LONG-RUN PERFORMANCE OF STOCK RETURNS FOLLOWING JUNK BOND OFFERINGS

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ABSTRACT

This paper examines the long-run, post-issue stock price performance of 377 firms that issued below-investment-grade bonds during the 1976-1989 period. Three different methodologies are used, that control for the usual sources of bias affecting long run performance studies (new listing bias, rebalancing bias, skewness bias, and non-random sampling bias). The three show very similar results. The buy and hold abnormal returns are significantly different from zero and negative starting from the fourth year after the issue, supporting to what we have called the cyclical over-optimism hypothesis which basically states that there is a cycle in financing, and that in some phases of the cycle investors will be willing to accept paper that is overpriced.

Key words: Junk Bond Offerings, Long-Run Stock Performance.
JEL Classification: G14, G32.

RESUMEN

Este artículo examina el rendimiento accionario de largo plazo, posterior a la emisión, de 377 empresas que emitieron bonos de baja calidad durante el periodo 1976-1989. Se utilizaron tres diferentes metodologías que controlan las fuentes de sesgo usuales en este tipo de estudios. Las tres metodologías arrojan resultados muy similares. Los retornos anormales son significativamente negativos a partir del cuarto año posterior a la emisión, respaldando a la que hemos llamado hipótesis de sobre optimismo que, básicamente, plantea que existe un ciclo en el financiamiento y que en ciertas etapas de este ciclo los inversionistas estarán dispuestos a aceptar papeles sobrevaluados.

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This paper is concerned with the estimation and analysis of the long-run post-issue stock-price performance of firms that issued junk bonds during the 1976-1989 period. Several previous studies have analyzed the long-run stock-price performance of companies following the announcement and issue of securities. The empirical evidence shows generally negative long-run abnormal performance for periods following the issue of equity. Ritter (1991) finds for a sample of 1,526 initial public offerings (IPOs) in the 1975-1984 period, that the three-year post issue return is 29.13% smaller than the return of its size-adjusted portfolio benchmark (t statistic of –5.89). Loughran and Ritter (1995) report for a sample of 4,753 IPOs in the 1970-1990 period a five-year –50.71% abnormal return when compared to matching-by-size control firms (t statistic of –11.37). Spiess and Affleck-Graves (1995) report for a sample of 1,247 firms performing seasoned equity offerings (SEO) during the 1975-1989 period, a five-year return 30.99% below the corresponding return for the matching-by-size and book-to-market control firms (and significant at the 5% level). Finally, Loughran and Ritter (1995) find for a sample of 3,469 SEOs a five-year abnormal return of –59.40% when compared to matching-by-size control firms (t statistic of –16.80).

In terms of empirical evidence for the long-run performance of companies after they issue debt, McLaughlin, Safieddine, and Vasudevan (1998a) find, for a sample of 828 issuers of convertible debt between 1980 and 1993, a three-year stock price abnormal return of –11.4% (significant at the 5% level) when compared with a matching-by-size and book-to-market firms benchmark. McLaughlin, Safieddine, and Vasudevan (1998b) do not look at stock price performance. They report negative abnormal operating performance for a sample of 960 companies that issued non-convertible debt between 1980 and 1993. The operating performance is defined here as the ratio of annual pre-tax operating cash flows generated by the firms, to the book value of assets. Lee and Loughran (1998) document, for a sample of 986 convertible bond issues during the 1975-1990 period, a five-

1 When a firm issues bonds, these securities are typically rated either by the Moody’s Investor Service or by the Standard and Poor Company (S&P). The S&P rating scale goes from AAA for the least risky bonds to D for the most risky bonds, and the default probability is one of the main factors considered when assigning a rate. Bonds perceived as having a low default risk (the ones rated of AAA, AA, A, or BBB) are denominated investment grade bonds, and those bonds perceived as having a high default risk (the ones rated of BB, B, CCC, CC, C or D) are denominated junk bonds, below investment grade bonds, or high yield bonds.
LONG-RUN PERFORMANCE OF STOCK RETURNS

year –30.40% (significant at the 5% level) abnormal stock price return when compared to a matching-by-size and book-to-market firms benchmark. Finally, Spiess and Affleck-Graves (1999) report, for a sample of 392 straight debt issues performed between 1975 and 1989, a five-year abnormal stock return of –14.30% (t statistic of –1.16), and for a sample of 400 issues of convertible debt a five-year abnormal stock price return of –36.95% (t statistic of –4.10), when using as benchmarks control firms that match the ones in the sample by size and book-to-market.

Some of the arguments and hypotheses that have been proposed to explain the under-performance experienced by debt issuers in the periods following the issues are:

i) Overvalued Stock and Market Underreaction: Spiess and Affleck-Graves (1999) suggest that debt offerings, like equity offerings, are signals that the firm is overvalued. They also indicate that the market appears to underreact at the time of the debt-offering announcement, so that the full impact of the offering is only realized over a longer time horizon\(^2\).

ii) Realization of Poor Operating Performance: The papers by McLaughlin, Safieddine, and Vasudevan (1997a), and Lee and Loughran (1998) find a decline in operating performance in the years following the convertible debt offering. Profit margin and return on assets for the issuers decrease by 50% in the four years after the issue. The stock price underperformance would be explained by changes in expectations following the realization of poor operating performance. This evidence is consistent with the models proposed by Gilson and Warner (1999) and by Covitz and Harrison (1999), where managers have inside information and are assumed to be able to time the bond issues during periods of good operating performance.

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\(^2\) Event studies performed by Mikkelson and Partch (1986), Eckbo (1986), Shyam-Sunder (1991), and Castillo (1999) find significant negative market price reactions to announcements of convertible debt issues, and negative but not significant market price reactions to the announcement of straight debt issues.
Measurement Problems: As indicated by Barber and Lyon (1997), Kothari and Warner (1997), and Lyon, Barber, and Tsai (1999), the traditional methodologies used to compute abnormal returns and the benchmarks used in many of the long run performance studies are subject to several sources of bias. The negative long run performance documented by some studies could be the result of methodological mistakes. While this argument applies for most of the studies performed before 1997, both Lee and Loughran (1998), and Spiess and Affleck-Graves (1999) control for most of those sources of bias, so this argument would not be valid in their cases.

The papers by Barber and Lyon (1997), Kothari and Warner (1997), and Lyon, Barber, and Tsai (1999) analyze the empirical power and specification of long run performance tests. Barber and Lyon (1997) document that test statistics based on abnormal returns calculated using a reference portfolio such as the market index are misspecified, and empirical rejection rates for the zero abnormal returns hypothesis exceed the theoretical rejection rates.

Barber and Lyon (1997) identify three sources of misspecification: (i) The new listing bias that arises because the firms in the index or reference portfolio typically include new firms that begin trading after the event date; (ii) The rebalancing bias, which arises when the returns of the reference portfolio are calculated assuming periodic rebalancing, and (iii) The skewness bias that arises because long run abnormal returns are positively skewed. They find that while cumulative abnormal returns give positively

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3 Given that empirical evidence shows underperformance of Initial Public Offerings, by including those new listed companies in the benchmark portfolio, the return of that benchmark will be negatively biased and the abnormal return of the sample will be positively biased.

4 For example, when buy and hold returns are calculated using an equally weighted reference portfolio, the long run return on the portfolio is compounded assuming monthly (or daily) rebalancing of all the securities in the portfolio. To maintain equal weight of all securities in the index, securities that have beaten the portfolio average are sold, while those that have lagged the portfolio average are purchased. This rebalancing will lead to a positively biased return on the reference portfolio (if bid-ask spreads are ignored) and therefore to a negative bias in the buy and hold abnormal returns.

5 Due to the aggregation method, the skewness bias is particularly serious when using long run buy and hold returns instead of cumulative abnormal returns. Buy and hold returns are positively skewed, since it is common to observe a sample firm with an annual return in excess of 100%, but uncommon to observe a return on the market index in excess of 100%. Since abnormal returns are calculated as the sample firm return less the market return, the abnormal returns are positively skewed.
biased test statistics, buy and hold abnormal returns yield negatively biased test statistics. Barber and Lyon (1997) propose a particular way to construct the benchmark in which every company in the sample is matched to a control firm by size and by the book-to-market ratio. This approach yields well-specified test statistics in most of the cases considered⁶.

Kothari and Warner (1997) also find that many tests for long horizon abnormal returns are severely misspecified, and that their results are robust to many different abnormal return models. Using the Market Adjusted Model (MAM), the Market Model (MM), the Capital Asset Pricing Model (CAPM), and the Fama-French three-factor Model (FF), they find that returns aggregated over long periods using either the cumulative abnormal return (CAR) aggregation method or the buy and hold (BH) accumulation method are all positively biased, producing an overrejection of the zero abnormal returns hypothesis⁷. They conclude that non-parametric and bootstrap tests could be used to reduce misspecification.

Lyon, Barber, and Tsai (1999) document that, in addition to the control firm approach presented by Barber and Lyon (1997), two other approaches would yield well-specified tests statistics in random samples. The first approach is based on a traditional event study framework and buy and hold abnormal returns, where carefully constructed reference portfolios are free of the new listing and rebalancing biases, and where the skewness bias is controlled with a bootstrapped version of a skewness-adjusted t-statistic. The second approach is based on a calendar-time portfolio method originally discussed by Fama (1998).

Rosenbaum and Rubin (1983) developed and proposed an alternative methodology to match firms in a sample with control firms that solves the bias generated when the firms in a sample are not selected randomly. This methodology allows summarizing several pre-event characteristics of the firms in a single index called propensity score. By matching the firms in the sample to control firms with a similar index, a more accurate measurement of the impact of a certain event on the firms in the sample is obtained. The

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⁶ The control firm approach eliminates the new listing bias (since both the sample and the control firm must be listed in the identified event month), the rebalancing bias (since both the sample and the control firm returns are calculated without rebalancing), and the skewness problem (since the sample and control firms are equally likely to experience large positive returns).

⁷ The sources of bias that they identify are cumulation bias, skewness bias, sample selection and survival bias, and calendar time period bias.
propensity score methodology has been gaining strong support among statisticians over the past few years, and many applications are starting to be published. Two recent applications in economics are Lechner (1999) and Dehejia and Wahba (1999). Both papers analyze the post event impact in earnings and employment of different training programs. To my knowledge, nobody has applied this methodology to the study of firms performance following any kind of event.

This paper examines the long-run performance of companies that issued junk bonds during the 1976-1989 period, to test the efficiency hypothesis (Yago, 1991), that the development of this market permitted the financing of profitable investment projects for which financing might not otherwise have been available, allowing these companies to outperform their industries. It also investigates the alternative cyclical overoptimism hypothesis (Edwards, 1933; Hickman, 1958) that basically states that there is a cycle in financing, and that in some phases of the cycle investors will be willing to accept overpriced papers. Abnormal returns are computed based on different benchmarks, and based also on different accumulation methods, to eliminate or reduce all the sources of bias identified by Barber and Lyon (1997), Kothari and Warner (1997), and Lyon, Barber, and Tsai (1999).

This paper is organized as follows: Section I describes the different methodologies used to measure performance. Section II presents the main results of the study under each of the methodologies. Section III contains the main findings and concludes the paper.

I. METHODOLOGY

A: Sample Design:

The sample is composed of firms that issued junk bonds during the 1976-1989 period. A total of 377 junk bond issues were included in the sample, using the following procedure:

8 The overoptimism hypothesis suggests that during certain periods the market would be more optimistic and low quality firms would be able to place their issues. Under this hypothesis one would expect not only that firms issuing during the overoptimistic periods would earn abnormally low returns after the issue, but also that a disproportionately high share of them would end up being forced into bankruptcy.
1) A list of all the corporate debt issued during the 1976-1989 period, and initially rated between BB+ and D (as indicated by the Standard and Poor’s Monthly Bond Guide) was generated. A total of 1,260 issues were identified here.

2) The Wall Street Journal Index (WSJI) was used to obtain additional information such as the type of debt issued, issue size, risk rate, and the name of the underwriter. The 183 issues not found in the WSJI were excluded from the sample.

3) The Center for Research and Security Prices (CRSP) database was used to check whether the companies were listed and their returns were available for the relevant period. The issues were excluded from the sample if the name of the issuer was not found in CRSP, or if not enough returns were available during the estimation period. Finally, if a company issued junk bonds more than once during the period, only the first issue was considered in the sample. A total of 633 issues were excluded here.

4) The COMPUSTAT database was consulted to verify if the book value of the equity of the issuer was available at the beginning year. A total of 67 issues were excluded in this step.

The characteristics of the 377 issues included in the sample are summarized in tables 1 to 4. Table 1 shows the number of junk bond issues per year, the amount of debt issued per year, and the average size of the issues, all for the 1976-1989 period. Table 2 presents some sample descriptive statistics and the distribution of some characteristics such as firm size, book-to-market ratio, firm trading age, and number of months the firms stay in the sample after the issue. Table 3 shows the distribution of the offerings classified by year of issue, initial rate assigned by the S&P Company, and underwriter name. Table 4 presents the distribution of the offerings classified by year of issue, type of issue and underwriter’s name.

9 Abnormal returns were also computed in this study using the Market Model and the Fama–French Model. Because the parameters used in those models are estimated using pre-issue stock returns, only first issues were included in our sample to avoid the problem of computing parameters with data that would be at the same time pre-issue returns for some issues and post issue returns for others.

10 For a company that issued bonds between January and June of year t, the required book value is the one at December of year t-2, and for a company that issued bonds between July and December of year t, the required book value is the one at December of year t-1.
TABLE 1
ANNUAL DISTRIBUTION OF JUNK BOND ISSUES IN THE SAMPLE.

<table>
<thead>
<tr>
<th>Year</th>
<th>Number of Issues</th>
<th>Total Debt Issued</th>
<th>Average Size of Issue</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Millions of $</td>
<td>Millions of $</td>
</tr>
<tr>
<td>1976</td>
<td>8</td>
<td>277.0</td>
<td>34.6</td>
</tr>
<tr>
<td>1977</td>
<td>24</td>
<td>641.5</td>
<td>26.7</td>
</tr>
<tr>
<td>1978</td>
<td>31</td>
<td>758.8</td>
<td>24.5</td>
</tr>
<tr>
<td>1979</td>
<td>23</td>
<td>534.5</td>
<td>23.2</td>
</tr>
<tr>
<td>1980</td>
<td>57</td>
<td>1140.3</td>
<td>20.0</td>
</tr>
<tr>
<td>1981</td>
<td>9</td>
<td>380.0</td>
<td>42.2</td>
</tr>
<tr>
<td>1982</td>
<td>22</td>
<td>995.0</td>
<td>45.2</td>
</tr>
<tr>
<td>1983</td>
<td>29</td>
<td>1739.6</td>
<td>60.0</td>
</tr>
<tr>
<td>1984</td>
<td>29</td>
<td>2622.5</td>
<td>90.4</td>
</tr>
<tr>
<td>1985</td>
<td>29</td>
<td>2695.8</td>
<td>93.0</td>
</tr>
<tr>
<td>1986</td>
<td>50</td>
<td>4099.0</td>
<td>82.0</td>
</tr>
<tr>
<td>1987</td>
<td>27</td>
<td>6020.0</td>
<td>223.0</td>
</tr>
<tr>
<td>1988</td>
<td>16</td>
<td>3878.0</td>
<td>242.4</td>
</tr>
<tr>
<td>1989</td>
<td>23</td>
<td>3010.0</td>
<td>130.9</td>
</tr>
<tr>
<td>1976-1989</td>
<td>377</td>
<td>28792.0</td>
<td>76.4</td>
</tr>
</tbody>
</table>

TABLE 2
DISTRIBUTION OF SOME CHARACTERISTICS OF THE SAMPLE

<table>
<thead>
<tr>
<th>Size / Book to Market Ratio / Trading Age / Months in Sample</th>
</tr>
</thead>
<tbody>
<tr>
<td>Size Millions of $  Book to Market Ratio  Trading Age (months)</td>
</tr>
<tr>
<td>Min 4,1 0,034 35,0 1,0</td>
</tr>
<tr>
<td>25 Percentile 45,0 0,394 78,0 59,0</td>
</tr>
<tr>
<td>Median 107,1 0,627 125,0 84,0</td>
</tr>
<tr>
<td>75 Percentile 256,4 1,036 215,0 84,0</td>
</tr>
<tr>
<td>Max 6677,9 5,549 731,0 84,0</td>
</tr>
<tr>
<td>Mean 249,2 0,786 179,9 69,5</td>
</tr>
</tbody>
</table>

Size is Market Value of Equity, in millions of US$. Book to Market is the ratio of Book Value over Market Value on December of the year before the issue. Trading Age is the number of months of available trading data before the issue, from CRSP. Months in sample indicate the number of months after the issue that the firm is listed in CRSP and therefore included in the sample.
B: Benchmarks and Abnormal Returns.

Abnormal return can be measured as the difference between the realized return and the normal or expected return. For each company i and period t we have

\[ \epsilon_{it} = R_{it} - E[R_{it} | X_t] \]  

(1)

where \( \epsilon_{it} \) is the abnormal return of company i in period t, \( R_{it} \) represents the actual return of that company in that period; \( E[R_{it} | X_t] \) is the normal or expected return for company i in period t; and \( X_t \) corresponds to the conditioning information for the model of normal performance. The normal or expected returns of the securities in the sample are modeled here using a matching-by-size and book-to-market model, or a matching by propensity score methodology that summarizes some characteristics of the issuers we want to control for.

C: The Event Time - Matching Portfolio Approach

The abnormal return is measured as the excess return over a portfolio that matches each company in terms of two characteristics: size and book-to-market\(^1\). The new listing bias is eliminated by forming for each company in the sample a portfolio of firms matched by size and book-to-market, using the methodology proposed by Lyon, Barber, and Tsai (1999): twenty-five reference portfolios are constructed, as follows:

a. For each firm in the sample the bond issue date is verified. The size (market value of equity) of all the firms in CRSP is recorded one month before the issue date, and the book-to-market ratio from COMPUSTAT is computed for those firms based on the December of previous year data.

\(^1\) Size is defined as the market value of equity. Book-to-market is defined as the ratio of book value of equity to market value of equity.
b. All the NYSE firms are ranked by size and five portfolios each with 20% of the total of NYSE firms are formed. Portfolio size breakpoints are registered. All the firms traded at NYSE are ranked by book-to-market and 5 portfolios each with 20% of the total number of NYSE firms are formed. Portfolio book-to-market ratio breakpoints are registered. Each firm in NYSE would then belong to one of the 25 portfolios formed based on size and book-to-market.

c. The Amex and Nasdaq firms are assigned to the appropriate NYSE portfolios based on the recorded breakpoints for size and book-to-market.

d. Each firm in the sample is assigned to one of the 25 portfolios based on its size and book-to-market. The monthly returns of each of the firms in the benchmark portfolio are tracked from the month of the issue and for seven years after the issue. The average monthly returns of the benchmark portfolios are computed using equal weights for all the firms in the benchmark. The buy and hold returns are then computed as described in section 2.3.2.

e. The process is repeated for each of the 377 firms in the sample. Table 6 shows how many firms in the sample were matched to each of the 25 matching-by-size and book-to-market portfolios. Sample firms were more frequently matched to small size and low book-to-market portfolios.

To draw inferences regarding the long run performance of the companies in the sample the monthly abnormal returns must be aggregated both across securities and through time. The aggregation methodology used here to measure performance is known as the buy and hold abnormal returns (BHAR). The BHAR are computed by aggregating first through time to obtain the abnormal return between the two points $t_1$ and $t_2$, for each of the stocks in the sample, as shown by

$$BHAR_{i,t_2-t_1} = \prod_{t=t_1}^{t_2} (1 + R_{it}) - \sum_{j=1}^{n} \prod_{t=t_1}^{t_2} (1 + R_{jt}) \left( \frac{n_s}{n} \right)$$

(2)
where $R_{it}$ is the return of company $i$ at month $t$; $t_1$ corresponds to the issue bond date for firm $i$; $n_s$ corresponds to the number of companies in the portfolio matching the sample firm by size and book-to-market at time $t_1$, and $R_{jt}$ corresponds to the return of the firms in the benchmark portfolio. Not only is the new listing bias eliminated by applying this procedure, but also the rebalancing bias is controlled by using this particular procedure where the returns of each firm in the benchmark portfolio are first aggregated through time and then averaged across companies\(^\text{12}\).

The BHAR are aggregated across companies to compute the average buy and hold abnormal return for the sample BHAR as

$$\text{BHAR}_{t_2-t_1} = \frac{\sum_{i=1}^{N} \text{BHAR}_{i,t_2-t_1}}{N}$$  \hspace{1cm} (3)$$

where $N$ represents the average number of firms in the sample during the $t_2-t_1$ period. To correct the skewness bias resulting from computing long run buy and hold reference portfolios, the following bootstrapped skewness-adjusted $t$-statistic can be used:

$$t_{sa} = \sqrt{n} \left( S + \frac{\hat{\gamma}^2}{3} + \frac{\hat{\gamma}}{6n} \right)$$ \hspace{1cm} (4)$$

with

$$S = \frac{\text{BHAR}_{t_2-t_1}}{\sigma_{\text{BHAR}_{t_2-t_1}}}, \quad \hat{\gamma} = \frac{\sum_{i=1}^{N} (\text{BHAR}_{i,t_2-t_1} - \text{BHAR}_{t_2-t_1})^3}{N\sigma_{\text{BHAR}_{t_2-t_1}}^3}$$

\(^\text{12}\) As indicated by Lyon, Barber, and Tsai (1999), the buy and hold abnormal returns will suffer from new listing bias if new companies are allowed into the reference portfolios after the issue. The rebalancing bias is observed when the returns of the firms in the reference portfolio are averaged across firms first and aggregated through time later.
where $\hat{\gamma}$ is an estimate of the skewness coefficient. Bootstrapping the test statistic requires drawing $b$ subsamples of size $n_b$ from the original sample. The skewness-adjusted $t$ statistic $t_{sa}^b$ is computed for each of the $b$ bootstrapped subsamples, and the critical values for the transformed test statistic are calculated from the $b$ values of the transformed statistic. Following Lyon, Barber, and Tsai (1999), $b = 10,000$ bootstrapped subsamples of size $n_b = N/4$ were drawn, and in each case the statistic $t_{sa}^b$ was computed\(^{13}\). From the distribution of 10,000 $t_{sa}^b$ values generated, the two critical values $x_{lower}^b$ and $x_{upper}^b$ were calculated by solving:

\[
Pr[t_{sa}^b \leq x_{lower}^b] = Pr[t_{sa}^b \geq x_{upper}^b] = \frac{\alpha}{2}
\]

(5)

where $\alpha$ is the significance level at which the hypothesis that the mean long run abnormal return is equal to zero is tested. This hypothesis is rejected if the value of the whole sample $t$ statistic $t_{sa}$ is between the two computed critical values.

**D The Calendar Time Methodology**

The calendar-time portfolio methods offer some advantages over tests that employ either cumulative or buy-and-hold abnormal returns. First, this approach eliminates the problem of cross sectional dependence between sample firms because the returns on sample firms are aggregated into a single portfolio. Second, the calendar-time portfolio methods yield more robust test statistics in random samples\(^{14}\). The procedure is applied as

\(^{13}\) The formula used to compute the $t$ statistics for the $b$ bootstrapped subsamples is identical to the one presented in (4). The only difference lies in the way parameter $S$ is computed. For the subsample, $S_b$ is defined as the difference between the BHAR of the subsample and the BHAR for the whole sample, over the standard deviation of the BHAR of the subsample.

\(^{14}\) Source: Lyon, Barber, and Tsai (1999).
follows: at each calendar month $t$ the monthly abnormal return of each firm in the sample is computed as

\[ AR_{it} = R_{it} - R_{pt} \]  

(6)

where $R_{it}$ represents the monthly return of firm $i$ in calendar month $t$, and $R_{pt}$ corresponds to the monthly return of the portfolio benchmark for firm $i$. The firms are included in the sample at each calendar month $t$ only if the issue of the junk bond occurred between $S$ and $S-1$ years before that month. The equally weighted mean abnormal return across firms in each calendar month $t$ is computed as

\[ MAR_t = \frac{1}{N_t} \sum_{i=1}^{N_t} AR_{it} \]  

(7)

where $N_t$ represents the number of firms included in the sample on calendar month $t$. A grand mean monthly abnormal return is then calculated considering all the calendar months with $MAR_t$ available during the 1976 to 1996 period, using the formula

\[ MMAR = \frac{1}{U} \sum_{t=1}^{U} MAR_t \]  

(8)

where $U$ represents the number of months with available $MAR_t$ during the 1976-1996 period. This grand mean monthly abnormal return can be used to test the hypothesis of zero abnormal performance over some relevant post issue period.

\[ E: The \ Propensity \ Score \ Methodology \]

The non-random selection of firms that compose a sample in any type

15 The portfolios used as benchmark here are the same ones constructed before, matching each of the firms in the sample by the equity size and the book-to-market ratio.

16 In this paper $t$ represents all the months from January of 1976 to December of 1996, and $S$ takes values 1 to 7.
of causal effect study is a potentially serious source of bias. Rosenbaum and Rubin (1983) show that the sample selection bias can be solved by using a non-parametric matching technique called propensity score methodology. In a non-random experiment such as the one we are dealing with here, the units considered in the sample and the units included in the control group are not always directly comparable because they could differ in a systematic way. In other words, this is a non-random experiment because the firms considered in the sample were not selected randomly. As long as the issuing of junk bonds is not a random event, i.e., as long as there are some factors that influence a company's decision to issue junk bonds and those factors might themselves be related to the dependent variable, the difference between the post-issue performance of the sample firms and the post-issue performance of the control group firms will be a biased estimator of the true impact of the issue. This problem can be solved by identifying all the pre-intervention characteristics of the issuing firms that potentially explain systematic differences between issuing firms and control firms, and controlling for them. A version of this direct matching method is applied by the other two methodologies presented in this paper, where we control for size and book-to-market. One disadvantage of this methodology is that it is not practical and that sometimes it is not feasible to control for all the pre-intervention characteristics, especially when there are too many of them.

The propensity score methodology proposed by Rosenbaum and Rubin (1983) summarizes all the pre-intervention characteristics in a single variable (the propensity score). Sample firms and control firms are matched by the propensity score and then compared. If the variables included in the propensity score are good indicators of the factors that systematically differ between the sample firms and the control group firms, then comparison of observations with similar propensity scores is in essence similar to the matching portfolio technique. The propensity score can be viewed as the probability, given observable characteristics, that an observation will be included in the sample group. Therefore, by matching on the propensity score we are effectively controlling for the impact of the characteristics that differ across groups and are related to group assignment. The propensity score methodology was applied in this study in the following way:

17 See for example Heckman and Robb (1985).
a) Four pre-intervention characteristics that could potentially explain differences in the post-issue stock price performance across firms were identified, namely:
- Equity market size.
- Equity book-to-market ratio.
- Three-year pre-issue market adjusted return.
- The exchange where the stocks were listed. 18

b) These four pre-intervention characteristics, and the buy and hold post-issue returns for up to seven years, were computed for each of the 377 junk bond issuers in the sample.

c) The firms in the control group were selected as follows: all the firms in CRSP that did not issue junk bonds during the 1976-1989 period were considered, and an artificial issue date was randomly assigned to each of them as suggested by Lechner (1999). 19 In addition, firms had to have enough data available to compute all the characteristics and up to seven years of “post issue” performance. The four characteristics were computed for each of the 1,365 firms that satisfied all of these conditions.

d) A Logit model was adjusted to the data by considering the measurements of the pre-intervention characteristics as independent variables and defining a binary dependent variable that took the value one for the firms in the sample and the value zero for the firms in the control group. The model to be estimated was

\[
P(Y_i = 1 | X_i) = \frac{e^{X_i \beta}}{1 + e^{X_i \beta}}
\]  

(9)

18 The equity market size corresponds to the market value of the firm’s equity at the end of the month previous to the junk bond issue. The equity book-to-market ratio corresponds to the book value of equity over market value of equity, both measured at the end of the last December previous to the junk bond issue. The three-year pre-issue market adjusted return corresponds to the difference between the return of each of the firms in the sample and the return of the value weighted CRSP index. Each firm is listed either in the NYSE, the Amex, or the Nasdaq. Two dummy variables were used to identify where each firm was listed.

19 Given that the firms in the sample issued junk bonds during the 1976-1989 period, each of the firms in the control group was randomly assigned a fictitious “issue date” corresponding to the last trading day of June of one of the years between 1976 and 1989.
where \( Y_i \) represents the dummy variable taking value one for the firms in the sample and value zero for all the others; \( X_i \) represents a vector with the estimated values for the four pre-intervention characteristics of each firm; \( \beta \) represents the vector of parameters to be estimated. Using the estimated Logit model, the propensity score represented by

\[
\hat{P}(Y_i = 1|X_i) = \frac{e^{x_i\hat{\beta}}}{1 + e^{x_i\hat{\beta}}}
\]

was computed for each of the firms in the sample and for each of the firms in the control group.

e) The propensity scores of all the firms in the sample were sorted out and assigned to 10 groups or deciles with the first group containing those firms in the sample with a propensity score between 0.0 and 0.1, and the tenth group containing the firms in the sample with a propensity score between 0.9 and 1.0. The same process was applied to the firms in the control group. The average value of each of the four pre-intervention characteristics for a given decile of sample firms were compared to the average value of the pre-intervention characteristics of the corresponding decile of control group firms, to verify that the propensity score successfully summarized these characteristics in a single index. If the averages for the pre-intervention characteristics of sample firms were very different from the averages for the characteristics of control firms within deciles, then the Logit model would need to be adjusted and computed again until these means were similar.

f) Buy and hold returns for one to seven years after the issue date were computed for each of the firms in the sample and in the control group. The average buy and hold returns were computed for each of the deciles formed previously as

\[
BHR_{sj}^{\alpha} = \frac{\sum_{i=1}^{n_j} BHR_{si}^{\alpha}}{n_j}
\]
where $BHR_{ji}^{t_0}$ represents the buy and hold return of the sample firm $i$ for the period starting on the issue date and ending $t$ periods later; $n_j$ represents the number of firms in decile $j$; $j$ represents the decile, and $BHR_{sj}^{t_0}$ corresponds to the average buy and hold return of the sample firms in decile $j$. The same formula is applied to compute buy and hold returns for each firm in the control group and the averages per decile.

g) Buy and hold abnormal returns for each of the deciles were computed as the difference between the average buy and hold return of the firms in the sample and the buy and hold return of the firms in the control group that had similar propensity scores (those in the same deciles), using the formula

$$BHAR_{j}^{t_0} = BHR_{sj}^{t_0} - BHR_{cj}^{t_0}$$

where $BHAR_{j}^{t_0}$ corresponds to the buy and hold abnormal return of the sample firms in decile $j$; $BHR_{sj}^{t_0}$ represents the average buy and hold return of the sample firms in decile $j$; and $BHR_{cj}^{t_0}$ corresponds to the average buy and hold return of the control group firms in decile $j$. Finally a grand average of the buy and hold abnormal returns across deciles was computed weighing each decile by the total number of both sample and control group firms that belong to them.

II. RESULTS

A. Results Using The Event Time - Matching Portfolio Methodology.

Figure 1 shows the Monthly BHAR from 1 to 84 months after the issue of junk bonds. Panel A of Table 5 shows the buy and hold abnormal returns for the periods ending in each of the seven years. The hypothesis of no
abnormal returns cannot be rejected for the periods ending in years one, two, three, and six. The abnormal return for the period ending in year five is negative and significant at the 15% level, and the abnormal returns for the periods ending in years four and seven are negative and significant at the 10% level. Panel B of Table 5 shows the cross sectional distribution of the buy and hold abnormal returns for the periods ending in years one to seven. The proportion of the firms in the sample presenting positive abnormal returns moves from a maximum of 43.2% (for year one) to a minimum of 30.2% (for the period ending in year seven).

A.1. Post-Offering Performance Categorized by Firm and Offering Characteristics

A.1.1. The Buy and Hold Abnormal Returns for the Period Ending in Year Three:

Table 6 shows that for the three-year period following the issue of junk bonds, issuers of straight debt and issuers of debt with equity overperformed the benchmark portfolios, while the issuers of convertibles underperformed their benchmarks. None of these abnormal returns is significant for that period.

A similar cross section analysis (not presented here) shows that the NYSE firms in the sample presented a positive abnormal return for the period ending in year three, while the AMEX firms presented more negative abnormal returns than the NASDAQ firms for the same period, but none of these abnormal returns is significant. We also obtained that Drexel firms had more negative abnormal returns than firms using other underwriters, even after controlling for type of issue, but again none of the abnormal returns for that period is significant. More negative abnormal returns were obtained for firms that issued CCC bonds, and when controlling for type of issue, this result holds for issuers of straight bonds and for issuers of debt with equity. For convertibles the issuers of B bonds are the ones reporting a more negative abnormal return. More negative abnormal returns were obtained for firms with higher book-to-market ratios, but when controlling for type of issue the result only holds for issuers of straight debt. No clear pattern is observed across issuers of convertibles or debt with equity. Fi-
nally, no clear pattern was obtained across firms when they were grouped by size, trading age, or by the three-year pre-issue market adjusted return.

A.1.2. The Buy and Hold Abnormal Returns for the Period Ending in Year 7

Table 6 shows that issuers of straight debt underperformed the benchmark by 39.2% over the seven-year post-issue period. The hypothesis of no underperformance cannot be rejected in this case. The issuers of convertible debt and the issuers of debt with equity show more severe and significant underperformance, of –66.0% and –73.5% respectively, for the same seven-year period.

A similar Cross Section Analysis (not presented here) shows a more severe seven-year underperformance for the companies listed on Amex, with this pattern holding across all types of issues. In fact this subgroup of issuers is the only one for which underperformance is significant in all cases. We also obtained that the firms that had Drexel Burnham as their underwriter reported a more severe underperformance than the firms that used other underwriters, with this result only reversing in the sub-group of firms issuing debt with equity. A similar analysis shows that firms issuing bonds rated CCC present a more severe underperformance than the companies issuing either BB or B rated debt, with this result holding true across all types of issues. Once we control for the type of issue, firms in the higher book-to-market quintiles tend to have more negative abnormal returns. Across all types of issues the smaller companies (those assigned to the first size quintile) are the ones with more severe and significant underperformance. Younger companies (those in the first three quintiles) more severely underperformed the benchmark portfolios, but this tendency is only apparent for the case of straight debt issues and for all the issues grouped together, with no clear pattern observed across issues of convertible debt and across issues of debt with equity. Finally, no clear pattern is found across issues grouped by the three-year pre-issue performance. No relationship seems to exist between performance before and after the issues.
B: Calendar Time Results

Table 7 shows the monthly average abnormal returns of the issuers of junk bonds, classified by both calendar year and age\textsuperscript{20} of the issue. Each row of Table 7 shows the average abnormal return of the firms in the sample in a particular calendar year of the 1977-1996 period, and each column of Table 17 contains the abnormal return of a group of issuers classified by number of years since the issue (or age) in the range of 1 to 7 years. From the classification of issuers by age of the issue the most notable results were: abnormal returns are not significant during the first three years following the issue, and they become significantly negative from years four to seven\textsuperscript{21}. Figure 2 shows both the monthly average abnormal returns and the cumulative monthly average abnormal returns for issues in the sample with one to seven years of age. From the analysis of the issuers grouped by year, it is apparent that: significantly negative abnormal returns are concentrated during the 1981-1990 period, that non significant and significantly positive abnormal returns are observed during the 1977-1980 and the 1991-1996 periods, and that the years with the most negative abnormal returns are: 1981, 1987, and 1990. From these three years, two of them (1981 and 1990) correspond to recessive periods, and the third one (1987) corresponds to the year of the stock market crash. Figure 3 shows both the monthly average abnormal returns and the cumulative monthly average abnormal returns for issues in the sample during the 1977-1996 calendar years period.

Table 8 shows the result of running regressions to explain the monthly average abnormal returns, using variables such as the age of the issue, the calendar year, a dummy for recessions, a dummy for decreases in the S&P500 stock index, a dummy for changes in total investment as a percentage of GDP, and the default rate of junk bonds. The age coefficients are all negative and significant in particular for bonds at least 4 years old. The only significant calendar year variable in regression 1 is the one for year 1991. Regressions 2 and 3 exclude the year variables and include other variables that account for economic and business activity. The dummy

\textsuperscript{20} The age of an issue represents the number of years since the issue.
\textsuperscript{21} Abnormal returns are significant during the first three years only in a few cases, in particular during years 1981 and 1990.
TABLE 8
AVERAGE ABNORMAL RETURNS BY CALENDAR YEAR AND BY AGE OF THE ISSUE

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<tr>
<th>Variable</th>
<th>Coefficient</th>
<th>t-Statistic</th>
<th>Coefficient</th>
<th>t-Statistic</th>
<th>Coefficient</th>
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The Age variables are dummies to identify how many years have passed since the issue of the junk bond. The Year variables are dummies to identify the year the abnormal return is being computed for. Reces is a dummy that indicates years with recessions. S&P is a dummy that indicates years when the S&P500 index experienced drops. Dinvest is a dummy that identifies years when total investment was smaller than in the previous year. Default is the average default rate per year.

Sources of Data: CRSP database, Datastream Database, Capital Access International.
TABLE 9
ABNORMAL POST ISSUE PERFORMANCE USING THE PROPENSITY SCORE METHODOLOGY

Panel A: Average Pre-Intervention Characteristics and Propensity Score of Sample Firms

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<th>NYSEd</th>
<th>AMEXd</th>
<th>BTM</th>
<th>SIZE</th>
<th>MAR</th>
<th>PS</th>
<th># FIRMS</th>
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Panel B: Average Pre-Intervention Characteristics and Propensity Score of Control Group Firms

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<th>SIZE</th>
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<td>d1</td>
<td>0.50</td>
<td>0.00</td>
<td>1.20</td>
<td>2603.30</td>
<td>-0.30</td>
<td>0.06</td>
<td>283</td>
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<tr>
<td>d2</td>
<td>0.40</td>
<td>0.10</td>
<td>0.90</td>
<td>384.80</td>
<td>-0.10</td>
<td>0.15</td>
<td>527</td>
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<tr>
<td>d3</td>
<td>0.30</td>
<td>0.30</td>
<td>0.80</td>
<td>214.60</td>
<td>0.30</td>
<td>0.24</td>
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<tr>
<td>d4</td>
<td>0.10</td>
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<td>0.70</td>
<td>128.10</td>
<td>0.80</td>
<td>0.34</td>
<td>139</td>
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<tr>
<td>d5</td>
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<td>0.50</td>
<td>0.60</td>
<td>110.40</td>
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<td>0.44</td>
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<tr>
<td>d6</td>
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<td>0.40</td>
<td>0.50</td>
<td>126.30</td>
<td>1.80</td>
<td>0.53</td>
<td>18</td>
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<tr>
<td>d7</td>
<td>0.00</td>
<td>0.50</td>
<td>0.20</td>
<td>63.80</td>
<td>2.60</td>
<td>0.68</td>
<td>4</td>
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<tr>
<td>d8</td>
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<td>0.00</td>
<td>0.40</td>
<td>8.10</td>
<td>3.60</td>
<td>0.74</td>
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<tr>
<td>d9</td>
<td>0.00</td>
<td>0.00</td>
<td>0.10</td>
<td>101.70</td>
<td>4.00</td>
<td>0.82</td>
<td>1</td>
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<td>d10</td>
<td>0.00</td>
<td>0.00</td>
<td>0.70</td>
<td>57.00</td>
<td>3.40</td>
<td>0.94</td>
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</table>

Panel C: Grand Average of Buy and Hold Abnormal Returns

<table>
<thead>
<tr>
<th>BHAR1</th>
<th>BHAR2</th>
<th>BHAR3</th>
<th>BHAR4</th>
<th>BHAR5</th>
<th>BHAR6</th>
<th>BHAR7</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total</td>
<td>3.4%</td>
<td>-4.5%</td>
<td>0.7%</td>
<td>-13.6%</td>
<td>-18.8%</td>
<td>-24.8%</td>
</tr>
</tbody>
</table>

Notes:
NYSEd and AMEXd represent the proportion of firms in each subsample that were listed in the NYSE and the AMEX exchanges.
BTM represents the Equity Book to Market ratio average.
SIZE represents the average equity market value in millions of US$.
MAR represents the average three-years pre-issue market adjusted return.
PS represents the average propensity score.
# Firms indicates the number of companies in each decile.
BHARt represents the weighted average of the buy and hold abnormal return, for the period starting on the issue date and ending t years later. These buy and hold abnormal returns were computed for each decile first and a grand mean was computed weighting each decile by the total number of firms in them.
variables for recessions and stock market downturns have negative and significant coefficients, in particular in regressions 2 and 4. Regression 4 considers dummy variables for years 1991 to 1996. These calendar year variables have positive coefficients and become significant when the recession and S&P variables are also included in the regressions.

C: Results Using the Propensity Score Methodology.

Table 9 outlines the main results obtained from applying the propensity score methodology. Panel A shows the average for each of the four pre-intervention characteristics and the propensity score for each of the deciles formed from the firms in the sample, grouped by propensity score. The last column shows the number of firms in each of the deciles. Panel B shows the same information, for firms in the control group. The average value of the pre-intervention characteristics of the sample firms and the average value of the pre-intervention characteristics of the control group firms are generally similar for each decile, especially in deciles 2 to 6, where most of the firms are concentrated. This suggests that the propensity score model used successfully gathers those characteristics in a single index. Panel C shows the weighted average buy and hold abnormal returns resulting from computing first the buy and hold abnormal returns in each of the deciles, and then weighting these abnormal returns by the total number of firms belonging to each of the deciles. The results are very similar to and consistent with the ones provided by matching on the basis of by size and book-to-market ratio. The buy and hold abnormal returns obtained are small during the first three years after the issue, and become clearly negative starting from the fourth year after the issue.

III. SUMMARY AND CONCLUSIONS

The post-issue performance of the 377 junk bond issuers considered in the sample was evaluated using three alternative methodologies. The first is event-time based and compares the buy and hold returns of the firms in the sample with the buy and hold returns of carefully constructed portfolios matching each company in the sample by size (defined as the market value
of equity) and the book-to-market ratio. The second methodology is calendar-time based and compares monthly returns of the firms that issued junk bonds in the previous seven years to the return of a portfolio matching those firms by size and book-to-market ratio. These two methodologies control for the usual sources of bias (new listing, rebalancing, and skewness) affecting previous long run performance studies. The Propensity Score methodology not only controls for all the usual sources of bias, but also controls in a more completely way for sample selection bias.

The buy and hold methodology reveals that the underperformance of the firms in the sample is only evident starting from the fourth year after the issue. Issuers of straight debt show negative but not significant abnormal returns by the end of the seventh year. The underperformance is more severe for the issuers of straight bonds that had Drexel Burnham as underwriter, for those companies listed in Amex and Nasdaq, for firms with higher book-to-market ratio (those in the top 3 quintiles), for smaller companies (those in the first two quintiles), and for younger firms (those in the lower 3 quintiles). The issuers of convertible bonds show more severe underperformance than the issuers of straight debt. For issuers of convertible debt, the underperformance is more severe for issuers that had Drexel as underwriter, for companies listed in Amex, for issuers of CCC rated bonds, and for companies in the higher book-to-market quintile. The issuers of debt and equity are the ones with more severe underperformance over the seven-year period. Here the underperformance is more severe for Amex-listed firms, issuers of CCC rated bonds, companies with higher book-to-market ratio (higher 3 quintiles), and for smaller firms (those in the first quintile).

The calendar-time methodology reveals that underperformance of the firms in the sample was particularly severe in the 1981-1990 period, and for firms with junk bond issues 4 to 7 years old. The relationship between performance and age of the issue found here could be explained as follows: after a company issues junk bonds, some investments are made and some time is needed to evaluate the performance of those investments. A few years later, when the maturity of the debt is close and the firm has to pay back or default, the market realizes that there is a higher than expected probability that the firm will not be able to pay back and negative abnormal
returns are realized. This seems to be the case for the 1981-1990 period. There is also a strong relationship between the level of abnormal returns and the economic and stock market activity indicators. This relationship suggests that the issuers of junk bonds are more sensitive to these variables than the benchmarks used to compute the normal returns. These results are also consistent with previous evidence that the junk bond market was negatively affected by several problems in the late 1980s, including the charges of Securities and Exchange Commission (SEC) violations presented against major junk bond market participants, the bankruptcy of some Savings and Loan (S&L) companies that supposedly overinvested in below investment grade bonds, new regulations that forced all the remaining S&L firms to liquidate their investments in junk bonds, and the bankruptcy of the junk bond market leader Drexel Burnham in 1990. Results for the 1991-1996 period are very different, with the firms in the sample overperforming the benchmark portfolios most of the time.

The three methodologies applied show very similar results. The buy and hold abnormal returns are significantly different from zero and negative starting from the fourth year after the issue, supporting to what we have called the cyclical overoptimism hypothesis proposed by Hickman and Edwards.

The increase in default likelihood could have been increased by the decline in the operating performance of the assets the company owned before the issue, or by the poor performance of the investment projects financed via the bond issue.
REFERENCES


