Stockholm School of Economics
Department of Finance

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BSc Thesis

The Effect of Open-end Index Revisions

A study of market efficiency on the Swedish Stock Exchange

Abstract

This study acknowledges the Swedish stock exchange's alignment with the efficient market hypothesis by analysing the change of constituents of the open-end OMX Stockholm Benchmark Index through an event study. We find evidence of abnormal return at the date of announcement for inclusions and exclusions. In the long-run, this is found to be explained by the information signalling hypothesis, implying a signalling effect from the change of constituents. This validates the semi-strong form of the efficient market hypothesis. Furthermore, we find evidence of abnormal return leading up to the announcement. This is believed to stem from risk arbitrageurs predicting changes of constituents. Evidence of abnormal volume at the effective date is found for both inclusions and exclusions.

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Keywords: Event study, abnormal return, market efficiency, OMX Stockholm Benchmark Index

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1. Introduction

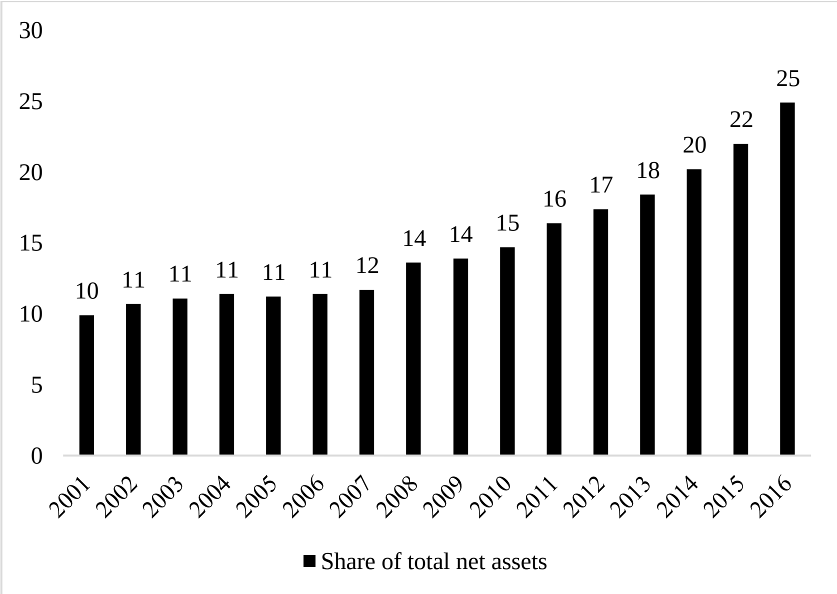
Every 6 months a press release is sent out by NASDAQ in regards to the announced constituent changes of Stockholm Benchmark Index (SBX hereafter). On average, 23 days following the press release, the announced changes go into full effect. In terms of price for the aforementioned securities: what happens before announcement? What happens between announcement and effective date? What happens after effective date?

According to neoclassical finance, the price of a security should be equal to its expected future cash flows discounted to represent a present value. If the quoted price deviates from the intrinsic value, market participants will be quick to exploit the opportunity (commonly referred to as arbitrage) and thereby adjust market inefficiencies. In a world of the many, important propositions within finance rest on the notion that investors should be able to transact any number of shares without affecting the share price. This holds both under the efficient market hypothesis (EMH hereafter) as expressed by Fama (1970) and has given rise to asset pricing models such as the CAPM, and the Modigliani-Miller theorem as expressed by Modigliani & Miller (1958). As far as supply of securities goes, the demand is under these theories assumed to be nearly horizontal, implying no shock of supply will affect share price.

The assumption of nearly horizontal demand curves has attracted vast attention from financial economists. Scholes (1972), Holthausen et al. (1984) etc. all test the hypothesis by looking at stock price reactions to buyer- or seller-initiated large block trades. As explained by Shleifer (1986), this could, however, be explained by an information assertion in relation the transaction. Instead, it is with the growth of equity index mutual funds that early evidence of no-information assertion-events are proven to affect share prices. As index funds mechanically purchase a fraction of stocks in the index, the demand of these funds represents a demand shock for constituent changes. Early evidence for the S&P 500 index, as examined by Shleifer (1986) and Harris & Gurel (1986), suggests an abnormal return for the changed stocks due to the demand shock. However, both theories find diverging explanations for the advent of abnormal return and thereby for the demand curves slope over different time intervals. The fundamentally diverging question is whether demand curves are sloping down temporarily as a reaction to uninformed demand shocks that creates price pressure, or if demand curves are downward sloping in the long-term (indicating a permanent abnormal return). The latter explanation could be aligned with the theory of information assertion in relation to the event (in the form of a certification effect), as examined by Jain (1987).

The increased abnormal return over time is proven by Harris & Gurel (1986) to be positively correlated with the growth of index funds. The development of these, in terms of assets under management, has indeed been very positive and could pose a potential explanation for the abnormal return seen. As these funds aim at minimising tracking error, they must incur "index turnover costs" (as labelled by Petajisto (2011)). Meanwhile, the index equity mutual share of total net assets of equity mutual funds globally, seen in Figure 1, has increased from 9.9% in 2001 to 24.9%[1], clearly illustrating the growth of the market.

Figure 1: Index equity mutual funds share of total net assets of equity mutual funds globally (%)



Price and return data from Investment Company Institute

Through an event study methodology, this thesis investigates whether there are any abnormal return present when inclusions or deletions are made to the SBX. The analysis investigates whether abnormal return can be found before, between and after announcement date (hereafter AD) and effective date (hereafter ED). AD is the date for the NASDAQ-announcement of index revisions, whereas ED is the date of potentiation for the announced revisions. On average, there are 23 days between AD and ED for our sample. Through this thesis, potential violations of the EMH will be analysed in relation to alternative theories. To do this, we have a data sample of 84 additions and 79 deletions from 16 semi-annual index revisions over an eight-year period. For each company, data has been gathered for share price and trading volume from 80 trading days before AD to 80 trading days after AD.

[1]Data from Investment Company Institute, 2017, Fact Book – A review of Trends and Activities in the Investment Company Industry (https://www.ici.org/pdf/2017_factbook.pdf)

The findings in this study include indications of the presence of abnormal return for constituent changes around AD and ED. For inclusions on AD, we find a positive abnormal return equal to 0.85% whereas for ED we find a negative abnormal return equal to 1.31%. For the 10 days following the AD we find a reversal of the abnormal return, cumulatively equal to -2.16%. For the 10 days leading up to AD, we find a cumulative abnormal return of -2.47%. This provides evidence of the PPH in the short-term. For the 10 days following ED, we find a cumulative abnormal return of -2.07%, whereas for the 10 days leading up to ED we correspondingly find -1.55%. Based on the findings for inclusions at ED, we are unable to draw conclusions as the results are not statistically significant or in line with acknowledged theories. For exclusions on AD, we find a cumulative abnormal return of -0.72%. For the 10 days following the AD, we see a continuing negative abnormal return equal to -0.52%. This indicates that the DSH or the ISH is valid for exclusions in our sample as the price effect seemingly is permanent over our time frames. For the 10 days leading up to AD we find a cumulative abnormal return of -0.35%. For exclusions on ED, we observe a positive cumulative abnormal return of 0.31%. This is not in line with acknowledged theories, nor is it statistically significant – thus we are unable to draw reliable conclusions regarding this. For the 10 days following ED, we find cumulative abnormal return equal to -0.34%, and for the 10 days leading up to ED, we find a cumulative abnormal return equal to 1.21%. Once again this is not statistically significant. To summarise, we find no significant evidence of abnormal return at ED. If extending the time frame across both event dates, while including operational and valuation variables, we find conclusive evidence of the ISH being valid. This stems from the fact that over the long-term there is evidence of abnormal return, while a regression of abnormal return versus the qualitative variables indicated an outperformance for the quality companies. For exclusions, the evidence of the ISH being valid is firm. However, in order to come to the same conclusion for inclusions, we are required to disregard the raw returns indicating a price reversal for them after AD. Hence, the results for inclusions are not as conclusive as for exclusions.

This thesis proceeds as follows. Section 2 clarifies index-specific attributes and our subsequent hypothesis. Section 3 presents findings from a wide range of previous literature in an international context. Section 4 presents our data and its sources. Section 5 presents our methodology for the study. Section 6 presents the results of our studies and a discussion around them. Section 7 concludes our study.

2. Hypothesis

A change of index constituents has to be foregone by a change in underlying factors affecting company-specific attributes relating to index-specific criteria. A positive change in the factors could induce an inclusion into the index, whereas a negative could do the opposite. The chapter is structured as follows. The first part will elaborate on SBX specific attributes, such as the criteria of interest. This will shed light on which company-specific factors that could affect changes of constituents. The second part will formulate the resulting research questions.

2.1 SBX methodology

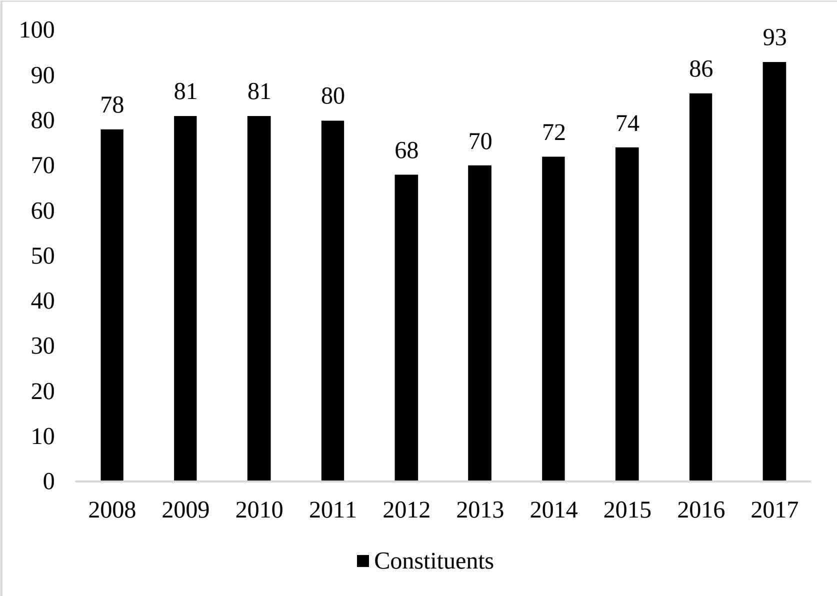
All companies listed on the NASDAQ OMX and the First North in Sweden are eligible for inclusion into the SBX. All stocks are divided between 19 Supersectors (ICB level 2) based on industry classification and sorted according to the previous 12 months official turnover. Generally, across the whole universe, the bottom 30th percentile is removed and the top 10th percentile is included (with a maximum of 25 shares). Within each Supersector, the shares contributing to the 85% highest float-adjusted market capitalisation are included. Companies with special observation-status could be excluded automatically upon NASDAQ discretion. The free float-component is calculated as follows:

$$Free\ float = Total\ shares\ outstanding\ (TSO) - Holders\ of$$
$$\geq 5\%\ TSO\ (excl.hedge\ funds)$$

As of May 2018, the index has 93 constituents. However, as the index is open-ended, the number of constituents can change over time. This is further illustrated by the fact that the number of additions has exceeded that of deletions since 2013, implying an increased fragmentation of the market in terms of float-adjusted market capitalisation. New rules were implemented in relation to the reweighting in June 2012 effecting the sector classification primarily.[2]

[2] More on this topic in section 4.2.2.

Figure 2: Number of SBX constituents ending of 2008-2017



Data from NASDAQ Global Index Watch

2.2 Formulation of hypothesis

We arrive at 4 research questions that we aim to evaluate in this study:

1) *Is there abnormal return for inclusions/exclusions into the Stockholm Benchmark Index before, at and/or after announcement date?*
2) *Is there abnormal return for inclusions/exclusions into the Stockholm Benchmark Index before, at and/or after effective date?*
3) *If yes in questions 1 and/or 2, does the abnormal return identified represent contradictions of the efficient market hypothesis?*
4) *If no in questions 1 or 2, is the information signalling hypothesis valid?*

Based on the transparency and mechanical methodology of the index, we expect to find abnormal return leading up to the AD, between AD and ED but with a reversal following ED. This would hypothesise that the PPH is in play, with non-elastic (downward sloping) demand curves as short-term demand drives the price. This would contradict the EMH and be in line with the findings of Chung & Kryzanowski (1998), Chan & Howard (2002) and Mase (2007). The former and latter prove the PPH by looking at closed-end indices, whereas Chan & Howard (2002) are among the few looking at open-end indices – and hence are expected to have results in line with our expected findings for the SBX.

3. Previous literature

A vast majority of the previous studies have employed US capital markets and specifically the S&P500 as the index of interest, with a wealth of methodologies practiced. Moreover, there are several studies with non-US capital markets employed. The interest in the area has been amplified by its potential explanatory power on arbitraging on capital markets. The chapter is structured as follows. The first part elaborates on the academic framework with an account of relevant theories. The second part elaborates on the studies on the S&P 500 (US capital markets), including a brief account of the general structure of the index and with a division of pre-1989 and post-1989 studies. The third part elaborates on the studies on non-US capital markets. The fourth part will include a discussion of our fit into the sphere of existing research on the subject.

3.1 Academic framework

Throughout the course of this report, we will address the alignment of our results with empirical theories. Primarily, the focus will be on four hypotheses together comprising the potential explanations of our results.

3.1.1 The efficient market hypothesis

The efficient market hypothesis (EMH) was first introduced by Fama (1970), and prescribes the notion that all security prices fully reflect the information available on the market. Three forms of efficiency have been introduced: the weak form (historical prices and returns are reflected in the prevailing share price), the semi-strong form (the information in the weak form and in addition all publicly available information) and the strong form (the information in the weak and semi-strong form and in addition information from the daily operations, i.e. internal information). He supports his evidence of the EMH by acknowledging traders' inability to predict future prices, thereby inducing a semi-strong form on a general basis. If not all publicly available information is fully reflected in the security price, the market will quickly adjust this as investors are assumed to be rational, according to Fama (1970). By assuming securities have perfectly elastic demand, a shock of supply should not have any effect on the prevailing price.

3.1.2 The imperfect substitutes hypothesis / the demand supply hypothesis

Under the EMH, markets are assumed to be made efficient by supply and demand pressures as deviations from this will be taken advantage of. If stocks have close substitutes, the underlying value is not dependent on supply; hence implying demand curves are nearly horizontal and no change of constituents should be accompanied by abnormal return. Under the imperfect substitutes hypothesis (or demand supply hypothesis, DSH), as presented by, among others, Scholes (1972), investors do not regard different stocks as close substitutes. Under this condition, demand curves should in the long-run slope downward (i.e. be less than perfectly elastic). An abrupt change of market forces for a security will be accompanied by a permanent price change as the increased attention will inquire a specific clientele to absorb a share of the free float. Hence, in the case of index revisions; according to the DSH, an included share should imply index funds acquire a portion of the free float, thereby decreasing the supply and thus long-term equilibrium shifting outwards.[3]

3.1.3 The price pressure hypothesis

The DSH assumes an increased (decreased) interest in a security following an index inclusion (exclusion). Under the price pressure hypothesis (PPH), as discussed by among others Harris & Gurel (1986), a temporary effect in stock price will be seen following an index change due to the temporarily increased trading volume as there is a demand (supply) shock due to index funds' entrance. The PPH violates the EMH as it assumes short-term downward sloping demand curves and as the lack of available substitutes will temporarily drive the stock price above its long-run equilibrium following an increased demand.

Since the PPH assumes full reversal of the share price when the market has returned to its long-term equilibrium, the share price development on a longer term is of interest as none of the EMH, the DSH and the ISH make any such assumptions. If no full reversal is found, results would support the DSH or the information signalling hypothesis (as described below). On the contrary, if there are no abnormal return found whatsoever; results support the EMH.

3.1.4 The information signalling hypothesis

In theory, the information signalling hypothesis (ISH) is aligned with the EMH in regards to the provision of all publicly available information in the price of a security. As presented by among others Mikkelson (1981), it assumes that the assertion of new information has a permanent signalling value on the prevailing price. Specifically, index inclusion (exclusion) would, according to the ISH, lead to a share price appreciation (depreciation) as there are informational benefits (damages) in relation to this. The information can stem from different benefits or damages (e.g. index inclusion could indicate positive long-term prospects). The ISH has been debated by scholars to explain the price movements seen following large block trades;

[3] With the inverse relationship for exclusions.

an offer to buy a large block may signal positive news about the stock as a small premium might be in place for the trade to happen.

3.2 Studies with US capital markets employed

To a large part, the studies with US capital markets employed have been using the S&P 500 as the index of interest. The S&P 500 consists of 505 stocks issued by 500 companies listed on the New York Stock Exchange (NYSE) or the NASDAQ Stock Market. In order to qualify as a potential candidate for the index, the company must satisfy three liquidity-based size criteria: market capitalisation must be greater than or equal to $6.1bn, annual traded volume must be greater than or equal to market capitalisation on a float-adjusted basis and monthly traded volume must be greater than or equal to 250,000 shares in each of the six months leading up to the evaluation date. Moreover, if fulfilling the liquidity-based criteria, the company is selected by a committee, that assesses each company using eight criteria, including: length of public listing, liquidity, public float, sector classification etc. However, as constituent selection is at the discretion of the Index Committee and as the committee has an objective to reduce constituent turnover to reduce tracking error and transaction costs, there is a subjectivity related to the S&P 500. The subjectivity of the committee does not extend to the conceived investment attractiveness, hence not revealing new information about future return distributions (implying no-information assertion). However, this factor reduces arbitrageurs' ability to predict inclusions and exclusions beforehand.[4]

In October 1989, S&P revised their announcement methodology for changes of constituents; from announcing changes the same day as they go into full effect (AD = ED) to announcing changes one week ahead of effective date (AD + 7 days = ED). Pre-1989, two studies have been of importance for the subject; Shleifer (1986) which introduced the DSH and Harris & Gurel (1986) which introduced the PPH. Both also relativized this to the ISH by arguing against the information assertion related to the changes of constituents.

Shleifer (1986) states that as index funds take a fraction of the publicly available float when a firm is included, there is a shift of the demand curve – implying a non-horizontal relationship for the curve. Through a daily event study, in which he uses the cumulative average prediction error as a proxy for abnormal return, he finds a statistically significant 2.8% abnormal return at AD for additions to the S&P 500 between 1976 and 1983. Moreover, Shleifer (1986) finds no evidence of a share price depreciation following the events. Cumulatively, he

[4] As proposed by, among others, Chen & Howard (2002).

finds a share price appreciation of close to 3% at AD and with no price reversal for at least 10 to 20 trading days, as implied by the DSH. He also acknowledges alternative explanations for the abnormal return, namely the potential certification effect from index inclusion. However, through a quantitative analysis of the relation between abnormal return and bond rating, no evidence of this theory is found. Harris & Gurel (1986) also find an abnormal return for stocks included in the S&P 500. In opposite to Shleifer (1986), they find evidence of a partial reversal of the abnormal return between day two to day 21 – thereby contradicting the DSH as demand curves are not downward sloping in the long-run according to their results.

Harris & Gurel (1986) extend their analysis to include a share turnover component and related this to potential abnormal volume as measured versus the market turnover. Through this, they find that, on average, volume at day one is 1.89 times greater than the average daily volume as measured versus market average. This supports the PPH while contradicting the EMH. This is further illustrated by them through the division of abnormal average daily volume by year; clearly showing signs of increased abnormal volume as index funds grow. Finally, through qualitative reasoning, they provide evidence against the information signalling theory.

Following the studies by Shleifer (1986) and Harris & Gurel (1986), many scholars have followed suit and provided further evidence of abnormal return for stock inclusions into the S&P 500. Jain (1987) finds abnormal return for additions to supplementary indexes where the level of indexing is small or non-existent. This finding indicates a certification effect from index inclusion, in line with the ISH. Chen et al. (2004) argue against these findings, as there is no observable price effect prior to 1976 for S&P 500 inclusions despite index funds being rare during this period.

Following the implementation of seven days between AD and ED for the change of constituents into the S&P 500, several studies research the effect seen. Beneish & Whaley (1996), Lynch & Mendenhall (1997) and Chen et al. (2004) all find evidence of abnormal return. Whereas Beneish & Whaley (1996) show that these are followed by reversals, Lynch & Mendenhall (1997) argue that no such reversal occurs and Chen at al. (2004) find an asymmetry in the observed price effects as additions generat permanent price effects, whereas deletions see reversed abnormal return. Lynch & Mendenhall (1997) prescribed the abnormal return seen on AD as potentially consistent with three theories (the DSH, the ISH and the PPH) albeit qualitatively discussing against the possible informational value an index inclusion could incur, whereas the permanent change seen only could be described by the DSH. They also include deletions in their sample, finding significant evidence of negative abnormal return for them.

Generally, there is conclusive evidence of abnormal return for constituent changes to the S&P 500. The question of academic interest is rather why the abnormal return arises and if it is permanent.

3.3 Studies with non-US capital markets employed

Even though most attention has been focused on the US capital markets, a set of studies have been conducted with non-US capital markets employed. Kaul et al. (2000), Biktimirov (2004) and Chung & Kryzanowski (1998) all examine the effects of changes in index constituents on the Toronto Stock Exchange (TSE) 300 index for different time intervals. The TSE 300 is a closed-end, float-adjusted market capitalisation index with annual reweightings. Kaul et al. (2000) report abnormal return for stocks that undergo an increase in index weight following the change of rules for the TSE 300 in 1996. Biktimirov (2004) finds support for a downward sloping demand curve, whereas Chung & Kryzanowski (1998) find reversed abnormal return. The latter study finds support of a statistically significant 60-days cumulative abnormal return leading up to AD, which the authors argue to be an indication of additions being chosen from stocks that have outperformed markets prior to selection.

Mase (2007) contrasts the mechanical inclusion criteria, which is fully based on market capitalisation and instead studies the FTSE 100 index (closed-end) between 1992 and 2005. The index includes the 90 largest companies listed on the FTSE plus an additional 10 from the 91-110 largest based on a set of specific rules. Thereby, he concludes that any potential subjectivity in the choice of newly added firms for the FTSE 100 index versus the S&P 500 is lower, and hence has higher predictability. His findings suggest no abnormal return, but with positive cumulative abnormal return seen for the 10 days prior to AD. This is argued to stem from anticipatory trading from arbitrageurs enabled by the predictability of index revisions. The abnormal return is subsequently reversed, in line with the PPH.

Petajisto (2011) instead looks at the small-cap LTSE index Russell 2000 (closed-end) versus the S&P 500, as the number of observations for the former is far greater. He finds significant abnormal return for the small-cap universe for both additions and deletions, with partial reversal but does not conclude with any conclusion as “lack of statistical power prevents us from making more accurate inferences about the long-term price impact”. Furthermore, he introduces the concept of “index turnover cost”, relating to the costs (in terms of abnormal return) incurred by passive indexers on the event date to purchase the stock. These are, as opposed to the explanation provided by Chen et al. (2004), due to a low predictability and transparency in regards to constituent changes.

So far, we have accounted for closed-end indices. Similar to the SBX, the Australian All Ordinaries Share Price Index (AOI) is an open-end index based on float-adjusted market capitalisation. Chen & Howard (2002) study the index, and find abnormal return at the day before the ED. These are, however, reversed in the days following the ED[5]. This is explained by the authors as an indication of a price reversal effect stemming from the abating selling pressure by index funds, in line with the PPH.

To the best of our knowledge, no study has been made on the SBX. However, Andelius & Skrutkowski (2008) and Ledmyr & Karlsson (2017) both study the effects of constituent changes on the Swedish OMXS30. Whereas the former cannot show any significant abnormal return, the latter does (significant average abnormal return of 1.2% at the AD for additions, and a negative 1.6% for deletions). In comparison with the returns found for the S&P 500 seen in Shleifer (1986) and Harris & Gurel (1986), abnormal return is lower for OMXS30 constituent revisions. Ledmyr & Karlsson (2017) explain this by a higher predictability for OMXS30 revisions implying index fund buying is spread out over a longer period of time. Furthermore, they find a weak short-term reversal of abnormal return but with no significance. A weakness in both reports is the lack of data; as explained by Andelius & Skrutowski (2008), who have a sample of observations for 14 inclusions and 12 deletions in total between 2000 and 2017.

3.4 Our fit into the existing sphere of literature

We believe this report to fit well into the sphere of existing literature as the comparability is ranging across several factors and indices. Firstly, as the SBX is an open-end index, we believe there will be comparability to Chen & Howard (2002) in terms of abnormal return for the universe of open-ended indices. Secondly, we believe comparability to Andelius & Skrutkowski (2008) and Ledmyr & Karlsson (2017) will be existent due to the geographic focus. Also, we believe this report to create value as the number of observations is greater than in previous studies on the Swedish market (to our knowledge); thereby creating potential validity for previous studies. Thirdly, we believe comparability will exist versus studies based on the S&P 500 in terms of potential geographic differences. Fourth, and most importantly

[5] No account for AD is made due to lack of data.

according to us, is the alignment of our results versus the hypotheses examined in previous literature.

4. Data

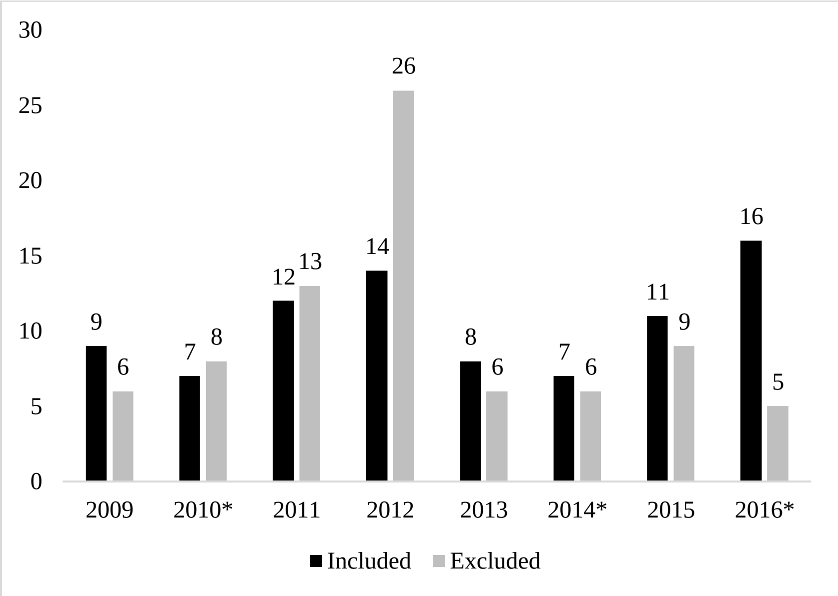
We have used several sources for the collection of data and the aggregation of it into datasets for the evaluation of SBX inclusions and exclusions. Primarily, the data collected is divided into four sets; stock prices and share turnover, historical changes of index constituents, Fama-French specific factors and operational and valuation data related to each company. The chapter is structured as follows. First, the data gathered is outlined together with a brief account of sources. Second, a discussion of potential data limitations and problematizations is presented.

4.1 Discussion of data

For our price and turnover data for equity securities, we have used the Bloomberg Excel add-in for this study. As there are several resources (Thomson Reuters Eikon, Yahoo Finance, Factset etc.) for the data collection of share prices and equity turnover, we deem the Bloomberg Excel add-in to be as proficient as other methods due to its abundancy of data. Previous research on the subject of changes in index constituents on the Swedish stock market (Ledmyr & Karlsson, 2017) have used S&P Capital IQ and Bloomberg as the primary databases. This data is gathered for the purpose of measuring abnormal return and volume for each security.

The second set of data collected is related to the historical changes of index constituents as announced by NASDAQ Stockholm. This data is collected manually through NASDAQ Global Index Watch, namely from the press releases by NASDAQ in relation to the announcement of revisions. This data includes the included and excluded stocks from the SBX on a semi-annual basis with announcement dates ranging from May 2009 to November 2016 (in total 16 occasions with in total 87 additions and 79 deletions included in the sample). However, as 3 of the additions are undergoing initial public offerings during the examined period of time, we decide to remove them from our final sample as historical share prices during the full estimation period are unavailable.

Figure 3: Change in constituents over the sample period



**One addition removed 2010, 2014 and 2016, respectively*

Data from NASDAQ Global Index Watch

Thirdly, we have used Fama-French factors as prescribed in Fama & French (1992). These have been retrieved from the Swedish House of Finance Data Center. The purpose of these variables is to implement the four-factor model as formulated by Carhart (1997).

Fourth, we have gathered revenue and price-to-book ratio data for the 6 years leading up to each reweighting in order to calculate growth rates in revenue and price-to-book ratio for our sample. The number of observations are affected by how long the companies have been listed and as a consequence the five year CAGRs generally have fewer observations than the one year growth rates. Changes from zero to something above or below zero have been represented by a 100% increase and decrease, respectively.

Table 1 – Variable description Descriptions of variables used, all of which are dummy variables. Operational and valuation variables originate from LTM, L3Y and L5Y company metrics of included and excluded firms at the announcement date.		
Variable	**# observations**	**Dummy variable description**
INCLUSION	84	1 = Inclusion into the SBX
EXLUSION	79	1 = Exclusion from the SBX
Operational variables		
REV1	81	1 = Company is in the low 50th percentile in revenue growth rate last year
REV5	72	1 = Company is in the low 50th percentile in revenue CAGR last five years
Valuation variables		
PB1	78	1 = Company is in the low 50th percentile in price-to-book ratio growth rate last year
PB5	67	1 = Company is in the low 50th percentile in price-to-book ratio CAGR last five years

Aside from the three additions excluded from our dataset due to insufficient historical data following the undergoing of an initial public offering, Fama-French data recouped from the Swedish House of Finance is limited to all dates until 1 January 2017. Hence, for the final reweighting of our sample, data is extracted for in total only 60 trading days.

4.2 Problematization & data limitation

Studying changes of index constituents and abnormal return over a long-run event study methodology brings up several implications with corresponding risk for data limitations, biases and errors.

4.2.1 Incorrect estimations of expected returns

Although we have applied a wide collection of strategies through the use of the currently appropriate Fama-French four-factor model, this means that our employed models potentially could specify the risk of the actual stock incorrectly, thus over- or undercompensating for true expected returns.

4.2.2 Changes in the SBX inclusion rule in 2012

The SBX index changed its criteria for inclusion in 2012. Since the scope of our study includes data from inclusions and exclusions from both before and after 2012, this might be a problem for the consistency of the study. Specifically, the fundamental change was related to the classification of stocks as NASDAQ OMX decided to adopt the Industry Classification Benchmark (ICB) as a replacement for the Global Industry Classification Standard (GICS). The fundamental difference between these is the sector classification, which hence triggered a re-classification of many companies according to the new structure. Based on the index structure as specified in section 2.1, the change is likely to have an impact on the outcome of our results. In order to avoid any mistakes relating to this change, we test for abnormal return with a divided sample as found in section 6.1.5.

4.2.3 Bias towards established firms

As we have excluded three firms from our sample because of them recently being listed leading up to the announcement date of their inclusion into the SBX index. This could lay ground for selection bias towards more established firms but since the total number of these exclusions in relation to our total sample is relatively low, we do not estimate this to be a major problem in our study.

Moreover, as firms under observation status potentially can be excluded based on NASDAQ discretion, there is a risk of subjectivity in the selection process. However, as observation status requires external factors to play their part based on specified regulations, we do not believe this to have inferred with the results. Also, as no firm has been excluded due to merger or bankruptcy, we do not see survivorship bias as an issue in our sample.

5. Methodology

As presented in section 2.2, we aim at testing the formulated research questions through an event study approach presented by MacKinlay (1997) and Brown & Warner (1980). We have further complemented these sources with a dummy variable approach developed in the studies of Schipper & Thompson (1983, 1985) and Collins & Dent (1984). Event date is set at AD and ED respectively. This section will be structured as follows. The first part will present the methodology applied for measurement of abnormal return in a specified event window. The second part will present the methodology applied for the accumulation of abnormal return around the event window for our sample of observations. The third part will present our regression model. The fourth part will present the methodology applied for the measurement of abnormal trading volume.

5.1 Measurement of abnormal return

Similar to Ledmyr & Karlsson (2017) and as prescribed by MacKinlay (1997) we set the event window to event date, allowing for the measurement of abnormal return on AD and ED solely ($t_0 = AD, ED$). Moreover, the abnormal return in the event window are calculated as ex post return of the security minus the normal return of the security in the period. For firm *i* and event date *t*, abnormal return is returned by:

$$AR_{it} = R_{it} - E(R_{it}|X_t)$$

Where AR_{it} is defined as the abnormal return for time period *t* for firm *i*, R_{it} is defined as the actual return for time period *t* for firm *i* and $E(R_{it}|X_t)$ is defined as the normal return for time period *t* for firm *i*. X_i represents the conditioning information of the normal return model.

For the calculation of actual return, we use the natural algorithm of the daily closing price for each firm, accordingly:

$$R_{it} = ln\left(\frac{p_t}{p_{t-1}}\right)$$

Where p_t is defined as the security price at time *t*.

We employ a market and risk adjusted model, which takes into account both the market return and a specific firm’s exposure to one or more pre-specified risk factors as described by Brown & Warner (1980). The addition of risk factors to a market adjusted model allows for decreasing variance of the abnormal return. The model used is Carhart’s (1997) four-factor model, which is an extension of Fama & French's (1993) three-factor model, accordingly:

$$E(R_{it}|X_t) = \alpha_i + \beta_{RMRF,i}RMRF_t + \beta_{SMB,i}SMB_t + \beta_{HML,i}HML_t + \beta_{PR1YR,i}PR1YR_t + \mathcal{E}_{it}$$

Where $RMRF_t$ is the excess return on a value-weighted aggregate market proxy at time *t*, SMB_t is the return for small companies less large companies in terms of market capitalisation at time *t*, HML_t is the return of high value stocks less low value stocks in terms of book-to-market ratio at time *t* and $PR1YR_t$ is the return of past winners less past losers in terms of returns at time *t*. The latter is in our model reformulated, in line with Ledmyr & Karlsson (2017) from $PR1YR_t$ to MOM_t. Hence, the finalised model is:

$$E(R_{it}|X_t) = \alpha_i + \beta_{RMRF,i}RMRF_t + \beta_{SMB,i}SMB_t + \beta_{HML,i}HML_t + \beta_{MOM,i}MOM_t + \mathcal{E}_{it}$$

By combining our model for abnormal return with Carhart's (1997) four-factor model, we get the following model for estimation of abnormal return:

$$\begin{aligned}\widehat{AR}_{it} &= R_{it} - E(R_{it}|X_t) \\ &= R_{it} - (\hat{a}_i + R_{Ft} + \hat{\beta}_{RMRF,i}RMRF_t + \hat{\beta}_{SME,i}SMB_t + \hat{\beta}_{HML,i}HML_t \\ &\quad + \hat{\beta}_{MOM,i}MOM_t)\end{aligned}$$

Where the alpha and betas are estimated using an ordinary least squares (OLS) regression during a window of 70 trading days prior to our 10-day pre-event window, spanning t_{-80} to t_{-11}. This is a somewhat shorter period than the 120-day period suggested by MacKinlay (1997). However, in order to avoid overlapping research periods between reweightings and considering that 70 trading days should be sufficient for our estimation window to cover short-term returns, we have decided to go with 70 trading days spanning t_{-80} to t_{-11} to also avoid overlapping with our pre-event windows.

5.2 Accumulation of abnormal return

Similar to Ledmyr & Karlsson (2017), we use a cumulative abnormal return (CAR) approach in four different time windows. CAR is calculated accordingly:

$$\widehat{CAR}(t_t, t_{t+n}) = \sum_{\boldsymbol{t}}^{\boldsymbol{t_n}} \widehat{AR}_{it}$$

For the calculation of CAR in different windows, we define the time intervals of interest as follows:

- Pre-event window 1: t_{-10} to t_{-1}

- Pre-event window 2: t_{-5} to t_{-1}
- Post-event window 1: t_1 to t_5
- Post-event window 2: t_1 to t_{10}

Moreover, as our data go beyond t_{-10} to t_{10}, we aim at graphically illustrate longer time intervals.

5.3 Regression model

For the subsequent regression we will perform in this study, we aim at finding a general effect through the following model:

$$\widehat{AR}_i = \alpha_i + \beta_{Inclusion} * Dummy_{inclusion,i} + \mathcal{E}_i$$

Where the $\beta_{Inclusion}$ is the coefficient of abnormal return for included stocks and the dummy variable is 1 for inclusions and 0 otherwise. The same method is applied when regressing abnormal return for exclusions.

To test the potential signalling power in a change of constituents, we include an effect of operational and valuation variables as formulated by Ledmyr & Karlsson (2017) for the companies in our sample. Therefore, for each variable a regression is run through the following model:

$$\widehat{AR}_i = \alpha_i + \beta_{perational/valuation\ variable,i} * Dummy_{operational/valuation\ variable,i} + \mathcal{E}_i$$

Where the dummy variable depends on operational and valuation metrics and split them by the median. The operational metrics include revenue growth rate the year prior to the event date and CAGR over the last 5 years before the event date. The valuation metrics include price-to-book ratio growth rate the year prior to the event date and 5 year CAGR running up to the event date. Further details on the variables and the construction of the dummies are given in Table 1. Given that we use an if-statement in the form of a dummy variable to illustrate the lower 50th percentile, the higher 50th percentile will be illustrated by the a_i in each regression performed.

For the examination of abnormal trading volume seen in relation to changes of constituents, we use a similar approach as that of Beneish & Whaley (1996), where we define a Mean Volume Ratio (MVR). The MVR is calculated accordingly:

$$MVR_{it} = \frac{V_{it}}{\frac{1}{N * \Sigma_{t=t_1}^{t_n} V_i}}$$

Where V_{it} represents the share turnover at time *t* for stock *i* and N is the number of firms in the sample. MVR is calculated over the same time windows as the abnormal return, that is: for t_{-10} to t_{10} over four different windows as defined above. The measurement of abnormal trading volume is made versus a historical normalised volume of the company as well as for the market, similar to the approach of Harris & Gurel (1986):

$$\frac{V_{it}}{\Sigma_{t=t_1}^{t_n} V_i} = \frac{V_{it}}{V_{mt}} * \frac{V_m}{V_i}$$

Where $\frac{V_{it}}{\Sigma_{t=t_1}^{t_n} V_i}$ is defined as the abnormal volume for firm *i* at the event date, V_{it} defined as the actual trading volume for firm *i* at the event date, (V_{mt}) defined as the actual trading volume of the market at the event date, V_m is defined as the average trading volume of the market in the 8 weeks preceding the announcement less the pre-event window 1 (t_{-50} to t_{-11}). V_i is defined as the average trading volume of firm *i* in the 8 weeks preceding the announcement less the 10-day pre-event window. The removal of the pre-event window is made to reduce the potential effect from abnormal volume on the expected value in line with the approach carried out for the estimation of betas for the Fama-French factors.

6. Results & discussion

The results of our studies are presented below. The chapter is structured as follows. First, we will present the results seen when the AD is the event date. In relation to the AD, we will present three additional analyses; first, we include operational and valuation variables in the regression for inclusions; second, we extend our time window to 80 trading days before the AD until 80 trading days following the AD and; third, we split the dataset into pre-2012 and post-2011 to find potential effects from the change of inclusion criteria in 2012. For the second part, we will present the results seen when the ED is the event date. Both sections include a presentation of descriptive statistics, regressions for abnormal return and an account of the volume.

6.1 Announcement date study

This section presents our findings when using AD as the event date for our models.

6.1.1 Descriptive statistics

Table 2 presents the descriptive statistics of abnormal return at AD for inclusions (Panel 1) and deletions (Panel 2).

The first panel shows that there is abnormal return on the event day as both the average and the median indicate abnormal return equal to 0.85% and 0.89%, respectively. For the period leading up to the AD, we find a CAR on average equal to 0.12% and 0.82% for the 5 and 10 days, respectively. This indicates a potential predictability in the upcoming inclusions. However, the lower median (-0.13% and -0.07%, respectively) indicates the existence of outliers in the sample. The abnormal return at the event day seems to be partially reversed over the following days as seen in the two post-event windows. However, the reversal of CAR -0.40% and -0.29% respectively is not greater than the abnormal return seen on the AD. This provides evidence of the DSH or the ISH[6]. This is fully in line with our expectations of abnormal return at the AD as well as between the AD and the ED.

The second panel shows that there are negative abnormal return for exclusions at the AD, as the average abnormal return for the 79 observations is -0.72%. For the 5 days leading up to the AD, abnormal return for exclusions is -0.66% on average. For the 10 days prior to the AD, the CAR is equal to -2.05% on average. This once again indicates a predictability of exclusions. For the 5-day and 10-day window following the AD, we find continued negative

[6] As we cannot exclude the possibility of the inclusion being an information assertion event at this stage. Also, we remain to conclude that this provides evidence against the PPH.

abnormal return. This is in line with our expectations of abnormal return for the period between the AD and the ED[7] and what we see for inclusions.

Table 2 – Descriptive statistics of abnormal return at announcement of inclusion into and exclusion from the SBX index					
Descriptive statistics of abnormal return around announcement of inclusion or exclusion. Data from 2009 – 2016.					
Panel 1 – Announcement of inclusion into the SBX index					
Event window	**Event day**	**5 days pre event**	**10 days pre event**	**5 days post event**	**10 days post event**
# observations	84	84	84	84	84
Max	12.49%	18.57%	20.12%	7.92%	11.33%
Average	0.85%	0.12%	0.82%	-0.40%	-0.29%
Median	0.89%	-0.13%	-0.07%	-0.51%	0.36%
Min	-9.73%	-8.67%	-14.60%	-12.10%	-18.19%
Standard deviation	2.81%	4.47%	6.68%	3.97%	5.32%
Panel 2 – Announcement of exclusion from the SBX index					
Event window	**Event day**	**5 days pre event**	**10 days pre event**	**5 days post event**	**10 days post event**
# observations	79	79	79	79	79
Max	5.57%	33.98%	25.00%	10.35%	20.24%
Average	-0.72%	-0.66%	-2.05%	-0.91%	-0.45%
Median	-0.87%	-0.13%	-2.59%	-0.49%	0.49%
Min	-10.22%	-27.65%	-36.15%	-15.50%	-20.40%
Standard deviation	2.58%	8.18%	10.35%	4.87%	6.51%

6.1.2 OLS regression results

Table 3 contains the results of the four-factor Fama & French (1992) event study regression on cumulative average abnormal return of included (regression 1, 3, 5, 7, 9) and excluded (regression 2, 4, 6, 8, 10) securities with AD as the event date.

For inclusions, the results imply a positive 0.85% abnormal share price performance (significant at the 1%-level) at the AD. Interestingly, for the 10 days prior to the AD, the results imply a 0.83% abnormal return share price performance (not statistically significant), in line with the hypothesised theory of transparency and objectiveness in the selection (as opposed to the S&P 500) contributing to predictability and hence allowing arbitrageurs to exploit market opportunities.[8] Moreover, results imply a reversal of the abnormal return seen at the AD, as both the 5 day and the 10-day period in our sample indicate a -0.40% and -0.28% CAR (not statistically significant) respectively. These results are aligned with the descriptive statistics, and similarly provides evidence of the DSH or the ISH as the reversal is not larger than the abnormal return seen at the AD as proposed by the PPH.

For exclusions, a -0.72% abnormal share price performance (significant at the 5%-level) on the AD is exhibited. All four time windows formulated indicate a negative CAR.

[7] We assume price reversal to occur after the ED.
[8] As formulated by Chen & Howard (2002).

For the 10 days leading up to the AD, exclusions show a CAR of -2.05% (significant at the 10%-level). This strengthens the notion of predictability as discussed above. For the 5 days following the AD, results show a CAR of -0.90% (significant at the 10%-level). In terms of theories, this provides evidence for the DSH or the ISH. However, as opposed to the findings for the inclusions, the negative abnormal return on the AD continue in the period following the event date and hence is not indicating a reversal of abnormal return in the given time frames. This could potentially be in line with our expectations of price reversal occurring post-ED, as we believe index funds to transact at the ED as a way of minimising tracking error. If this is the case (will be reviewed in the next section), then our findings are in line with the PPH. If, instead, the negative abnormal return continues; the DSH or the ISH is valid.

Table 3 - Abnormal return around announcement of inclusion into and exclusion from the SBX index
Result from OLS regression of abnormal return against inclusion/exclusion dummy variables. Event windows: 1 = Announcement day, 2 = 5-days pre announcement day, 3 = 10-days pre announcement day, 4 = 5-days post announcement day, 5 = 10-days post announcement day. Number in percentage points. Please see Table 1 for full overview of the variables and their properties. Data from 2009 – 2016. Robust standard errors in parentheses. *=10% significance, **=5% significance, and ***=1% significance.

Event window	1	1	2	2	3	3	4	4	5	5
Regression	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
INCLUSION	0.85***		0.12		0.83		-0.40		-0.28	
	(0.30)		(0.48)		(0.72)		(0.43)		(0.58)	
EXCLUSION		-0.72**		-0.66		-2.05*		-0.90*		-0.45
		(0.29)		(0.91)		(1.16)		(0.54)		(0.73)
Constant	-0.00**	0.00***	-0.00	0.00	-0.00*	-0.00	-0.00	-0.00	-0.00	-0.00
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Observations	84	79	84	79	84	79	84	79	84	79
R-Squared	4.72%	3.18%	0.02%	0.50%	0.46%	2.66%	0.41%	1.99%	0.11%	0.28%

Figure 4 and Figure 5 plots the raw returns in two time windows of 20 and 80 trading days around the AD for the full sample of inclusions. Figure 4 shows a positive share price performance leading up to the AD that is somewhat reversed in the following days even though the positive performance seems to continue overall. Figure 5 illustrates the positive share price development leading up to the AD during the first 40 trading days. Both results for the period before the event date are in line with our findings of the regression. Around 36 trading days following the AD, we see a full price reversal. This validates our theory of a price reversal occurring post-ED, and is in line with the PPH.[9]

[9] Do, however, note that this is raw return and hence not abnormal. There is potential skewness in the results found as no account of expected returns has been made.

Figure 4: 20 trading days cumulative average raw return for inclusions

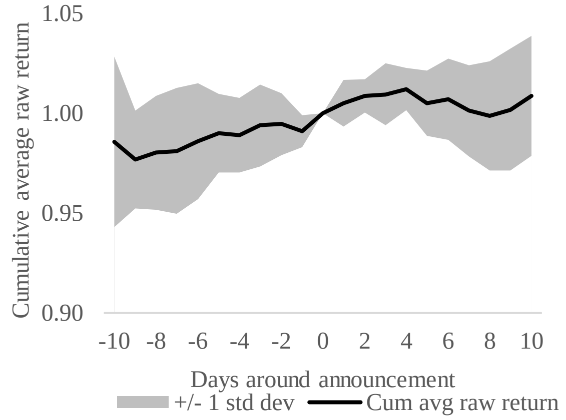
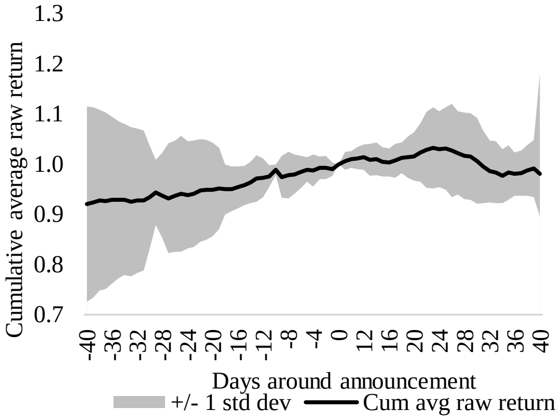


Figure 5: 80 trading days cumulative average raw return for inclusions



Price and return data from Bloomberg

Figure 6 and Figure 7 plots the raw returns in two time windows of 20 and 80 trading days around the AD for the full sample of exclusions. Figure 6 illustrates similar results as those seen in the regression; a negative price development both before and after the AD. If extending the time frame, and looking at Figure 7, we find no opposing evidence of this. This implies that the results for exclusions is not aligned with that of inclusions, and no price reversal is found in the given time frames. Instead, this strengthens the DSH, as there seems to be a permanent change in demand for exclusions over our time windows.

Figure 6: 20 trading days cumulative average raw return for exclusions

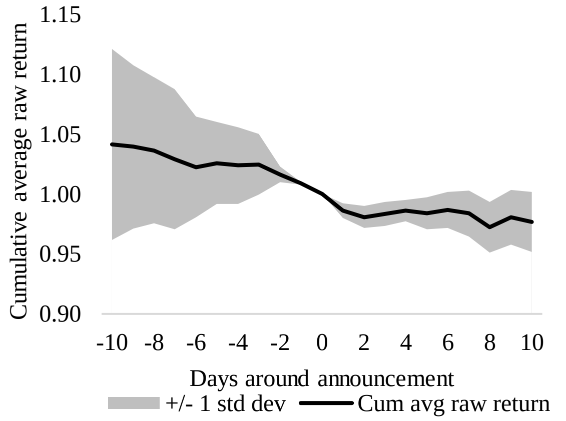
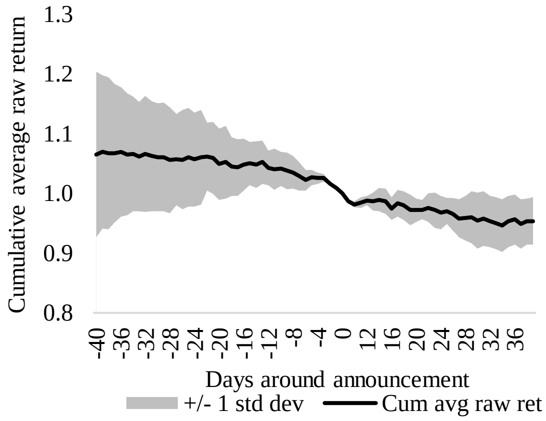


Figure 7: 80 trading days cumulative average raw return for exclusions

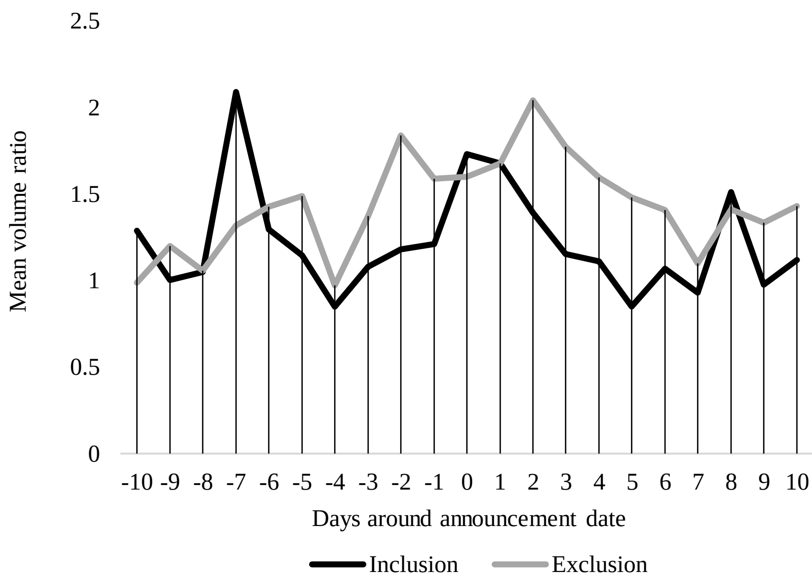


Price and return data from Bloomberg

For inclusions, we have so far been able to find evidence of reversal of the abnormal return following event date, whereas no such evidence is found for exclusions. For the latter, both the regressions and the graphical analysis of raw returns have implied validity for the DSH or the ISH. As the DSH assumes an abrupt shift in demand as index funds transact, potential abnormal volume would validate it versus the ISH[10]. Thus, we try to separate it from the ISH by studying the average of MVR below.

In Figure 8, there is evidence of increased volume for inclusions and exclusions, in line with the findings of Harris & Gurel (1986) and Mase (2007). For inclusions, this further validates the PPH. For exclusions, the increased volume validates the DSH versus the ISH. While the results suggest constituent changes to be a non-informational event, the ISH is not fully ruled as the abnormal volume are not significantly high and thus might not provide an exhaustive explanation. Interestingly, the signs of abnormal volume before the AD are weak but evident on some days and on average for the full window. This would illustrate the effect of arbitrageurs predicting constituent changes in advance.

Figure 8: Average of mean volume ratio around AD



Volume data from Bloomberg

To summarise, the abnormal share price movements for the constituent changes provide conclusive evidence of inefficiencies on the market for inclusions. To separate the DSH and the PPH, we primarily look at post-event date share price movements. According to previous literature on the topic, the short-term demand (supply) for inclusions (exclusions) will lead to abnormal volume as index funds are trying to enter (offload) a holding. As seen in Figure 8, there are some evidence of a higher average of mean volume ratio on the AD, albeit lower than previous studies in the field. For inclusions, there is an apparent share price reversal from the AD both for the subsequent 10-day period (partial reversal) and 40-day period (full

[10] Although index funds transacting at the announcement date intuitively would imply tracking error.

reversal). This reversal is larger than the abnormal return seen on the AD, providing evidence of the PPH. As seen for exclusions, the negative abnormal return on AD is not reversed following AD. This provides evidence against the PPH and in line with the DSH or the ISH. Moreover, as the abnormal volume is lower than in previous studies and the MVR not being significantly high, we do not rule out the ISH for exclusions at this stage – therefore not ruling out the EHM either.

6.1.3 Test for the ISH with operational and valuation variables

So far, we have observed a significant abnormal return on the AD for exclusions, as indicated in Table 3, and it is now motivated to further analyse this tendency[11]. We have chosen to do this by introducing new dummy variables, representing operating performance and valuation metrics in order to create proxies for quality and non-quality companies in our sample. The dummy variables will take the value 1 if the corresponding firm has a growth metric that is in the lower 50th percentile among all observations, and 0 if not. The regression outcomes are shown in Table 4 below. The purpose of the test is to provide evidence for or against the ISH for both inclusions and exclusions.

Table 4 illustrates the effect for inclusions on the AD. For the revenue variables, the outputs are non-significant but they all hint about a lower abnormal return for the low quality companies than for the high ones. Regression 2 shows that the companies in the lower median in terms of revenue growth experience a 0.6 p.p. lower abnormal return on average than the companies in the upper median. Furthermore, looking at the valuation variables, we see some significant outcomes on the 10% level. Regression 4 indicates that firms in the lower 50th percentile, when it comes to P/B value growth last year, tend to have a 1.07 p.p. lower abnormal return than the firms in the upper 50th percentile. These outcomes are significant also when controlled against the operational variables, as shown in regression 6 and 8. This stands in contrast to the findings of Ledmyr & Karlsson (2017), who find significant results for the operational but not the valuation variables. This is not in line with our earlier evidence for the PPH, and instead provides signs of the ISH being valid for inclusions.

[11] As proposed by Ledmyr & Karlsson (2017)

Table 4 - Abnormal return at announcement date for firms being added to the SBX index
Result from OLS regression of abnormal return against operational/valuation growth dummy variables. Each column represents our event window (1=Announcement day). All variables are dummy variables. Operational growth variables represent dummies if companies are in the low median of the specific variable. 1Y represent one year historical growth, 5Y represent five year historical CAGR. Numbers in percentage points. Please see Table 1 for full overview of the variables and their properties. Data from 2009 – 2016. Robust standard errors in parentheses. *=10% significance, **=5% significance, and ***=1% significance.

Event window	1	1	1	1	1	1	1	1	1
(Regression)	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
INCLUSION	0.85*** (0.30)								
Operational growth variables									
REV1		-0.61 (0.65)				-0.82 (0.68)	-0.58 (0.64)		
REV5			-0.15 (0.56)					-0.17 (0.56)	-0.16 (0.56)
Valuation growth variables									
PB1				-1.07* (0.61)		-1.22* (0.65)		-1.07* (0.62)	
PB5					-0.86 (0.62)		-0.84 (0.61)		-0.87 (0.62)
Constant	-0.00** (0.00)	1.09*** (0.36)	0.90** (0.44)	1.24*** (0.39)***	1.13*** (0.39)	1.63*** (0.55)	1.36*** (0.47)	1.30** (0.52)	1.19** (0.52)
Observation	84	84	84	84	84	84	84	84	84
R-Squared	4.72%	1.15%	0.06%	3.40%	2.13%	5.43%	3.17%	3.49%	2.20%

Table 5 illustrates the effect for exclusions on the AD. Conversely to what we see for exclusions, the operational variable show statistically significant results on the 10%-level. Regression 2 shows that those companies that are in the lower median in terms of revenue growth experience a 1.01 p.p. lower abnormal return on average than the companies in the upper median. This outcome is significant also when controlled against the valuation variables, as shown in regression 6 and 7. For the valuation variable, no statistically significant results are found but they all hint about lower abnormal return for the low quality companies. This validates the ISH[12] versus the DSH for exclusions.

[12] And hence also the EMH.

Table 5 - Abnormal return at announcement date for firms being added to the SBX index
Result from OLS regression of abnormal return against operational/valuation growth dummy variables. Each column represents our event window (1=Announcement day). All variables are dummy variables. Operational growth variables represent dummies if companies are in the low median of the specific variable. 1Y represent one year historical growth, 5Y represent five year historical CAGR. Numbers in percentage points. Please see Table 1 for full overview of the variables and their properties. Data from 2009 – 2016. Robust standard errors in parentheses. *=10% significance, **=5% significance, and ***=1% significance.

Event window	1	1	1	1	1	1	1	1	1
(Regression)	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
EXCLUSION	-0.72** (0.29)								
Operational growth variables									
REV1		-1.01* (0.57)				-1.06* (0.57)	-0.98* (0.56)		
REV5			-0.56 (0.58)					-0.56 (0.58)	-0.52 (0.60)
Valuation growth variables									
PB1				-0.22 (0.61)		-0.38 (0.60)		-0.23 (0.60)	
PB5					-0.39 (0.58)		-0.30 (0.57)		-0.32 (0.60)
Constant	0.00*** (0.00)	-0.12 (0.41)	-0.43 (0.42)	-0.59 (0.50)	-0.52 (0.41)	0.14 (0.58)	0.01 (0.50)	-0.29 (0.60)	-0.29 (0.47)
Observation	79	79	79	79	79	79	79	79	79
R-Squared	3.21%	3.71%	1.19%	0.17%	0.57%	4.23%	4.04%	1.38%	1.57%

Due to multicollinearity, we have not expanded the time period in this regression and instead decided to stick with analysing the effects on the announcement day. However, Table 4 and Table 5 are related to Figure I, Figure II, Figure III and Figure IV found in the Appendix which plot average cumulative raw returns separated by high and low median revenue (for exclusions) and price-to-book ratio (for inclusions) growth companies. For inclusions, the one year high and low price-to-book value growth graph indicates that high median price-to-book ratio firms perform better on the long-term than the low median ones, further supporting our significant observations in table 4 for the longer-term. The same tendency for price-to-book ratio growth firms seems to be true also for the five year CAGR version, however, the magnitude of the difference seems to be lower. For exclusions, the one year high and low revenue growth graph indicates high median revenue growth firms perform better on the long-term than the low median ones. Conversely, no such evidence is found for the five year CAGR version.

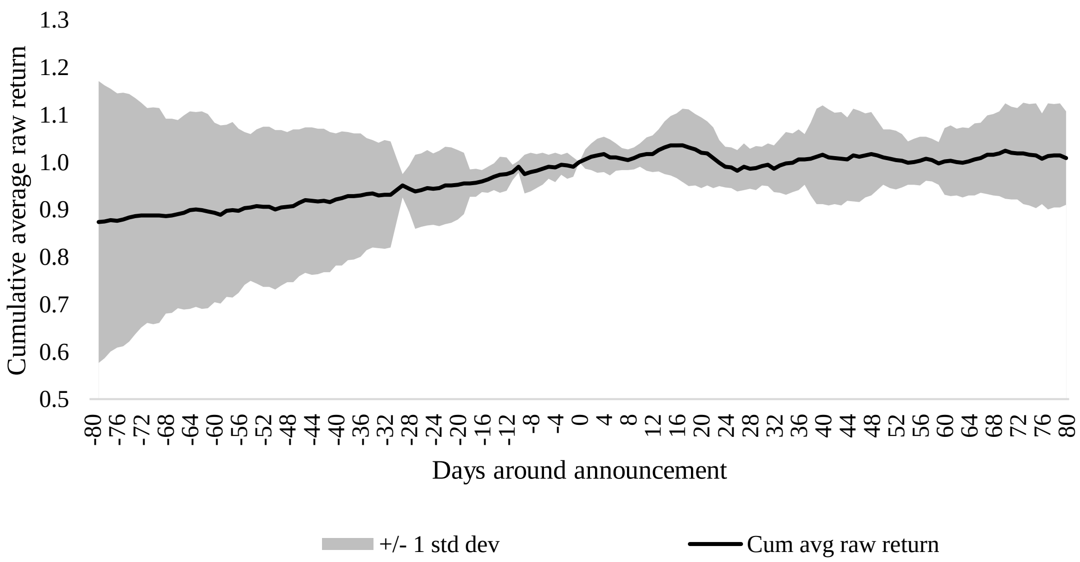
6.1.4 Long-term analysis

In section 2 we formulated our expectations of abnormal return on the AD, including abnormal return between the AD and the ED and a reversal of this for the period after ED. This would align our results with the PPH. However, as the analyses made in the chapter ranges from 20 trading days around the AD and the ED, while the average range between the respective event dates is 23 days for our sample, we believe a long-term analysis provide clarity on the performance between the dates.

Figure 9 and Figure 10 illustrates the long-term performance indexed to the event date for inclusions and exclusions respectively. For inclusions, a continuing price increase in the 80 trading days prior to the AD is found. This could provide support of predictability and the ISH, implying that high quality companies are likely to be included into the index. However, since the criteria is based on float-adjusted market capitalisation; an increasing market capitalisation could be the trigger of inclusion rather than a sign of quality. This is also indicated by Ledmyr & Karlsson (2017) as well as Chan & Howard (2002). The 80 trading days following the AD show an initial increase but with a full reversal back to the mean value. Interestingly, this provides support for the PPH and is evidence against the DSH and the ISH. If the latter would hold, a permanent price change would be required since the information assertion would imply an improved quality of inclusions. These results are compatible with the ones seen in the regression, but not when including qualitative variables.

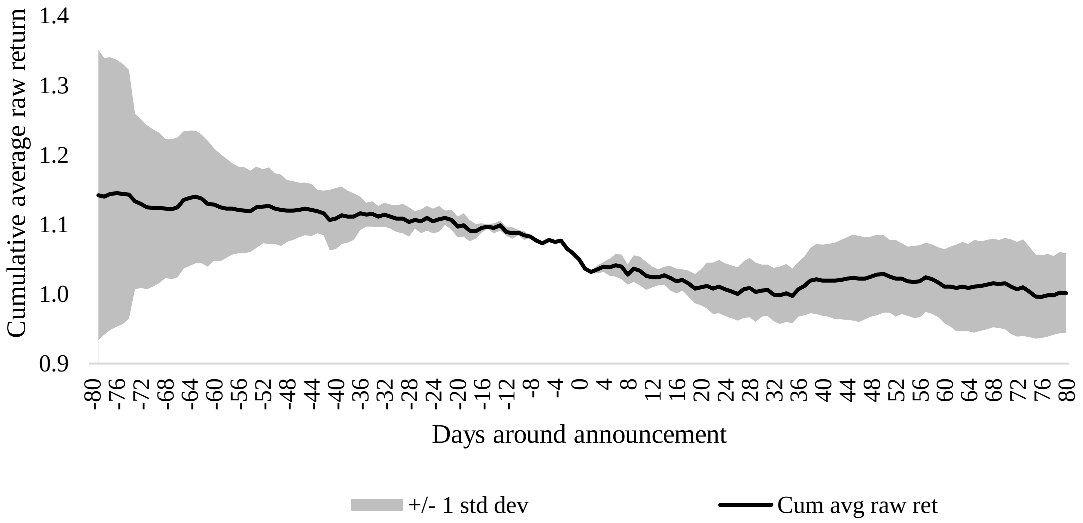
For exclusions, a similar pattern is initially found. There is an obvious negative price development for the 80 trading days leading up to the AD. This could once again indicate predictability, and provide support for the ISH. For the 80 trading days following the AD, we see no evidence of full price reversal. Rather, the negative price development continues. The results therefore indicate permanent abnormal return in the long-term, well in line with the DSH or the ISH. Based on this and the results seen above, we believe evidence of the ISH being valid for exclusions to be very strong.

Figure 9: 160 days cumulative average raw return for inclusions



Price and return data from Bloomberg

Figure 10: 160 days cumulative abnormal raw return for exclusions



Price and return data from Bloomberg

6.1.5 Test of effect from methodology change in 2012

As noted in section 4.2.2, the SBX index changed its inclusion criteria in 2012 and in order to fully understand the effects of this change, we have decided to further split the AD dataset in order to perform two new regressions; one before and one after the changes in methodology.

For the period before 2012, at the AD the abnormal return is small in magnitude and not significant while the magnitude increases for the pre- and post-windows. Few significant observations are made, and with AD results inversely related to those for the full sample. A positive post-event date performance is found for inclusions, and a negative performance post-event date performance for exclusions. However, the robustness in data is questionable as the observations are made up of only 28 inclusions and 27 exclusions.

Table 6 - Abnormal return around announcement of inclusion into and exclusion from the SBX index 2009-2011
Result from OLS regression of abnormal return against inclusion/exclusion dummy variables. Event windows: 1 = Announcement day, 2 = 5-days pre announcement day, 3 = 10-days pre announcement day, 4 = 5-days post announcement day, 5 = 10-days post announcement day. Number in percentage points. INCLUSION and EXCLUSION are dummy variables. Please see Table 1 for full overview of the variables and their properties. Data from 2009 – 2011. Robust standard errors in parentheses. *=10% significance, **=5% significance, and ***=1% significance.

Event window	1	1	2	2	3	3	4	4	5	5
Regression	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
INCLUSION	-0.23 (0.52)		-0.42 (0.83)		0.47 (0.12)		0.61 (0.74)		0.95 (0.96)	
EXCLUSION		0.05 (0.49)		0.80 (1.62)		-0.90 (2.27)		-2.25* (1.18)		-0.39 (1.48)
Constant	0.00 (0.00)	-0.00 (0.00)	0.00 (0.00)	-0.00 (0.00)	-0.00 (0.01)	0.00 (0.00)	-0.01* (0.00)	-0.00 (0.00)	-0.00 (0.00)	0.00 (0.00)
Observations	28	27	28	27	28	27	28	27	28	27
R-Squared	0.37%	0.02%	0.20%	0.69%	0.12%	0.44%	0.64%	8.48%	1.08%	0.17%

However, while looking at the period following the change in inclusion criteria we observe that both exclusions and inclusions have abnormal return that are significant at the 1%-level and are larger in magnitude than the corresponding values for the period 2009-2016. In the 5-days post-announcement window where we see a negative abnormal return of 0.90% significant at the 10%-level. This is in line with our general results of a partial reversal. For exclusions, the 10 days leading up to the AD show a CAR of -2.62% (significant at the 10%-level). This is also in line with our general results.

Table 7 - Abnormal return around announcement of inclusion into and exclusion from the SBX index 2012-2016
Result from OLS regression of abnormal return against inclusion/exclusion dummy variables. Event windows: 1 = Announcement day, 2 = 5-days pre-announcement day, 3 = 10-days pre-announcement day, 4 = 5-days post announcement day, 5 = 10-days post announcement day. Number in percentage points. Inclusion and exclusion dummy variables. Please see Table 1 for full overview of the variables and their properties. Data from 2012 – 2016. Robust standard errors in parentheses. *=10% significance, **=5% significance, and ***=1% significance.

Event window	1	1	2	2	3	3	4	4	5	5
Regression	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
INCLUSION	1.39*** (0.35)		0.40 (0.59)		1.01 (0.89)		-0.90* (0.52)		-0.93 (0.72)	
EXCLUSION		-1.12*** (0.34)		-1.42 (1.09)		-2.62** (1.32)		-0.21 (0.53)		-0.49 (0.80)
Constant	-0.00*** (0.00)	0.00*** (0.00)	-0.00 (0.00)	0.00 (0.00)	-0.01* (0.00)	0.00 (0.00)	-0.00 (0.00)	-0.01* (0.00)	-0.00 (0.00)	-0.00 (0.00)
Observations	56	52	56	52	56	52	56	52	56	52
R-Squared	12.11%	7.36%	0.20%	2.35%	0.76%	4.71%	2.76%	0.14%	1.41%	0.37%

Previous studies have attempted to primarily qualitatively find evidence of the ISH. Since the methodology of the SBX involves no subjectivity; a measure of information signalling could potentially include the mechanical rules of the index. If these are changed and the abnormal return increases (as found), one could assume that the information assertion has increased due to the new rules favouring high quality companies. Therefore, potential evidence of the ISH could be seen in relation to the change of rules as the potential informational signal changes in relation to it. Evidence found in the section could, therefore, provide further evidence of the ISH.

6.2 Effective date study

This section presents our findings when using ED as the event date for our models.

6.2.1 Descriptive statistics

Table 8 presents the descriptive statistics of abnormal return at ED for inclusions (Panel 1) and exclusions (Panel 2).

The first panel shows a negative abnormal return for inclusions on the event day equal to -1.31% on average. For the days prior to the event day, we observe positive abnormal return on average, potentially being a continued development from the AD. This is in line with our expectations. Following the ED, data shows strong negative abnormal return in both windows (-3.39% for the 10-day period). These results provide evidence of a reversal of the abnormal return seen during the period leading up to the ED, providing evidence of the PPH. These results are also most likely related to the index funds' temporary demand shock for inclusions.

The second panel shows a positive abnormal return on ED for exclusions equal to 0.30% on average. However, the median is 0.02% – indicating that there are some positive outliers in our data sample. For the 5 days and 10 days prior to ED, we observe mixed abnormal return overall without any firm results. When it comes to the post-event window for the ED, we see positive tendencies both on a 5 and 10 day basis. This is in line with our interpretation in the first panel; as index funds stop selling the stocks will slightly rebound again.

Table 8 – Descriptive statistics of abnormal return at effective date of inclusion into and exclusion from SBX index
Descriptive statistics of abnormal return around effective date of inclusion or exclusion. Data from 2009 – 2016.

Panel 1 – Effective date of inclusion into SBX index					
Event window	**Event day**	**5 days pre event**	**10 days pre event**	**5 days post event**	**10 days post event**
# observations	84	84	84	84	84
Max	4.37%	20.23%	32.38%	20.08%	14.38%
Average	-1.31%	1.16%	1.65%	-1.17%	-3.39%
Median	-0.96%	1.34%	1.10%	-1.40%	-2.61%
Min	-12.92%	-11.33%	-22.16%	-14.06%	-24.54%
Standard deviation	2.41%	6.47%	8.82%	5.08%	6.83%
Panel 2 – Effective date of exclusion from the SBX index					
Event window	**Event day**	**5 days pre event**	**10 days pre event**	**5 days post event**	**10 days post event**
# observations	79	79	79	79	79
Max	11.10%	20.49%	28.64%	25.66%	30.81%
Average	0.30%	-0.19%	0.04%	0.22%	1.11%
Median	0.02%	1.34%	0.94%	0.08%	1.10%
Min	-7.04%	-29.25%	-22.20%	-20.00%	-16.63%
Standard deviation	2.85%	7.23%	8.38%	5.40%	6.39%

6.2.2 OLS regression results

Table 9 contains the results of the four-factor Fama & French (1992) event study regression on cumulative average abnormal return of included (regression 1, 3, 5, 7, 9) and excluded (regression 2, 4, 6, 8, 10) securities with ED as the event date.

For inclusions, the results imply a -1.31% abnormal share price performance (significant at the 1%-level) at the ED. The period prior to the event date shows evidence of positive abnormal return (significant at the 1%-level), whereas the period following the event date shows negative abnormal return (significant at the 5%- and 10%-level respectively). This is in line with most results found in previous sections and our expectations. Practically, the negative abnormal return at the ED are puzzling as one could assume that index funds should aim at transacting at the ED to minimise tracking error – and thereby stimulating a temporary demand shock.

For exclusions, no statistically significant results are found whatsoever. At the ED, there is a positive 0.31% abnormal share price performance. For the days prior to the ED, there is a positive cumulative abnormal share price performance seen 10 days prior to the event, but not for the 5 days prior. For both time windows following the ED, there is a positive cumulative abnormal share price development. This could indicate a reversal of abnormal return seen pre-ED, however as seen for the long-term analysis in section 6.1.4; no full reversal occurs for our sample and hence this is ruled out.

The results seen in Table 9 are aligned with those of Chen & Howard (2002)[13]. They discover abnormal return at the period before the ED, but this is reversed in the days following the ED.

Table 9 - Abnormal return around effective inclusion into and exclusion from the SBX index
Result from OLS regression of abnormal return against inclusion/exclusion dummy variables. Event windows: 1 =Effective day, 2 = 5-days pre effective day, 3 = 10-days pre effective day, 4 = 5-days post effective day, 5 = 10-days post effective day. Number in percentage points. Inclusion and exclusion dummy variables. Please see Table 1 for full overview of the variables and their properties. Data from 2009 – 2016. Robust standard errors in parentheses. *=10% significance, **=5% significance, and ***=1% significance.

Event window	1	1	2	2	3	3	4	4	5	5
Regression	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
INCLUSION	-1.31***		1.16*		1.65*		-1.17**		-3.39***	
	(0.26)		(0.70)		(0.96)		(0.55)		(0.74)	
EXCLUSION		0.31		-0.20		0.03		0.23		1.12
		(0.32)		(0.81)		(0.94)		(0.60)		(0.71)
Constant	0.00	-0.00***	-0.00	-0.00	0.00	0.00	0.00	0.00**	0.00	-0.01***
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Observations	84	79	84	79	84	79	84	79	84	79
R-Squared	11.38%	0.59%	1.48%	0.04%	1.88%	0.00%	2.51%	0.09%	11.87%	1.22%

Figure 11 illustrates the short-term cumulative average raw return for inclusions indexed to ED, and Figure 12 the corresponding long-term effect. The pattern in the charts suggests a strong share price performance before the ED with a weak performance in the short-term in the subsequent period. Some 30 days after ED, the negative price movement is reversed. As this is indexed to the ED, and we previously have concluded that there are abnormal return leading up to the ED, any increase from the indexed value indicates a long-term abnormal return if measuring from the AD. This provides evidence of the DSH or the ISH. Since we, in section

[13] As explained earlier; Chen & Howard (2002) also studied an open-end index

6.1, provided evidence of the ISH, we believe there is conclusive evidence of the ISH being valid for inclusions in the long-term.[14]

Figure 11: 20 trading days cumulative average raw return for inclusions

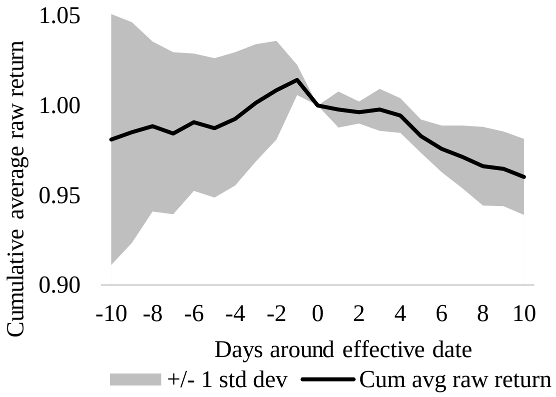
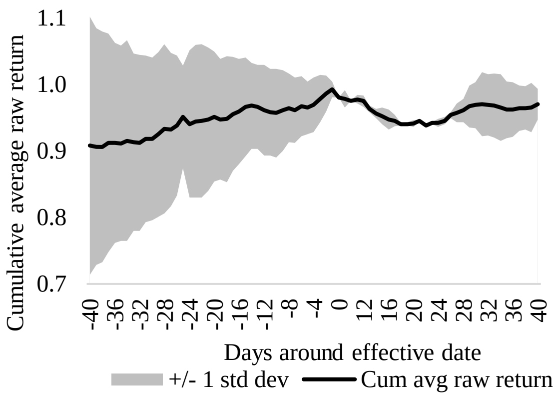


Figure 12: 80 trading days cumulative average raw return for inclusions



Price and return data from Bloomberg

Figure 13 illustrates the short-term cumulative average raw return for exclusions indexed to ED, and Figure 14 the corresponding long-term effect. The findings suggest a weak share price performance before and after the ED. This is aligned with our results for exclusions over all measurement periods and event dates. Thus, we believe the evidence of the ISH being valid are conclusive for exclusions.

Figure 13: 20 trading days cumulative average raw return for exclusions

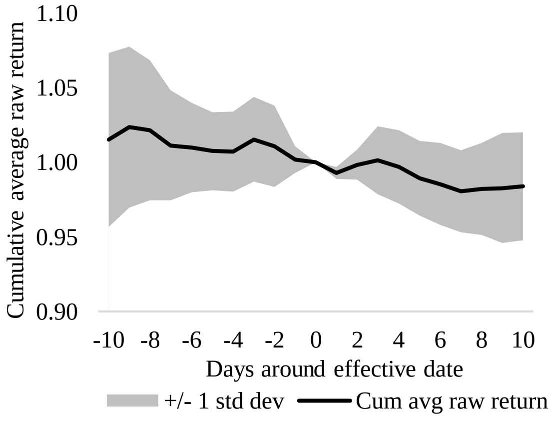
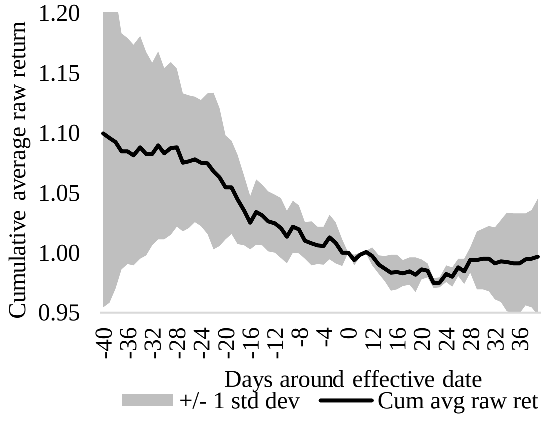


Figure 14: 80 trading days cumulative average raw return for exclusions

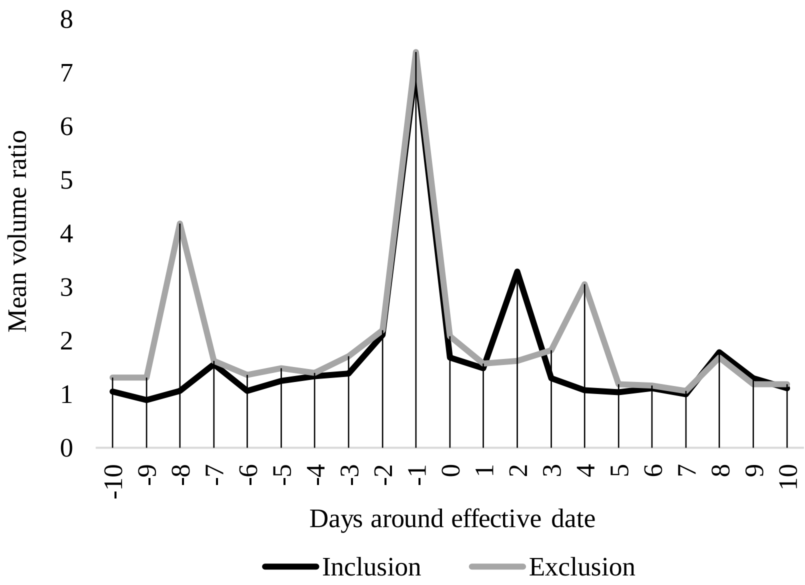


Price and return data from Bloomberg

[14] This would, however, require us to disregard from Figure X, which illustrates the reversal for the 80 trading days following the AD. Nevertheless, since it is raw returns, we believe the measurement of abnormal return for the period subsequent to the ED should override it.

Figure 15 plots the average mean volume ratio around effective date. There are clear patterns of abnormal volume one day prior to ED. This is well in line with the findings of Beneish & Whaley (1996), Lynch & Mendenhall (1997), Petajisto (2011) and Ledmyr & Karlsson (2017). This event is believed to stem from the index fund manager's goal of minimising tracking error, and hence transacts constituent changes as close to ED as possible without having to incur any index turnover cost as formulated by Petajisto (2011).

Figure 15: Average mean volume ratio (days around effective date)



Volume data from Bloomberg

To summarise, if only studying the ED as such; for inclusions, we find significant evidence of a negative abnormal return, which is foregone by positive abnormal return but followed by negative abnormal return. These results are incompatible with the EMH as abnormal return is found. However, evidence against all theories could be provided.[15] For exclusions, results indicate an ambiguous development leading up to the ED and a positive development post-ED. However, as there is no statistical significance to our results, we do not draw any conclusions based on this.

If instead, including the ED as a part of the wider picture, and including the results seen in section 6.1 with the AD as the event date, we find evidence of the ISH being valid for both inclusions and exclusions. This stems from the fact that both sets show long-term abnormal return results. However, this requires us to assume that the raw returns seen in Figure 4 and

[15] As the event date abnormal return is negative for inclusions and positive for exclusions, which is incompatible with all theories.

Figure 5 are inadequate for inclusions. Therefore, we see some weakness to the findings for inclusions. Furthermore, for exclusions, we see firm evidence for the ISH being valid.

7. Conclusion

Abnormal return for stocks affected by changes of constituents in indices have been a topic of significant study during the modern era of financial economics. Previous academia has to a large extent proven the presence of abnormal return for both included and excluded stocks, independently of the index methodology and geographic differences.

In this study, we formulate four hypotheses, out of which two are related to two different time lapses and two are related to the findings compatibility with previously formulated (and debated) market hypotheses.

In the sample, we find support for abnormal return around announcement date. This is in line with previous literature on the topic. For inclusions around announcement date, the findings indicate a post-event reversal of the abnormal return. This is established to be in line with the PPH. For exclusions around announcement date, the abnormal return is not reversed subsequent to the event date. This provides support for the DSH or the ISH. If extending the analysis to include operational and valuation variables, we find evidence of the ISH for both inclusions and exclusions. This is incompatible with the preceding findings for inclusions. Therefore, if extending the time frame for inclusions by including the ED and the period subsequent to it, we find evidence of abnormal return on the long-term. This could provide evidence against the PPH, thereby validating the ISH. These results are aligned with those of Jain (1987) and Dhillon & Johnsson (1991) on the S&P 500.

For the ED as the event date, we find no support for abnormal return as explained by the theories in the study. Instead, for inclusions we find negative abnormal return (as opposed to the EMH, the DSH, the PPH and the ISH), significant at the 1% level. This is puzzling, as no previous literature finds similar results. These results are foregone by positive cumulative abnormal return and followed by negative cumulative abnormal return, in line with our expectations and all with a statistical significance of below 10%. For exclusions, no statistically significant results are found. Nevertheless, we find a positive abnormal return at ED. Once again this is as opposed to previous literature and puzzling. The positive abnormal return at ED is foregone by mixed cumulative abnormal returns and followed by a continued positive cumulative abnormal return in the subsequent time windows (not statistically significant).

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Appendix

Table I: SBX constituents as of 26 April

Ticker	Weight	Shares
NDA SS Equity	6.47196	3199.462016
VOLVB SS Equity	5.677639	1645.514821
ATCOA SS Equity	5.001033	646.333454
ERICB SS Equity	4.581767	3072.395752
SWEDA SS Equity	4.126201	950.884806
ASSAB SS Equity	3.93939	938.994825
SAND SS Equity	3.599192	1028.596457
INVEB SS Equity	3.569963	414.490609
SHBA SS Equity	3.183724	1431.691667
ESSITYB SS Equity	3.125084	637.990089
HMB SS Equity	2.953641	905.61664
SEBA SS Equity	2.826935	1453.912927
HEXAB SS Equity	2.73424	234.391337
TELIA SS Equity	2.674337	2727.953412
ATCOB SS Equity	2.385851	339.490537
ABB SS Equity	2.178577	473.941863
BOL SS Equity	1.820754	259.835611
ALIV SS Equity	1.805096	63.173627
AZN SS Equity	1.681056	121.862603
KINVB SS Equity	1.575337	220.250924
ELUXB SS Equity	1.562204	261.633159
SWMA SS Equity	1.52474	172.71
SKFB SS Equity	1.418319	352.554625
SCAB SS Equity	1.39274	637.748898
ALFA SS Equity	1.338604	272.646605
SKAB SS Equity	1.318077	344.12561
VOLVA SS Equity	1.0841	313.888509
LUPE SS Equity	1.037076	183.80868
SECUB SS Equity	1.016213	320.082993
TRELB SS Equity	0.985873	211.037451
CAST SS Equity	0.856218	273.201166
TEL2B SS Equity	0.850674	327.901093
MIC SS Equity	0.785643	59.42409
HUSQB SS Equity	0.754447	389.015878
INVEA SS Equity	0.740593	87.273436
INDUC SS Equity	0.703378	167.025537
NIBEB SS Equity	0.688119	343.022705
EKTAB SS Equity	0.676144	305.927741
SOBI SS Equity	0.661113	163.504625
FABG SS Equity	0.634041	281.165672
DOM SS Equity	0.586344	295.833333
KINDSDB SS Equity	0.576648	216.318568
ICA SS Equity	0.542946	78.44725
INDUA SS Equity	0.494518	112.637423
HOLMB SS Equity	0.493122	50.949001
LUNDB SS Equity	0.490987	36.48
BALDB SS Equity	0.488805	97.886929

Ticker	Weight	Shares
AAK SS Equity	0.45629	25.795978
HPOLB SS Equity	0.456202	227.310605
SSABB SS Equity	0.455211	522.46948
BILL SS Equity	0.448167	156.164876
GETIB SS Equity	0.43044	210.94647
INTRUM SS Equity	0.409604	73.663139
PEABB SS Equity	0.383519	214.618414
AHSL SS Equity	0.378899	301.048509
AXFO SS Equity	0.377891	104.935356
STER SS Equity	0.348219	89.119522
HUFVA SS Equity	0.338289	117.738184
MTGB SS Equity	0.328134	41.38907
HEMF SS Equity	0.3241	134.069012
LATOB SS Equity	0.309174	136.199323
WALLB SS Equity	0.308589	177.3
JM SS Equity	0.293606	71.059683
WIHL SS Equity	0.289184	65.328219
NCCB SS Equity	0.287179	74.932804
KLED SS Equity	0.262817	192.194906
SSABA SS Equity	0.239491	219.011954
EVO SS Equity	0.238862	19.0643
NETB SS Equity	0.211375	196.147317
ATT SS Equity	0.191563	97.6
VITR SS Equity	0.170282	11.723462
BETSB SS Equity	0.169757	122.15573
BONAVB SS Equity	0.169498	69.528277
GRNG SS Equity	0.159497	59.654785
PNDXB SS Equity	0.155909	47.024999
HMED SS Equity	0.149838	25.590048
SAGAB SS Equity	0.145075	62.718996
CLAB SS Equity	0.139786	195.189995
SHOT SS Equity	0.138959	72.089553
BIOGB SS Equity	0.132701	14.272383
KLOVB SS Equity	0.131404	538.522342
ATRLJB SS Equity	0.124091	40.058428
BIOT SS Equity	0.114094	55.654424
CAPIO SS Equity	0.08864	100.223359
SAS SS Equity	0.083298	171.642927
CTM SS Equity	0.082861	30.147644
KARO SS Equity	0.077287	101.88607
RECIB SS Equity	0.075497	32.384778
CEVI SS Equity	0.072918	20.273815
MCOVB SS Equity	0.072909	47.279891
RAYB SS Equity	0.059314	20.758516
AOI SS Equity	0.054379	305.859402
FINGB SS Equity	0.051744	289.489615

Figure I: Cumulative average raw return 1Y P/B growth median for inclusions

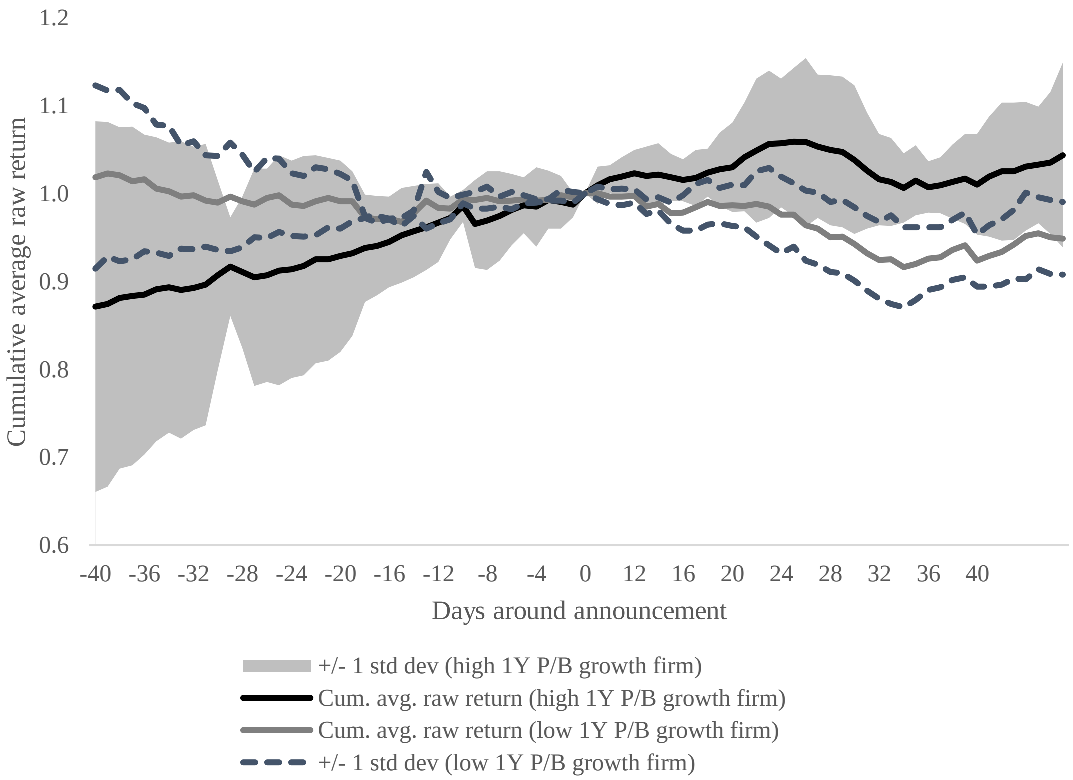

Figure II: Cumulative average raw return 5Y P/B growth median for inclusions

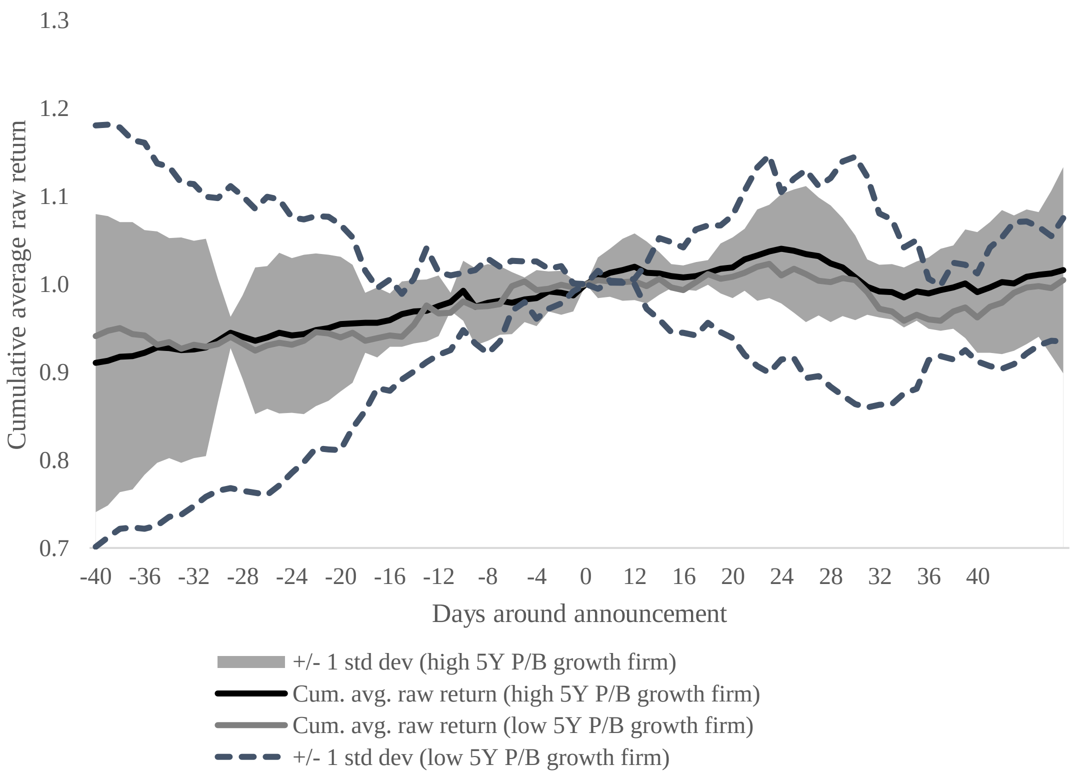

Figure III: Cumulative average raw return 1Y revenue growth median for exclusions

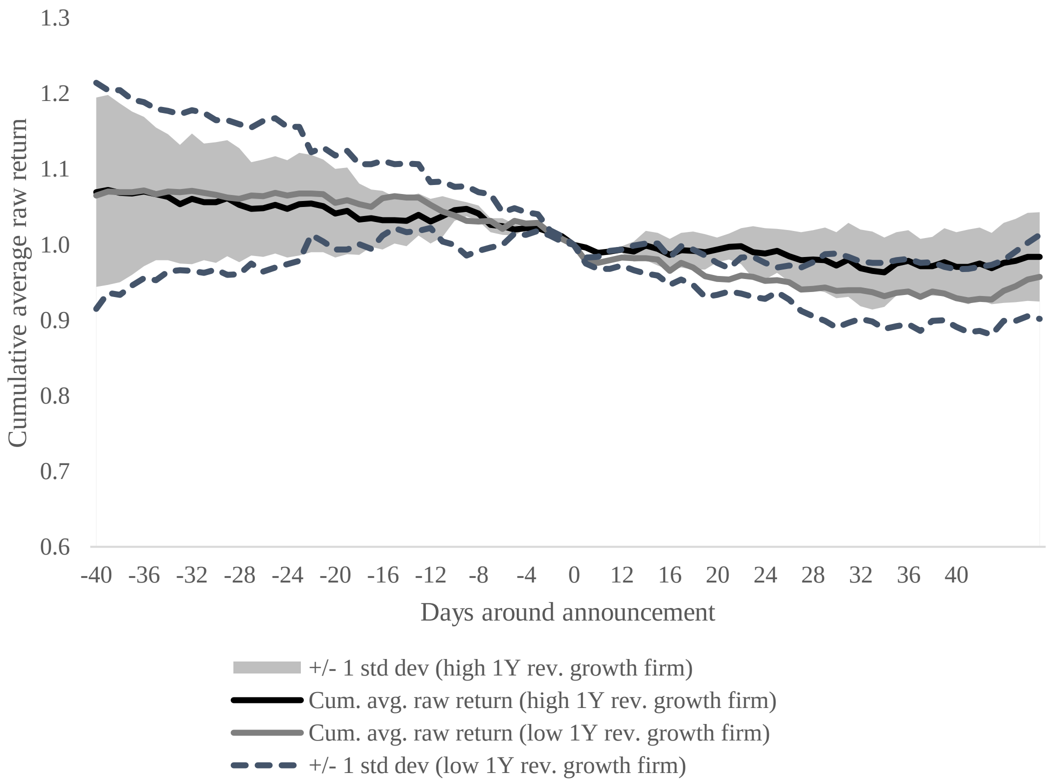

Figure IV: Cumulative average raw return 5Y revenue growth median for exclusions