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Discounts in closed-end investment trusts, a source of abnormal returns?

A study on the British market 2000-2009

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Abstract
We investigate if the ratio of net asset value to market value (discount if market value is lower than net asset value, premium if market value is higher than net asset value) is a factor driving abnormal returns in British investment trusts companies (ITC). We control for other factors commonly thought to predict returns above the Capital Asset Pricing Model but still find the size of the contribution from a discount on abnormal returns to be quite substantial. Our conclusion is that the discount represents some sort of underpricing that leads to returns above the expected level. This is in violation of the idea about efficient markets which says that all publicly known information should already be reflected in the share price. Hence, it should not be possible to predict excessive risk adjusted returns by studying easily available accounting information if we have efficient markets.

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1 Introduction

1.1 Background

Investors constantly search for ways to beat the market, some actually to do it and praise their investment strategy. Others claim that abnormal returns are due to pure luck and no sustainable investment strategy for achieving excessive returns exists. According to these who believe in efficient markets achieving positive risk-adjusted returns should be very difficult since stock prices follow a random walk, they change randomly and cannot be predicted.

Another well known theory is the law of one price. It says that the same assets should not sell at different prices even if these assets are bundled differently since smart investors will locate and exploit these price differences, selling the expensive asset and buying the cheap one. The laws of supply and demand will then quickly force prices to converge and hence price differences of the same assets would be extremely rare and short lived.

The discount on net assets owned indirectly through an investment trust is subject to a lot of scrutiny. It is present in a large fraction of ITCs in many different markets and a constant headache to management. If one can acquire assets for less than their underlying value, shouldn't it be possible to buy cheap, hold and then make a profit? Analysts commonly use a high discount as an argument for buying a certain ITC so at least some people seem to believe so. We will investigate if the discount can be a source of abnormal returns in British investment trusts.

1.2 Aim of the study

We use the word discount to refer to the ratio of market value of net assets to market value of the trust (share price times number of shares) since the majority of all ITCs trade at a discount. One should though be aware that there are ITC where the market value exceeds the current value of the underlying portfolio.

Buying an Investment Trust Company (ITC) share because of the high discount is a common argument from brokerage firms and analysts. A number of studies have been conducted investigating if it's possible to earn abnormal returns using investment strategies based on going long in ITCs with a relatively large discount. The idea behind this strategy is that high discounts represent some kind of underpricing and could be a violation of the Efficient

Market Hypothesis. Both the results and the conclusions regarding their implications are mixed and also dependent on the settings of the study.
It has been seen that strategies for achieving abnormal returns often cease to work after they get known to the public; the market incorporates the info so it cannot be used to predict future abnormal returns any longer.[2] Since most of the studies that concluded it was possible to earn abnormal returns were done quite a few years ago it would be interesting to see if we can establish a general connection between the discount and abnormal returns in present times.

Hence, the research topic of this study is: ***Are abnormal returns related to the size of the discount in investment trusts on the British market?***

Our hypothesis is that a high discount could yield abnormal returns because the net assets owned by the trust are acquired at a low price. Also the discount level has a tendency to move and change during times; it is thought to be mean reverting to its sector mean.[3] Hence a currently large discount should present opportunities to earn abnormal returns in a future time periods.

1.3 Scope of research and contribution

The aim of this study is not to identify and explain the causes of the discount in an ITC. We are not interested in testing another specific investment strategy but rather to try in general if the discount can explain abnormal returns. In order to isolate the impact of the discount on the returns we need to control for other factors that are generally recognized as influencing returns above the Capital Asset Pricing Model (CAPM). We are not trying to come up with a "ready to use" investment strategy but rather, using a thorough and up to date sample, see if we can establish a relation between abnormal returns and the discount that can serve as a base for further studies within this field or an idea for an investment strategy.

Geographical: The majority of the previous studies on this topic have been done using American or British data. It would therefore certainly be interesting to investigate the relation between the discount and abnormal returns in Swedish investment companies. However, we believe that our available sample of companies is not large enough for being able to make

[2] Bodie, Kane and Marcus (2004), p. 345, 357
[3] Prior (1999)

reliable statistical inference. Instead we choose to carry out our research on British data because of the rich sample of different investment trusts. The specific settings the British ITCs operate in will be taken into account when we try to generalize our results.

1.4 Outline

In section 2 *Investment trust and previous research,* further information about investment trust as such is presented together with previous studies about the discount phenomenon and how it can yield abnormal returns. In section 3 *Theoretical framework* the theories and models applied in the study are explained. The process and how the test was conducted is described under section 4 *Method and data* where also the regression model and the including variables are presented. Section 5 *Results* will be presented followed up by a validity section that justifies our research method. This is followed up by section 7 *Analysis* where we interpret our results and lastly section 8 *Conclusions* where we discuss the meaning of our results in a wider perspective.

2 Investment trusts and previous research

Here we define an investment trust as such and present some previous studies made about the discount in ITCs and its relation to abnormal returns. .

2.1 Investment trust

2.1.1 General description UK investment trust

An investment trust can invest in a broad array of assets. This makes it possible for small investors to get a level of diversification they would not have been able to achieve on their own by investing in an ITC. They also benefit from the managements ability to pick the right investments. A small investor who invests in an ITC also benefits from the pooling of money with other investors to achieve economies of scale that can reduce dealing and administration costs compared to operating on his/her own. Some ITCs specialize in a certain sector or geographical market. An ITC is a closed end fund that issues shares in order to raise capital for investing. This usually only happens once, when the fund is created. This means that they have a fixed number of shares that trade on the stock market. A consequence of this is that the market value of the company is determined by the current supply and demand for the shares in the ITC on the stock market, not solely by the market value of the underlying portfolio which is the case in open end funds. An implication of this is that the market value of the ITC does not have to correspond to the market value of its net assets.

Each ITC has a board of directors who are appointed to look after the interest of the shareholders. The board of directors then chooses the fund manager to make the decisions about what assets to invest in.[4]

2.1.2 Special rules and legal requirements for investment trusts

In order to be classified as an investment trust certain legal requirements have to be fulfilled;

- The companies' income should be derived mainly from ownership of securities or stocks.
- The ITC have to be resident in the United Kingdom.

[4] The Association of Investment Companies factsheet, "An introduction to investment companies", November 2007, <http://www.theaic.co.uk/Guide-to-investment-companies/Factsheets/>

- Distribute at least 85 % of its investment income as dividends to shareholders in the trust
- The shares of the trust are quoted on a stock exchange.
- The trust is not allowed to distribute realized capital gains on investments as dividends to its shareholders. It is only allowed to distribute the income that comes from dividends on securities owned by the ITC.
- The ITC must not hold any more than 15 % of its funds in a single company with the exception of another investment trust.
- The trust must not under the control of five or fewer participants; it must have several owners which is normally satisfied since it is listed on a stock exchange.[5]

If these conditions are fulfilled then special tax rules apply for the ITC. The trust is not taxed on realized capital gains on their investments but on their income from investments, dividends from shares and securities. This is in order to avoid double taxation that could otherwise arise when investors sell their shares in the ITC and are taxed on their possible capital gains. Approved ITCs are also exempt from paying tax on gains from loan relationships and derivative contracts which are normally taxed.[6]

2.1.3 The discount and its implications

The net asset value is the actual underlying value of the trust. This is the total value of all assets controlled by the trust minus all its liabilities. Net asset value has to be calculated every day according to rules given by the UK Financial Services Authority. Unquoted shares are valued by management according to rules also given by the FSA. The market value of the trust is determined as the share price times the number of shares outstanding. As mentioned earlier, the net asset value and the market value of the ITC are rarely the same. The ratio of net asset value to market value is often referred to as a premium or discount depending on if the market value is higher or lower than the NAV respectively. As mentioned earlier we use the word discount in our thesis to refer to this ratio since few ITCs trade at a premium;

discount = (NAV-MV)/MV or consequently: (NAV/MV)-1.

The discount is a constant headache for the management of ITCs for several reasons; first it can be seen as an indicator of investors' confidence in the management and expectations of future performance of the ITC. A discount is obviously a bad remark; the same assets are

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[5] Income and Corporation Taxes Act 1988, Section 842

[6] HM Revenue and Customs, article CTM47110, viewed on April 9th 2010, <http://www.hmrc.gov.uk/manuals/ctmanual/ctm47110.htm>

valued at less only because they are owned indirectly by the investor through the ITC. A discount can also be an impediment when raising new capital. If the new issue is made at the value of the net assets no investors would be willing to participate since the value of the shares would immediately depreciate when they start to trade on the exchange. If the issue is made at the value of the discounted ITC shares then the company obtains less capital than the value of the net assets that they trade away. ITCs with a high discount also face a risk of hostile takeover since the value of the net assets can be obtained through liquidation. For the reasons given above constant efforts are made by the management of ITCs to reduce the discount.[7]

The presence of the discount is subject to a lot of attention and the debate goes on whether this phenomenon is a market anomaly that can be exploited for earning abnormal returns or if there are in fact rational factors that can explain the discount.

2.2 Previous studies

2.2.1 Explanatory factors of the discount

For decades, many researchers have observed and tried to find explanations for the existence of the discount in investment trusts. The results have been mixed, only occasional and limited relationships have been found between the level of the discount and proposed explanatory factors. The results are also often dependent of the setting. For example, investigations of the generally recognized factors return on net assets, administrative expenses and taxes have been tested to see if they are related to the level of the discount but only week and irregular empirical relationships have been shown.[8]Although it still cannot be fully explained, some researchers have developed theories that partly can be supported by empirical evidence.

Perhaps one of the most cited studies was conducted by Malkiel (1977). His study showed a number of factors such as unrealised capital appreciation, dividend policy and the level of investment in illiquid shares that was related to the level of the discount. However these could only explain a small part of the discount. He also showed that the explanatory factors that have been identified seem to vary over time. This leads Malkiel to conclude that there is inefficiency in the market and that investor psychology influence the level of the discount.

[7] Blennow, E. ‘Rea på börsen’, Stock Magazine, No. 4, 2007, <http://www.aktiespararna.se/artiklar/Reportage/Rea-pa-borsen/>

[8] Hjelström (2007), p. 65

Hjelstöm concludes that there appear to be a few rational factors that could cause the discount. Agency costs are claimed to increase the discount. Here the agency problem arises because the minority shareholders (assumed to be able to influence the market price) do not trust the majority shareholders and the management team since they have the ability to extract private benefits for themselves which is in direct opposition to maximizing shareholder value. The discount is larger in ITCs where different measures of the ownership concentration are larger.[9] Also, administration costs are shown to be related to the level of the discount when these are considered as an agency costs rather than normal expenses.[10] He also finds that owner structure appears to affect the level of the discount. Very stable, large owners seem to increase the discount. If there is a structural stability between different owner groups this also seems to enlarge the discount. This is then confirmed by a comparison between British and Swedish ITCs. Ownership concentration is much higher in Swedish investment trusts than in British and Swedish companies have significantly higher discounts than British companies do. This could be a rational argument for the discount that then contradicts the idea of underpricing. The average discount for British ITCs have been 13 % for the years 1973-2004, the corresponding figure for Swedish companies is 22 %.[11]
Hjelström also finds that portfolio diversification could be a factor influencing the size of the discount. A larger, very diversified trust has a higher probability of containing securities not wanted by the individual investor. This negative impact from diversification is dependent on the assumption of minority shareholders that actively trade the stock of the ITC and have strong perceptions of the securities held by the trust.[12] This might seem contradictive to the argument that the value ITCs offer to small investors is diversification of funds. It has though been shown that holding a portfolio of relatively few different shares is enough to diversify away nearly all firm-specific risk.[13]

Brickley and Schallheim (1985) made a study that showed signs of market inefficiency relating to the valuation of ITC. They studied the US market from 1962-1982 and showed that substantial gains could be made when the fund allowed shareholders to obtain the market value of the fund's assets (liquidation). Hence the discount is real and not a result from inaccurate reporting, a theory that had been brought forward earlier. They also documented

[9] Ibid, p. 218
[10] Ibid, p. 251
[11] Ibid, p. 3, 153, 261, 264
[12] Ibid, p. 209, 214, 241
[13] Evans and Archer (1968)

the availability of abnormal returns which occurred during the announcement of a liquidation; the latter suggesting that market inefficiency exists.

Draper (1989) finds that the market price of ITC shares reacts very fast to news regarding looming takeovers, threat of open ending the trust and liquidations. He uses these observations to conclude that the pricing of ITC shares is efficient. However, he states that the size of the discount “remains an enigma”.

The general idea behind a big part of the earlier research is whether the discount can be proven to be a market-inefficiency. If this is the case then it should be possible to earn abnormal returns exploiting this mispricing. However, if the discount is caused by rational factors it should not be possible to earn excess returns without taking on additional risk.

2.2.2 Discount as a predictor of abnormal returns

Several studies have been carried out to see if it is possible to earn abnormal returns employing certain investment strategies based on taking advantage of the discount. Richards, Fraser and Groth (1980) compared different mechanical trading rules in order to earn excess returns on an investment portfolio. The rule was to purchase shares of ITCs where the discount had widened and sell those ITCs where the discount had narrowed. They concluded that it was in fact possible to earn abnormal returns employing different investment strategies based on the level of the discount. Their results also indicated that specialized funds are more profitable than diversified funds. The general strategies originated from RFG was further tested and strengthened by Anderson (1986). He found that it was possible to earn excessive returns since that the revision of the discount level could be predicted.

Another study that have compared the returns of closed-end funds in relation to the discount levels was made by Thompson (1978) where he compared the performances of different portfolios containing ITCs with the highest discounts and portfolios containing ITCs with the highest premiums respectively. During a period from 1940 to 1975 he found that trusts on the NYSE selling at a premium appear to underperform those selling at a discount which he interpreted as a sign of market inefficiency. An investor that adopted Thompson strategy would have been able to earn abnormal returns of 4 % annually between the years 1940 – 1975.

In 1994, Cheng et al. made a study where they investigated a simple discount based investment strategy. They looked at investment trust companies on the London Stock Exchange between the years 1985-1989 and compared the returns in relation to the discount levels. They purchased ITCs with high discounts and sold those with low discounts. They found a tendency that confirmed Thompson’s study and concluded this was a market inefficiency even if the significance wasn’t very strong.

2.2.3 Our study in relation to previous research

There still is no general consensus or empirically supported theory of what factors are causing the discount. However, without having to explain or understand why the discount exists it has been possible to achieve excess returns by exploiting the discount/premium. We feel that our study would be interesting since there haven’t been many similar studies made in recent times, especially not on the UK market. It would interesting to compare our results with previous studies since our spontaneous thought is that the reporting and accounting principles have changed to being more accurate and frequent – the access to information is a lot better now compared to several decades ago. The discount was earlier thought to be due to inaccurate reporting; it is possible that the increased transparency could have changed the relationship between the discount and returns. It is a common thought within the finance world that strategies that can earn abnormal returns and are easy to use should vanish once they get known to the public. This is because share prices should immediately reflect new information once it gets disclosed. Therefore it is interesting to see if excessive returns in ITCs can still be predicted despite all the attention focused on the discount today.

3 Theoretical framework

Theories applied in this study will be presented below.

3.1 The efficient market hypothesis

The efficient market hypothesis (EMH) basically means that stock prices are always right. Given the available information the market will always set a price that correctly estimates the intrinsic values of financial assets.[14] When new information becomes available it will rapidly influence market prices and then become useless for predicting future return patterns. EMH does allow over- and under reactions when new information becomes available. However, it is required that the reactions are random and follow a normal distribution so that the net effect on market prices cannot be predicted and exploited to earn abnormal returns. Hence, occasional deviations from zero abnormal return can occur but the market as a whole is always right.[15] There are three major versions of the hypothesis:

Weak:

This form of the EMH states that share prices currently reflect all available information that can be obtained by studying past trading data. Hence price movements should only come from new information not contained in previous time series. This means there should not be any patterns to how assets prices evolve and that trend analysis is useless. If past performance could convey any useful information about future performance all investors would immediately exploit these information and stock prices would be bid up to their correct value.[16]

Semi-strong:

In addition to the information already captured by stock prices in the weak assumption here all publicly known information on firm characteristics such as product line, quality of management etc should be reflected in the stock price. That means that no information that is obtainable by the general public should have any power to influence asset prices. When new information is released it should immediately be incorporated into share prices. Hence, fundamental analysis, for ex carried out by brokerage firms and analysts, should be fruitless.[17]

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[14] Fama (1965)
[15] Fama (1998)
[16] Bodie, Kane and Marcus (2004), p. 348
[17] Ibid, p. 348-349

Strong:

The strong market hypothesis states that absolutely all information is reflected in the stock price, even info generally thought available only to company insiders. This means there are no gains to be made from insider trading. In theory, it is impossible to outperform the market. The strong hypothesis is thought to be quite extreme, it is quite reasonable to think that inside corporate officers do have access to significant information long enough before the general public to be able to profit from it. Also, insider trading is a very hot topic which contests the strong form of the EMH.[18]

According to EMH it should not be possible to earn abnormal returns through investing in ITCs with high discounts. If such an easy investment strategy could earn risk-adjusted returns above normal it would violate even the weak-form of EMH. The weak form states that all info that can be derived from studying past market trading data, for ex the information conveyed by the ratio of the value of net assets to market cap of an ITC, should already be reflected in the price of the stock.

3.2 Abnormal returns

Abnormal returns is the difference between the actual realized return and a benchmark, used to isolate the effect on returns from the factors we are interested in. Our abnormal return is defined as actual return minus the return we could expect given the specific investment trusts systematic risk, calculated according to the Capital Asset Pricing Model. This systematic risk is the risk that comes from the investments co-variation with the market, the only risk investors should be rewarded for bearing since firm specific risk can be diversified away.[19] The CAPM is used in many other papers as a way to calculate the benchmark return so we feel quite confident in using it despite some of the models documented shortcomings.

3.3 Arbitrage pricing theory and law of one price

The starting point in the APT is the *law of one price* which states that if two assets are similar in all relevant economic aspects they should sell for the same price. This implies that in an efficient market a security must have the same price, regardless of how the security is created

[18] Ibid, p. 349
[19] Ibid, p. 284

or packaged. The intuition behind this law is that sellers will flock towards where the highest prices prevail and buyers towards where the lowest price is prevalent. The forces of supply and demand will then drive the prices of two economically equal securities (equal but packaged differently or traded in different markets) to converge. The law of one price in practice is thought to be carried out by arbitrageurs. The arbitrage pricing theory states that it should not be possible to buy the same financial assets at different prices even if these are bundled differently because of the presence of arbitrageurs. If the same two assets were sold at even slightly different prices an arbitrageur who identified this discrepancy would short the expensive asset and long the cheaper one, thus creating a riskless position and earning the difference. Since the position has a net zero exposure to macroeconomic and firm-specific factors it is riskless. Hence, any investor regardless of risk aversion would want to take a position as large as possible. It also does not require any initial investment so in theory it is enough with one single arbitrageur to force prices to come together. This means the any discrepancies in prices should be extremely rare and only exist for a short instant.[20]

However, one impediment to arbitrage in investment trusts can be identified. One could imagine that arbitrageurs would go long in ITC with a discount, buying the net assets at a price lower than their market value. One problem is that the discount may widen which makes this strategy extra risky.[21] It has been shown that the discount tend to be higher in those ITCs that are more difficult to take arbitrage positions in,[22] indicating that there is an impediment to the APT present. This relates back to the actual findings by Hjelström that ITCs with very stable ownership structures appear to have higher discounts than average. This could be due to this observed fact of limitations to efficient arbitrage in ITCs.

[20] Ibid, p. 325
[21] Ibid, p. 393
[22] Pontiff (1996)

4 Method and data

In this section we describe how the test has been conducted. We start by explaining the choice criteria of our sample followed up by a presentation of the regression model. Then we present the variables included along with our hypothesis about them. To finish off we explain our rules for drawing statistical inference.

4.1 Selections

4.1.1 Data source

We obtain all our data from Thompson Datastream. Because of the recognition and wide use of this database all the data taken from Datastream is considered accurate.

4.1.2 Market

This study is based on observations of British investment trusts available in Thompson Datastream. Because of the very good access to data on accounting information the two most appropriate markets for this kind of study are the United States and United Kingdom. We have chosen to study the British market since considerably less similar studies have been conducted on the UK market compared to the US.

4.1.3 Time period

This study investigates a ten-year period from 2000-2009. The aim is to choose a time period as recent as possible but still large enough to capture the impact of our variables of interest and at the same time cover different economic cycles. Another supporting argument is that we have noticed that there haven't been many similar studies conducted for the recent decades investigating abnormal returns from alleged mispricing of investment trusts specifically on the British market.

4.1.4 Data frequency

Our regression is done on a quarterly basis. We feel that quarterly data is a suitable time frequency to capture the effects on abnormal returns from changes in the discount. With ten years data and many ITCs it should also give us enough observations to be able to reach statistical significance on our results. Some smaller companies may also be less likely to update changes and performance measures more frequently than quarterly. Using data that is more frequent might then not be an appropriate since it could decrease consistency between different segments of our data sample.

4.1.5 Choice of criteria

The general aim has been to include as many samples as possible to strengthen the reliability of the test. The first choice of criteria is that data must be available for all the variables in the regression model, that is we must have access to data on the following at least on a quarterly basis for each ITC;

1) Market value of net assets
2) Market value
3) Dividend yield
4) Total return on net assets
5) Total return on the ITC

We get all of these directly from Datastream (see Appendix 1 for exact definition of measures). We use 1) and 2) to calculate the premium ourselves since this measure could not be taken directly from Datastream.

Firms belonging to the same group with very similar price developments have been excluded since some groups might consist of ten different firms which appear very similar and it is not clear to us if these companies are separate entities or not. We also had to exclude a few ITCs with such odd return patterns that beta could not be calculated. We felt this was a better idea than including them in the regression without a proper measure of expected returns.

We also require that the firm has been a going-concern during the ten years of the study's time frame and additional four years prior to 2000 for estimating the beta values. From the original total observations of 264, 68 have been considered approvable and used in this study. Our choice criteria could lead to survivorship bias, this issue is discussed in the analysis. See Appendix 2 for full list of ITCs included in the study.

4.2 Multiple regression model

To determine the relationship between the discount and abnormal returns we use a multiple regression model with abnormal returns as the dependent variable, discount as the independent variable and a set of control variables. When we add a relevant control variable, for ex logarithm of market cap we take the effect from market cap on abnormal returns out of

the error term and put it explicitly in the equation. We are then able to measure the effect on abnormal returns from a change in the level of the discount holding market cap fixed.[23] Controlling for factors that have empirically been shown to generate returns outside the CAPM helps us isolate the effect from the discount on abnormal returns.
To estimate the regression model:

$$AR_j = \alpha_j + \beta_1 discount_{t-1,j} + \beta_2 RNAV_j + \beta_3 log\_size_j + \beta_4 DY_{t-1,j}$$

we use the method of ordinary least squares (OLS). It chooses the estimates of the independent variables to minimize the sum of squared residuals, minimizing the function
$\sum(AR_j - \beta_1 - \beta_2 - \beta_3 - \beta_4)^2$.

Because we wish to study the impact of the discount on abnormal returns in many firms in several time periods we need to treat our sample as panel data doing our OLS regression. All regressions are done by the statistics program Stata.

4.3 Regression Variables

4.3.1 Dependent variable - abnormal return (AR)

Our dependent variable is the abnormal return on a quarterly basis, defined as actual return minus a benchmark return calculated using the CAPM. Our actual return is calculated as $R_{it} = (RI_t - RI_{t-1})/RI_{t-1}$ using the total return index[24] from Thompson Datastream that treats dividends as being reinvested and therefore capture the full increase in value. Our benchmark return is calculated applying the CAPM.
In order to determine the expected return according to CAPM for every company in every quarter, beta values need to be calculated. For each year starting from 2000 to 2009 a beta value for each company has been calculated from daily data four years prior to the actual year:

$$\underbrace{t-4 \qquad\qquad\qquad\qquad t}_{\text{applied beta value for period } t}$$

[23] Wooldridge (2008), p. 69
[24] see Appendix 1 for full explanation of RI

This will result in each company having 10 different beta values representing each year in the observed period. The annual beta is used for every quarter in that particular year. We have to obtain data from the years 1996-2009.

As a proxy for the return on the market portfolio the total return on the FTSE 350 has been used. As a measure of the risk free rate we use the interest rate on 3 month UK treasury bills since these are virtually risk free. We consider the 3 month UK treasury bills to be a close proxy for the risk-free rate since the bankruptcy risk of the UK Government is virtually zero in our time perspective. The 3-month T-bill is extensively used in research applying the CAPM so we feel confident that it is a reasonable proxy for the risk free rate. We treat the UK as the whole market when we use the FTSE 350 as a proxy for the market portfolio and the UK 3-month t-bill rates as a proxy for the risk free rate; this may not be completely accurate since some of the stocks held by the ITCs are traded on other markets than the UK stock market. The implications of this issue will be further addressed in the analysis of our OLS estimators. However, since other benchmarks, e.g. S&P500, are extensively used as a proxy for the market portfolio in other research we feel reasonably confident using the FTSE 350.

We run the following OLS regression; $R_{it} – R_{ft} = \alpha_i + \beta_i(R_{mt} – R_{ft})$ to obtain the beta values we will later use to estimate the expected return. R_{it} is defined as above and R_{mt} calculated similarly based on the total return index of the FTSE 350 index.

4.3.2 Explanatory variable of interest – discount level

Our variable of interest in this study is the discount level. Net asset value and market cap have been imported from Datastream and then used to compute the random variable (NAV/MV)-1. It is defined so that the ratio will be positive if we have a discount and negative if we have a premium. What we want to test is if positive abnormal returns can be explained by the presence of a discount in a previous time period. We use the discount at the beginning of the period, the abnormal returns in every quarter is regressed on the discount at the beginning of that period:

$$AR_{t,j} = \alpha + \beta_1 discount_{t-1, j} + \beta_2 RNAV_{t, j} + \beta_3 log\_mv_{t, j} + \beta_4 DY_{t-1, j}$$

Buying an ITC with a discount equals acquiring the net assets at a lower price than if these were to be purchased directly. The possible abnormal returns should then come in subsequent time periods. Our argument is supported by the fact that analysts often use a high discount today as an argument for buy recommendations of ITCs.

We therefore state the null hypothesis that a discount in market value compared to net asset value leads to zero abnormal returns. If we obtain a positive coefficient (a change in the level of the discount leads to a change in abnormal returns in the same direction) that is statistically significant we can reject our null hypothesis.

H_0: $\beta_1 discount = 0$

H_1: $\beta_1 discount > 0$

4.4 Control variables

We add relevant control variables in order to isolate the explanatory effect of the discount on abnormal returns. Other factors that can be suspected to affect abnormal returns are included as independent variables in our model in order to see the effect on abnormal returns from the discount holding these other effects constant. In order to test the sole impact of our variable of interest we will have to identify and include other factors that might have an effect on abnormal returns. These control variables will be presented and discussed below.

4.4.1 Return on net asset value (RNAV)

Our first control variable is the return on net asset and this measure is directly accessible from Datastream. The variable shows the theoretical growth of share value under the assumption that dividends are reinvested to purchase additional equity shares of the company to the closing bid price.[25]

The variable is constructed as:

$$R_t = P_t/P_{t-1} * (1+DIV_t/N),$$

where N is the amount trading days under a year, taken to be 260.

[25] Se appendix 1 for full definition

This control variable is expected to have the high prediction value on the ITCs returns. The logic can be derived from the Residual Income Valuation model where the return on net asset value has a direct effect on the valuation:

$V_0 = NAV_0 + \sum((RNAV_t - r_e) * NAV_{t-1})/(1+r_e)^t$

We expect a positive and strong correlation between return on net assets ant total return for the ITC. However, in risk adjusted returns according to CAPM expected return have been deducted. If expected return is a good measure it should be quite similar to return on net assets since expected return for the whole ITC should be the return on its underlying portfolio of investments minus the additional expenses incurred by management. We still expect an impact of RNAV on abnormal returns since its unlikely that CAPM would fully capture the variations in return in the underlying portfolio. We believe that an increase in return on net assets will lead to an increase in abnormal returns in the same time period.

H_0: $\beta_2 RNAV = 0$
H_1: $\beta_2 RNAV > 0$

4.4.2 Market value (MV)

Our second control variable is size. The "size effect" where firms with a smaller market cap have higher risk-adjusted returns over time than firms with a larger market cap is widely investigated relating to the field of efficient markets. The proof for this effect is quite stable and often claimed to be a compensation for the higher risk in small firms or the illiquidity of smaller firms.[26] It has also been thought that because of the less scrutiny and information available regarding smaller firms investors will be more resistant to own these stocks and they therefore require a higher expected return.[27] Some research has claimed that this effect is sample specific and/or dependent on the methodology. However, recent research using a method specifically designed to avoid bias finds that smaller firms on the UK market do actually have higher risk adjusted returns than larger firms during the year 1988 to 2004.[28] It is also often used as a control variable in previous research trying to explain abnormal returns. Since the size of the different ITCs vary tremendously it is appropriate to use the natural

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[26] Bodie, Kane and Marcus (2004), p. 362-363
[27] Banz (1981)
[28] Andrikopoulos et al. (2008)

logarithm of market cap to scale down those huge differences and also because this random variable is an absolute measure and not a relative value.[29]

The market cap size is expected to have a negative relation with abnormal returns.

H_0: $\beta_3 log\_mv = 0$

H_1: $\beta_3 log\_mv < 0$

Often the ratio of book value of equity to market value of equity is used together with market cap as variable thought to be able to predict returns outside the CAPM. However in our study we choose to leave it out of the model, this issue is discussed further in t validity section.

4.4.3 Dividend yield (DY)

Dividend yield is defined as the dividend in relation to the market value of equity. Datastream has calculated the variable on gross dividends (including tax credits) where available. Investment strategies that go long in stocks with high dividend yield have been thought to earn abnormal returns. This has been widely investigated with differing results depending on setting and methodology.

The signaling power of dividends and dividend yields has been widely investigated in previous research. The basis for viewing dividends as an indicator of future return patterns comes from the signaling hypothesis where informational asymmetries in the market leads investors to interpret increased dividends as a signal of permanently higher expected future cash flows since companies rarely want to reduce or omit dividends in subsequent years.[30] For example Balachandran et al. (1996) finds a negative price reaction as a result of omitted dividends on the UK market for the years 1986-1993.

It has though been brought forward that the dividend yield effect may be a proxy for some size related factor. For ex Keim (1985) finds that dividend yields and market cap is inversely related and that high dividend yield effect may be a manifestation of the relation between returns and market capitalization, the size effect described above. On the other hand, Verner and Thaler concludes that the excess returns from high dividend yield stocks are not a size

[29] Banz (1981)
[30] Balachandran and Nguyen (2004)

related effect. Instead their argument goes that since investors overreact, they overweight recent information compared to long term trends. Due to this fact stock prices may temporarily divert from their underlying fundamental value. This implies that stocks which have hit a rough path, “losers”, are undervalued for some time as their earnings come back but then they will bounce back, generating excessive returns. Firms whose market cap have declined recently but still maintain their dividends (which are the most common policy unless the company is in serious trouble) will then have high dividend yields. The observation that firms with high dividend yields earn high returns in subsequent time periods might hence be due to this loser effect described above.[31]

Even though the high dividend yield effect have been shown to be absent in the UK market for the years 1984 to 1994,[32] we feel it is a good idea to include it as a control variable since it is commonly used in research as an explanatory factor of abnormal returns. Our null hypothesis is that dividend yield will have a zero effect on abnormal returns and the alternative hypothesis that dividend yield will have a positive impact on abnormal returns.

H_0: $\beta_4 DY = 0$

H_1: $\beta_4 DY > 0$

We regress the impact of dividend yields in the previous period on the abnormal return in the current period since we believe that a high dividend yields in t leads to the reversal effect on returns described above in a subsequent period t + 1.

4.5 Statistical inference

4.5.1 T-test

Using a t-test means trying how many estimated standard deviations $\hat{\beta}_j$ is away from zero. The reason our estimator has a t-distribution is because the constant standard deviation has been replaced with the standard error which is a random variable.[33] We use a two sided test with a five percent significance level ($|t_{krit}| = 1.96$) to declare an estimator statistically significant or not. The null hypothesis is that the relevant independent variable has no effect on the dependent variable and we reject the null hypothesis if our estimator has a t-value that

[31] Werner, De Bondt and Thaler (1987)
[32] Filbeck and Visscher (1997)
[33] Wooldridge, (2008) p 121-122

is lower than minus 1.96 or higher than 1.96. With this rather strict rule we feel confident about our results that are the basis for our analysis.

4.5.2 F-test

To determine if our set of independent variables together explain abnormal returns it is wise to use an F-test. This is because if we would test each t-statistic at $\alpha = 5$ % the overall probability of falsely rejecting the null hypothesis would be much greater than 5 %. With 4 independent variables the probability of making a type-1 error (falsely rejecting the null hypothesis) would be $\{1-(1-0.05)^4\} = 19$ %. The F-test helps us determine if the group of variables is jointly significant. In case there is multicollinearity (which makes it difficult to determine the partial effect on each variable separately) this is a much lesser problem for statistical inference with the F-statistic than with the separate t-statistics. We can use the F-statistic to test if our 4 independent variables have a compound effect on abnormal returns. The null hypothesis is that none of the independent variables have any impact on abnormal returns against the alternative that at least one of them has. The lower the p-value the better the model.[34, 35]

[34] Ibid, p. 143-148

[35] Alicia Carriquiry, lecture notes, course 328 Applied Business Statistics, Iowa State University, viewed on 14th May 2010, < http://www.public.iastate.edu/~alicia/stat328/notes.htm>

5 Results

In this section we present the results of our study.

5.1 Regression results

The results from our regression,

$AR_{t,j} = \alpha + \beta 1discount_{t-1,\,j} + \beta 2RNAV_{t,\,j} + \beta_3 log\_mv_{t,\,j} + \beta_4 DY_{t-1,\,j}$

are illustrated in below table using robust standard errors:

Dependent variable Abnormal returns	Robust Coefficient	Standard error	t	P>t	95 % confidence interval lower bound	95 % confidence interval upper bound		Number of observations	2652
Return net assets	.5802763	.0258162	22.48	0.000	.5296544	.6308982		F(4,2647)	142.41
Discount	.1463949	.0318473	4.60	0.000	.0839468	.208843		Prob > F	0.0000
Log market cap	.0119628	.0024541	4.87	0.000	.0071506	.0167749		R^2	0.3738
Dividend yield	-.000555	.1065946	-0.01	0.996	.2095721	.2084621		Root MSE	.10427
Intercept	-.2462085	.0477056	-5.16	0.000	-.3397526	-.1526644			

5.2 Variable of interest

We can see that our variable of interest discount has a positive sign and is statistically significant at a very low significance level; we therefore reject the null hypothesis about no impact of the discount on abnormal returns. The coefficient says that if the discount increases by 1 % this leads to an increase in abnormal returns of .146 % in the next quarter, holding all other factors constant. If we take a look at the confidence interval we see that in 95 % of the cases the true population value of the coefficient on the discount would lie between 0.0839 % and 0.209 %.

5.3 Control variables

Also our control variable log market cap is significant but with the opposite sign than we predicted, we therefore cannot reject our null hypothesis regarding the size. Here instead a larger market value leads to higher abnormal returns. However, this does not mean that we accept the null hypothesis, only that we fail to reject it.

The effect from dividend yield is insignificant. We cannot reject our null hypothesis about an increase in abnormal returns in a later time period from an increase in dividend yields in the current time period. Our t-statistic is so insignificant we cannot say anything about the possible effect of dividend yields on abnormal returns.

The very significant impact of RNAV implies that when return on the underlying portfolio increase this leads to an increase in abnormal returns in the same period. We can reject the null hypothesis about no impact on abnormal returns from the return on the investments by the ITC. If return on the investments increase by 1 % then abnormal returns should increase by 0.58 % in the same quarter of a year. This may seem reasonable at first sight but if we think about the definition of abnormal returns it becomes a bit more puzzling. This issue will be addressed further in the analysis section.

We also have a statistically significant constant with a negative sign. The constant is – 0.246 which would be the abnormal returns if all our explanatory factors were zero.

5.4 Prediction value

R^2 is 37.38 % which means that 37.38 % of the variation in abnormal returns can be explained by variation in the independent variables.

5.5 F-statistic

We can reject the null hypothesis that our independent variables together have no explanatory effect on abnormal returns at a very low significance level. Our independent variables jointly explain abnormal returns very well.

6 Test of validity

We are here presenting the additional tests we have made in order to strengthen the validity and robustness of our study.

6.1 Conditions for Ordinary Least Squares

A certain number of conditions[36] have to be fulfilled for us to have unbiased estimators,[37] estimators whose expected value equals the population value.

1) The first condition is that the underlying model we want to estimate is linear in parameters β_1, β_2.. β_k. It can formally be stated as $y = \beta_0 + \beta_1 x_1 + \beta_2 x_2 + \beta_k x_k + u$, where the betas are unknown parameters and the u is a random unobservable error term. This formula is quite flexible since both the dependent and the independent variables can be arbitrary functions of the underlying variables of interest. We are very confident that this condition is satisfied in our regression model.

2) The second condition stipulates that we should have a random sample of observations following the population model above. Here we could have a problem because of the choice criteria of our sample. The population we are studying includes only those investment trusts that have been active as a going-concern during 1996-2010. One might suspect that ITCs with higher returns are more likely to have survived the period and hence we might have a sample with disproportionately many firms that earn abnormal returns. This could bias our results since the prevalence of a premium/discount in these firms might be falsely thought to be the sole driver of abnormal returns when it is in fact our choice criteria that lead us to have high abnormal returns. Firm-specific reasons for abnormal returns and a premium/discount that happen to be there by chance could lead to bias in our estimators. Even if this fact does not invalidate our whole research it is something one should be aware of and the implications of a possible survivorship bias will be elaborated on in the analysis part.

3) The third condition stipulates that in the sample (and hence neither in the population) none of the independent variables can be perfectly correlated with each other. Actually even high multicollinearity is acceptable as long as it's not perfect. However, one risk

[36] Wooldridge, (2008) p 84-87
[37] Ibid, p. 847

getting high standard errors if the independent variables are highly correlated with each other. A test of multicollinearity will be carried out in a section 6.2 below along with a discussion of its implications on our results.

4) We also need an assumption about how the error term is distributed in order for our regression to produce unbiased estimators. We need the error term to be on average unrelated to the independent variables, $E(u|x_1, x_2, x_3, \ldots x_n)= 0$. There will always be factors we cannot account for through independent variables and these will be collectively captured through u. A source of failure for this assumption is if we leave out an important explanatory variable that is correlated with our other explanatory variables. In general this is not a very big problem in multiple regressions but still we need to be very careful with defining our control variables.

If conditions 1-4 are satisfied then the procedure by which we obtain the OLS estimates is unbiased, $E(\hat{\beta})= \beta_j$ for any values of the population parameter β_j . This however does not mean that we can ensure that the estimated value is the same as the actual value; only that we have no reason to believe that our estimate is neither more likely to be too big nor more likely to be too small.[38]

5) Even though it is not absolutely necessary for obtaining unbiased estimators, an assumption of homeskedasticity is often added since it simplifies mathematical and computational treatment by knowing not only the central tendencies of $\hat{\beta}$ but also have a measure of the spread in the sampling distribution. The homoskedasticity assumption means that the error term u has the same variance regardless of the value of the independent variables, the error term is unrelated to the independent variables, $Var(u|x_1, x_2, x_3, \ldots x_n)= \sigma^2$. If the variance of the error term is related to the independent variables instead we have hetereoskedasticity that invalidates t-tests and F-tests which we use to determine statistical significance.[39] We will test for heteroskedasticity and explain its implications for our sample further down.

If in addition to conditions 1-4 also condition 5 holds then the Gauss –Markov Theorem holds. This theorem justifies OLS rather than any other competing estimators. Again, under

[38] Ibid, p. 88
[39] Ibid, p. 94-95, 265

condition 1-4 the OLS estimators are unbiased. Under these assumptions there could however be many unbiased estimators. If there is one with smaller variance than OLS this one is a better method. If also condition 5 is satisfied however we can argue that OLS is the *best linear unbiased estimator* which means the following; an estimator is a rule that can be used on any sample of data to produce an estimate. As stated above, an estimator is unbiased if $E(\hat{\beta})= \beta$ for any β_0, β_1, β_k. Linear means that the estimator $\hat{\beta}$ can be expressed as a linear function of the data on the dependent variable, $\hat{\beta}_j = \sum_{i=1}^{n} Wij * ARj$ where each w_{ij} can be a function of the sample values of all independent variables. The OLS estimators in their turn are expected to be linear. The meaning of "best" is smallest variance, the linear combinations of the OLS estimators achieves the smallest possible variance among all linear unbiased estimators.[40] Again, the Gauss Markov Theorem justifies the OLS rather than any other method for estimating multiple regression models.

6) We have seen that under the Gauss Markov assumptions OLS is useful for describing the precision of the population estimators. However, we need the full sampling distribution of $\hat{\beta}_j$ in order to perform statistical inference. Even if the conditions 1-5 are satisfied the distribution of $\hat{\beta}_j$ can have virtually any shape which makes statistical inference a problem. The sampling distributions of the OLS estimators depend on the distribution of the underlying errors. We make an assumption that the errors are independent of the explanatory variables and normally distributed in order to make the sampling distribution of $\hat{\beta}_j$ tractable. If the error term is normally distributed this means that the sampling distributions of the OLS estimators are also normally distributed. If $\hat{\beta}_j \sim \text{Normal}\{\beta_j, \text{Var}(\hat{\beta}_j)\}$ then $(\hat{\beta}_j - \beta_j)/se(\hat{\beta}_j) \sim t_{n-k-1}$, we see that this assumption is of outmost importance for us in our hypothesis testing of our independent variables.

If in addition to conditions 1-5 also assumption 6 hold then OLS estimators now have significantly stronger efficiency properties than under pure Gauss Markov. The OLS estimators now have the smallest variance of all unbiased estimators, even compared to non-linear estimators.[41] A normality test and its implications will be covered further down.

[40] Ibid, p. 103
[41] Ibid, p. 117-118

6.2 Robust tests

6.2.1 Multicollinearity

One problem with multicollinearity is that it increases the standard errors. This means that t-statistics will be smaller and it will therefore be more difficult to reject the null hypothesis. Signs of multicollinearity could therefore be that none or few of the explanatory variables are statistically significant according to the t-test but the group of variables is significant according to the F-test. In general, multicollinearity is a bigger problem with a small sample.[42] As we could see in results all our explanatory variables except one are significant. The fact that we have a large sample works in our favor for being able to make statistical inference since it helps to reduce standard errors.

Correlation matrix independent variables	Return net assets	Discount	Log market cap	Dividend yield
Return net assets	1.0000			
Discount	-0.0316	1.0000		
Log market cap	-0.1033	0.6361	1.0000	
Dividend yield	0.1259	0.0653	0.0482	1.000

Table 2: Correlation matrix between the dependent variables

The highest observed correlation is between log_size and premium, a positive correlation of 0.6361. When two independent variables are highly positively correlated their OLS estimators tend to be negatively correlated. If the estimator for log market cap would be lower than the real population value it is possible that our estimator of the discount would be higher than its population value or vice versa. This will be taken into account later in the analysis. Another problem might be that one independent variable could be a linear combination of a group of

[42] Richard Williams, Department of Sociology, University of Notre Dame, viewed on May 12th 2010, <www.nd.edu/~rwilliam/stats2/l11.pdf>

other variables, yet not highly correlated with any one of them.[43] Since we don't see any worrying signs of multicollinearity in our results and have a large sample size we don't elaborate on this issue further with alternative tests for detecting correlation between the independent variables. Also it's difficult to determine a cut-off point where correlation between independent variables becomes a problem. One should however be aware that there is a correlation between our variable of interest, the discount, and our control variable, log of market cap, and this might have consequences for statistical inference.

6.2.2 Heteroskedasticity

If there is a presence of heteroskedasticity the variance of the error term changes with the explanatory variables, the variance is not uncorrelated across the independent variables. This means OLS no longer has the smallest variance. Heteroskedasticity causes the estimators of the variances, Var($\hat{\beta}_j$), to be biased. OLS standard errors are based directly on these variances which mean that t-statistics no longer have a t-distribution under heteroskedasticity and hence we can no longer rely on t-tests to determine statistical significance nor use the t-statistic to construct confidence intervals. Same argument applies to F-tests, the F-statistic no longer has an F-distribution in case heteroskedasticity which then of course makes statistical inference from the F-test impossible.[44]

We will use a basic test to see if the variance of the error term depends on the explanatory variables. If this is true it could invalidate our OLS statistics.

We have our model of $AR_j = \alpha_j + \beta_1 discount_{t-1,j} + \beta_2 RNAV_j + \beta_3 log\_size_j + \beta_4 DY_{t-1,j} + \varepsilon$ and we take assumptions 1-4 as fulfilled. Assumption 4 states that

$E(u|x_1, x_2, x_3, \ldots x_n)=0$ so that our OLS estimators are unbiased. We make our null hypothesis to test assumption 5, H_0: $Var(u|x_1, x_2, x_3, \ldots x_n)= \sigma^2$. If we cannot reject H_0 at a reasonable significance level than we can conclude that heteroskedasticity appears not to be a major problem in our sample. We have made the assumption that u has zero conditional expectation, $E(u|x_1, x_2, x_3, \ldots x_n)=0$, hence $Var(u|x) = Var(u^2|x)$. This means that our null hypothesis is equivalent to $E(u^2| x_1, x_2, x_3, \ldots x_n) = E(u^2) = \sigma^2$. Now we see that we can test for signs of heteroskedasticity by checking if the expected value of u^2 is related to any of the explanatory variables. We do this by running the regression $u^2 = §_1 discount_{t-1,j} + §_2 RNAV_j + §_3 log\_mv_j$

[43] Ibid
[44] Ibid, p. 264-265

+§$_4$DY$_{t-1,j}$ + v, v is the error term with an expected value of zero given all values of the independent variables.[45]

Our null hypothesis of no heteroskedasticity can be stated H_0: §$_1$=§$_2$=§$_3$=§$_4$=0 and if the above stated assumption regarding v is true then we can use t and f-statistics to interpret the results of the regression. Our results from the regression turn out to be:

Dependent variable: uhat_sq							
Independent variables	Coefficient	Standard error	t-value	P>t		$F_{4,2647}$	5.97
Return net assets	.0095951	.0095929	1.00	0.317		P> F	0.001
Discount	.0389299	.0175623	2.22	0.027		R^2	0.0771
Dividend yield	.0465377	.0422764	1.10	0.271		Root MSE	0.02954
Log market cap	-.0000337	.0011236	-0.03	0.976			
constant	.0039727	.0226228	0.18	0.861			

Table 3: Results from the heteroeskedasticity test

We see that the squared residual is explained by the discount which means assumption 5 is not accurate for our sample. The null hypothesis is rejected both according to the F-test and T-test on the individual estimators. There are signs of heteroskedasticity in our sample.

Fortunately there is a remedy for this problem; we can use robust standard errors in order to still be able to use the OLS estimators to determine statistical significance. We can adjust standard errors so that T-statistics and F-statistics are valid in the presence of heteroskedasticity of unknown form, especially since we have a larger sample. There are many different ways to compute heteroskedasticity robust standard errors, showing how these can be derived is beyond the scope of this thesis. The only difference between the usual OLS t-statistic and the robust t-statistic is how the standard error is computed.[46] Stata can compute

[45] Ibid, p. 271-273
[46] Ibid, p. 265-267

the robust standard errors and use these to compute robust estimators so we simply take these for granted later.

6.3 Test for normality

Assumption 6 (see section 6.1) implies that the error term u is independent of the explanatory variables and normally distributed. This leads to the OLS estimators having normal distributions which is a prerequisite for being able to use t-tests and F-tests to determine statistical significance. If the error term is not normally distributed than the t-statistic is not exactly t-distributed and the F-statistic is not exactly F-distributed.

We perform 5 different tests of normality on the error term (see Appendix 3). From our 3 non parametric it appears as if the distribution of our residual is not exactly normal even though we cannot see how far off it really is. We then detect a couple of severe outliers in the interquartile range tests which could indicate a non normal distribution of our error term. We then use a Shapiro-Wilks test that rejects the null hypothesis that our residual is normally distributed at a very low significance level.

It seems as if assumption 6 is a bit shaky and could in fact be wrong for our sample. However, there is a way around this problem. Assumption 6 is equal to saying that the distribution of the dependent variable given the values of the independent variables is normally distributed.[47] If we have a large enough sample size we can use the central limit theorem[48] to say that the OLS estimators are asymptotically normally distributed and hence t-statistics and F-statistics have t and F-distributions respectively. A derivation of asymptotic normality is beyond the scope of this thesis. Application of the central limit theorem makes it possible for us to drop the assumption regarding a normal distribution of the error term. We only have to assume it has fixed variance[49] which is a much less aggressive assumption. In our new situation $(\hat{\beta}_j - \beta_j)/se(\hat{\beta}_j) \sim N(0,1)$ because the distribution is only approximate. However this is the same as $(\hat{\beta}_j - \beta_j)/se(\hat{\beta}_j) \sim t_{n-k-1}$ since the t-distribution approaches the normal distribution when the degrees of freedom gets large. Hence, statistical inference can be carried out exactly the same way as if assumption 6 holds if the central limit theorem applies. Usually having a model with several independent variables requires a larger sample in order to be able to use the

[47] Wooldridge (2008), p. 172
[48] Newbold (2006), p. 243
[49] assumption 5 about homoskedasticity, fulfilled by the use of robust standard errors

approximations of distributions.[50] Since we have more than 2500 observations we feel confident that our OLS estimators can be used for statistical inference even though having a model with several independent variables normally require more observations for this purpose.[51]

6.4 Implications of omitted explanatory variables

If we do not include a certain independent variable that has an explanatory effect on abnormal returns we could get a biased estimator of the discount if the excluded variable is correlated with the discount. The direction of the bias depends on the direction of the contribution from the left out variable on abnormal returns and on the direction on the correlation between the left out variable and the discount. The size of the bias is determined by the size of the correlation and the size of the coefficient on the left out variable.

	$Corr(x_{discount}, x_{left\ out\ IV}) > 0$	$Corr(x_{discount}, x_{left\ out\ IV}) < 0$
$\beta_{(left\ out\ IV)} > 0$	Positive bias	Negative bias
$\beta_{(left\ out\ IV)} < 0$	Negative bias	Positive bias

For ex if we would leave out a variable with a positive impact on abnormal returns and this variable is positively correlated with the discount we would get a positive bias on our OLS estimator of the discount. Our estimator will on average be higher than the real population value since a part of the effect from our left out variable on abnormal returns will be captured by the discount because of the correlation between these two.[52]

6.4.1 Omitted variable: Book-to-market ratio

Fama and French use their 3 factor model to show that firms with high returns have high factor loadings on size and book-to-market-values. They argue that even though size and the book-to-market ratio are not risk factors themselves they might act as proxies for sources of risk.[53] For example it has been shown that returns on portfolios based on these two effects seem to predict the business cycle in many countries.[54] It has been empirically shown also by others that firms with low market cap and high BV/MV have generated returns higher than those predicted by the CAPM.

[50] Wooldridge (2008), p. 174-175
[51] Ibid, p.175
[52] Ibid, p. 92-93
[53] Fama and French (1993)
[54] Bodie, Kane and Marcus (2004), p. 367

In many other studies a ratio of book value of equity to market value of equity is included as a control variable when investigating a specific source of abnormal returns. It would therefore certainly make sense for us to include it just as we do with market cap. However, we suspect that this ratio could be very highly correlated with the discount. The discount is the net asset value over the market value of the trust on the stock exchange. Net asset value is defined as the total value of the ITCs assets minus the value of the trusts liabilities, the theoretical value if the ITC was liquidated immediately.[55] We believe net asset value could be very highly correlated with book value of equity (depends on accounting rules and definitions). Since the denominator is the same in both random variables we feel that an inclusion of a book to market measure could increase problems of multicollinearity and make it more difficult to carry out statistical inference on the discount. We therefore choose not to include a random variable of the book value of equity to market value of equity.

However, if book to market ratio can explain abnormal returns and this effect is not the same as the effect from the discount we might get a biased estimator of the discount because we leave out a measure of the book to market ratio, this is provided that these two are positively correlated.

[55] See appendix 1 ”inputs regression” for full definition

7 Analysis

In this section we analyse and interpret the results of our study and try to discuss plausible explanations of the results.

7.1 Discount as explanatory variable

Our results show that it is possible to earn abnormal returns in a subsequent time period through holding ITC shares with a discount, irrespective of all other explanatory factors. This could be due both to the observed “mean reversion effect” in the level of the discount and to the fact that the underlying portfolio is acquired cheaper than if this was purchased directly. The inference from looking at the confidence interval is that our estimate is quite good but far from perfectly reliable. The lower bound of our 95 % confidence interval of the population value is 0.0839. In 95 % of all cases we can be certain that a one percent increase in the discount leads to never less than 0.0839 % increase in abnormal returns. This is a strong argument for viewing the discount as a source of abnormal returns for investment purposes.

We feel that the OLS estimator of 0.146 is quite high. If this were the true population value a discount of 13 % would yield abnormal returns of 1.9 % quarterly. Because of our choice criteria it is plausible that we have a sample that has higher abnormal returns than the average of the underlying population. We only include ITCs that have survived the whole period, this makes it possible that we have vetted out trusts with substantial negative abnormal returns since these are likely to belong to the group that has been eliminated from our sample. We also noticed that the average discount in our sample was 16,4 % compared to the average of 13 percent for British investment trusts during the years 1973-2004. The existence of upward biased abnormal returns (due to our choice criteria) and a high discount in the sample could lead to a high coefficient on the estimator of the discount even though it is possible that these two are present simultaneously in the sample without the discount being the source of the abnormal returns.

Another possible reason for the high estimator of the discount is the relatively high correlation between this factor and log of market cap. As explained earlier, if two variables are positively correlated their estimators is normally negatively correlated. If the estimator of log market cap would be lower than its population value due to sample specific reasons it is possible that we have obtained an estimator of the discount that is higher than the real population value.

It is also possible to get an upward bias if we have left out any independent variable from our model that has a positive impact on abnormal returns and is also positively correlated with the discount. We chose not to operationalize the book to market effect as an independent variable in our model since we suspected that a ratio of book value of equity to market value of equity would be extremely highly correlated to the discount. Sources of the excessive returns on high book to market firms is, as mentioned above, often claimed to be either because these firms are underpriced or because a high book to market ratio could be a proxy for some risk factor that effects equilibrium returns. It could be that effects from the book to market phenomenon are captured by the discount. This would make our estimator upwardly biased.

However, as mentioned in previous research Thompson managed to identify a simple strategy based on going long in ITCs with a high discount that would have yielded abnormal returns of 4 % per year for 35 years straight. Many others have also managed to earn above average returns through following investment strategies based on investing in ITCs with a discount. However, we have to be fair and say that the effect on abnormal returns from the discount we have found is stronger than in the majority of the previous research.

7.2 Control variables

7.2.1 Log of market cap

We fail to reject the null hypothesis that a smaller market capitalization leads to higher returns. Instead we get a very significant estimator with the opposite sign; higher market cap leads to higher abnormal returns in the same time period. Our operationalization of the “size effect” by taking the logarithm of market cap failed. It appears as the size effect where smaller firms have higher risk adjusted returns than larger firms is not present among ITCs on the British market. Sources of the size effect is often claimed to be the higher risk in smaller firms that makes investors less willing to hold these shares and hence increase the required rate of return. We believe this mechanism is not valid for ITCs; it only takes a small number of different shares to diversify away basically all idiosyncratic risk so we cannot see any logic reasons why smaller trusts would have higher risk-adjusted returns than larger ones.
A firm which has positive returns will also experience an increase in market value of equity.
We believe that the positive, statistically significant estimator we get on log market cap is a proxy for underlying return which the CAPM fails to capture. When we subtract expected return from actual returns this effect is then left in abnormal returns.

This variable is also quite highly correlated with the discount which makes it difficult to draw any economic conclusions about the effect from the size of the market capitalization on abnormal returns in ITCs.

7.2.2 Dividend yield

We also fail to reject the null hypothesis that a high dividend yield leads to positive abnormal returns in the following time period. Our t-statistic is highly insignificant. We find no evidence that the signaling effect where higher dividends convey information about future abnormal returns is present among ITCs on the UK market. Our result is in line with Filbeck and Visscher (1997) and Gwilym et al. (2005) who concluded that a high dividend yield fail to project excessive returns on the British market in general. Our operationalization of the high dividend yield effect is that the impact on abnormal returns comes in the following quarter. There is no general consensus among the proponents of the high dividend yield strategy that this is the most appropriate operationalization of this effect. Our estimator depends on this assumption and it can be discussed if the one quarter time lag is the right one.

Market value is the denominator in both the measure of dividend yield and the discount. However, we see in our multicollinearity test that the correlation between these two independent variables is quite low. We therefore have no reason to suspect that the dividend yield obscures the OLS estimator of the discount.

7.2.3 Return on net asset value

We see a very strong impact on abnormal returns from return on the underlying portfolio. This indicates that our application of the CAPM to calculate expected returns could be wrong. There is a general consensus that abnormal returns should be hard to predict, usually they are considered to occur randomly. Actual returns minus expected returns should not be this easy to predict by return on the underlying assets. Our results imply that maybe our measure of expected returns is not that good.

When we apply the CAPM to calculate the benchmark returns we use the FTSE 350 as a proxy for the market portfolio. This could be a weakness since some of the ITCs have investments in foreign markets. This could lead to a bias in our beta value used to calculate expected return.

The general idea that the return on the underlying portfolio is the strongest factor influencing actual return of the ITC is though very reasonable. It is expected that the size of the contribution from the return on net assets is the largest of all explanatory factors.

7.3 Intercept

The intercept indicates that there are some factors that influence abnormal returns that we have not been able to incorporate in our model. Market cap cannot be zero but very low and this serves as an indicator that if the values of our random variables are very low (the underlying portfolio does not generate any returns and it is not currently discounted) we can expect negative abnormal returns.

7.4 R-square value

As seen above our independent variables explain 37.38 % of the variation in abnormal returns.

Even though our R-square value is considered quite high compared to what is seen in research of similar caliber to ours we still might be able to find other explaining variables that can increase the prediction value.

One other factor that has been claimed to predict returns above/outside the CAPM is for example the P/E-ratio, first proposed by Basu (1977). This was later shown to be a proxy for size by Reinganum (1980). There are probably many sources of abnormal returns that could be hypothesized about; the problem is finding a good operationalization for them to put into a regression model.

8 Conclusions

Here we make some concluding remarks about the findings in our study and address whether these can be expected to be valid in other settings. We also give some suggestions to other research topics relating to our study.

8.1 Conclusions regarding our results

We can conclude that our results implies that there are excessive returns to be gained from investing in ITCs that trade at a value lower than the value of its net assets. This indicates that there is in fact a present market inefficiency. It appears as if a substantial fraction of the ITCs trading at the UK market are underpriced. This is in violation of the Efficient Market Hypothesis which says that publicly available information should already be reflected by market prices. It should therefore not be possible to predict returns by studying the relationship between two simple and publicly available accounting numbers. It could also be that the discount is a proxy for some risk factor and therefore contributes to return. However if this is the case, why has no one been able to identify and explain this risk factor captured by the discount considering all the research that has been carried out on the topic of abnormal returns in investment trusts? We are currently leaning towards the idea that the discount is a significant market anomaly and that this mispricing appears to be possible to exploit.

We saw earlier that the size of the contribution from the discount on abnormal returns was quite high. The measure of net asset value over market value is very similar to the common operationalization of the book to market effect. It could then be that the discount effect on abnormal returns is another expression of the widely recognized book to market effect.

8.2 Can we generalize our results?

British ITCs are subject to significantly stricter regulations than its counterparts in Sweden. One example is the rule that a British ITC cannot have more than 15 % of its funds in another company (another trust being the exception). This rule does not exist on the Swedish market. The effect is that Swedish ITCs in general have much higher concentrations of holdings than the British ones. Also other institutional settings vary between the markets. It has been observed that the discount in Swedish ITCs was on average 22 % compared to 13 % for British trusts. We cannot say that our results can be proportionately generalized to apply in other markets since our study was carried out on British ITCs which operate in a quite distinct setting. However, we see no reason why the principles of the relationship between underpricing and abnormal returns should not apply in a somewhat similar setting.

8.3 Suggestions for future research

It would certainly be interesting to investigate why arbitrageurs are not able to exploit the price differences between the investment portfolio of an ITC and the market value of the same portfolio constructed and traded directly over the stock exchange. Some ITCs hold unquoted shares which makes it difficult to replicate their portfolios for arbitrage purposes. It has though been shown that the discount is present even in ITCs which have portfolios with only quoted shares alternatively that could be fully replicated. According to the Arbitrage Pricing Theory the presence of similar financial assets that trade at different prices presents a riskless investment opportunity where the arbitrageur can earn the difference. The discount is on average 13 % on the British market and even higher on the Swedish market. These price differences should then present the possibility of enormous arbitrage profits. Today instead abnormal returns can be earned by investors using very basic investment strategies of buying ITCs with a high current level of the discount. Effective arbitrage would eradicate these abnormal returns by bidding up prices of ITC shares to their right level.

Two impediments to arbitrage in ITCs are thought to be the risk of an increase in the discount for the investor who is going long in the ITC and the difficulty of exactly replicating a portfolio containing unquoted shares. Are there other factors which impede efficient pricing of ITCs? We think that researching this issue would be extremely interesting since it appears to be a violation of the widely accepted APT and also because of the profit opportunities that could arise to the investor that can understand and exploit the mechanisms behind the discount.

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Appendices

Appendix 1: Inputs in regression model

Dividend yield – datatype (DY)

The dividend yield expresses the dividend per share as a percentage of the share price. The underlying dividend is calculated according to the same principles as datatype DPSC (Dividend per share, current rate) in that it is based on an anticipated annual dividend and excludes special or once-off dividends. For some countries the dividend used is a forecast.

Dividend yield is calculated on gross dividends (including tax credits) where available. Note that dividend yield for UK, Irish and French stocks is calculated on gross dividends (including tax credits), although dividends per share for these countries are displayed net.

Net asset values - datatypes (NAVP) and (NAVD)

Applicable to UK Investment Trusts only.

The net asset value is the total value of the Trust's assets (the value of the underlying portfolio) minus all its liabilities. The Trust's assets are divided by the number of shares (shareholders) in issue. In theory the net asset value shows how much the Trust might be worth (per shareholder) if it were liquidated immediately.

The net asset value is expressed as an amount per ordinary share, and will move in line with the performance of the underlying portfolio of investments.

The net asset value is calculated as follows:

The portfolio of securities (the underlying investments of the Trust) are disclosed in its Annual Report and Accounts. Datastream creates the portfolio of investments for a Trust every year-end, and Datastream's model tracks the value of those investments. After liabilities are deducted, the net assets are divided by the number of shares which gives a value of net assets per share. If convertible stock is outstanding, we assume full conversion. In the case of warrants, see below.

Datastream continues to calculate and display net asset values until we obtain an official published net asset value. This then overwrites the Datastream estimate and also readjusts the 'modelling' of our estimate. (Effectively this rebases our computation.)

Note
Appropriate indices are used whenever the particular investments of a Trust are not known. This is usually when a Trust is first issued and whenever portfolio changes occur.

The datatype is available in two forms:

Net assets at par - datatype (NAVP)

An investment trust can issue warrants which may be exercised into the ordinary share on a future date. Assuming warrant holders do not exercise their right into the ordinary, then there are fewer shareholders to divide the assets amongst. In this case the net asset value is said to be undiluted because the warrants are unexercised. It is also known as the net asset value at par.

Net asset value diluted - datatype (NAVD)

If you assume all warrant holders do exercise into the ordinary, the assets will be distributed among a larger number of shareholders. Therefore, the net asset value will become smaller and this is said to be diluted because the warrants are exercised. Dilution occurs only when the warrant subscription price is below the NAVP.

Return index – datatype (RI)

A return index (RI) is available for individual equities and unit trusts. This shows a theoretical growth in value of a share holding over a specified period, assuming that dividends are re-invested to purchase additional units of an equity or unit trust at the closing price applicable on the ex-dividend date. For unit trusts, the closing bid price is used.

For all countries except the USA and Canada detailed dividend payment data is only available on Datastream from 1988 onwards. Up to this time the RI is constructed using an annualised dividend yield, as follows:

$$RI_t = RI_{t-1} * \frac{PI_t}{PI_{t-1}} * \left(1 + \frac{DY_t}{100} * \frac{1}{N}\right)$$

Where:

RI_t = return index on day t

RI_{t-1} = return index on previous day

PI_t = price index on day t

PI_{t-1} = price index on previous day

DY_t = dividend yield % on day *t*

N = number of working days in the year (taken to be 260)

From 1988 onwards (and from 1973 for US and Canadian stocks), the availability of detailed dividend payment data enables a more realistic method to be used in which the discrete quantity of dividend paid is added to the price on the ex-date of the payment. Then:

$$RI_t = RI_{t-1} * \frac{P_t}{P_{t-1}}$$

except when t = ex-date of the dividend payment D_t then:

$$RI_t = RI_{t-1} * \frac{P_t + D_t}{P_{t-1}}$$

Where:

P_t = price on ex-date

P_{t-1} = price on previous day

D_t = dividend payment associated with ex-date *t*

Gross dividends are used where available and the calculation ignores tax and re-investment charges. Adjusted closing prices are used throughout to determine price index and hence return index.

RIs for new issues will initially be based on an anticipated annualised dividend until data on the first actual dividend payment becomes available. At this point the RI is calculated back to the base date.

Market value / market capitalisation – datatype (MV)

Market value on Datastream is the share price multiplied by the number of ordinary shares in issue. The amount in issue is updated whenever new tranches of stock are issued or after a capital change.

- For companies with more than one class of equity capital, the market value is expressed according to the individual issue.
- Market value is displayed in millions of units of local currency.

Par net asset value total return – datatype (NAVPRI)

This datatype allows users to view a Gross Total Return value based on PAR net asset values. Dividends are re-invested on the Ex-Dividend date into the net asset value.

Appendix 2: List of ITCs included in the study

3I GROUP
ABERDEEN ALL ASIA
ABERDEEN ASIAN SMCOS.
ABERDEEN DEV.CAP.ORD.
ABERDEEN NEW DAWN IT.
ABERDEEN NEW THAI
ABERFORTH SMCOS.
ACORN INCOME FUND
ADVANCE DEVP.MKTS.TST.
ALBION PROTECTED VCT
ALLZ.DRES.ENDOW.2010
ARTEMIS ALPHA TRUST
AURORA IT.
BLACKROCK LNAMER.IT.
BLACKROCK WORLD MNG.
BLUE PLANET EUR.FINL.
BLUE PLANET WWD.FINLS.
BRITISH & AMERICAN IT.
BRITISH SMCOS.VCT
CAYENNE TRUST
CITY NATRES.HI.YLD.TST.
DUNEDIN ENTERPRISE
EASTERN EUROPEAN TRUST
ECLECTIC INVESTMENT CO.
EUROPEAN ASSETS TST.
F&C CAPITAL & INCOME
F&C US.SMALLER COS.
FIDELITY ASIAN VALUES
FIDELITY EUR.VALUES
FIDELITY JAPANESE VALUES
FIDELITY SPC.VALUES
FINSBURY WWD.PHARM.
FORESIGHT VCT
FRAM.INNOV.GW.TST.
GART.GROWTH OPT.ORD.IT.
GARTMORE FLEDGLING TRUST
GARTMORE IRISH GW.FD.
GRESHAM HOUSE - MARKET VALUE
HENDERSON OPPS.TRUST
HERALD INV.TST.
HG CAPITAL TRUST
INTL.BIOTECHNOLOGY
INVESCO ASIA TRUST

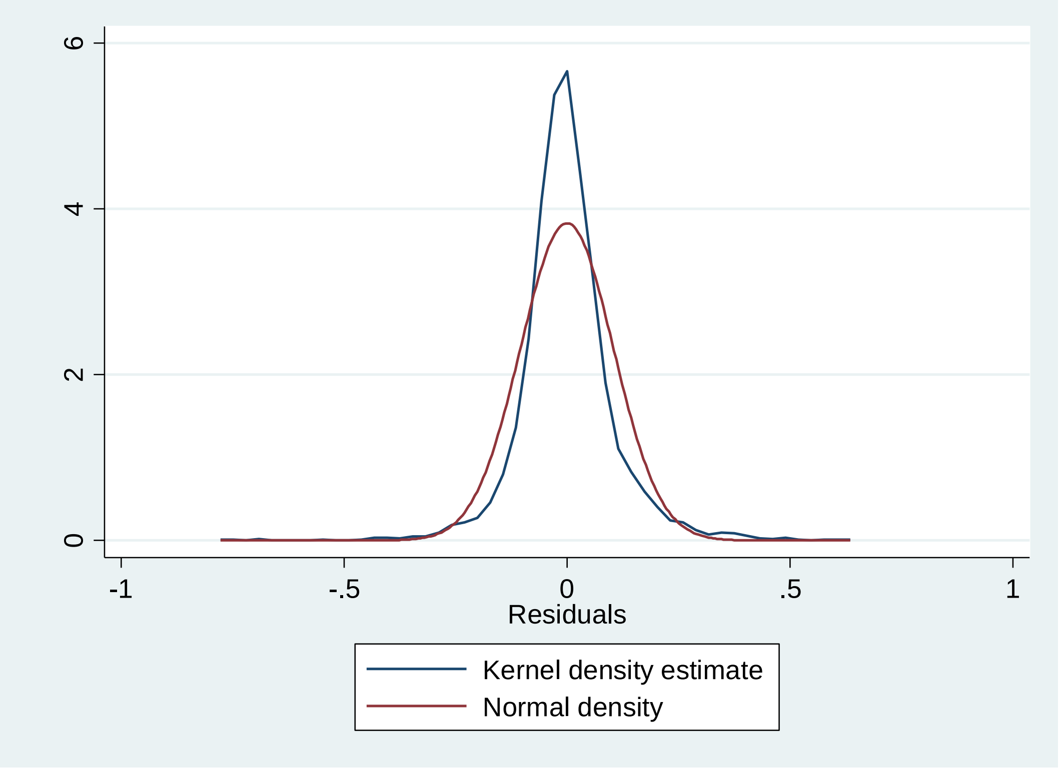
INVESCO INCOME GROWTH -
MARKET VALUE
JPMORGAN ASIAN
JPMORGAN CHINESE
JPMORGAN INDIAN IT.
M&G EQUITY PKG.UNITS
M&G HIGH INC.PKG.UNITS
MARTIN CURRIE PRTF.IT.
MIDAS INCOME & GW.TST.
NEW INDIA IT.
OXFORD TECHNOLOGY VCT
PANTHEON INTL.PARTS.
PENNINE AIM VCT
PERPETUAL INC.& GW.
POLAR CAPITAL TECH.TST.
RCM TECHNOLOGY TRUST
RENAISSANCE US GW.IT.
RIT CAPITAL PARTNERS
SCHRODER ASIA PAC.FD.
SCHRODER JAPAN GW.FD.
SCOTTISH ORIENTAL SMCOS.
SMALL COMPANIES DIV.TST.
STAKEHOLDERS' MMTM.IT.
STANDARD LIFE UK SM.COS.
SVM UK ACTIVE FUND
THE BIOTECH GROWTH TST.

Appendix 3: Normality tests

All our normality tests are done in Stata.

Kernel density test

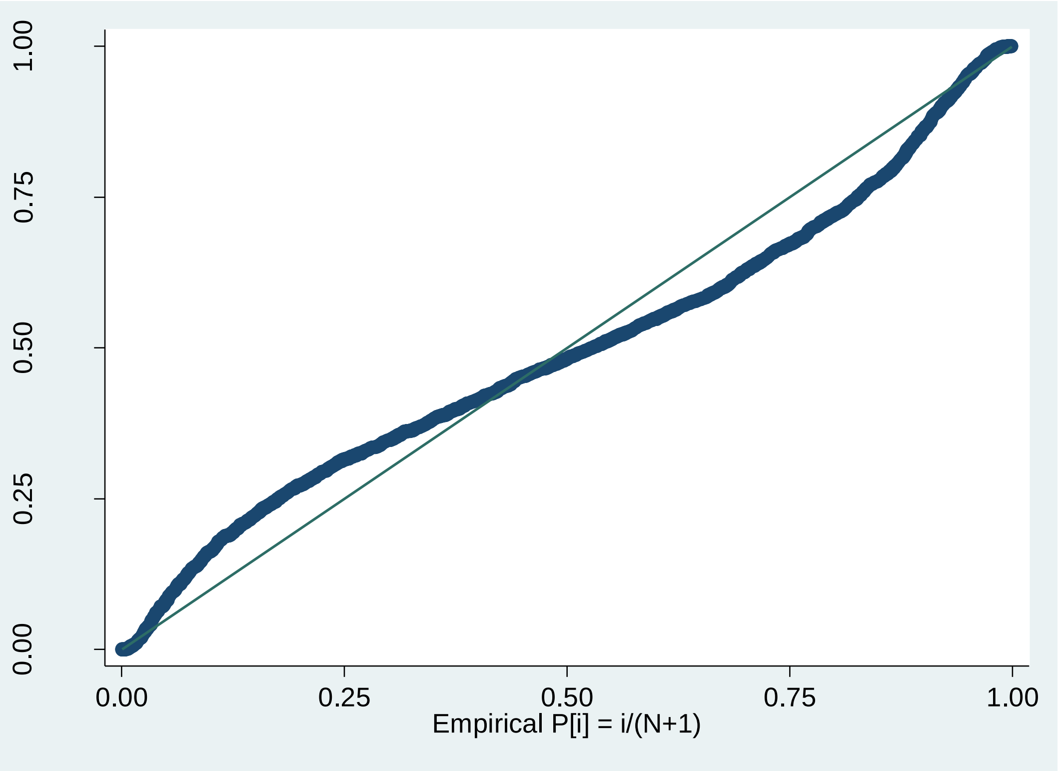
We start with a non parametric way to estimate the probability function of a random variable. We plot a graph of the residuals kernel density plot, which can be thought of as a histogram with narrow bins and a moving average, with a normal distribution overlapping.



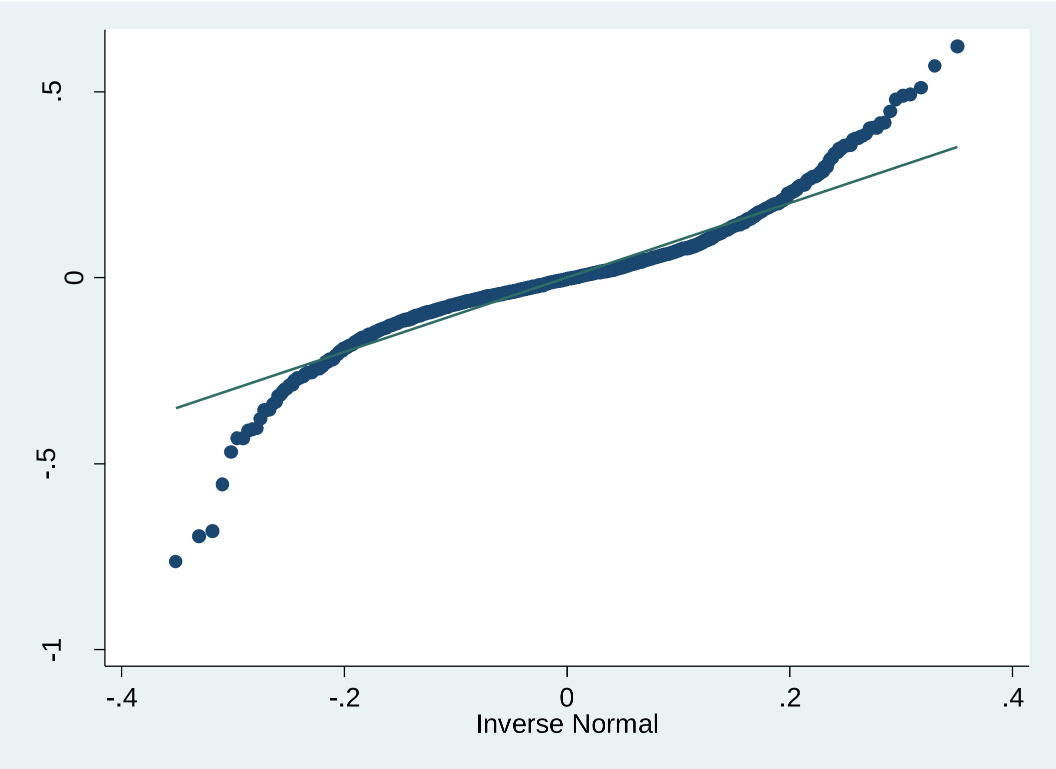
According to this test the distribution of our residual appears to be a little tighter around the middle than a normal distribution.

P-norm

Next we use the pnorm command to compute a standardized normal probability graph that is sensitive to non-normality in the middle range. We see that there are in fact small deviations that could indicate non normality in the error term.



Qnorm
Next we use the qnorm command in stata to plot the quantiles of the residual against the quantiles of a normal distribution. This comparison is sensitive to non normality near the tails.



We see that there are deviations in both tails that seem to indicate that residuals are not normal.
Since we are not yet sure if residuals can be assumed to be normally distributed we move on to numerical tests.

Iqr
We use a test called interquartile range, available in Stata. Iqr determines normality based on the presence of severe outliers, defined as being either 3 inter-quartile-ranges below the first quartile or 3 inter-quartile-ranges above the third quartile. The presence of severe outliers is a sign of a non normal distribution of the residual.

	Low	High
Inner fences	-.1951	.1912
# mild outliers	55	78
% mild outliers	2.07%	2.94%
outer fences	-.3399	.3361
# severe outliers	15	26
% severe outliers	0.57%	0.98%

There are a number of severe outliers. This could indicate that our residual is not normally distributed.

Shapiro-Wilk test
The Shapiro-Wilk test directly tests the null hypothesis that a random variable is normally distributed.

Shapiro-Wilk	W	test for	normal data	
Variable Obs	W	V	z	Prob>z
r 2652	0.92359	117.078	12.238	0.00000

The p-value is 0.00000 so we see that we can clearly reject the null hypothesis that our residual is normally distributed.