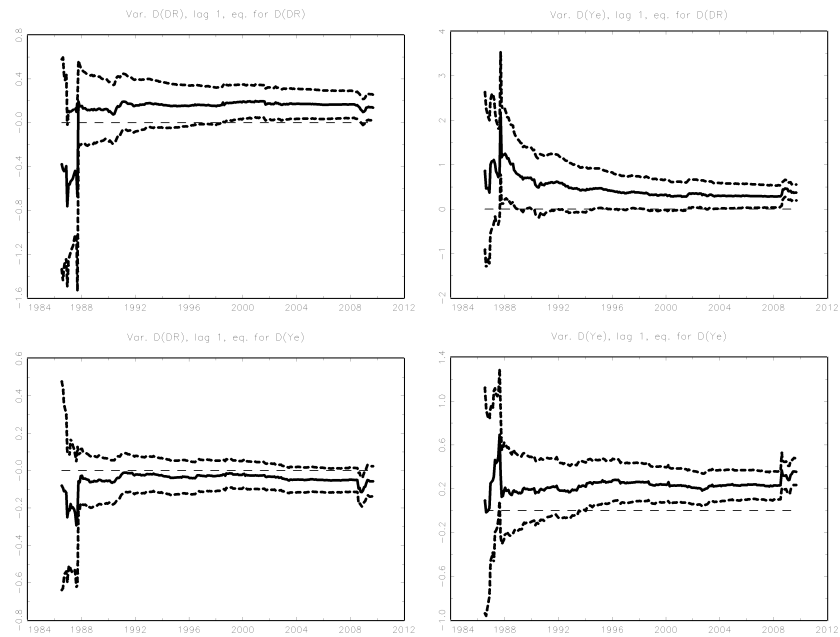
The following figure reports the recursive estimate of the error correction term (η) of the VECM. Estimates are obtained by recursively estimating the model considering just part of the sample. Dotted lines represent the 95% confidence interval.



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Figure 2.12: VECM: Recursive Estimates 2 (1986-2009)

VECM: Recursive Estimates (1986-2009). The following figure reports the recursive estimate of the short run matrix of coefficients (A) of the VECM. Those estimates are obtained by recursively estimating the model considering just part of the sample. Dotted lines represent the 95% confidence interval.



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Figure 2.13:
VECM: Recursive Eigenvalue and Tau-t Statistics

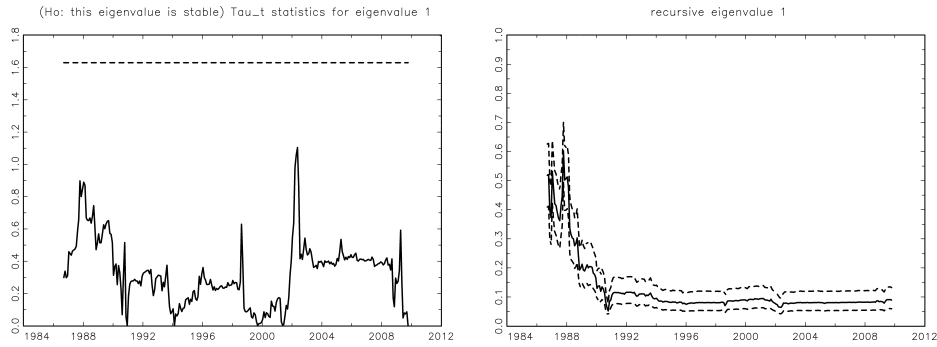
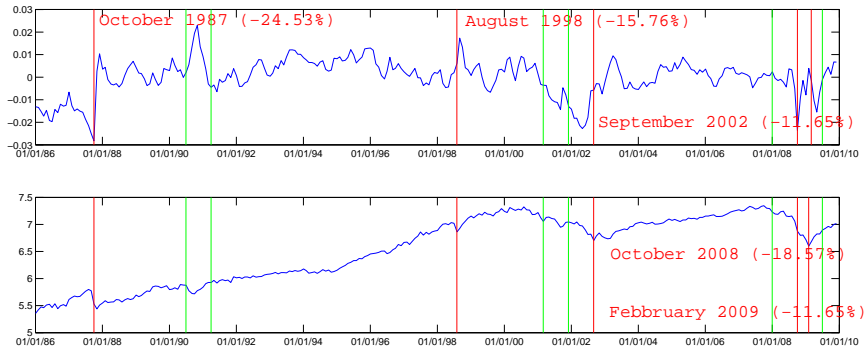


Figure 2.14: Cointegration Residuals and S&P500 Index Price

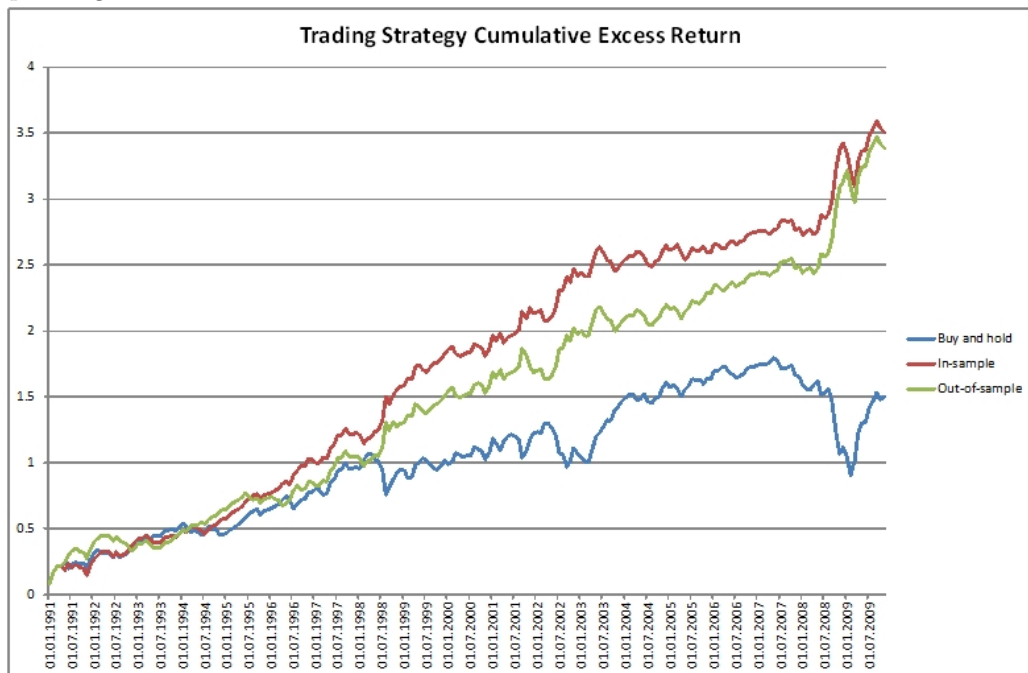
The first graph shows the time series of the residuals of the cointegration relationship between implied discount factor and PYRN*. The second figure represents the log of the price of the S&P500 index. Vertical green lines denote recessions as determined by the NBER, while the red lines denote the five lowest monthly returns of the S&P500.



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Figure 2.15: Cumulative Excess Return

The figure compares the cumulative return with respect to the yield on 3-month T-bill (without reinvestment) of three strategies: first, the buy and hold; second, exploiting in-sample predictability; and third, exploiting out-of-sample predictability. The sample period goes from 1.1.1991 to 31.11.2010



Chapter 3

Expected Return, Implied Discount Factor and Economic Growth: An international Comparison

Using the Finite Horizon Expected Return Model, the national equity implied discount factor for 26 countries is derived. It is shown that this measure explains the cross sectional difference in the average realized returns between the countries considered. We further demonstrate that the growth perspectives of different countries explain the observed differences in discount factors: the higher the rate of growth of the GDP, the higher the discount factor. This finding is consistent with the predictions of the Solow model. In addition, the excess growth in earnings (with respect to ROE) positively correlates with the excess growth of the GDP with respect to its long term average. Finally, by using principal component analysis (PCA), it is shown that one component accounts for more than 50% of the cross-sectional difference in the implied discount rate. This factor is strongly correlated with the credit spread on US corporate bonds; the variability in the time series of discount factor is thus primarily determined by changes in the default risk.

3.1 Introduction

The correct estimation of the cost of capital is one of the most central aspects in economics and finance. Many efforts have been spent investigating the domestic US market, but there is still not an unanimously accepted model. Even less efforts have been spent in the international context. The CAPM cannot be straightforwardly extended in the international context by simply including foreign investment opportunities. Because of the non existence of a unique risk-free asset and the presence of exchange risk, is not reasonable to assume that all investors have the same investment opportunity set. Under the assumption of integrated financial and consumption good markets, a simple version of international asset pricing model (IAPM) can be derived. In this specification the excess return of an asset with respect to the domestic risk free rate is proportional to the international systematic risk. The test of the IAPM can be reduced to a series of individual CAPM tests for the various national markets and a test of the international risk pricing relationship for the national indices. There is evidence that stock prices are strongly affected by domestic factors, however prices do depend on international events both directly and indirectly (see e.g. Solnik, 1974). In addition, Karolyi and Stulz (2002), in their review of international finance, concluded that the country's risk premium depends on its covariance with the world market portfolio. Erb, Harvey and Viskanta (1996) found no relationship between the beta and the average market returns, but they shown a strong link between the country's credit rating and the semi-annual market return in US dollars: higher rating (meaning lower risk) leads to lower expected returns.

This work contributes to this strand of the literature by identifying a relationship between national market returns. We provide evidence that the time-series dynamics are governed by the risk aversion of investors, measured by the U.S. credit spread. This factor alone accounts for more than 50% of the cross-sectional variability in expected returns. The cross-section of the average expected returns is explained by the growth outlook of the domestic economy, measured by GDP growth, consistently with the prediction of the Solow model (1956).

3.1. INTRODUCTION

In this perspective, this work can be related to the research on the relationship between stock prices and the real economy. The existing literature generally confirms a positive correlation between stock return and economic growth, as measured by capital expenditure, industrial production, GNP, money supply, short term interest rates and other variables (see Fama (1981), Geske and Roll (1983), for example). Chen (1991) documented that domestic macroeconomics variables are indicators for the current and future economic growth, confirming the findings of Chen et al, (1986) on the ability of domestic variables to forecast stock returns by forecasting the economic growth. Similar findings were also produced for other stock markets (see, for example Hamao (1988), Mukherjee and Naka (1995) for Japan). Kwon, Shin and Bacon (1997) showed that the significant variables in predicting stock returns are sometimes different from country to country. Wongbangpo and Sharma (2002) analysed the role of selected macroeconomics variables on the stock price of five ASEAN countries over the period 1985 to 1995. They documented both a short and long term link between stock price and GNP, consumer price index, the money supply, the interest rate and the exchange rate. Conversely, Ritter (2005) finds a negative correlation between real stock return and GDP growth over the period 1900-2002. He motivated this finding by arguing that economic improvements do not go to the existing shareholders; in particular, the increase in capital and in labour input goes into new corporations such that the dividends of existing firms are not boosted. Reactions to unexpected changes in economic growth are largely transitory. He further argues that only three pieces of information are necessary to estimate future equity returns: first, the current P/E ratio (with smoothed earnings); second, the fraction of corporate profits that will be paid out to shareholders; and third, the probability of catastrophic events. A recent publication of Goldman Sachs (May 2011) criticized this findings and provided further evidence of a strong positive relationship between GDP growth today and market return last year. Faugere and Van Erbach (2006), using a supply-side growth model, demonstrated that the average stock market return and the return on corporate assets and debt depend on GDP per capita growth and that the equity premium matches the U.S. historical average over 1926-2001.

3.1. INTRODUCTION

The national implied expected returns are derived by using the finite horizon expected return model, first developed by Gordon (1997). This methodology can be brought back to the family of cash-flow based models that aim to compute the implied discount rates from cash-flows and market stock prices. The main contributions in this area are, among others, the works of Preinreich (1938), Edwards and Bell (1961), Gordon (1997), Feltham and Ohlson (1995), Botosan (1997), Ohlson and Juettner-Nauroth (2000), Gebhardt, Lee and Swaminathan (2001), and Gode and Mohanram (2001).

Implied discount rates can generally be interpreted as expected returns. Botosan and Plumlee (2001) showed that the derived implied cost of capital, using several cash flow based methodologies, is consistently associated with six risk proxies suggested by theory and prior research. They concluded that the estimates of the expected cost of equity capital, using the unrestricted form of the classic dividend discount formula (rDIV), are a reliable proxy for the expected cost of equity capital. Among the models with less data requirement, the Gordon (1997) model correlate the most with rDIV. They also noticed that neither measure should be relied upon to estimate the magnitude of expected cost of equity capital or the implied risk premium at the individual firm level. We therefore empirically verify the relationship between the implied discount factor coming from the Gordon (1997) model and the realized market returns for a sample of 26 countries, including both industrialized and emerging economies. We find that the implied discount factor explains the cross-section of observed market returns, with a one-to-one relationship. Changes in the implied discount factor account for about 70% of the observed variability in returns.

3.2 Methodology and Data

There are numerous different methodologies in the literature for estimating the cost of equity capital. The two main approaches that have received most of the attention are the market models and the dividend discount models. In the first category, (e.g. the CAPM) the expected return on any security depends on the sensitivity to a given risk factor (usually the market). In the second, the cost of equity is estimated on the basis of today's market price of a given security and some forecasts of future cash flows. Throughout this paper the latter approach, in particular the so called finite horizon expected return model (FHERM) first developed by Gordon and Gordon (1997), is used. The main assumptions are that earnings are the sole source of funds for equity investments, that dividends are the sole means to distribute funds to investors, and that beyond the finite horizon T the expected return on equity will be equal to the risk-adjusted discount rate. Given the above conditions and relying on the discounted cash flow methods, in particular, on the well known dividend discount model (DDM), the following equation can be derived: (see the technical appendix for details on the derivation)

$$P_{t,i} = \sum_{\tau=1}^T \frac{E_t(dps_{t+\tau,i})}{[1 + DR_{t,i}]^\tau} + \frac{E_t(eps_{t+1+T,i})}{DR_{t,i} [1 + DR_{t,i}]^T} \quad (3.2.1)$$

where $P_{t,i}$ is the price of security i at time t , $DR_{t,i}$ is the risk-adjusted discount rate of security i at time t , and $E(dps_{t,i})$ and $E(eps_{t,i})$ are the expected dividend and the earnings per share for stock i at time t .

As a proxy for $E(eps_{t,i})$ and $E(dps_{t,i})$ the average analysts' forecasts about future earnings and dividends are used. This can be done under the assumption that the average analysts' forecasts equate the market's expectations.¹

¹Many articles have been written on this issue, without coming to an unanimous conclusion. Supporting the hypothesis of rational analyst forecasts include, among others, the works of Givoly and Lakonishok (1984), Givoly (1985), and Keane and Runkle (1998). Additionally, the evidence that earnings revisions are often associated with abnormal stock returns confirms the hypothesis of useful information content in the analysts' forecasts. For a review of recent literature on this topic, refer to the work of Ramnath, Rock and Shane (2008).

3.2. METHODOLOGY AND DATA

By reverse engineering of Equation 3.2.1 we numerically derive the risk-adjusted discount rate implied by current market prices. For the practical estimation, we use T ranging from 1 year up to 5 years, depending on data availability.

To be fair, it is important to notice that with the above methodology we completely ignore the term structure of discount rates and the dynamics in the risk premiums and risk free rates across different maturities. For this reason, one must be cautious in using the derived implied discount factor for budgeting decision, since ignoring the term structure of discount rates may lead to right skewed distribution in the expected net cash flows². If the objective is to correctly estimate the right discount factors to be applied in a particular valuation framework, every cash flow should be discounted at the appropriate rate such that all information about the term structure of the discount rates is taken into account. In particular, if the discount rates are time-varying and serially correlated, the cost of capital at any date would need to be estimated conditioned on the set of variables that predict the risk-premium³. The main difficulties are then to choose the appropriate set of instruments that predict future returns and to produce reliable estimates of the model parameters.

The goal of this paper is not, however, to propose a methodology to estimate the cost of the capital, but rather to compare the implied discount factors across countries and to relate them to realized market returns and macroeconomic growth. The potential problems outlined above should not be an issue since the discount factors are simply computed (not estimated) from market data (given the model). Consequently, they can be interpreted similarly as the discount rates of a console.

The data on the analysts forecasts are taken from the I/B/E/S summary statistics database that collects data for individual US and non US firms.

²Fama (1996) showed that when NCFs are priced by discounting their expected values with constant expected 1-period simple returns, and when the distribution of 1-period simple returns on the market values of NCFs are roughly symmetric, then the distribution of NCFs more than 1 period ahead are skewed right.

³Ang and Liu (2004) presented an analytical methodology for valuing stochastic cash flows that are correlated with risk-premiums, risk-free rates and time varying betas.

3.2. METHODOLOGY AND DATA

Most of the time series are available from 1986 and are updated monthly. The data on non-US stocks are taken from the DataStream database; US stocks, from CRISP. All time series are denominated in their local currency. The macroeconomic data is taken from the IMF and the world bank database. 11579 stocks listed in 26 countries are considered, including both developed and emerging economies. The analysis covers the period from January 1987 to March 2011. Once the individual discount factors are estimated by means of the previously introduced FHERM model, it is possible to compute the “national” implied market discount factor by simply aggregating the individual time series:

$$DR_{t,c} = \frac{1}{N_c} \sum_{i=1}^{N_c} DR_{t,i} \quad (3.2.2)$$

where $DR_{t,c}$ is the equally weighted risk-adjusted market implied discount factor for country c at time t expressed in the domestic currency, $DR_{t,i}$ indicates the expected return for stock i , and N_c is the total number of firms listed in country c included in the sample. In order to compute the sensitivity of prices to earnings and discount rate, it is useful to derive a “simplified” version of the FHERM. This can be easily done by imposing some additional constraints. In particular, imposing ROE to be equal to expected cost of equity and EPS to grow from the first year at ROE , the stock market price can be expressed as the simple perpetuity (see again the technical appendix for a detailed derivation):

$$P_{t,i} = \frac{E_t(EPS_{t+1,i})}{DR_{t,i}} \rightarrow DR_{t,i} = \frac{E_t(EPS_{t+1,i})}{P_{t,i}} \quad (3.2.3)$$

Keeping $EPS_{t,i}$ fixed and using the definition of returns, it is possible to compute the sensitivity of the returns on changes in the discount factors:

$$r_{t,i}(DR_{t,i}) = \frac{P_{t,i} - P_{t-1,i}}{P_{t-1,i}} = \frac{DR_{t-1,i} - DR_{t,i}}{DR_{t,i}} \quad (3.2.4)$$

This approximation is particularly useful since it does neither depend on earnings nor on dividends.

It is similarly possible to use Equation 3.2.3 to express market returns as

3.2. METHODOLOGY AND DATA

a function of the change in the earnings and in the implied discount rates:

$$1 + r_{t,i} = \left[\frac{ESP_{t,i}}{EPS_{t-1,i}} \frac{DR_{t-1,i}}{DR_{t,i}} \right] \quad (3.2.5)$$

Or, more conveniently in log form:

$$\log(1 + r_{t,i}) = \log\left(\frac{ESP_{t,i}}{EPS_{t-1,i}}\right) + \log\left(\frac{DR_{t-1,i}}{DR_{t,i}}\right) \quad (3.2.6)$$

The above expression emphasizes the fundamental relationship between returns, cash flows, and discount rates. Prices will go up when earnings grow; they will fall when discount rates increase. If one assumes earnings to grow on average at ROE and that the discount rate is equal to ROE , next month earnings can be expressed as:

$$EPS_{t,i} = EPS_{t-1,i} e^{dr_{t-1,i} + \epsilon_{t,i}} \quad (3.2.7)$$

where $(dr_{t-1,i} = \log(1 + DR_{t-1,i}))$ is the continuously compounded discount rate and $\epsilon_{t,i}$ is the unexpected earnings growth. In other words, next month's earnings will be determined by the expected part $(dr_{t-1,i})$ and by an unexpected component $(\epsilon_{t,i})$ having a mean zero and a standard deviation of σ_ϵ . Substituting the above expression into Equation 3.2.6, one finally obtains:

$$\log(1 + r_{t,i}) = \log(1 + DR_{t-1,i}) + \log\left(\frac{DR_{t-1,i}}{DR_{t,i}}\right) + \epsilon_{t,i} \quad (3.2.8)$$

Using this expression it is easy to distinguish the three main components that determine the observed market returns. The first term can be interpreted as the expected return that an investor requires in order to hold a risky security, or, alternatively, as the return that the security is able to provide over the long run. The second represents the change in the riskiness of the security or the change in the risk aversion of the investors. It can be interpreted as the discount rate news. Finally, the last term can be interpreted as the unexpected change in the earnings of the firm, i.e., cash flow news.

This methodology advantageously provides a clear framework to analyse

market returns and allows one to directly measure and separate the different forces acting on these returns. The cost of the model is the relatively strong assumptions necessary to derive it and the need for accurate forecasts about earnings and dividends. This may cause severe problems in analysing single securities. For example, the bad quality of the forecasts data or firm's specificity may violate the assumptions of the model. However we believe that those problems are mitigated at the aggregate level since analysts' forecasts should, on average, be sufficiently accurate while any abnormal rate of growth should be averaged out.

3.3 Data Set and Summary Statistics

Returns

National monthly market returns are derived by computing the individual returns from adjusted stock prices and then taking their arithmetical average in order to aggregate the data. The resulting time series can be interpreted as an equally weighted index. The actual selection of stocks included in this analysis results from the intersection of the I/B/E/S and DataStream databases. In addition, we require that each stock has a valid stock price; that is, each stock must have at least one estimate for earnings per share (or eventually dividend per share). Finally, we require that the resulting implied discount factor is positive and lower than 50%. The sample is updated monthly by including newly listed companies and by excluding stocks that have defaulted in the previous month or that no longer satisfy our requirements. If the resulting country sub-sample is sufficiently big, the choice of the firms to include in the analysis is restricted to those with the highest analysts' coverage. This is done in order to ensure a better quality of the estimates.

The details on the sample used, as well as the summary statistics on returns are shown in Table 3.1. The last row "world" refers to the equally weighted average of the returns of the single countries. The average monthly log return over the full sample period for the world index was 0.9% with

3.3. DATA SET AND SUMMARY STATISTICS

a monthly standard deviation of 4.81%. Looking at country level, average returns are quite heterogeneous, ranging between a minimum of 0.31% for Italy to a maximum of 2.31% for Brazil. The standard deviation instead ranges from a low of 5.04% for Belgium to a high of 11.41% for Greece. Every time series show a Kurtosis that is well above three, indicating fat tails. The skewness tends to be negative for most of the countries, with the exception of Malaysia, Philippines, and Finland. These statistics are in agreement with the strong evidence reported in the literature that returns are not normally distributed. The autocorrelations coefficients indicate, for most of the countries considered, that returns tend to be positively autocorrelated at one month lag. A noteworthy exception is the USA, for which no statistically significant autocorrelation is found at any lag at monthly level. Japan, Italy, South Korea, and UK can be considered as borderline cases for which autocorrelation is near the significance level. Autocorrelations at higher lags are generally not significant, with the exception of Greece, Austria and the Scandinavian which present some correlation at higher lags. This may indicate that not all the stock markets are totally efficient. Many may present some predictability in returns.

In Table 3.2, the estimated pairwise monthly correlations between the national market returns are reported. Panel A reports the estimate for the full time period analysed in this paper (1987-2011); panel B considers only the first half of the sample (1987-1999); panel C considers only the second half (1999-2011). The average correlation between the different countries is around 0.55 over the full sample, while it is around 0.43 for the early sample and 0.67 for the last decade. Not surprisingly, the correlation is in general the highest between the industrialized countries, in particular between the US and Europe.

More interestingly, in general the correlation between countries is considerably higher in the second half of our sample than in the first half (roughly quantifiable as an increase of about 25%). Furthermore, the correlation coefficients are more homogeneous in the second half of the sample. This phenomenon appears to be particularly significant in the emerging countries. In the early sample, the correlation between emerging and developed countries

is relatively low, but in the late sample, the correlations have dramatically increased, indicating a higher interdependence between countries. This may have a considerable impact in portfolio selection, as investments in those countries are often thought to provide a good portfolio diversification. This was probably true in the past, but this feature may have disappeared. In other words, the possibility of diversification across the countries is lower in recent years as the stocks markets are more connected. This is a clear manifestation of the increased interdependence between the markets and the globalization of the world economy. Another interesting example of this trend is the strong increase in the correlations between European countries after 1999, when the European Monetary Union was created. The average correlation coefficient increased from 0.54 for 1987-1999 to 0.78 for 1999-2011. Nonetheless, one cannot say that there is a definitive evidence that the cross-country correlations have significantly increased. Longin and Solnik (1995) documented an increase in the correlation of stock returns for various developed markets over the 1960-1990 period. Bekaert, Hodrick and Zhang (2009) instead found little evidence, over the time period 1980-2005, of a trend in cross-country return correlations, except within Europe.

Implied Discount Factor

In this section, we present the statistical properties of the time series of the implied discount factor (DR) extrapolated from Equation 3.2.1, as derived and discussed in section 2. The data is aggregated according to Equation 3.2.2. All the numbers are calculated for each month and they are expressed as an annual rate. Figure 3.1 shows the time series of the estimated discount factors for the countries considered in this work. An overview of the plots gives some interesting insights. The most evident pattern is that the implied discount factors tend to be countercyclical: they increase in bad times and decrease in good times. The most evident spikes correspond to economic crises, as for example in the recent financial crisis. Due to the global magnitude of the most recent crisis, one can notice that almost all the time series dramatically increase in 2008 and only return to the pre-crisis level in 2010.

3.3. DATA SET AND SUMMARY STATISTICS

There are likewise peaks corresponding to the burst of the technology bubble in 2001-2002 and the Dow Jones crash in 1987. In 1997-1998, there was a strong increase in the discount rates of all the Asian countries (Hong Kong, Malaysia, Singapore, South Korea, Philippines and to a lower extend Japan) that can be easily connected to the Asian currency crisis. The increase in other countries was less pronounced. Discount rates tends to increase also in correspondence of local shocks and uncertainty. Consider the peak of 1999 in Greece. The strong increase in the discount rate occurs during the bull market starting in late 1998. This can be explained only if the expectations about future earnings growth increase more than the DR and, consequently, they completely compensate the decrease in prices originated by higher risk. When this happens, it is usually a signal of irrational (or manipulated) expectations; this typically defines a bubble. It is now recognized that at that time the market was somehow manipulated and abused. At the end of 1999, the Greek stock market finally collapsed. Investor loss of confidence in the market was probably the most damaging long term consequence. From 2000 onwards, there was an exodus of funds from the ASE. Following the collapse of the Greek stock market, some corporate governance reforms were undertaken in order to prevent future manipulations. Gradually, investors regained confidence and the discount rate decreased as the stock market recovered.

We note that national discount factors tend to converge and to move together. This is particularly clear after 2006, and it is consistent with the previous observation that the international cross-correlations of market returns have increased significantly over the last few years. It can be interpreted as further proof of an increase in the integration of stock markets.

Summary statistics are presented in Table 3.3. The average discount rate was 9.52%, broadly corresponding to the average realized return for the equally weighted “world index”. The discount rates are quite heterogeneous across different countries, ranging from a minimum of 4.61% for Japan to a maximum of 14.36% for Brazil. They also vary substantially through time; the average “world” discount rates range between a minimum of 6.01% and a maximum of 16.96%. This clearly indicates that they are far from constant as many financial models assume, and supports the use of stochastic discount

3.3. DATA SET AND SUMMARY STATISTICS

models. DR are strongly persistent, as the AR coefficient suggests, but they are not unit root process. Formal tests on stationarity are presented in Table 3.4. We employ the Augmented Dickey Fuller group test for unit root, but comparable results are found using other methodologies. Both the Fisher and the Choi statistics clearly reject the null of a joint unit root. In general, the unit root can be excluded for each of the individual series as well. The ADF test rejects the null of a unit root on 20 countries over 27 at the 10% critical level. The fact that the hypothesis of a unit root for some countries cannot be rejected is not of a big concern because of the low power of the test and the limited number of observations. We therefore conclude that the DR are strongly persistent but do not present a unit root. This is coherent with economic theory, predicting that discount rates do not increase indefinitely.

As with interest rates, the implied discount rates appear to be mean reverting. This is particularly evident during the periods of crisis. This behaviour can be statistically described using an Ornstein-Uhlenbeck Process, a class of stochastic process designed to deal with mean reversion. A process is said to follow an Ornstein-Uhlenbeck process, if the following stochastic differential equation is satisfied:

$$dDR_t = \kappa(\bar{DR} - DR_t)dt + \sigma dW_t \quad (3.3.1)$$

where $\kappa > 0$, represents the “speed” of the mean reversion, \bar{DR} is the long run level of the variable, $\sigma_t > 0$ is the volatility of the process, and W_t denotes the Wiener process. For the practical estimation, the following discrete specification is used:

$$\Delta DR_{i,t} = \alpha_i + \beta_i DR_{i,t-1} + \epsilon_{i,t} \sigma \sqrt{(\Delta t)} \quad (3.3.2)$$

where $\alpha = \kappa \bar{DR}$ and $\beta = -\kappa$. The above model is easily estimated by linear regression; it is particularly convenient to fit the model in the panel

3.3. DATA SET AND SUMMARY STATISTICS

framework⁴.

Equation 3.3.2 is estimated via standard least square regression. Results are summarized in Table 3.5. The first column reports the estimate for a seemingly unrelated regression (SUR) specification, wherein α_i and β_i are allowed to be different for all countries. The second column refers to the Fixed Effect (FE) specification in which one sets the speed of mean reversion to be common ($\beta_i = \beta \forall i$). The third column reports the results for a pooled model in which both α and β are equal for all countries.

The advantage of the SUR specification is that it allows for different dynamics across the countries. The estimates suggest that, not surprisingly, the long run level of discount rate ($\bar{D}R$) is different for every market, ranging from a minimum of 6.9% for Japan, to a maximum of 13.7% for Brazil, with a cross-country mean of 9.6%. All the coefficients are positive and statistically significant and they are near to the unconditional mean of the time series of implied discount rates.

The estimates of κ are less accurate. Although all the coefficients are positive, indicating that the DR tends to converge to its long term equilibrium value, some of the coefficients are not statistically significant at the 5% critical level. The adjusted R^2 of the regression is 2.23%: the noise dominates over the mean reversion behaviour. Consequently, the predictability of the time series based on the past realizations is quite limited, consistently with the efficient markets hypothesis. Finally, the Durbin-Watson statistic (1.78) indicates that the residuals are only slightly positively autocorrelated.

Given the low accuracy of the κ_i , we test for a common speed of mean reversion. The Wald test does not reject this hypothesis (see Table 3.6); the null of a common $\bar{D}R$ is instead clearly rejected. Given these results, the previous model is estimated including a Fixed Effects (FE). As expected, the κ is positive (4.75%) and statistically significant at the 1% critical value. This confirms the mean reversion behaviour of the implied discount rate. As expected, the performance of the model in term of R^2 are only slightly

⁴Results may be biased because of the Euler discretization of the continuous-time dynamics of the model (see Lo (1988), Broze, Scaillet and Zakoian (1995), and Yu (2009)), the bias is typically not too large and negligible for the practical purposes of this paper. We therefore expect that the qualitative conclusions are unaffected.

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inferior compared to the unrestricted SUR model. The fixed effect terms are all significant and, in general, different across countries.

In conclusion, all the time series show a significant mean reversion behaviour, suggesting the presence of a common transitory component in expected return. The long term average rate, in contrast, varies between countries, and this indicates the presence of a basis risk that is country dependent. As will be demonstrated in the next sections, the difference in the long term equilibrium level can be explained by the different growth rates of the economy, while the mean reversion is determined by a general default risk factor that tracks the risk aversion of the investors and is largely shared by all countries.

3.4 The Link Between Implied Discount Factor and Market Returns

Discount Factor As The Expected Return

It is generally widely accepted that the expected returns vary over time⁵. For this reason, it is extremely difficult to estimate the expected return from realized market returns. Using the implied discount factor as a proxy can be a valid alternative. The goal of this section is to empirically verify that the implied discount factor is a useful proxy for the expected return by checking that the observed pattern in realized returns is compatible with the time series of the discount factors.

As a first analysis, we check if the unconditional mean of returns coincides with the unconditional mean of implied discount factors for all the countries in the sample⁶. We must first take into account the part of return resulting from changes in the discount factor; this return is a direct consequence of

⁵A large body of the existing literature suggest that the risk-premia vary over time (see, e.g., Shiller 1984; Campbell and Shiller 1988; Fama and French 1988, 1989; Campbell 1991; Hodrick 1992; Lamont 1998; Lettau and Ludvigson 2001)

⁶Cooper (1996) shows that in estimating the price of a security given its future cash flows, the corrected (in order to include estimation errors and serial correlation in returns) discount factors are closer to the arithmetic mean than to the geometric mean.

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an unexpected change in the risk premium required by investors. A simple way to account for this is to use the approximation of Equation 3.2.4. The fraction of the average return explained by this can thus be expressed as:

$$r_{t,c}(DR_{t,c}) = \frac{1}{T-t} \frac{DR_{t,c} - DR_{T,c}}{DR_{T,c}} \quad (3.4.1)$$

where $DR_{t,c}$ is the implied discount rate for country c , and t and T are respectively the first and the last monthly observations, and $(T-t)$ is the number of monthly observations considered. Applying this adjustment, the following unconditional regression can be estimated:

$$\bar{r}_c - r_{c,T}(DR_c) = \alpha + \beta \bar{DR}_c \quad (3.4.2)$$

where \bar{r}_c is the time series average of realized market returns (monthly) in country c .

If DR_c can be interpreted as a proxy for the expected return and if the realized return tends to converge in mean to its expectation, the intercept of the above regression should be zero while its slope should be equal to one. Estimations are reported in Table 3.7. The column “full sample” reports the estimate relative to the case in which the averages are computed using all the available data, where the numbers of observations may differ across countries; the column “common sample” refers to the case in which only the common observations from 1999 to 2011 are considered. As expected the α s are not statistically different from zero, and the β s are close to the expected value of one. Comparable results are obtained both using the full and the common sample, indicating that the results are robust to different sample periods. Although very simple, this specification performs quite well in explaining the cross-country differences in the unconditional average realized market returns, with an adjusted R^2 of around 30%.

The above model can be extended in order to explicitly include the information coming from changes in the discount rates. Since the number of observations for a single country is quite limited, and the returns are very volatile, it is useful to work in the panel setting, in order to simultaneously

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include information from the time series and from the cross sectional data. The following specification will be considered:

$$r_{t+1,c} = \alpha_c + \beta_c dr_{t,c} + e_{t,c} \quad (3.4.3)$$

where $r_{t+1,c}$ refers to the next month annualized log market return for country c , $dr_{t,c}$ is the log implied discount rate for country c in month t and $e_{t,c}$ is a country-specific noise term. All the parameters are estimated via feasible generalized least squares (FGLS). Cross-sectional heteroskedasticity is assumed for the estimation of the variance matrix. Specifically, we allow for a different residual variance for each cross section. The residuals between different cross-sections and different periods are assumed to be uncorrelated. A preliminary analysis of the correlation structure of residuals confirms this assumption. The correlation matrix of the residuals is reported in Table 3.9. The coefficient covariance is estimated according to the White period method. This method is robust to arbitrary serial correlation and time varying variances in the disturbances. With this procedure, estimated parameters are robust both to cross-sectional and serial correlation.

The estimates of Equation 3.4.3 are presented in Panel A of Table 3.8. All numbers are annualized. The results are similar to those obtained in the unconditional setting; the intercept is not statistically different from zero ($\alpha = -0.0131$), and the slope is statistically equal to one ($\beta = 1.0289$). Therefore, the implied discount rate is able to explain the positive mean observed in the returns. This is an important evidence in favour of the hypothesis that DR can be interpreted as the expected return.

The possibility of individual intercepts and individual slopes is also tested. The first hypothesis is verified by testing for redundant fixed effects, while the second hypothesis can be tested by estimating a SUR model. For this purpose, a Wald test is performed on the restrictions that all $\beta_i = 1$. Results of the Wald tests are presented in Panel B; the estimates of the SUR model without intercept are presented in Table 3.10. The SUR model is estimated by introducing an AR(1) term in order to directly account for serial correlation, since one has too many parameters to reliably estimate the covariance

3.4. THE LINK BETWEEN IMPLIED DISCOUNT FACTOR AND MARKET RETURNS

matrix of the White Period method. Both the tests reject their respective null, suggesting that the pooled model is the best specification. The individual β estimates of the SUR model are in general imprecisely estimated given the extreme noisiness of returns and the quite limited sample, but they nevertheless appear scattered around one. The only noteworthy exception is the US, for which the slope is statistically higher than one. This can be a consequence of the limited availability of the data or of the fact that the American stock market has consistently outperformed expectations over the last 20 years. This may also explain why, according to much academic work, the equity premium in the USA appeared to be too high. However, we note that the level of the $DR_{t,c}$ does not explain monthly variation in returns, as the near zero R^2 statistic suggests.

The fact that the β_i are statistically significant implies that returns are somehow predictable by the implied discount rate. This is consistent with the large body of empirical literature evidencing that the P/E, D/E and B/M are useful in predicting returns, especially over the long-term horizon. These ratios can in fact, be derived from the dividend discount models by imposing some restrictive assumptions, similarly to the $DR_{t,c}$ used here. For this reason, it is reasonable to believe that they contain information similar to the implied discount rate. However, in contrast to the simple price ratios, our approach has the advantages that it is forward looking, does not require model calibration, and has a clear theoretic interpretation⁷. However, this approach requires more data to be implemented and heavily relies on the accuracy of forecasts.

To conclude this section, the hypothesis that the implied discount factor can be viewed as a proxy for expected return can not be rejected by the data in both a conditional and unconditional sense. We note that the extreme noise of the time series of returns does not exclude the possibility that this relationship may arise purely by chance and that other valid (and perhaps better) alternatives may exist. For this reason, further investigations on this

⁷More recently, Lettau and Van Nieuwerburgh (2008) have shown that shifts in the steady-state expected returns and in the growth rate of fundamentals are responsible for the instability of the forecasted returns and that the adjusted price ratios robustly forecast returns in the sample.

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topic are strongly recommended. Unfortunately, since we must rely on a single trajectory, a definitive conclusion will, most probably, never be drawn.

The Determinants of Market Returns

In the previous section, we have shown that the level of the implied discount rate explains the observed positive average in market returns and the corresponding cross-county differences, but it does not explain the variability in returns. For this reason, it is useful to “decompose” the market returns in two main components: the first related to fundamentals, the second related to the discount factor. In this way, it is possible to estimate the proportion of variance that is due to changes in the discount rate and, by residual, the proportion that is due to changes in the cash flows. Using the relationship derived in Equation 3.2.8 and the results of the previous section, it is possible to estimate the following linear regression:

$$\log(1 + r_{t,c}) - \log(1 + DR_{t-1,c}) = \alpha + \beta \log\left(\frac{DR_{t-1,c}}{DR_{t,c}}\right) + \epsilon_{t,c} \quad (3.4.4)$$

This expression can be easily estimated in the panel framework. The results are summarized in Table 3.11. The first column reports the estimate for the full sample period; while the second, the estimate for the sub-sample 1999-2011. The coefficients are estimated via FGLS, with the cross-sectional weighting matrix. A robust covariance matrix of coefficient is estimated via the White period method. All the numbers refers to monthly returns.

The intercept of the full sample is both statistically and economically equal to zero. For the recent sample, the intercept is slightly negative but the economic significance is relatively small (-0.16%). This indicates that the positive mean of the market return is captured by the implied discount rate, as previously shown. Consistent with Equation 3.2.8, the slope coefficients are near the value of one⁸. The R^2 of the model is around 70%, indicating that the biggest part of the observed variance in returns is explained by

⁸The slightly lower values for the β are most probably due to the omitted-variable bias, since returns are also influenced by changes in earnings and one can reasonably assume that they are correlated with changes in the implied discount rate.

3.4. THE LINK BETWEEN IMPLIED DISCOUNT FACTOR AND MARKET RETURNS

changes in the discount factor. Estimates do not change substantially in the two periods suggesting that the model is quite robust. This is in line with other studies that show discount rate news to account the most for observed variability in returns.⁹

The residuals of the above regression can be interpreted as the “surprises” in earnings. A graphical inspection suggests that the residual are cyclical: they tend to be higher in periods of economic expansion and lower in period of contraction. The average residuals are plotted in Figure 3.2; the vertical red lines represent the NBER recession periods. One can easily notice that in any recession the residuals tend to be negative with a strong increase afterwards. Interestingly the drop in the time series of average residuals for the Asian countries (Panel B) corresponds to the big currency crisis of 1997-1998. This suggest the presence of a link between “earnings surprises” and economic growth. This link can be formally studied through the following regression:

$$\epsilon_{t,c} = \alpha + \beta_1 [GDP_{t,c} - E(GDP_{t,c})] + \beta_2 [GDP_{t+1,c} - E(GDP_c)] \quad (3.4.5)$$

where $\epsilon_{i,t}$ is the residual of the regression in Equation 3.4.4 and is a proxy for “unexpected” cash flow news, and $[GDP_{t,c} - E(GDP_c)]$ is the unexpected growth in the real GDP for country c at time t . For the sake of simplicity, we assume that $E(GDP_c)$ is well approximated by the time average of GDP growth. The model is fit using monthly data. Since data on GDP growth is only available quarterly, we assume that it is constant within a given quarter. This may however result in a loss of information, so we introduce in the regression the next quarter GDP growth ($GDP_{t+1,c}$) as well, which will differ, by construction, from the $GDP_{t,c}$ only in the last month of the quarter, thus allowing us to better incorporate the investor’s information set.

⁹Among others, Roll (1988) showed that systematic economic influences account for no more than one-third of the monthly variation in individual stocks. Similarly, Cutler, Poterba, and Summers (1989) found that is difficult to explain as much as half of the variance in aggregate stock prices on the basis of publicly available news bearing fundamental news. Campbell and Ammer (1993) also showed that returns are attributable to changing expectations of future excess stock returns, and that returns have a standard deviation two or three times greater than the standard deviation of news about future dividend growth.

The results are summarized in Table 3.12. In all the specifications tested, all the β 's are highly statistically significant, confirming the graphical impression that the surprises in earnings are correlated with the surprises in the growth of the economy. In other words, this means that the unexpected growth in earnings follows the business cycle; in period of good economic activity, approximated by the above average growth in the domestic real GDP, earnings tends to increase more than what is indicated by changes in the discount rate, and vice-versa. The explanatory power of the model is around 5%, and increases to almost 10% if one considers only the second half of the sample. This is consistent with the fact that rational investors pay attention to macroeconomic news in order to update their belief on earnings perspective.¹⁰ As a robustness check, the model is re-estimated only using the second half of the sample. The qualitative results do not change substantially.

3.5 The Determinants of the Discount Factor

Implied Discount Rate and The Real Economy

It is possible, based on the Solow model, to derive a theoretical relationship between GDP growth and the return on the real capital of the economy. We introduce a slight modification in the Cobb-Douglass production function in order to deal with nominal data. Nominal data are preferred for two main reasons. First, nominal data is what is observed and thus does not need to rely on any adjustment (considering also that inflation in reality can not be actually measured). Second, we believe investors do not really care about the level of the price when they plan an investment abroad; they only consider the eventual depreciation/appreciation in the nominal exchange rate. The evidence so far presented finds no reliable relationship between the two, at least in the short-medium term.

¹⁰In a recent contribution Agarwal and Hess (2012) documented that unanticipated changes in the business conditions represent common earnings shocks which lead stock market analysts to adjust their earnings expectations for many different firms. The results show that macroeconomic news must influence stock prices through the earnings (or cash flow) expectations channel.

3.5. THE DETERMINANTS OF THE DISCOUNT FACTOR

Let us assume that the domestic production can be modelled according to the following modified Cobb-Douglass type function with constant returns to scale:

$$Y_t = \Pi_t \cdot A_t \cdot K_t^\alpha \cdot L_t^{1-\alpha} \quad (3.5.1)$$

or more conveniently in log form as:

$$\log(Y_t) = \log(\Pi_t) + \log(A_t) + \alpha \log(K_t) + (1 - \alpha) \log(L_t) \quad (3.5.2)$$

where Y_t is the nominal domestic output, Π_t is the general level of the prices, A_t accounts for technological progress, K_t is the total amount of capital in the economy, L_t is the amount of labour force employed in the production, and α is the output elasticity of the capital. It is known that any factor of the production has to be remunerated at its marginal productivity; that is:

$$r_t = \frac{\alpha Y_t}{K_t} \quad (3.5.3)$$

where r_t is the rate of return of the capital. We assume that the capital accumulates according to:

$$\dot{K}_t = Y_t s - K_t \delta \quad (3.5.4)$$

where s is the saving rate of the economy and δ is the depreciation rate of the existing capital. In a steady state growth economy, the rate of return on the real capital can be shown to be:

$$r_t = \frac{\alpha}{s} \cdot GDP_t^{nom} + \frac{\alpha \delta}{s} \quad (3.5.5)$$

Finally, let's assume that the equity is remunerated in proportion of r_t :

$$r_t^e = \gamma r_t \quad (3.5.6)$$

where γ is an adjustment for risk. Taking all this together, and setting the expected return of equity as the implied discount rate (DR_t) it is possible to

3.5. THE DETERMINANTS OF THE DISCOUNT FACTOR

derive the following specification:

$$DR_t = c + \beta GDP_t^{nom} \quad (3.5.7)$$

where $c = \frac{\gamma\alpha\delta}{s}$ and $\beta = \frac{\gamma\alpha}{s}$, or, in terms of real GDP and inflation rate:

$$DR_t = c + \beta GDP_t^{real} + \lambda i_t \quad (3.5.8)$$

where $\lambda = \frac{\alpha\gamma}{s(1-\alpha)}$.

The previous expressions can be derived under the assumptions that the economy is closed and it is in a steady state growth path. These conditions are generally not fully fulfilled. Therefore, it can be problematic to test this model on a time series framework. In addition, the model does not impose the parameters to be constant over time. For those reasons, we test the model unconditionally using the cross-section of data. The goal is to verify that the differences in the inflation rates and in the GDP growth translate in a different expected equity rate of return. Taking expectation with respect to time, the above specifications can be written as:

$$E_t(r_{t,i}) = E_t\left(\frac{\gamma_i\alpha_i}{s_i}GDP_i^{nom} + \frac{\gamma_i\delta i}{s_i}\right) = c_i + \beta_i E_t(GDP_i^{nom}) \quad (3.5.9)$$

and

$$E_t(r_{t,i}) = c_i + \beta_i E_t(GDP_i^{real}) + \lambda_i E_t(i_i) \quad (3.5.10)$$

In order to estimate the parameters in Equation 3.5.9, some restrictions on the parameters must be imposed. In particular, the saving rate s , the risk premium on equity γ and the output elasticity of capital α are assumed to be constant and common for all countries considered. These restrictions are justified by the relative ease with which capital circulates between countries. This leads to a homogenisation in the availability of capital across countries. It is therefore plausible to imagine that savings can be easily "transferred" from one country to another.

Given the results of the previous sections, Equations 3.5.9 and 3.5.10 can be estimated using, as proxy for $E_t(r_{t,i})$, the time average of the implied

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discount factors. $E_t(GDP_i^{nom})$ and $E_t(GDP_i^{real})$ are approximated by the average quarterly growth rate of the nominal and real GDP respectively while the average inflation rate $E_t(i_i)$ is approximated by the GDP deflator rate. The results for the time period from 1987 to 2011 are summarized in Table 3.13. The cross-section of the average discount rates is well explained by the model, as the adjusted R^2 statistics (59%) suggests; more than half of the observed variability in the average level of the implied discount rates can be explained by macroeconomic factors in a manner consistent with the Solow framework.

All the coefficients are positive and highly statistically significant. The number reported indicates that a difference of 1% in the average GDP growth between two countries will cause the expected returns on equity to differ by 0.5%. The reliability of the models can also be checked by computing the implied model coefficients. Assuming the average saving rate is 0.24 (corresponding to the average rate observed in the considered sample), the implied depreciation rate δ is around 11.6%.¹¹ The implied $\gamma\alpha$ is 12.32%, which means that an increase in 1% of equity capital will cause an increase of 0.12% in the output of the economy.

To summarize, the analysis performed so far confirms a statistically significant positive relationship between GDP growth and the implied discount factor. The higher the nominal growth rate of the economy, the higher the expected return on the equity capital.

Finally, we comment on the role of inflation in determining the expected return. The numbers presented here show, not surprisingly, that inflation plays an important role in explaining the difference in DR across countries, but the parameter estimate (0.60) is less than one. This may cast some doubts on the common practice to compare stock market performance according to real rate of returns. An investor investing in a foreign country is not really concerned about the level of prices in that country. The investor is concerned only with the capital appreciation he can make and on the change

¹¹This value corresponds to the average depreciation rate across all items as provided by the Bureau of Economic Analysis (BEA), see http://www.bea.gov/scb/account_articles/national/0597niw/tablea.htm

in the movements of the exchange rate. Since no evidence of a 1-to-1 relationship between inflation and exchange rate has been demonstrated, it seems more reasonable to work with the nominal rate of returns when comparing investments between different countries, and then adjusting the return for the exchange rate (e.g. using the forward exchange rate).

Implied Discount Rate and The Credit Spread: a PCA Approach

In this section, we further analyse the main factors affecting the implied discount rate. To do this, we first reduce the data using the standard principal component analysis approach (PCA). In order to be meaningfully applied, this method requires that the data present a stationary variance-covariance structure. The Augmented Dickey Fuller test usually rejects the null of a unit root at the 5% probability level for the time series of squared discount rates ($DR_{t,c}^2$). Thus the squared implied discount rates appear to be highly persistent but without being $I(1)$. Given the high persistence of the data, as a robustness check, we decided to perform the PCA on both the original time series and on the differentiated data ($\Delta DR_{t,c} = DR_{t,c} - DR_{t-1,c}$) to exclude any concern about stationarity. Since PCA requires the same number of observations across all the variables, we consider only the 21 countries having complete observations over the time period March 1987-December 2010.

The two approaches gives substantially the same results for the first component, the correlation between the two signals is 0.9979. The other principal components do not seem to coincide, although the second and the third component appear to be switched between the two approaches. Table 3.14 reports the correlation coefficients between the principal components. For the analysis of $DR_{t,c}$ the second components has marginal explanatory power. Interestingly the weights associated are strongly correlated with the time average level of the domestic risk-free interest rates approximated by the respective three months interbank rate (see Figure 3.3). This may indicate the existence of a relation between the risk-free rates and the expected returns on the equity, although such a relation does not appear to play an important

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role in explaining the variability of the data.

The first component of ($PCA1$) in contrast, captures more than half of the cross-sectional variability of the data, and seems to coincide with the U.S. credit spread. We define the credit spread as the difference between the yield on long term U.S. government and BBB rated bond. The correlation between monthly change in the credit spread and in the $PCA1$ is 0.59. This is consistent with Merton's (1974) structural model of default, which predicts that the higher the credit spread, the lower the equity price and, consequently, the higher the expected returns. Figure 3.4 report the standardized time series of the U.S. credit spread and the first principal component. Both the variables are countercyclical, increasing in bad times and decreasing in good times. This pattern can be easily explained by considering that in period of low economic activity, corporations have a lower capability of generating profits and, consequently, a lower capability to meet all their obligations, leading to an increase of the risk of default. A complementary explanation is that in bad times, investors are more risk averse, and thus they require a higher rate on return. The above findings can be studied via the following regressions:

$$PCA1_t = \alpha + \beta Spread_t \quad (3.5.11)$$

Alternatively, by first differenced variables:

$$\Delta PCA1_t = \alpha + \beta * \Delta Spread_t \quad (3.5.12)$$

Estimates of the above regressions are reported in Table 3.15. In both specifications, the β s are positive and statistically highly significant. It is not possible to directly assess the magnitude of the causal relationship because of the manner in which a PCA is computed. The regression in 3.5.11 may, however, be spurious. Since the dependent variable is highly persistent, spurious results may emerge unless the variables are near cointegrated. In this regard, the ADF test on the residuals clearly reject the null of no co-integration and thus mitigates the concern of meaningless results. The two regressions taken together confirm the impression that the two variables are related both in

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the short and in the long horizon. Furthermore, the correlation is quite high, as the two R^2 statistics indicate.

The weights associated with the first component (Table 3.16) are all positive and relatively homogeneous across the countries considered. Furthermore, they are negatively correlated with the volatility of the implied discount factor (-0.60). Thus, the exposition to this source of risk is positive, and, on average, of equal magnitude for all the countries considered in this study.¹² This helps to explain why returns are so strongly correlated across countries. It is not clear whether this source has to be primarily identified with the credit risk per se or with the risk aversion of investors. Over this point Elton et al. (2001) showed that much of the information in the default spread is unrelated to default risk and that the spread can be largely (80%) explained as a reward for bearing systematic risk unrelated to default.

To summarize, the evidence presented so far indicates that the main factor affecting the implied discount factor (as indicated by the PCA) can be identified with the credit spread in the U.S. This factor is responsible for the time variation in the time series of $DR_{t,c}$ and captures both the increase in the risk aversion and in the implied default probabilities. The long term average level of the discount factors is determined by the different growth outlooks of each countries economy, proxied by the average growth of the nominal gross domestic product, as discussed in the previous section.

3.6 Conclusions

Using the Finite Horizon Expected Model, the implied discount factors for a large sample of stocks were derived. We aggregated the discount factors by country to have a measure of the national equity implied discount factors. This measure is able to explain the cross sectional difference in the average realized returns between the countries considered. Furthermore, it has been

¹²There is ample evidence that bond downgrade are followed by negative equity returns, confirming the positive relationship between the credit spread and the implied cost of equity capital. Refer, among others, to the work of Olthausen and Leftwich (1986), Hand, Holthausen, and Leftwich (1992), and Dichev and Piotroski (2001).

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shown that almost 70% of the variability of returns can be explained by changes in this one factor. This suggests that the implied discount factor can be interpreted as the expected return on the equity. On the basis of this findings, we propose a decomposition of returns in three main parts: one that relates to expected return, one that relates to unexpected changes in the discount factor, and a last term that relates to unexpected changes in the cash flows of the firms. This decomposition is extremely useful in understanding what actually determines results.

In the second part, we investigated over the determinants of the implied discount rate. We demonstrated that the growth outlook of the country, summarized by the GDP growth, explains the observed differences in the level of the DR : the higher the rate of growth of the GDP, the higher the discount factor. All parameter unchanged, this will translate into a negative correlation between market returns and GDP growth. The relationship found is coherent with the predictions of the Solow model.

At the same time, GDP growth also affects the cash flows of the companies, as their ability to generate profits depends heavily on the business cycle. Specifically, we found that excess growth in earnings with respect to ROE is correlated with excess growth of the GDP with respect to its long term average; a higher GDP growth rate translates into higher firms' profits that will be reflected into higher markets returns. As these two effects tend to offset each other, a direct analysis on markets returns and GDP will, most probably, not detect any correlation.

Finally we have shown using the PCA that one component accounts for more than 50% of the cross-sectional difference in the implied discount rate. This factor is strongly correlated with the credit spread, suggesting that the variability in the time series of discount factors is determined by changes in the default risk originating both from an increase in the risk aversion of investor and a deterioration of the financial health of the companies. In other words, the cross-country differences in the long term levels of the implied discount rates are determined by the respective growth outlook of the economies, while the time series dynamics are determined primarily by changes in the perceived credit risk.

3.7 Technical Appendix

Derivation of Gordon formula

By definition, the expected return on any securities is given by the expected dividend $E(DPS_{t+1})$ plus the expected price appreciation $(E(P_{t+1}) - P_t)$ divided by the initial price P_t :

$$E(r_t) = \frac{E(DPS_{t+1}) + (E(P_{t+1}) - P_t)}{P_t} \iff P_t = \frac{E(DPS_{t+1}) + E(P_{t+1})}{1 + E(r_t)} \quad (3.7.1)$$

Iteratively substituting for $E(P_{t+\tau})$ in the above equation, the well known dividend discount model (DDM) can be obtained:

$$P_t = \sum_{\tau=1}^{\infty} (1 + E(r_t))^{-\tau} E(DPS_{t+\tau}) \quad (3.7.2)$$

This equation states that the stock price P_t should equate the present value of all the stream of expected future dividends $E(DPS_{t+\tau})$. Unfortunately, DDM is not practically implementable because it requires dividend forecasts for every year into the future. Some simplifying assumptions need to be imposed. The simplest one is to assume a constant rate of growth of dividends and a constant discount factor $E(r_t)$, which simplify Equation 3.7.2 to:

$$P_t = \frac{E(DPS_{t+1})}{E(r) - g} \iff E(r) = \frac{E(DPS_{t+1})}{P_t} + g \quad (3.7.3)$$

where g is the assumed constant growth rate in dividends. A weakness of this model is the assumption of a constant perpetual growth in dividends. Gordon and Gordon (1997) attempt to overcome this weakness. Assuming that earnings are the sole source of funds for equity investment and that dividends are the sole means for distributing funds to investors, they re-specify the previous equation in terms of earning per share EPS_{t+1} , earnings retention rate RTR and return on equity (ROE).

$$E(r) = \frac{E(EPS_{t+1})(1 - RTR)}{P_t} + (ROE * RTR) \quad (3.7.4)$$

The works of Holt (1962), Brigham and Pappas (1966), and others have shown that a corporation cannot be expected to have abnormally high or low growth rates forever; for this reason, the expected return that investors require and the return on equity have to be the same in the long run. Under the assumption that ROE is equal to the rate of return that investors require on its shares, Equation 3.7.4 simplifies to:

$$E(r) = \frac{E(EPS_{t+1})}{P_t} \iff P_t = \frac{E(EPS_{t+1})}{E(r)} \quad (3.7.5)$$

Gordon and Gordon (1997) considered the case in which abnormal performances are foreseeable only up to a finite horizon T . They assume that beyond this time ROE and $E(r)$ will coincide.

$$E(r) = ROE, \tau > T \quad (3.7.6)$$

Combining Equations 3.7.2 and 3.7.5 under that condition the following expression is easily derived:

$$P_t = \sum_{\tau=1}^T \frac{E(DPS_{t+\tau})}{[1 + E(r)]^\tau} + \frac{E(EPS_{t+1+T})}{E(r) [1 + E(r)]^T} \quad (3.7.7)$$

Derivation of the Solow Model

Consider the Cobb-Douglas production function:

$$Y_t = \Pi_t \cdot A_t \cdot K_t^\alpha \cdot L_t^{1-\alpha} \quad (3.7.8)$$

or, in log form:

$$\log(Y_t) = \log(\Pi_t) + \log(A_t) + \alpha \log(K_t) + (1 - \alpha) \log(L_t) \quad (3.7.9)$$

Taking the first derivatives with respect to time one gets:

$$\frac{\dot{Y}_t}{Y_t} = \frac{\dot{\Pi}_t}{\Pi_t} + \frac{\dot{A}_t}{A_t} + \alpha \frac{\dot{K}_t}{K_t} + (1 - \alpha) \frac{\dot{L}_t}{L_t} \quad (3.7.10)$$

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The marginal productivity of the capital can be obtained by taking the first derivative with respect to K of Equation 3.7.8:

$$\frac{\delta Y_t}{\delta K_t} = \alpha \Pi_t A_t K_t^{\alpha-1} L_t^{1-\alpha} = \alpha \frac{Y_t}{K_t} \quad (3.7.11)$$

Assume the capital accumulates according to:

$$\dot{K}_t = sY_t - \delta K_t \quad (3.7.12)$$

where s and δ are the saving rate and the depreciation rate respectively. Dividing both sides by K , one gets the growth rate of capital:

$$\frac{\dot{K}_t}{K_t} = s \frac{Y_t}{K_t} - \delta \quad (3.7.13)$$

This will be constant only if $\frac{Y_t}{K_t}$ is constant, which is satisfied only if Y_t grows at the same rate of the capital (K). This means the economy is in a steady state growth path:

$$\frac{\dot{K}_t}{K_t} = \frac{\dot{Y}_t}{Y_t} \quad (3.7.14)$$

Substituting this into equation 3.7.10 and defining g as the increase in the technology, n as the increase in the labour and i as the inflation rate one obtains:

$$\frac{\dot{Y}_t}{Y_t} = i + g + \alpha \frac{\dot{Y}_t}{Y_t} + (1 - \alpha) n \quad (3.7.15)$$

Rearranging the terms:

$$\frac{\dot{Y}_t}{Y_t} = \left(\frac{i + g}{1 - \alpha} + n \right) \quad (3.7.16)$$

Defining $x_t = \frac{K_t}{Y_t}$, taking the logarithm and taking the first derivative with respect to time one gets:

$$\frac{\dot{x}_t}{x_t} = \frac{\dot{K}_t}{K_t} - \frac{\dot{Y}_t}{Y_t} \quad (3.7.17)$$

Substituting this into Equation 3.7.15 under the assumption of a steady state

3.7. TECHNICAL APPENDIX

economy one gets:

$$\frac{\dot{K}_t}{K_t} - \frac{\dot{x}_t}{x_t} = i + g + \alpha \frac{\dot{K}_t}{K_t} + (1 - \alpha)n \quad (3.7.18)$$

or

$$\frac{\dot{x}_t}{x_t} = (1 - \alpha) \left(\frac{\dot{K}_t}{K_t} - \frac{g + i}{1 - \alpha} - n \right) \quad (3.7.19)$$

Substituting in the above expression into Equation 3.7.13 one gets:

$$\frac{\dot{x}_t}{x_t} = (1 - \alpha) \left(\frac{s}{x_t} - \delta - \frac{g + i}{1 - \alpha} - n \right) \quad (3.7.20)$$

In the steady state economy, the capital/output ratio is assumed to be constant:

$$\frac{s}{x_t^*} - \delta - \frac{g + i}{1 - \alpha} - n = 0 \quad (3.7.21)$$

or

$$x_t^* = \frac{s}{\frac{g + i}{1 - \alpha} + n + \delta} \quad (3.7.22)$$

Finally combining equations 3.7.11, 3.7.16 and 3.7.22, one can derive an expression for the rate of return of capital:

$$r_t = \frac{\alpha}{s} (GDP_t^{nom} + \delta) \quad (3.7.23)$$

In terms of real GDP, a similar expression can be derived. Notice that eq 3.7.16 can be restated as:

$$\frac{\dot{Y}_t}{Y_t} = \left(\frac{g}{1 - \alpha} + \frac{i}{1 - \alpha} + n \right) = GDP_t^{real} + \frac{i}{1 - \alpha} \quad (3.7.24)$$

So that eq. 3.7.23 becomes:

$$r_t = \frac{\alpha}{s} \left(GDP_t^{real} + \frac{i}{1 - \alpha} + \delta \right) \quad (3.7.25)$$

3.8 Tables & Figures

3.8. TABLES & FIGURES

Table 3.1: Market Returns: Summary Statistics

This table reports the summary statistics for the time series of returns for all the countries considered for the time period from January 1987 to March 2011.

Country	Code	First Obs.	# Obs	# of stock	Summary statistics						Autocorrelations				
					Mean	Median	Maximum	Minimum	Std	Skewness	Kurtosis	1	2	3	4
South Africa	ZAR	15.01.1987	290	348	1.13%	1.66%	18.17%	-32.47%	5.69%	-0.82	7.15	0.14	-0.04	0.04	0.01
Brazil	BRL	14.10.1999	136	135	2.31%	2.94%	20.65%	-27.53%	7.99%	-0.79	4.50	0.28	0.09	0.11	0.04
Canada	CAD	15.01.1987	290	800	1.01%	1.41%	16.03%	-28.33%	5.15%	-1.18	8.03	0.23	0.07	0.00	0.02
Mexico	MXN	18.06.1992	225	247	1.43%	2.33%	23.75%	-22.00%	6.71%	-0.14	4.02	0.22	0.04	0.01	0.08
United States	USD	15.01.1987	287	1547	1.35%	2.11%	26.91%	-26.49%	6.01%	-0.68	7.69	0.03	-0.06	0.00	0.06
Japan	JPY	15.01.1987	290	804	0.43%	0.07%	22.34%	-24.62%	6.39%	-0.06	3.89	0.11	0.02	-0.01	0.09
Hong Kong	HKD	15.01.1987	290	608	1.16%	1.92%	33.09%	-49.93%	9.19%	-0.83	7.36	0.13	0.02	-0.09	-0.11
Malaysia	MYR	15.01.1987	290	519	1.23%	0.87%	60.09%	-37.25%	9.21%	0.96	10.85	0.14	0.04	-0.05	-0.07
Philippines	PHP	17.09.1987	282	148	1.29%	0.95%	50.06%	-25.57%	9.54%	0.69	6.22	0.17	-0.01	0.01	0.00
Singapore	SGD	15.01.1987	290	612	0.82%	1.01%	29.88%	-43.65%	8.39%	-0.34	6.31	0.22	0.04	0.02	-0.07
South Korea	KRW	18.02.1988	277	511	1.07%	1.08%	45.52%	-30.88%	9.29%	0.31	5.63	0.12	0.04	-0.01	0.08
Austria	ATS	15.01.1987	290	152	0.66%	0.83%	20.57%	-25.87%	5.71%	-0.49	6.19	0.31	0.11	0.12	0.20
Belgium	BEF	15.01.1987	290	130	0.76%	1.07%	23.44%	-21.84%	5.04%	-0.52	6.77	0.22	0.01	-0.02	0.07
Denmark	DKK	15.01.1987	290	222	0.72%	0.73%	22.56%	-19.32%	5.16%	-0.24	5.55	0.21	0.02	0.11	0.17
Finland	FIM	20.08.1987	275	191	0.86%	0.89%	37.78%	-17.33%	6.72%	0.90	7.21	0.27	0.05	0.12	0.03
France	FRF	15.01.1987	290	496	0.87%	1.32%	17.31%	-25.28%	5.91%	-0.72	5.01	0.24	0.06	0.03	0.02
Germany	DEM	15.01.1987	290	462	1.26%	0.60%	57.94%	-29.09%	11.41%	1.31	7.92	0.20	0.09	0.09	0.14
Greece	GRD	19.11.1992	219	293	0.48%	1.12%	23.46%	-26.57%	6.14%	-0.74	6.02	0.20	0.14	0.27	0.10
Italy	ITL	15.01.1987	290	456	0.31%	0.57%	23.46%	-26.98%	6.54%	-0.22	5.11	0.11	0.00	0.11	0.05
Netherlands	NLG	15.01.1987	290	322	0.64%	1.21%	19.93%	-24.04%	5.47%	-0.82	6.46	0.30	0.09	0.05	0.05
Norway	NOK	15.01.1987	290	311	1.08%	1.87%	19.35%	-31.99%	6.98%	-0.74	4.94	0.27	0.14	0.09	-0.01
Spain	ESP	19.03.1987	288	257	0.73%	0.75%	22.83%	-38.43%	6.33%	-0.75	8.59	0.17	-0.04	0.06	-0.01
Sweden	SEK	15.01.1987	290	295	1.19%	2.07%	24.21%	-31.84%	7.01%	-0.59	5.32	0.22	0.16	0.05	-0.02
Switzerland	CHF	15.01.1987	290	337	0.59%	1.26%	15.05%	-33.38%	5.35%	-1.42	9.49	0.29	0.06	0.00	0.05
United Kingdom	BPN	15.01.1987	290	600	0.94%	1.45%	23.20%	-33.17%	5.72%	-1.07	8.70	0.12	-0.09	0.03	0.06
Australia	AUD	15.01.1987	290	575	0.73%	1.11%	20.71%	-38.48%	5.34%	-1.59	13.86	0.20	-0.02	0.09	0.02
New Zealand	NZD	15.01.1987	290	181	0.44%	0.58%	19.26%	-33.11%	5.18%	-0.50	9.35	0.17	-0.07	-0.01	-0.06
World	-	15.01.1987	290	11579	0.90%	1.65%	16.80%	-28.85%	4.81%	-1.37	9.32	0.25	0.06	0.05	0.05

Table 3.2: Return: Correlation Matrix

Panel A: Estimates over the full sample period. Panel B: Estimates over the first half of the sample (1987-1999). Panel C: Estimates over the second half of the sample (1999-2011)

[illegible]

3.8. TABLES & FIGURES

Table 3.3: Implied Discount Factor: Summary Statistics

This table reports the summary statistics for the time series of implied discount factors for all the countries considered for the time period from January 1987 to March 2011.

	Country	# Obs	Summary statistics							AR Coefficients						
			Mean	Median	Maximum	Minimum	Std	Skewness	Kurtosis	1	2	3	4			
South Africa	290	12.71%	12.10%	19.90%	8.02%	0.02	0.66	2.71	0.95	0.90	0.87	0.83				
	136	14.36%	13.90%	23.85%	8.29%	0.04	0.49	2.12	0.95	0.88	0.82	0.76				
	Brazil	290	8.92%	8.70%	16.13%	6.67%	0.01	2.09	11.04	0.92	0.82	0.73	0.64			
Mexico	225	11.92%	11.39%	18.75%	7.03%	0.03	0.45	2.23	0.96	0.92	0.88	0.85				
	287	7.75%	7.58%	13.18%	5.81%	0.01	0.84	3.22	0.95	0.90	0.87	0.83				
	United States	290	4.61%	4.56%	10.33%	2.28%	0.02	0.42	2.14	0.98	0.96	0.94	0.91			
Hong Kong	290	12.51%	12.59%	21.08%	8.06%	0.02	0.56	3.63	0.91	0.80	0.70	0.62				
	290	8.82%	9.02%	17.26%	3.32%	0.03	0.33	2.86	0.96	0.92	0.87	0.83				
	Malaysia	290	12.06%	11.70%	22.37%	6.55%	0.03	0.47	2.51	0.93	0.86	0.79	0.72			
Philippines	282	9.04%	9.11%	18.90%	3.93%	0.03	0.79	4.01	0.95	0.89	0.83	0.77				
	Singapore	290	10.33%	8.93%	23.20%	5.89%	0.04	1.45	4.25	0.97	0.94	0.91	0.88			
	South Korea	277	7.63%	7.44%	16.10%	4.23%	0.02	1.17	5.64	0.95	0.90	0.85	0.79			
Austria	290	8.26%	7.98%	13.77%	5.10%	0.02	1.02	4.25	0.95	0.89	0.83	0.77				
	Belgium	290	8.51%	8.20%	14.17%	5.92%	0.01	1.20	4.87	0.94	0.88	0.84	0.79			
	Denmark	290	9.50%	9.35%	14.80%	6.40%	0.02	0.76	3.45	0.30	0.28	0.24	0.20			
Finland	275	7.55%	7.26%	12.78%	5.20%	0.01	1.22	5.01	0.95	0.88	0.81	0.75				
	France	290	10.41%	9.07%	29.45%	5.81%	0.04	2.40	8.83	0.97	0.93	0.89	0.85			
	Germany	290	7.67%	7.24%	14.73%	5.08%	0.02	1.38	4.85	0.93	0.87	0.80	0.72			
Greece	219	8.27%	8.23%	12.52%	5.38%	0.01	0.36	2.74	0.92	0.85	0.77	0.69				
	Italy	290	9.62%	9.44%	16.25%	6.71%	0.02	1.35	5.30	0.94	0.86	0.79	0.72			
	Netherlands	290	11.27%	10.86%	19.56%	7.50%	0.03	1.19	4.04	0.94	0.86	0.80	0.75			
Norway	290	8.27%	8.29%	12.24%	5.29%	0.01	0.23	2.64	0.94	0.87	0.80	0.73				
	Spain	288	9.50%	9.18%	14.48%	6.58%	0.02	0.75	2.88	0.92	0.83	0.72	0.63			
	Sweden	290	8.95%	8.76%	13.64%	6.56%	0.01	0.89	3.71	0.94	0.87	0.79	0.72			
Switzerland	290	9.12%	8.98%	15.24%	6.73%	0.01	1.08	5.14	0.92	0.82	0.75	0.69				
	United Kingdom	290	9.56%	9.21%	16.30%	7.03%	0.02	1.27	4.86	0.94	0.87	0.80	0.72			
	Australia	290	9.86%	9.53%	17.06%	7.03%	0.02	1.14	4.35	0.94	0.87	0.82	0.78			
New Zealand	290	9.52%	9.21%	16.96%	6.01%	2.16%	0.96	4.20	0.92	0.86	0.80	0.74				
World																

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Table 3.4: Implied Discount Factor: Unit Root Test

This table reports the ADF Fisher group unit root test. The optimal number of lags is selected according to the AIC criterion.

Probabilities for Fisher tests are computed using an asymptotic Chi-square distribution. All other tests assume asymptotic normality.

Unit root test for DR				
Null Hypothesis: Unit root (individual unit root process)				
Method		Statistic		Prob.
ADF - Fisher Chi-square		190.72		0.00
ADF - Choi Z-stat		-8.99		0.00
Intermediate ADF test results DR				
Series	Prob.	Lag	Max Lag	Obs.
DR_AU	0.01	3	15	287
DR_BE	0.07	6	15	284
DR_BRA	0.29	3	12	133
DR_CA	0.00	1	15	289
DR_USA	0.17	2	15	285
DR_CH	0.01	1	15	289
DR_DE	0.11	2	15	288
DR_DK	0.06	15	15	275
DR_FI	0.01	0	15	275
DR_FR	0.02	1	15	289
DR_GR	0.03	14	14	205
DR_HK	0.01	3	15	287
DR_IT	0.00	3	15	287
DR_JP	0.77	1	15	289
DR_MEX	0.37	0	14	225
DR_MYR	0.15	15	15	275
DR_NL	0.01	1	15	289
DR_NO	0.10	7	15	283
DR_NZ	0.03	0	15	290
DR_OS	0.10	6	15	284
DR_PH	0.02	1	15	281
DR_SA	0.10	1	15	289
DR_SG	0.03	1	15	289
DR_SK	0.38	0	15	277
DR_SP	0.01	1	15	287
DR_SW	0.00	2	15	288
DR_UK	0.00	4	15	286

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Table 3.5: Implied Discount Factor: Mean Reversion

This table reports the estimate for the discrete version of the Ornstein-Uhlenbeck Process.

$$\Delta DR_{i,t} = \alpha_i + \beta_i DR_{i,t-1} + \epsilon_{i,t} \sigma \sqrt{(\Delta t)}$$

where $\alpha = \kappa DR$ and $\beta = -\kappa$.

*, **, *** means significant at the 10%, 5% and 1% respectively.

	SUR Model		FE Model		Pooled model	
Country	$-\beta$	$-\alpha/\beta$	$-\beta$	$-\alpha/\beta$	$-\beta$	$-\alpha/\beta$
South Africa	0.0526** (0.0227)	0.1296*** (0.0084)		0.1298***		
Brazil	0.0408* (0.0220)	0.1371*** (0.0255)		0.1380***		
Canada	0.0749* (0.0388)	0.0890*** (0.0038)		0.0889***		
Mexico	0.0322* (0.0172)	0.1150*** (0.0161)		0.1164***		
United States	0.0509 (0.0322)	0.0768*** (0.0049)		0.0768***		
Japan	0.0081 (0.0141)	0.0698 (0.0592)		0.0500***		
Hong Kong	0.0875** (0.0370)	0.1249*** (0.0067)		0.1246***		
Malaysia	0.0373 (0.0263)	0.0931*** (0.0135)		0.0921***		
Philippines	0.0681** (0.0330)	0.1172*** (0.0093)		0.1156***		
Singapore	0.0460** (0.0234)	0.0949*** (0.0111)		0.0948***		
South Korea	0.0245 (0.0188)	0.1011*** (0.0209)		0.1023***		
Austria	0.0429 (0.0297)	0.0776*** (0.0081)		0.0774***		
Belgium	0.0477* (0.0238)	0.0825*** (0.0057)		0.0825***		
Denmark	0.0547* (0.0326)	0.0860*** (0.0053)	0.0475*** (0.0132)	0.0862***	0.0262*** (0.0076)	0.0863***
Finland	0.0901*** (0.0267)	0.0950*** (0.0048)		0.0949***		
France	0.0487* (0.0260)	0.0781*** (0.0058)		0.0782***		
Germany	0.0724 (0.0517)	0.1030*** (0.0153)		0.1025***		
Greece	0.0292 (0.0241)	0.0788*** (0.0103)		0.0780***		
Italy	0.0755*** (0.0259)	0.0832*** (0.0041)		0.0835***		
Netherlands	0.0596** (0.0295)	0.0975*** (0.0059)		0.0978***		
Norway	0.0597*** (0.0203)	0.1087*** (0.0071)		0.1077***		
Spain	0.0608*** (0.0219)	0.0844*** (0.0048)		0.0849***		
Sweden	0.0805*** (0.0275)	0.0934*** (0.0046)		0.0922***		
Switzerland	0.0570** (0.0236)	0.0904*** (0.0046)		0.0905***		
United Kingdom	0.0835** (0.0397)	0.0914*** (0.0037)		0.0915***		
Australia	0.0574** (0.0273)	0.0956*** (0.0057)		0.0956***		
New Zealand	0.0626** (0.0316)	0.0989*** (0.0062)		0.0990***		
R^2	2.92%		2.43%		1.42%	
$Adj. R^2$	2.23%		2.08%		1.40%	
RSS	0.3830		0.3845		0.3871	
DW	1.78		1.79		1.81	

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Table 3.6: Ornstein-Uhlenbeck: Model Specification

This table reports the statistical test on parameter restriction in the Ornstein-Uhlenbeck model.

Panel A: Test for the null hypothesis that all κ are equal across countries.

Panel B: Test for redundant Fixed Effects terms in the panel regression (that is a unique long term mean for every country).

Panel C: Test the pooled model vs the Fixed Effect (FE) model and Seemingly Unrelated Regression model.

Panel A: Wald Test					
H_0 : all κ' are equal					
Test Statistic	Value	df	Prob.		
F-statistic	1.167713	(25, 7445)	0.2564		
Panel B: Redundant Fixed Effects Tests					
Effects Test	Statistic	d.f.	Prob.		
Cross-section F	3.097108	(26,7471)	0		
Panel C: F-test					
H_0 : FE Model		H_0 : Pooled Model			
H_A : SUR Model		H_A : FE Model			
F-stat	5% crit Value	Prob.	F-stat	5% crit Value	Prob.
1.0661	1.4971	0.3728	1.9633	1.4971	0.0024

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Table 3.7: Discount Factor and Realized Return:

This table reports the estimate of the unconditional OLS regression: $\bar{r}_i - r_{i,t}(DR_i) = \alpha + \beta \bar{DR}_i$

Full sample: The average is taken on all available observations.

Common Sample: The averages are computed on the same numbers of observations for every country.

*, **, *** means significant at the 10%, 5% and 1% respectively.

	Full Sample		Common Sample	
Years:	1987-2011		1999-2011	
α	-0.0088	-0.0382	-0.0230	
	(0.0354)	(0.0763)	(0.0454)	
β	1.3574***	1.2943	1.2499**	
	(0.3639)	(0.7677)	(0.4557)	
$Adj.R^2$	0.33	0.07	0.21	
DW	1.52	1.92	1.87	
$Nobs.$	27	27	26+	
+Belgium is dropped from the sample as an outliers				

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Table 3.8: Implied Discount Factor and Market Return

Panel A: reports the GLS estimates of the regression: $r_{i,t+1} = \alpha_i + \beta_i dr_{i,t} + e_{i,t}$
GLS weighting: Cross-section heteroskedasticity.
Coefficient covariance: White period method.
Panel B: reports the F-statistics on parameter restriction of the general regression:
The first row is the Wald type test on the restriction $\alpha_i = 0$ and $\beta_i = 1, \forall i$.
The second row is the test on redundant fixed effects ($\alpha_i = 0, \forall i$) assuming β to be common.
The third row is the Wald test on the $\alpha = 0$ and $\beta = 1$ assuming α and β to be common.

Panel A: GLS estimates			
Variable	Coefficient	Std. Error	t-Statistic
α	-0.0131	(0.0230)	-0.57
β	1.0289	(0.2672)	3.85
Weighted Statistics			
R^2	0.0010	Mean dependent var	0.0838
$Adj.R^2$	0.0009	S.D. dependent var	0.8450
S.E. of regression	0.8446	Sum squared resid	5141.19
F-statistic	7.4712	Durbin-Watson stat	1.6020
Prob(F-statistic)	0.0063		
Unweighted Statistics			
R^2	0.0017	Mean dependent var	0.0801
Sum squared resid	5142.33	Durbin-Watson stat	1.6251
Panel B: Coefficients test			
Null Hypothesis	Statistic	Prob.	
SUR: All $\beta_i = 1$; $\alpha = 0$	0.8507	0.69	
Redundant Fixed Effects Tests	0.4664	0.99	
Pooled: $\beta = 1$; $\alpha = 0$	1.5290	0.22	

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Table 3.9: DR vs Ret: Covariance Matrix Residuals

This table reports the estimated covariance matrix of the residual of the panel regression $r_{i,t+1} = \alpha + \beta dr_{i,t} + \epsilon_{i,t}$

	SA	BRA	CA	MEX	USA	JP	HK	MYR	PH	SG	SK	OS	DK	FI	FR	GR	DE	IT	NL	NO	SP	SW	CH	UK	AU	NZ
SA	0.47	0.15	0.24	0.20	0.25	0.19	0.42	0.29	0.36	0.37	0.15	0.21	0.19	0.20	0.22	0.17	0.28	0.27	0.23	0.30	0.28	0.31	0.26	0.27	0.27	0.20
BRA	0.15	0.87	0.21	0.29	0.25	0.18	0.30	0.18	0.26	0.26	0.30	0.22	0.20	0.21	0.22	0.30	0.25	0.22	0.22	0.23	0.18	0.23	0.20	0.20	0.19	0.10
CA	0.24	0.21	0.38	0.22	0.34	0.25	0.42	0.29	0.34	0.39	0.21	0.26	0.24	0.25	0.29	0.25	0.31	0.29	0.29	0.35	0.30	0.34	0.29	0.30	0.21	0.20
MEX	0.20	0.29	0.22	0.61	0.28	0.21	0.38	0.23	0.33	0.30	0.24	0.23	0.19	0.22	0.23	0.28	0.26	0.23	0.25	0.26	0.23	0.24	0.22	0.23	0.21	0.11
USA	0.25	0.25	0.34	0.28	0.55	0.30	0.48	0.29	0.34	0.43	0.32	0.29	0.26	0.26	0.35	0.27	0.39	0.34	0.33	0.37	0.34	0.40	0.34	0.37	0.31	0.22
JP	0.19	0.18	0.25	0.21	0.30	0.50	0.42	0.32	0.30	0.42	0.27	0.24	0.21	0.18	0.26	0.25	0.35	0.26	0.26	0.30	0.30	0.27	0.28	0.28	0.25	0.16
HK	0.42	0.30	0.42	0.38	0.48	0.42	1.35	0.78	0.75	0.92	0.39	0.32	0.32	0.29	0.38	0.35	0.51	0.44	0.42	0.57	0.50	0.50	0.47	0.50	0.38	
MYR	0.29	0.18	0.29	0.23	0.29	0.32	0.78	1.12	0.67	0.77	0.22	0.26	0.26	0.26	0.28	0.26	0.37	0.31	0.27	0.37	0.34	0.35	0.32	0.33	0.34	0.24
PH	0.36	0.26	0.34	0.33	0.34	0.30	0.75	0.67	1.21	0.68	0.32	0.31	0.28	0.27	0.28	0.32	0.35	0.32	0.31	0.37	0.36	0.35	0.33	0.34	0.36	0.28
SG	0.37	0.26	0.39	0.30	0.43	0.42	0.92	0.77	0.68	1.02	0.38	0.34	0.34	0.32	0.40	0.35	0.47	0.45	0.41	0.53	0.47	0.49	0.43	0.46	0.44	0.33
SK	0.15	0.30	0.21	0.24	0.32	0.27	0.39	0.22	0.32	0.38	1.21	0.22	0.19	0.23	0.25	0.15	0.29	0.25	0.27	0.23	0.24	0.25	0.21	0.26	0.21	0.14
OS	0.21	0.22	0.26	0.23	0.29	0.24	0.32	0.26	0.31	0.34	0.22	0.44	0.25	0.23	0.32	0.28	0.37	0.30	0.31	0.31	0.32	0.32	0.30	0.28	0.25	0.15
DK	0.19	0.20	0.24	0.19	0.26	0.21	0.32	0.26	0.28	0.34	0.19	0.25	0.37	0.28	0.29	0.26	0.32	0.30	0.29	0.33	0.28	0.34	0.28	0.27	0.24	0.16
FI	0.20	0.21	0.25	0.22	0.26	0.18	0.29	0.26	0.27	0.32	0.23	0.23	0.28	0.57	0.30	0.29	0.31	0.33	0.27	0.37	0.29	0.42	0.28	0.28	0.22	0.17
FR	0.22	0.22	0.29	0.23	0.35	0.26	0.38	0.28	0.28	0.40	0.25	0.32	0.29	0.30	0.49	0.36	0.43	0.40	0.38	0.38	0.39	0.43	0.37	0.36	0.27	0.20
GR	0.17	0.30	0.25	0.28	0.27	0.25	0.55	0.26	0.32	0.35	0.15	0.28	0.26	0.29	0.36	1.61	0.37	0.29	0.31	0.29	0.34	0.30	0.29	0.25	0.17	0.17
DE	0.28	0.25	0.31	0.26	0.39	0.30	0.51	0.37	0.35	0.47	0.29	0.37	0.32	0.31	0.43	0.37	0.55	0.44	0.41	0.44	0.42	0.47	0.42	0.39	0.31	0.21
IT	0.27	0.22	0.29	0.23	0.34	0.26	0.44	0.31	0.32	0.45	0.25	0.30	0.30	0.33	0.40	0.29	0.44	0.63	0.37	0.42	0.43	0.43	0.39	0.39	0.30	0.22
NL	0.23	0.22	0.29	0.25	0.33	0.26	0.42	0.27	0.31	0.41	0.27	0.31	0.29	0.30	0.37	0.38	0.29	0.41	0.37	0.41	0.38	0.37	0.30	0.33	0.28	0.19
NO	0.30	0.23	0.35	0.26	0.37	0.30	0.57	0.37	0.37	0.53	0.23	0.31	0.33	0.37	0.38	0.31	0.44	0.42	0.38	0.68	0.43	0.51	0.40	0.39	0.35	0.26
SP	0.28	0.18	0.30	0.23	0.34	0.30	0.50	0.34	0.36	0.47	0.24	0.32	0.28	0.29	0.39	0.29	0.42	0.43	0.37	0.43	0.60	0.42	0.39	0.41	0.34	0.26
SW	0.31	0.23	0.34	0.24	0.40	0.27	0.50	0.35	0.35	0.49	0.25	0.32	0.34	0.42	0.43	0.39	0.51	0.42	0.43	0.39	0.51	0.42	0.40	0.34	0.25	
CH	0.26	0.20	0.29	0.22	0.34	0.28	0.47	0.32	0.33	0.43	0.21	0.30	0.28	0.28	0.37	0.30	0.42	0.39	0.36	0.40	0.39	0.42	0.42	0.36	0.31	0.22
UK	0.27	0.20	0.30	0.23	0.37	0.28	0.50	0.33	0.34	0.46	0.26	0.28	0.27	0.28	0.36	0.29	0.39	0.30	0.33	0.39	0.41	0.40	0.36	0.30	0.34	0.23
AU	0.27	0.19	0.30	0.21	0.31	0.25	0.50	0.34	0.36	0.44	0.21	0.25	0.24	0.22	0.27	0.25	0.31	0.30	0.28	0.35	0.34	0.34	0.31	0.34	0.44	0.29
NZ	0.20	0.10	0.21	0.11	0.22	0.16	0.38	0.24	0.28	0.33	0.14	0.15	0.16	0.17	0.20	0.17	0.21	0.22	0.19	0.26	0.26	0.25	0.22	0.23	0.29	0.39

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Table 3.10: Discount Factor and Realized Return: SUR regression

This table reports the estimate of the SUR model without intercept:

$$r_{i,t} = \beta dr_{i,t-1} + e_{i,t}$$

*, **, *** means significant at the 10%, 5% and 1% respectively.

Variable	Coefficient	Std. Error	t-Statistic	Prob.
SA	1.0904***	(0.4173)	2.6130	0.01
BRA	1.8641***	(0.7249)	2.5715	0.01
CA	1.2504**	(0.5276)	2.3703	0.02
MEX	1.2551**	(0.5668)	2.2143	0.03
USA	2.0542***	(0.7240)	2.8373	0.00
JP	0.6320	(1.1799)	0.5356	0.59
HK	0.9307	(0.7163)	1.2994	0.19
MYR	1.2127	(0.8901)	1.3625	0.17
PH	1.0485	(0.7027)	1.4921	0.14
SG	0.7756	(0.8310)	0.9333	0.35
SK	1.0911	(0.8002)	1.3635	0.17
OS	0.7906	(0.6503)	1.2157	0.22
DK	0.8567	(0.5428)	1.5784	0.11
FI	0.9489	(0.6216)	1.5266	0.13
FR	1.1714*	(0.7022)	1.6680	0.10
GR	1.6477	(1.0204)	1.6147	0.11
DE	0.5177	(0.7233)	0.7157	0.47
IT	0.3186	(0.7295)	0.4367	0.66
NL	0.6843	(0.5111)	1.3390	0.18
NO	1.0667*	(0.5619)	1.8984	0.06
SP	0.8153	(0.7122)	1.1448	0.25
SW	1.3107**	(0.6724)	1.9493	0.05
CH	0.5791	(0.5523)	1.0485	0.29
UK	1.1762**	(0.5914)	1.9886	0.05
AU	0.8171	(0.5300)	1.5417	0.12
NZ	0.5060	(0.4801)	1.0540	0.29
AR(1)	0.2008***	(0.0336)	5.9763	0.00
Weighted Statistics				
R-squared	0.042919	Mean dependent var		0.083836
Adjusted R-squared	0.0394	S.D. dependent var		0.8469
S.E. of regression	0.8300	Sum squared resid		4930.21
Durbin-Watson stat	1.9988			

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Table 3.11: Return Decomposition:

This table reports the estimate of the panel regression:

$$\log(1 + r_{i,t}) - \log(1 + DR_{i,t-1}) = \alpha + \beta \log\left(\frac{DR_{i,t-1}}{DR_{i,t}}\right) + \epsilon_{i,t}$$

Cross-section GLS weighting: cross-section weight

Coefficient covariance: White period standard errors & covariance (d.f. corrected)

*, **, *** means significant at the 10%, 5% and 1% respectively.

Period	1987-2011	1999-2011
α	-0.0001 (0.0006)	-0.0016 (0.0005)
β	0.9207*** (0.0335)	0.9589*** (0.0285)
Weighted Statistics		
$Adj.R^2$	0.7013	0.7246
DW	1.6446	1.6271
Unweighted statistic		
R^2	0.5750	0.6309
DW	1.6916	1.6627

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Table 3.12: Cash Flow News and GDP Growth

This table reports the estimate of the panel regression:

$$\epsilon_{i,t} = \alpha + \beta_1 [GDP_{i,t} - E(GDP_i)] + \beta_2 [GDP_{i,t+1} - E(GDP_i)]$$

Parameters are estimated via GLS: weighting matrix, cross-section hetheroskedasticity. Robust coefficient covariance: White Period method.

Standard errors are reported in parenthesis

Model 4+ assumes $\beta_1 = \beta_2$

Model 5++ considers only the periods 1999-2011

*, **, *** means significant at the 10%, 5% and 1% respectively.

	Model 1	Model 2	Model 3	Model 4+	Model 5++
α	0.0005 (0.0006)	0.0005 (0.0006)	0.0005 (0.0006)	0.0005 (0.0006)	0.0001 (0.0007)
β_1	0.3360*** (0.0710)	0.7731*** (0.0752)		0.9040*** (0.0756)	1.1672*** (0.0862)
β_2	0.5683*** (0.0823)		0.8239*** (0.0765)		
Weighted statistics					
$Adj.R^2$	0.0548	0.0453	0.0510	0.0547	0.0968
DW	1.7062	1.6976	1.7159	1.7031	1.7676
Unweighted statistics					
R^2	0.0451	0.0348	0.0429	0.0443	0.0852
DW	1.7617	1.7575	1.7754	1.7590	1.8311

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Table 3.13: Implied Discount Rate vs. GDP

This table reports the coefficients estimates for the regression:

$$DR_i = c + \beta GDP_i + \lambda i_i$$

where: $c = \frac{\gamma\alpha\delta}{s}$, $\beta = \frac{\gamma\alpha}{s}$ and $\lambda = \frac{\alpha\gamma}{s(1-\alpha)}$.

s is the saving rate of the economy, δ is the depreciation rate of the existing capital, α is the output elasticity of the capital, and γ is an adjustment for risk. In model 1, we consider real GDP and inflation rate (GDP deflator) while in model 2, we consider the nominal GDP. *, **, *** means significant at the 10%, 5% and 1% respectively.

OLS Regression				
	Model 1	Model 2	Implied Coefficients	
c	0.0605*** (0.0069)	0.0586*** (0.0066)	s :	0.24
β	0.4322*** (0.1794)	0.5639*** (0.0905)	δ :	0.1160
λ	0.6088*** (0.1051)		$\alpha\gamma$:	0.1232
$Adj.R^2$	0.59	0.59		
DW	1.91	1.71		

Table 3.14: PCA: Correlation Matrix

This table reports the correlation between the Eigenvectors computed on $DR_{t,i}$ (PCA_i^{DR}) and on $\Delta DR_{i,t}$ ($PCA_i^{\Delta DR}$)

	ΔPCA_1^{DR}	ΔPCA_2^{DR}	ΔPCA_3^{DR}	ΔPCA_4^{DR}	ΔPCA_5^{DR}
$PCA_1^{\Delta DR}$	1.00	0.56	-0.25	0.40	0.42
$PCA_2^{\Delta DR}$	0.05	-0.04	0.85	-0.48	-0.47
$PCA_3^{\Delta DR}$	0.01	0.70	-0.09	0.10	-0.40
$PCA_4^{\Delta DR}$	0.00	-0.08	-0.20	0.13	-0.34
$PCA_5^{\Delta DR}$	0.00	0.12	-0.31	-0.53	0.07

Table 3.15: PCA and Credit spread

The table reports the OLS regression between the first eigenvector and the credit spread (Spread):

Model A : $\Delta PCA_{1,t}^{DR} = \alpha + \beta * \Delta Spread_t$

Model B : $PCA_{1,t}^{DR} = \alpha + \beta * Spread_t$

*, **, *** means significant at the 10%, 5% and 1% respectively.

Model A		Model B	
α	-0.0029 (0.0511)	α	-6.0122*** (0.3115)
β	2.4268*** (0.1953)	β	2.2393*** (0.1076)
$AdjR^2$	0.35	$AdjR^2$	0.60
DW	1.75	ADF_{T-stat}	-4.4013***
N_{Obs}	285	N_{Obs}	285

3.8. TABLES & FIGURES

Table 3.16: PCA, Eigenvalues and R^2

The following table reports the eigenvalues and the proportion of the variance explained for the PCA on the implied discount factor for 21 countries. The last two columns report the weights associated to the first component.

	PCA on $DR_{i,t}$		PCA on $\Delta DR_{i,t}$		W_{PCA1}	
	λ	R^2	λ	R^2	Country	Weights
Comp 1	9.7143	0.46	11.1565	0.53	USA	0.1252
Comp 2	4.8702	0.69	1.3759	0.60	AU	0.2206
Comp 3	1.5943	0.77	1.0292	0.65	DE	0.2603
Comp 4	1.4777	0.84	0.8074	0.68	HK	0.1173
Comp 5	0.7969	0.88	0.7562	0.72	JP	0.1596
Comp 6	0.5193	0.90	0.6414	0.75	SWE	0.2259
Comp 7	0.3904	0.92	0.6044	0.78	UK	0.2682
Comp 8	0.3678	0.94	0.5619	0.81	CA	0.2646
Comp 9	0.2959	0.95	0.4880	0.83	BE	0.2858
Comp 10	0.2039	0.96	0.4409	0.85	CH	0.2211
Comp 11	0.1516	0.97	0.4024	0.87	MYR	0.1130
Comp 12	0.1271	0.98	0.3877	0.89	DK	0.2737
Comp 13	0.1073	0.98	0.3681	0.91	SA	0.1660
Comp 14	0.0826	0.99	0.3342	0.92	NO	0.1686
Comp 15	0.0804	0.99	0.3093	0.94	FR	0.2944
Comp 16	0.0560	0.99	0.2814	0.95	OS	0.2352
Comp 17	0.0525	0.99	0.2547	0.96	NZ	0.1204
Comp 18	0.0338	1.00	0.2422	0.97	SG	0.1886
Comp 19	0.0279	1.00	0.2052	0.98	IT	0.2104
Comp 20	0.0262	1.00	0.1808	0.99	NL	0.2893
Comp 21	0.0237	1.00	0.1721	1.00	SP	0.2033

3.8. TABLES & FIGURES

Figure 3.1: Implied Discount Factor

These figures show the time series of the average implied discount factor for all the countries considered.

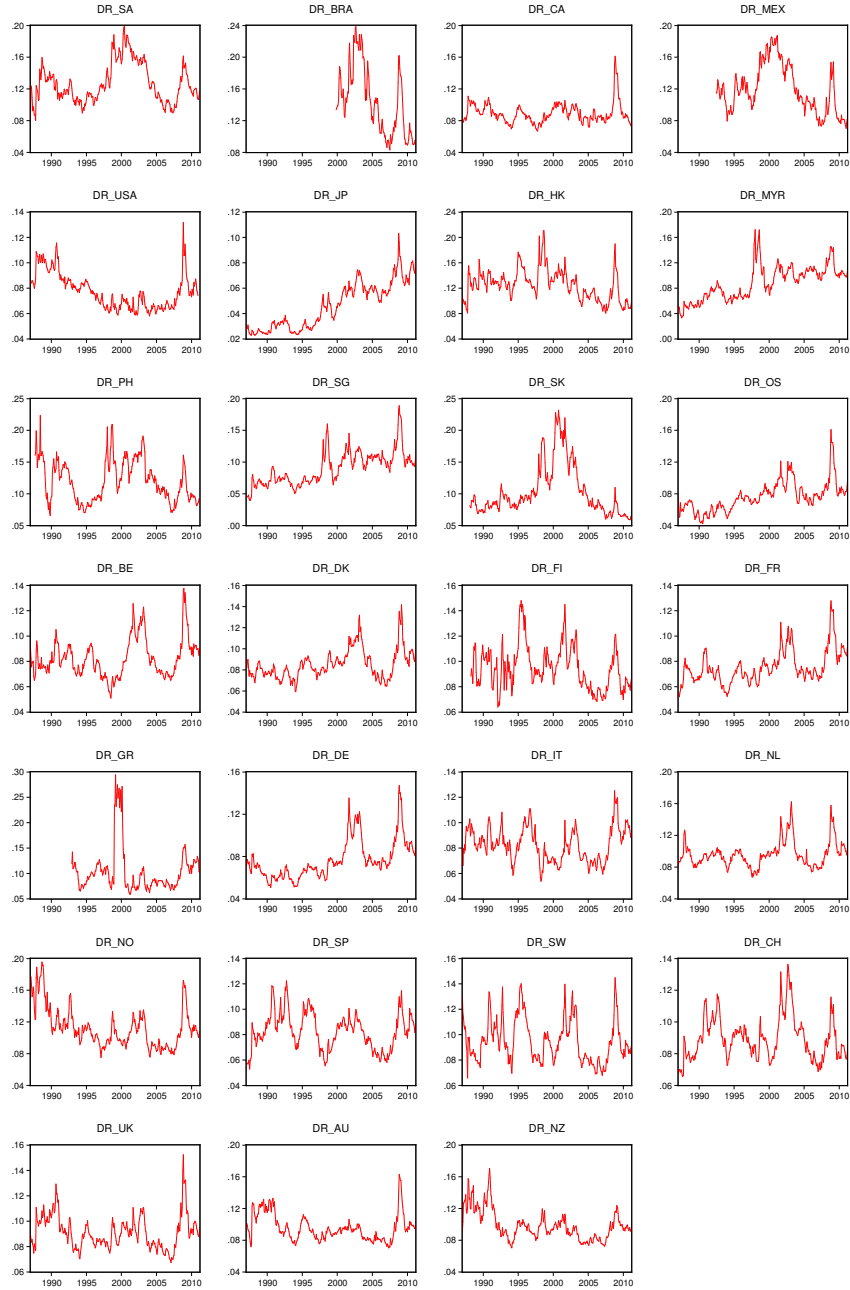


Figure 3.2: Earnings Residuals:

This figure shows the average residuals of the regression:

$$\log(1 + r_{i,t}) - \log(1 + DR_{i,t-1}) = \alpha + \beta \log\left(\frac{DR_{i,t-1}}{DR_{i,t}}\right) + \epsilon_{i,t}$$

Panel A: The average $\epsilon_{i,t}$ considering all countries

Panel B: The average $\epsilon_{i,t}$ considering only Asian countries

Vertical red lines are the NBER recession date in the USA, the vertical green line represents the Asian currency crisis of 1997, and the vertical black line represents the Black Monday of October 1987.

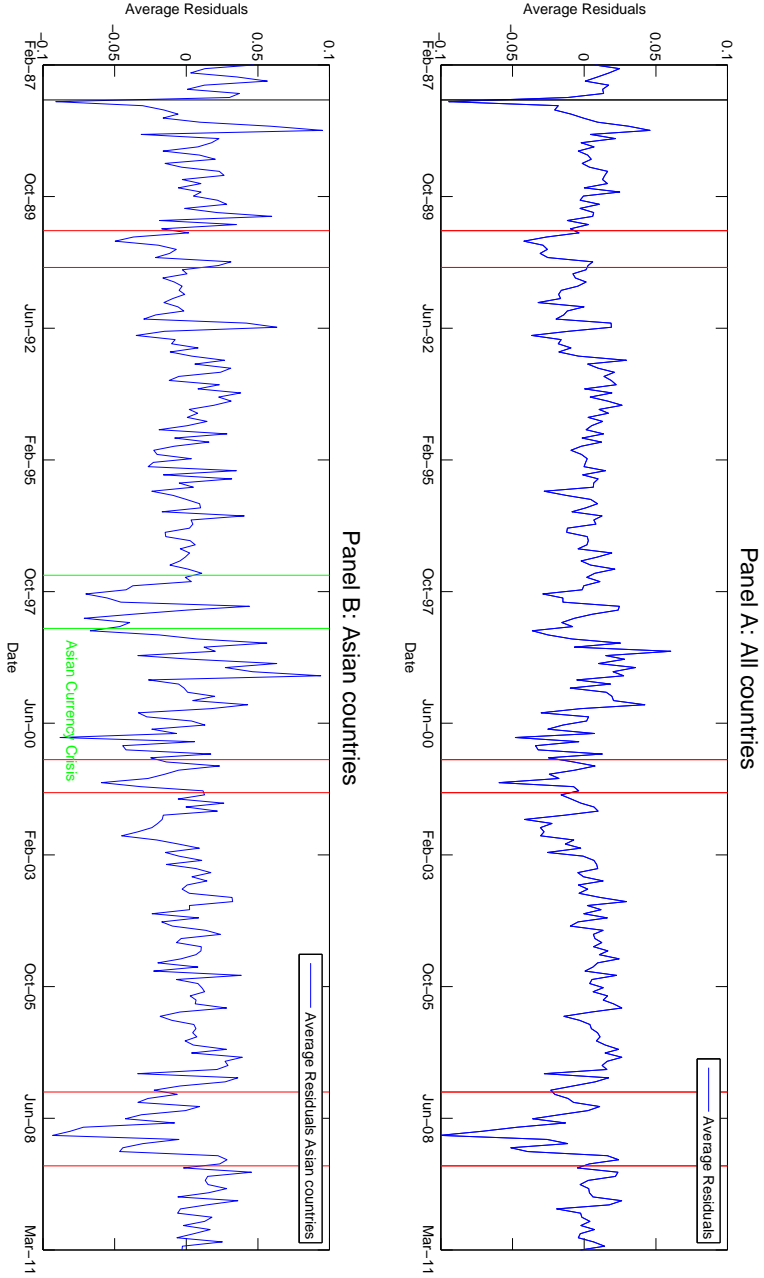


Figure 3.3: PCA Weights vs Interest Rates

This figure scatters the time series average of domestic 3-month interbank rate yields against the weights associated with the second PCA on $DR_{i,t}$.

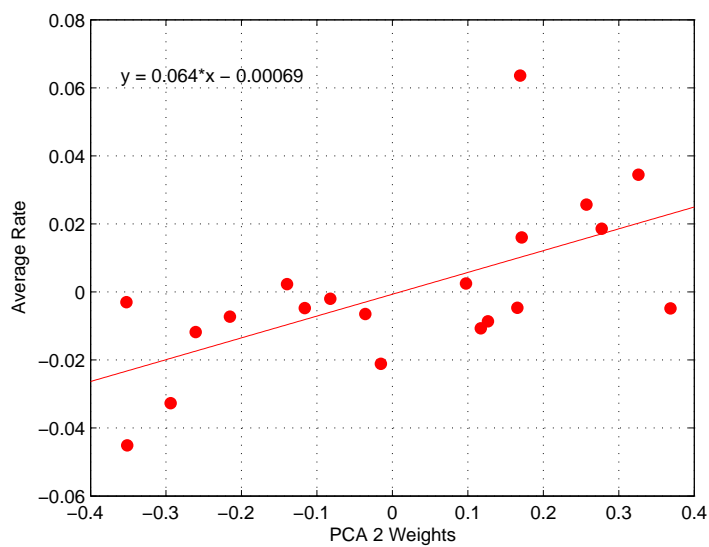
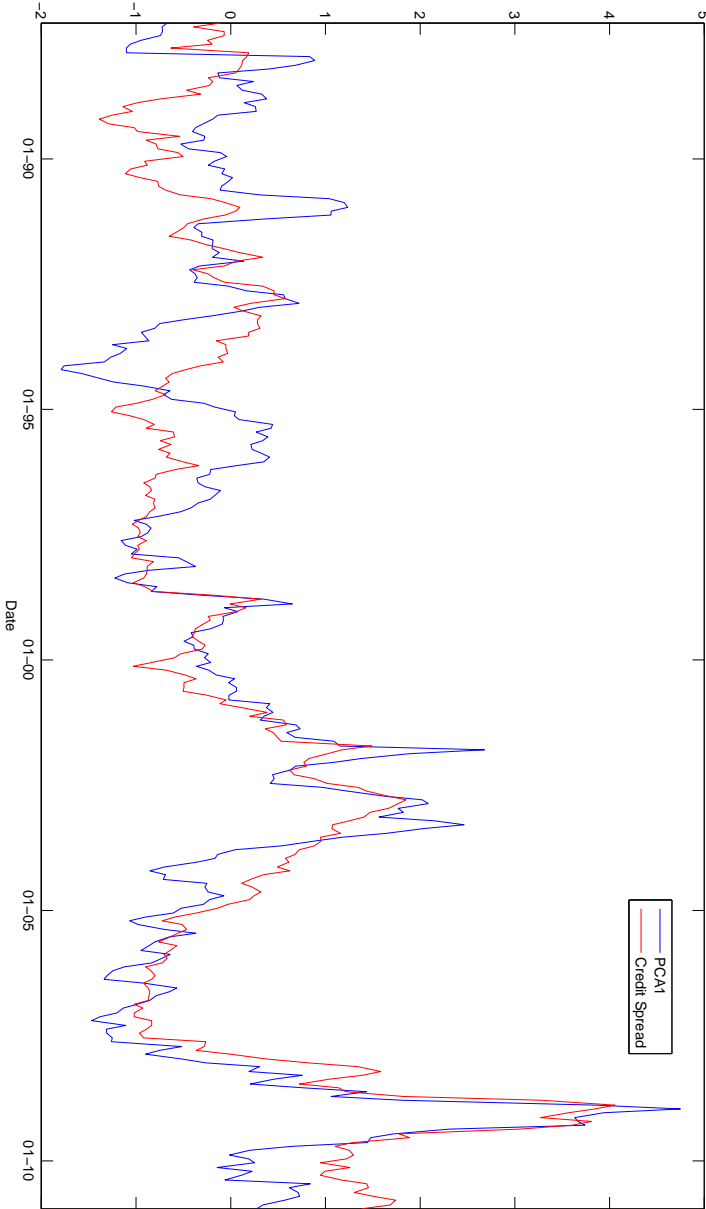


Figure 3.4: Credit Spread and Discount Rate:

This figure shows the standardized Z-score of the Credit Spread (BBB bond yield - 5-year US treasury Notes YTM) and the first component of the PCA analysis of the implied discount factors for 21 countries.



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