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A reconsideration of the traditional value factor

An adaption to the modern economy

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Abstract

The weak performance of the value factor within the last decades has led to a considerable debate among academics and professionals about whether investing based on a value strategy is still profitable. Previous research has shown that the original Fama and French (1993) value factor is outdated based on both its asset pricing ability and investment performance. This research will analyse this underperformance and give a feasible solution for it, namely the intangible value factor. This factor incorporates the intangible assets of a company, which are most of the time ignored. It is shown that this newly generated factor yields substantially better returns and performs at least as well or outperforms the traditional value factor based on asset pricing ability. This superior performance has been strong over the last few decades. This is shown with different kinds of performance measures. After having performed the analysis, it is possible to conclude that the value factor is not outdated in the current knowledge economy, but it does need some reconsideration.

Keywords: Factor investing, Value factor, Intangible value factor

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1. Introduction

Value investing, probably the most well-known investment strategy, has been losing its power in the last decades (Lev and Srivastava, 2019). Following this strategy, investors must go long in low-valued (value) stocks and short in high-valued (growth) stocks. By adopting this strategy, it is possible to capture companies whose stock prices are temporarily undervalued or overvalued by investors relative to their accounting fundamentals. The stocks will eventually undergo a price reversal which will drive the gains from value investing. This strategy has been leading to excess returns over the last few decades. Despite this long-lasting performance, it is recorded that the strategy has been losing its power since the financial crisis of 2008. Even the inventors of the well-known three and five-factor model, which incorporate the value factor, have argued that the value factor has become redundant (Fama and French, 2015). This underperformance, and even its negative returns, arises the question of whether the traditional value factor is still able to price assets well. According to this, the study focuses on the main research question:

Is the value factor outdated in the current knowledge economy?

Within the current knowledge economy, there has been a transition of companies from which its value is mostly based on tangible capital, to an economy where the emphasis lays much more on intangible assets, due to for example a lot of investments into research and development. When comparing the largest companies, based on market capitalization, in 2000 to the current largest companies, this transition is very evident. Among the largest companies, the stress has begun to lay much more on companies with a substantial part of their capital directed to intangible assets. Corrado & Hulten (2010) displayed that on average, intangible capital makes up around 34 per cent of a firm's total capital. More recently Eisfeldt and Papanikolaou (2013b), Falato, Kadyrzhanova, and Sim (2013), Ewens, Peters, and Wang (2020) and Belo, Gala, Salomao, and Vitorino (2022), all estimated that the contribution of intangible capital to the total value of the capital is around 50 per cent. A large part of the intangible assets is created by investments in employee, brand, and knowledge capital, which is expensed and thus does not appear on the balance sheet of a company. This has resulted in a growing mismeasurement of book equity (Eisfeldt, Kim

Papanikolaou, 2021). Because of this, the debate arises within financial literature, whether, instead of writing off the value factor, it should be adapted to the current economic conditions.

Eisfeldt, Kim and Papanikolaou (2021) have proposed the idea of an intangible value factor (HML^{INT}). This can be constructed by doing a simple modification to the original Fama and French (1993) value factor (HML). The construction of this renewed value factor follows the same methodology as the construction of the original one. The variation between the two results from the fact that intangible assets are added to the book equity of a firm. Intangible assets are measured following the perpetual inventory method to flows of Selling, General and Administrative (SG&A) expenses introduced by Eisfeldt and Papaniklaou (2013b). By following this method, it is possible to eliminate the divergence in valuation which arises when two similar companies invest the same amount of equity, however, one invests in tangible, and the other in intangible assets. including intangible assets in the book equity of a firm, and thus creating a renewed book-to-market ratio as a proxy for value stocks, may result in a revival of the value factor.

This research will give an extensive analysis of the performance of the traditional value factor, based on the book-to-market ratio, and will compare it with the performances of other value factor substitutes. Literature has provided investors with numerous different options of accounting ratios to use to construct the value factor. The earnings-to-price, dividend-to-price, cashflow-to-price, and sales-to-price ratios will all be investigated. These more traditional value factors will then be set side by side with the more modern intangible, value factor of Eisfeldt, Kim and Papanikolaou (2021), to ultimately conclude which factor has had the best performance over the research sample, and over more specific subsamples. Furthermore, the asset pricing ability of both the traditional value factor by Fama and French (1993) and the intangible value factor, will be compared. This analysis will be done by performing a Fama-Macbeth (1973) regression.

The diagnosis reveals that indeed the traditional value factor is outdated in the current knowledge economy. The return of the intangible value factor has outperformed the one from the traditional value factor. Also, it has a better pricing error at least within the Fama and French three factor framework (1993). The intangible value factor has had a cumulative return of 833%, relative to the 151% of the traditional Fama and French value factor. When sorting portfolios in quintiles based on their (intangible) book-to-market ratio and the size, the analysis also reveals a superior performance of the HML^{INT} within all different size quintiles. Furthermore, the research also shows that the intangible value factor performs a lot better than the other traditional value factors based on the sales-to-price, earnings-to-price, dividend-to-price, and cashflow-to-price. After having performed the research, it is safe to say that the value factor is not outdated in the current economy. Although, it does need some reconsideration. Capturing intangible assets within the calculation of the value factor will lead to superior results and strongly outperforms traditional value investing.

The paper will now continue as follows. In the second section, the existing literature will be reviewed. Value investing in general, and its performance is examined. Hereafter, the recent underperformance of the value factor will be analysed, and different possible solutions are given. Within the third section, the different hypotheses of the paper will be presented. In section 4, the data sources and the data being used are described. Hereafter, the conducted methodology of the paper is explained. The fifth section will present the results of the research. Lastly, in the sixth section, a conclusion of the research will be drawn, and possible improvements and ideas for further research are given.

2. Theoretical background

2.1 Basic principles of value investing and its evolution

The value strategy is based on the theory that among low-valued stocks, there are many undervalued ones, relative to their accounting fundamentals. The foundation was laid first by Benjamin Graham and David L. Dodd, in their book “Security Analysis” (1934). They found that investors will often profit by buying securities that are selling below their book value. Benjamin Graham later specified this in his book “The intelligent investor”. He says an investor must find companies with a market to book value of less than 1.20 (1965).

Following Graham and Dodd, Basu (1977) came with another influential academic innovation. Basu published the first modern empirical study of the value effect. In his paper, the value was measured by the price-earnings (P/E) ratios. He found that stocks with low P/E ratios, the value stocks, earned superior returns even after adjusting for risk. From here the basis was created for a wide variety of academic studies.

Investing based on this market to book value has later also been incorporated into factor investing. Investing based on asset pricing models has had a long history of positive abnormal returns. Its origin can be found in the capital asset pricing model, in which a factor for market risk was created (Sharpe, 1977). Many have tried to create factors that outperform the market and so the technique has developed itself over time. Stattman (1980) and Rosenberg, Reid and Lanstein (1985) have originally found that average returns in the US stock market are positively related to a ratio of the firm's book value (B) and its markets value (M). This relation has later also been found and its existence was confirmed in the Japanese stock market (Chan, hamao and Lakonishok, 1991).

In 1992, probably the most important research on the value factor premium was published. Fama and French studied the roles of the market beta, size, E/P ratio, leverage, and book-to-market ratio (B/M) in the cross-section of average stock returns. They found that size and book-to-market combined best explain the average returns in the US stock market within the 1963-1990 period. Following this, they incorporated the value factor in the Fama and French three-factor model (1993), which builds on the capital asset pricing model (CAPM) of Sharpe (1964). They made the addition of a size factor, SMB, and a value factor, HML. This value factor is constructed with a long-short portfolio, consisting of long positions in stocks with high B/M ratios and short positions in stocks with low B/M ratios.

Within the literature, alternative definitions for value have been examined as well. Factors based on the sales-to-price ratio, earnings-to-price ratio and dividend-to-price have been widely investigated, and it is found that these have explanatory power for stock returns as well (Naranjo, Nimalendran and Ryngaert, 1998; Ball and Brown, 1968; Ou & Penman, 1989). Nevertheless, the standard within the literature remained a value factor based on the book-to-market ratio.

While there is some agreement that value strategies have produced superior returns, the interpretation of why they have done is more controversial. Fama and French (1992) view the premium as compensation for the risk of financial distress since a value strategy tends to overweight financial distressed stocks. Alternatively, Lakonishok, Shleifer and Vishny (1994) find that value strategies have worked so well relative to growth strategies due to the overestimation of the future earnings of these growth stocks. In consequence, these growth stocks are overvalued and lead to an underperformance. Furthermore, another important factor is that most investors have shorter time horizons than required for value strategies to consistently pay off (De Long et al., 1990; Shliefer and Vishny., 1990). A more recent study confirms the finding that it is a compensation for longer investment horizons. Clark and Qiao (2020) investigated the value premium puzzle in the Chinese stock market. After they have established that the value premium does exist in the Chinese stock market, they tested whether the value premium exists due to a behavioural factor or that is a compensation for risk. They found strong evidence that the value premium reflects a compensation for bearing more risk associated with financial inflexibility. This risk is also called the liquidity risk.

2.2 Historical Performance of investing based on the value factor

Especially between 1980 and 1990, a lot of evidence has been found for an outperformance of value stocks, relative to growth stocks. Fama and French (1993), have examined the performance of the HML factor, a long-short portfolio based on the book-to-market ratio. They concluded that, within a dataset ranging from 1963 to 1990, the average HML return is 0.40% per month. Over the years, the value premium has been tested in more markets than solely the US stock market. Chan, Hamoa and lakonishok (1991) confirm the explanatory power of the B/M ratio with a dataset of stocks listed on the Tokyo Stock Exchange extending from 1971 to 1988. They investigated the different value factors, namely the earnings yield, book-to-market ratio, and cash flow yield. Within their research, they mentioned: *"The performance of the book-to-market ratio is especially noteworthy; this variable is statistically and economically the most important of the four variables investigated".* This is mostly since they found a monthly excess return of 0.44% for the value stocks relative to the growth stocks. The same outperformance is also found in a dataset consisting of stocks on the stock market of France, Switzerland, Germany, the U.K. and Japan in the period 1981 to 1991 (Capaul, Rowley & Sharpe, 1993). Lastly, the value premium has also been tested in a smaller and less liquid market, the New Zealand stock market. Bryant and Eleswarapu (1997) have used data from 1971 to 1993 and have obtained similar results as Fama and French (1993). They show that there is a premium for small firms and a positive relation between returns and book-to-market ratios. They do that the relationship was negative from 1988 to 1993. They attribute this finding to the fact that firms with a high ratio were more seriously affected by the New Zealand stock market crash in 1987.

Having analysed the various results of existing literature, it is possible to confirm, at least until the late 1980s, the existence of the value premium. This premium has not only been examined and found within the New York Stock Exchange, but also within various other stock markets around the world.

2.3 Underperformance in the last couple of years

It is now documented and believed by many researchers that the long-standing and highly popular strategy of investing in stocks with a high B/M ratio and selling stocks with a low B/M ratio has lost its edge in the past 12-14 years. In these recent years, there has been a strong underperformance of value investing relative to growth investing. Since 2007 value investing has underperformed growth investing with 55% as of mid-2020. The value factor is already suffering for 13.3 years, this is the longest drawdown of the factor since July 1963 (Arnott et al., 2020). This has led many market participants to argue that the value factor is dead. This underperformance is also documented within the tech bubble of the 1990s. This elevated the valuation of growth stocks until the end of the decade, thereby rendering the short part of the strategy a losing proposition. It is important to note that tech firms mostly have a low B/M ratio, thus they will be in the short or middle portfolio of an HML strategy. The adaption of the HML strategy has resulted in a loss of 10% from the beginning of the 1990s until the end of the decade (Lev and Srivastava, 2019). The beginning years of the 2000s have shown a brief resurgence of the traditional value factor after the dot-com bubble, this was mainly driven by the success of shorting tech stocks. The prices of the traditional growth stocks plummeted and 17% of the growth stocks failed and were delisted. Having a short strategy on these failing companies boosted the return on the long-short value strategy, leading to a good overall performance. This small revival only lasted until the financial crisis of 2008. It is extremely visible that the value strategy has lost its consistency, which it had until the late 1980s. It is, therefore, possible to say that the traditional value factor, based on the book-to-market ratio, does not deliver abnormal returns anymore.

2.4 Shifting economic climate and the current accounting measures

In the nineteenth and twentieth century, economists saw, as sources of value the traditional factors of production: land, labour and capital (Adam Smith, 1776). The production of goods was centred around these three things. While these factors have remained important for the economy, other factors have also experienced increasing importance. In the twentieth century, the economy began relying much more on intellectual skills, information, and technology. The US economy has shifted rapidly from agricultural to manufacturing to the current knowledge economy. The service- and technology-based industries, have made intangible assets like human capital, innovative products, software, patents, data and brands essential for companies. When Fama and French (1993) developed the value factor, the economy was based more on physical assets. Firms primarily owned physical assets such as property, plants, and equipment (PP&E). The economy has now shifted and it is estimated that 34% of the firms' total capital consists of intangible capital (Corrado & Hulten, 2009). Using more recent data, Eisfeldt and Papanikolaou (2013B), Falato, Kadyrzhanova, and Sim (2013), Belo, Gala, Salomao, and Vitorino (2019), and Ewens, Peters, and Wang (2019) all estimate the contribution of intangible capital to overall corporate capital stocks to be around 50%. Additionally, these studies also report higher investment rates for intangible assets relative to physical assets. The value factor based on the traditional B/M ratio did not account for this shift in equity allocation since book value is calculated according to the US generally accepted accounting principles (GAAP). Following these standards, R&D expenditures are classified as an expense and will thus not be incorporated into the book value of a firm. This shows economic reasons why B/M as a measure of value is not consistent anymore. Thus, based on the book-to-market ratio, a firm investing heavily in R&D, its brand, IT or business processes would appear to be an overvalued company, due to its understated denominator. Its overvaluation may not be so excessively high if its book value were measured differently. investments in intangible assets also typically decrease the capital invested into tangible assets, thus lowering the book value of a company. The current accounting measures lead the companies to be classified as growth stocks, because of their low book value. Many of these companies would be classified as neutral, or even as a value stock if there would be accounted for their intangible assets (Arnott et al., 2021). The effect of research and development expenditure on the performance of Australian companies has been examined by Bosworth and Rogers in 1998. They found that there is a large statistically significant positive correlation between these two. This indeed proves the fact that intangible assets are becoming increasingly more important in the current knowledge economy and could largely impact the return of value investing, based on traditional accounting multiples.

2.5 Possible solutions to or adjustments to the value factor and its performances

A few different solutions for this outdated book-to-market value factor can be found in the literature. Within this paragraph, a few alternatives to the traditional Fama and French (1992) value factor will be discussed. Within this research, it will be investigated which firm-level characteristics offer the greatest explanatory power for the cross-sectional and time-series variation in US stock returns. The research will focus on the recently find intangible book-to-market value but will also examine the more traditional Earnings-to-Price, Cashflow-to-Price, Sales-to-price and dividend-to-price ratios.

2.5.1 Earnings-to-price ratio

By definition, the value premium refers to the performance differences, calculated either in terms of absolute or risk-adjusted returns, between value and growth stocks. Based on this principle, Nicholson (1960) has first found scientific evidence for the value premium based on the earnings-to-price ratio. Following this, Basu (1975, 1977) documented the outperformance of high E/P portfolios also when adjusting for risk. Within the 1990's academics increasingly started studying the ability to predict abnormal returns based on the financial statement information, and more specifically also the post-earnings announcement drift. Bernard and Thomas (1990), Bartov (1992) and Ball and Bartov (1996), show that investors do not fully incorporate the implications of recently announced earnings for future earnings. Thus, an investment strategy based on unexpected earnings can yield abnormal returns during the following 4 quarters. A more recent study from Hou et al. (2011) reported the highest global value premium based on the E/P ratio over a sample of 27000 stocks from 49 different countries. The value premium based on the E/P ratio significantly outperformed the one based on the B/M ratio within this study.

2.5.2 Cash flow to price ratio

Taking depreciation and amortization into account gives you, instead of the earnings-to-price ratio, the cash flow to price ratio (Barbee et al., 2008). Fama and French (1992, 1996) and Lakonishok, Shleifer and Vishny (1994) have shown that stocks with high cash flow-to-price ratios do also generate a strong value premium in average returns. Fama and French (1998) did research on this over the sample period ranging from 1975 to 1995 within 12 different countries. Within this sample, they have found an annual value-weighted return, in excess of the T-bill rate, of 7.61% a year for a portfolio that buys stocks with a high CF/P ratio and shorts stocks with a low CF/P ratio. It generated the second-highest return. Only the book-to-market ratio generated a slightly better yearly return of 7.68%. The other ratios that were used as a measure for value stocks, the earnings-to-price and dividend-to-price, both performed worse.

2.5.3 Dividend-to-price ratio

A third possible alternative for the value factor based on the B/M ratio depends on the dividend-to-price ratio. Generally, high dividend-paying stocks are traditional value stocks. These companies can pay a higher consistent dividend as they do not have as many growth and investment opportunities as growth stocks. A few different hypotheses try and explain the reasoning behind using the D/P ratio. First off, the tax-effect hypothesis states that an investor receives higher before-tax, risk-adjusted returns on portfolios with higher anticipated dividend yield to compensate for the historically higher taxation of dividend income relative to capital gain income (Brennan, 1970). Furthermore, following the signalling hypothesis, dividend yield and its fluctuations reflect the management's beliefs about the future of the firm (Sant and Cowan, 1994). Because of this, higher D/P ratio companies could be assumed to signal the management's trust in the continuity of the company. This outperformance was first documented in 1979 by Litzenberger and Ramaswamy. Later, Fama and French (1998) compared the value premiums obtained from using four different portfolio formation criteria (i.e., D/P, E/P, CF/P and B/P) in thirteen different stock markets. They found that the D/P had the greatest value premium in only one of the markets from 1975 to 1995. A more recent study has shown that the D/P ratio has the lowest annual return compared to the other ratios. Moreover, it had an insignificant return compared to the same four portfolio formation criteria as were used by Fama and French (Hou et al., 2015).

2.5.4 Sales-to-price ratio

Introduced by Fisher in 1984, the use of the sales-to-price criterion became popular during the 1990s when the tech companies were booming. Within these days, it was hard to justify recommendations based on earnings and book values, as earnings were often negative and book values were low. Instead of using the earings-to-price ratio, the sales-to-price was used more often as it could also be used for distressed and young companies. The use of this multiple is also often motivated as sales are relatively difficult to manipulate compared to for example earnings and book values (Damadaran, 2012). A disadvantage of using the sales multiple is that it could be overestimated by increasing debt. The sales multiple does not indicate how much leverage is used, which most certainly makes a difference to the risks of the firms being compared. Another drawback of using the sales multiple is that if a firm generates high sales growth, but is also losing significant amounts of money, S/P could indicate a low relative valuation for such a firm. Although the existence of these disadvantages, it is still proven that the sales-to-price multiple works as a valuation criterion (Barbee et al., 2008). Within this paper, S/P has the best explanatory power of returns out of the tested portfolio formation criteria (E/P, CF/P, S/P and B/P).

2.5.5 Intangible value factor

Eisfeldt, Kim and Papanikolaou (2020) proposed an intangible-augmented value factor (HML^{INT}) and constructed this with a modification to the standard Fama and French HML^{FF} factor. They added the value of the intangible assets of a company, to the book equity. The intangible assets of a company are measured by applying the perpetual inventory method to flows of selling, general and administrative expenses. They have found a few important features of their intangible HML factor. First of they found a high correlation with the traditional value factor of 81%. Secondly, a strong and significant outperformance was found relative this the traditional value factor. The average returns of a portfolio which goes long in the HML^{INT} and shorts the HML^{FF} are 2.4% annually, with a standard deviation of 5.9%. This outperformance holds for the entire sample and is most pronounced in the post-crisis era. Thus, although both factors are highly correlated, there still is enough independent variation for a substantial outperformance. Lastly, they found it prices standard test assets with a lower pricing error than the value factor of Fama and French (1993). Futhermore, Peters and Taylor (2017), have also researched a value factor which incorporates intangible assets. The method they used to measure the intangible assets was a bit different from the method of Eisfeldt, Kim and Papanikolaou (2020). Rather than using 100% of the selling, general and administrative expenses, they used only 30% of it and added 100% of the research and development expenses. Peter and Taylor have also found a strong outperformance of this new value factor, in comparison to the traditional one.

3. Hypotheses

Based on previous research, a few hypotheses are constructed which help to answer the research question of whether the traditional value factor is outdated in the current knowledge economy. HML factors based on more traditional value standards like the earnings-to-price, dividend-to-price and sales-to-price ratios will be compared to the traditional one. These factors will be constructed in the same way as the HML^{FF} factor. The proposed hypotheses will give a broader and deeper view of the research topic.

Hypothesis 1: *"The intangible value factor performs at least as good or outperforms the traditional value factor".*

The Fama and French (1992) HML^{FF} factor will be the standard for the traditional value factor within this research. The HML factor as constructed by Eisfeldt, Kim and Papnikolaou (2021) will then be used to compare the performance. With this factor, several factor models will be constructed, to then compare the alphas and risk premia of the original HML^{ff} and the new HML^{INT} factor. Different well-known factor models will be used like the Fama and French three-factor model (1992) and the Fama and French five-factor model (2015). Furthermore, the investment returns of the factors will be analysed according to different portfolios sorts and their cumulative returns over time.

Hypothesis 2: "*The value factor as is used in the paper from Eisfeldt et al. (2021) performs the best compared to other definitions for value."*

The HML^{INT} factor by Eisfeldt, Kim and Papnikolaou (2021) will be compared HML factors based on more traditional value standards like the earnings-to-price, cashflow-to-price, dividend-to-price, and sales-to-price ratios. It is proven that investing based on these factors has historically outperformed the market (Basu, 1975; Barbee et al., 2008; Fama & French, 1998). This hypothesis will show whether the intangible value factor will not only outperform the book-to-market factor, but also the other traditional value proxies. This is tested based on their cumulative returns over the entire sample and specific subsamples.

Hypothesis 3: "The intangible value factor started outperforming the traditional value factor gradually over time".

When comparing the findings of Corrado and Hulten (2009) and more recent studies from Belo, Gala, Salomao, and Vitorino (2019), and Ewens, Peters, and Wang (2019), it can be seen that the magnitude of intangible assets has grown a lot over time, namely from 34% to 50%. With these findings, it is possible to conclude that intangibles are of growing magnitude and importance for a company. According to this, it will be tested whether the diversion between the HML^{INT} and HML^{FF} has been increasing over time.

Hypothesis 4: "The intangible value factor works best for technology stocks."

Within the last decade, there has been a strong rise in returns of stocks operating in the tech sector. This can largely be attributed to the so-called "FANMAG" stocks. This group of stocks consists of Facebook, Amazon, Netflix, Google, Apple and Microsoft. These have collectively appreciated more than tenfold since 2007. They represent 20% of the US stock market capitalization and 32% of the Fama-French large-cap growth portfolio as of June 2020 (Arnott et al, 2021). These stocks are a great example of the outperformance of the technology stocks, which are mostly classified as growth stocks. These are classified as growth stocks due to their small portion of tangible book value relative to their market valuation. Within this research, it will be tested if the technology stocks will perform better with an HML^{INT} factor relative to a HML^{FF} factor. This will be tested according to the standard industrial classification codes of the tech companies. Kile and Philips (2009) have clearly described which SIC codes belong to technology firms.

4. Data and methodology

4.1 Data

The data sample used in this study is obtained from the Center for Research Security Prices (CRSP) – COMPUTSTAT dataset from Wharton Research Data Services (WRDS). Within this research, all US individual stock data is obtained from companies listed on the NYSE, AMEX and Nasdaq. The sample period of the main study ranges from January 1975 to December 2021, furthermore, an analysis within subperiods will be conducted within the period 1975-1994, 1995-2021 (post-internet era) and 2007-2021 (post-crisis era). Financial, insurance and real estate firms, so companies with a SIC code between 5999 and 6800, are excluded from the research. For each stock, the monthly holding period returns, including dividends are obtained from CRSP. To test the different hypotheses, and correctly answer the research question, some accounting data is needed as well. This accounting data is needed to calculate the new HML factor according to the sales-to-price, earnings-to-price, dividend-to-price, and intangible book-to-market ratio. This yearly accounting data is downloaded from COMPUSTAT from January 1950 to December 2021. The earliest available data was needed to calculate the intangible value following the research from Eisfeldt, Kim and Papnikolaou (2021). The exact construction of the Intangible value factor will be explained in the following section. To test the fourth hypothesis, whether an investment strategy based on intangible value has a different effect on high technology industries, the firms need to be categorized based on the industry they are operating in. The standard industrial classification (SIC) codes, downloaded from COMPUSTAT are used for this. These codes have been criticized by researchers as they claim the classification is no longer applicable to modern companies. Kile & Phillips (2009) have provided a framework in which they identify high-technology companies according to their SIC codes. Within this research, this Classification of high-technology firms, as shown in table 1, will be used.

Table 1: SIC code classification for high-technology firms based on the framework of Kile and Phillips (2009)

High Technology Industry	**SIC codes**
Computer Hardware Manufacturing	355, 357, 367
Software development	737
Medical Technology	288, 387, 873
Communications	366, 481, 482, 484, 489
Electronic Manufacturing	362, 364, 367, 369
Internet and IT services	596, 731, 733, 736, 737, 738, 870, 874

4.2 Methodology

4.2.1 HML factor construction

The computation of the different value factors is done according to the original methodology of Fama and French (1993). Fama and French use six portfolio sorts based on size (market equity) and Book-to-market ratio (book equity / market equity). Book (common) equity is defined as the book value of stockholders' equity, plus balance-sheet deferred taxes and investment credit, minus the book value of the preferred stock. It is important to use the redemption, liquidation, or par value in this order as the book value for preferred stock. The B/M ratio is then book (common) equity of the fiscal year ending in calendar year t-1, divided by the market equity at the end of December t-1. In June of each year t from 1975 to 2021, all NYSE stocks on CRSP are ranked according to their size and book-to-market ratio. The median NYSE size is then used to divide NYSE, Amex and NASDAQ stock into two groups, a small (s) and a big (b) group. The book-to-market ratio is also used to divide the NYSE, Amex and Nasdaq stocks into 3 different groups based on the NYSE breakpoints for the bottom 30% (low), the middle 40% (medium) and the top 30% (high). Firms with a negative book-to-market ratio are excluded from the sample. Only firms with ordinary common equity are included in the tests. These are then allocated to 6 portfolios to the NYSE breakpoints (SL, SM, SH, BL, BM, BH). Monthly value-weighted returns on the six different portfolios are calculated from July of year t to June of year t+1. The portfolios are afterwards reformed every year in June. These portfolios are then used to calculate the high-minus-low (HML) portfolio. This is the difference between the high book-to-market portfolios (the value stocks) and the low book-to-market portfolios (the growth stocks) as shown in formula 1.

Table 2: Formation of 2x3 Portfolios based on size and Book-to-market

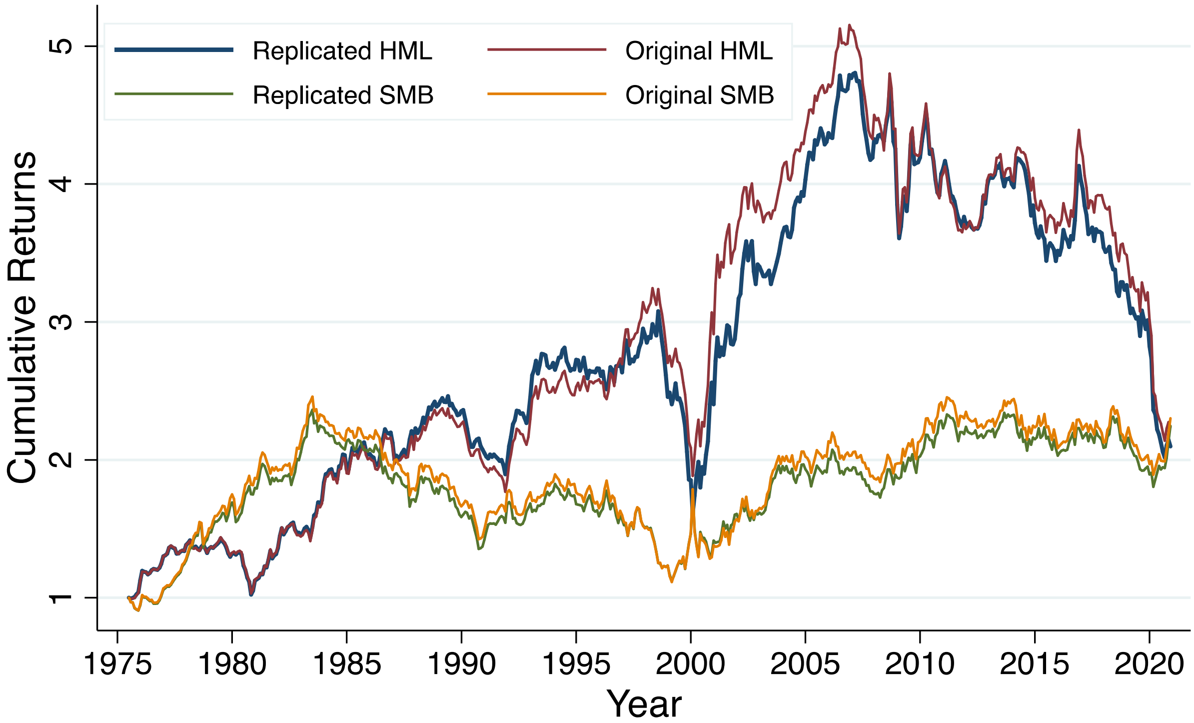
	Low Book-to-market (growth)	*Medium book-to-market*	*High Book-to-market*
Small market equity	SL	SM	SH
Big market equity	BL	BM	BH

$$HML = \frac{1}{2}(SH + BH) - \frac{1}{2}(SL + BL) \tag{1}$$

4.2.2 Robustness of factor creation

To now assess the robustness of our research, the classic HML factor (Fama and French, 1992) is constructed and compared to the original HML factor (Ken & French, 2022). This construction is done following the steps explained in the former section (section 4.2.1.). In addition to the HML factor, the SMB factor is also constructed for robustness purposes. The replicated HML and SMB factors have a correlation with the original factor, downloaded from the Kenneth R. French website, of respectively 97.54% and 99.34%. Furthermore, the cumulative returns of the two factors can be seen in figure 1. From this figure, it is possible to conclude that the factors, and thus the cumulative returns from these factors, are in line with the original ones from Fama and French. This confirms the robustness of the used methodology to construct the factors depending on different accounting ratios.

Figure 1: Cumulative returns of the Original HML and SMB factor downloaded from the Kenneth R. French website versus the replicated HML and SMB factor.



4.2.3 Construction of the intangible value factor

The construction of the intangible value factor, the HML^{INT}, follows almost the same methodology as introduced by Fama & French (1993), and as is explained in section 4.2.1. The difference between the two factors is within the calculation of the book equity, the numerator within the book to market ratio. The book equity needs to be adjusted for the intangible value a company holds. These adjustments will be done following the paper from Eisfeldt, Kim and Papanikolaou (2021). To construct this intangible book equity, the intangible assets must be added to the book equity:

$$B_{it}^{INT} = B_{it} - GDWL + \ INT_{it} \tag{2}$$

Within this formula B_{it} is the standard book equity, $GDWL_{it}$ is goodwill and INT_{it} is the intangible assets for firm i at time t. Following Park (2019), goodwill is subtracted from the intangible book value of a company for two reasons. First, goodwill is based on fair value accounting, analysing the relation between book-to-market ratio and expected stock return is only meaningful in historical cost accounting because the ratio is supposed to be one in fair value accounting (Penman et al, 2017). Secondly, former scientific research has pointed out that there is subjectivity in estimating the current fair value of goodwill and there are cases of goodwill impairment that are not backed by economic fundamentals (Ramanna and Watts, 2012). The intangible assets (INT_{it}) are computed with the perpetual inventory method following Eisfeldt and Papanikolaou (2013b). This results in the following equation:

$$INT_{it} = (1-\delta)INT_{it-1} + SG\&A_{it} \tag{3}$$

where $SG\&A_{it}$ are the Selling, General and Administrative expenses, these can be interpreted as organizational capital. To initialize, the first observation for selling, general and administrative expenses is used. This will thus be when the firm first appeared on COMPUSTAT. For firms older than 1950, the data recorded in 1950, will be used. This is then divided by the sum of the growth rate (=g) of SG&A expenses within our sample, which is 15.8%, and a depreciation rate (=δ) of 20% following Eisfeldt and Papanikolaou (2014).

$$Int_{it} = \frac{SG\&A_1}{g+\delta} \tag{4}$$

The newly generated intangible book equity (B_{it}^{INT}) will now be used instead of the normal book equity (B_{it}) to calculate the NYSE breakpoints and to hereafter form the portfolios. Apart from this, the intangible HML factor (HML^{INT}) is computed in the same way as the traditional HML factor. The procedure will be done following the Fama and French (1993) methodology, explained in section 4.2.1.

4.2.4 Additional long-established value factor constructions

To correctly analyse the current and historical power of value investing, some, more traditional, market multiples will be examined, namely the earnings-to-price, cash flow-to-price, sales-to-price and dividend-to-price ratios. As analysed within the literature review, section 2.5, investing based on these market multiples has a long-lasting history of excess returns. The accounting data, as downloaded from COMPUSTAT, will undergo some small conversions to be ready to work with. The following computations must be done, according to Barbee, Jeong and Mukherji (2008):

$$Earnings\ per\ share\ (EPS) = Fully\ diluted\ earnings\ per\ share\ excluding\ extraordingary\ items\ and\ discontued\ operations + \frac{(\ deffered\ taxes\ (TXDB) - Preffered\ dividends\ (DVP))}{Number\ of\ shares\ outstanding\ (CSHO)} \quad (5)$$

$$Cash\ flow\ per\ share\ (CFPS) = Earnings\ per\ share\ (EPS) + \frac{Depreciation\ and\ Amortiziation\ (DP)}{Number\ of\ shares\ outstanding\ (CSHO)} \quad (6)$$

$$Sales\ per\ share\ (SPS) = \frac{Net\ sales\ (SALE)}{Number\ of\ shares\ outstanding\ (CSHO)} \quad (7)$$

$$Dividend\ per\ share\ (DPS) = \frac{Total\ dividends\ (DVT) - Dividends\ preferred\ stock\ (DVP)}{Number\ of\ shares\ outstanding\ (CSHO)} \quad (8)$$

The above variables are used to calculate the four market multiples. These are all divided by the market equity as of December calendar year t-1. The factor construction hereafter follows the exact same methodology as has been used by Fama and French (1993) and has been replicated to construct the intangible value factor (as is explained in section 4.2.1.). In doing so, it is possible to construct HML factors for the four different market multiples. Consequently, this results in respectively the HML^{E}, HML^{CF}, HML^{S} and HML^{DIV}.

4.2.5 Fama-Macbeth regression

To estimate and assess the parameters of the intangible value factor the Fama-Macbeth (1973) regression method will be employed. With this method, it is possible to estimate the explanatory power of the model and premia for various risk factors. The parameters of the intangible value factor and traditional value factor will be examined within both the Fama and French three-factor model (1993) and the Fama and French five-factor model (2015).

To apply the Fama-Macbeth regression, run individual time-series regressions of the returns from each asset i on the different proposed risk factors of the asset pricing model to determine each asset's factor loadings ($\hat{\beta}_i$). The asset returns of 25 portfolios based on the size and book-to-market ratio are examined. These portfolios are downloaded from the Kenneth R. French data library. For this instance, MkrtRF, SMB, HML and momentum are regressed onto the asset's returns to estimate the parameters for the Fama and French three-factor model. Hereafter, the RMW and CMA factors are added to the regression to assess the Fama and French five-factor model.

$$R_{i,t} = \alpha_i + \beta_{i,F_1} F_1 + \beta_{i,F_2} F_2 + \cdots \beta_{i,F_K} F_{k,t} + \varepsilon_{i,t} \tag{9}$$

Having estimated the factor loadings, it is now needed to run a single cross-sectional regression of the timer-series average returns on beta. Within this regression, the estimated factor loading is the independent variable. This regression will be as follows:

$$R_{i,T} = \gamma_{T,0} + \gamma_{T,1} \hat{\beta}_{i,F1} + \gamma_{T,2} \hat{\beta}_{i,F_2} + \cdots \gamma_{T,m} \hat{\beta}_{i,F_m} + \varepsilon_{i,T} \tag{10}$$

This procedure will be executed for both the traditional HML factor and the newly estimated intangible HML factor. It is then possible to compare the risk premia of both the factors and their ability to price assets correctly.

5. Results

5.1 investment performances

Figure 5 in the appendix displays the correlation of the returns on the traditional and intangible value factors over time. As can be seen, the returns of the two factors are highly correlated. Within the entire sample period, the correlation is equal to 80.37%. In this section, it will be shown that there is still enough independent variation to allow for an outperformance of the intangible value factor over the traditional value factor. Also, the returns on the other, more traditional, value factors will be analysed.

Table 3 clearly shows the relative outperformance of the intangible value factor (HML^{INT}) versus the traditional value factor (HML^{FF}), when a single factor HML model is used. Within this table, both the factors are regressed on each other. This has been done for the entire samples, and the three subsamples (pre-internet, post-internet and the post-crisis era). Panel A displays the results of the HML^{INT} factor regressed on the HML^{FF} factor. The alpha (α) over the full sample is highly significant at a 1% level and equals 3.46%. It is possible to capture that the outperformance has been strongest within the Pre-internet era (1975-1994) and the beginning of the post-internet era (1995-2021). The alpha in the pre-internet era shows strong results as it equals 3.66% and is significant at a 5% level. The alpha in the post-internet era equals 3.65% and is highly significant at 1%. The outperformance within the post-crisis era has been fairly lower according to the alpha of 2.724%. Due to this lower outperformance from 2007 to 2021.

Panel B shows the converse results from the model in Panel A. The traditional HML factor is now regressed on the intangible HML factor. The results from the panel are not as significant as they are in panel A, despite this, they do confirm the findings. For the full sample, an alpha of -2.42% is found, with a significance at a 10% level. This shows the underperformance of the traditional HML factor relative to the intangible HML factor. Furthermore, a significant underperformance in both the post-internet era and the post-crisis era can be found. They are, respectively, significant at a 5% and 10% level. Also, panel B again shows a stronger underperformance of the traditional HML factor versus the intangible HML factor within the period ranging from 1995-2021 as within the period 2007-2021.

The results of these regressions confirm the outperformance of the newly generated HML factor relative to the traditional HML factor. Also, it shows that the relative performance of the HML^{INT} to the HML^{FF} has been lower in the period after the financial crisis of 2007. The greatest outperformance has been in the period ranging from 1995 to 2007. Based on the results of table 3 it is possible to say that there is still enough independent variation to allow for an outperformance of the intangible value factor over the traditional value factor.

Table 3: In this table, the relative performance of the HML^{FF} and the HML^{INT} factors. Alphas and betas of each return on the other, for the full sample as well as for sub-periods around the post-internet period and post-crisis period.

	Full sample	1975-1994	1995-2021	2007-2021
	(1)	(2)	(3)	(4)
$A. HML_t^{INT} = \alpha + \beta_{HML^{FF}} \times HML_t^{FF} + \varepsilon_t$				
$\beta_{HML^{FF}}$	0.666***	0.602***	0.663***	0.741***
	(24.38)	(9.62)	(20.63)	(21.28)
α (%)	3.456***	3.66**	3.648***	2.724*
	(4.51)	(2.71)	(3.47)	(2.39)
R^2	0.646	0.477	0.695	0.769
$B. HML_t^{FF} = \alpha + \beta_{HML^{INT}} \times HML_t^{INT} + \varepsilon_t$				
$\beta_{HML^{FF}}$	0.970***	0.793***	1.048***	1.039***
	(27.46)	(14.52)	(22.61)	(16.54)
α (%)	-2.424*	-0.7512	-3.744**	-3.528*
	(-2.53)	(-0.49)	(-2.78)	(-2.59)
R^2	0.646	0.477	0.695	0.769

5.2 Performance of different portfolio

Within this sector, the returns of different investment strategies based on the intangible HML factor will be balanced with the traditional one. The cumulative returns will be compared to the returns of a high-minus-low portfolio of the different established value factors, the Earnings-to-Price, Sales-to-price, Cashflow-to-Price, and Dividend-to-Price. Hereafter, the annualized monthly returns concerning different portfolio sorts will be analysed. To start, the average annualized monthly returns of the HML^{FF} and the HML^{INT} are given for the complete sample, as well as for different subsamples. The portfolios are then sorted in quintiles based on intangible and traditional book-to-market and are then subdivided into size quintiles. Hereafter, the monthly returns of decile portfolios based on both the traditional and intangible book-to-market will be analysed and compared.

Figure 2 plots the cumulative returns for several long-short (High-minus-Low) portfolios for the full sample ranging from 1975 to 2021. These portfolios are all constructed following the exact methodology of Fama and French (1993), as is explained in section 4.2.1. The figure clearly shows the outperformance of the intangible value factor relative to the original HML factor. In the entire data sample, ranging from 1975 to 2021, investing based on the intangible HML factor has generated a cumulative return of 833% in comparison to the 151% return generated by the original HML factor. This figure clearly shows the superior returns of the intangible value factor in comparison to the original one, but also compared to the other traditional value measures. The performance of a High-minus-low portfolio of the Sales-to-Price ratio has also been very remarkable. Over this timespan, investing based on this factor delivered a cumulative return of 681%. This factor also has a very evident outperformance relative to the original HML factor. When analysing this picture, it becomes very clear that investing based on the Dividend-to-Price generates the weakest returns. Through the years, it has generated a loss of 35.48%.

This outperformance of the intangible HML factor and Sales-to-price factor became very evident after the dot-com bubble in the year 2000. This is shown clearer in figure 6 in the appendix. Within the post-internet period, beginning in 1995, the intangible HML factor managed to accumulate a cumulative return of 144% in respect to a 7.8% loss when investing based on the original HML factor. The Sales-to-Price portfolio, on the other hand, managed to generate a cumulative return of 80.30%.

Since the 2007 financial crisis, the traditional HML factor has performed very poorly with a cumulative return of -43.85%. Within this period, the intangible HML factor has performed much better. It has managed to generate a cumulative return of 7.46% through the years. Apart from the Sales-to-Price HML, which generated a cumulative return of 6.67%, all established value factor has performed very poorly.

Figure 2: Cumulative returns of the "original" HML factor, intangible HML factor and HML factors constructed based on the Sales-to-Price ratio, the Cashlow-to-Price ratio, Earnings-to-Price ratio and the Dividend-to-Price ratio over the full sample period ranging from 1975 to 2021. These factors are all constructed following the Fama and French (1993) methodology.

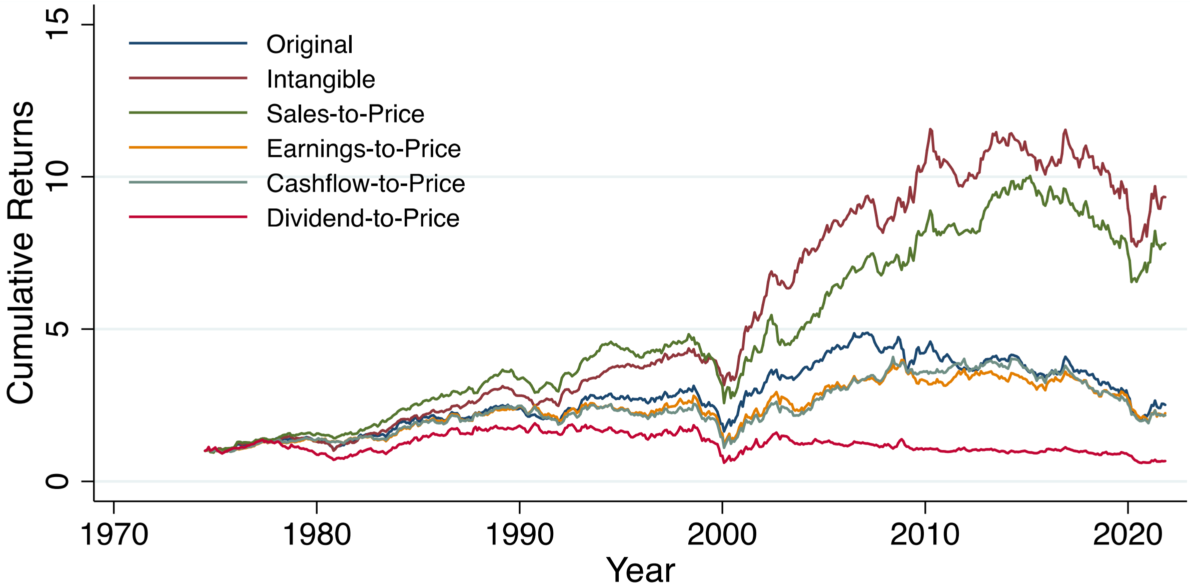


Table 4 displays the returns on both HML factors for the full sample and the different subsamples. As can be seen, the HML^{INT} has a superior performance in both the full sample and in all the different subsamples. Within the full sample, the is a yearly average return difference of 2.68%, which is significant at a 1% level. This better performance can especially be seen in the sample ranging from 1995 to 2021, where the the return difference between the two was 7.42%. According to this table, it is possible to conclude that the newly generated intangible HML outperformances the traditional HML. This outperformance has been the largest in the post-internet era.

Table 4: Monthly annualized returns on a High-minus-low portfolio for both the HML^{FF} and HML^{INT}

	Full sample	1975-1994	1995-2021	2007-2021
HML^{FF}	2.24%	5.67%***	-3.94%*	-4.96%*
HML^{INT}	4.92%***	6.70%***	3.48%***	0.15%**
HML^{INT} - HML^{FF}	2.68%***	1.03%	7.42%***	5.11%***

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

To further assess the outperformance of the intangible value factor versus the traditional value factor, the cumulative returns of one dollar invested in the portfolio that is long in the HML^{INT} and short in the HML^{FF} portfolio are displayed in figure 3 and compared to a portfolio which does the opposite. The superior return of the intangible value factor is again very evident. It also shows that the post-internet era, and to be more specific, the post-crisis era, is an important driver in the outperformance of the intangible value factor. The figure clearly shows that the intangible value factor started outperforming the traditional value factor increasingly over time. This is consistent with the growing magnitude of the intangible assets, documented by for example Corrado and Hulten (2009) and Ewens, Peters, and Wang (2019).

Figure 3: Cumulative returns of a portfolio that is long in HML^{INT} and short in HML^{FF} versus a portfolio which is long in HML^{FF} and short in HML^{INT}

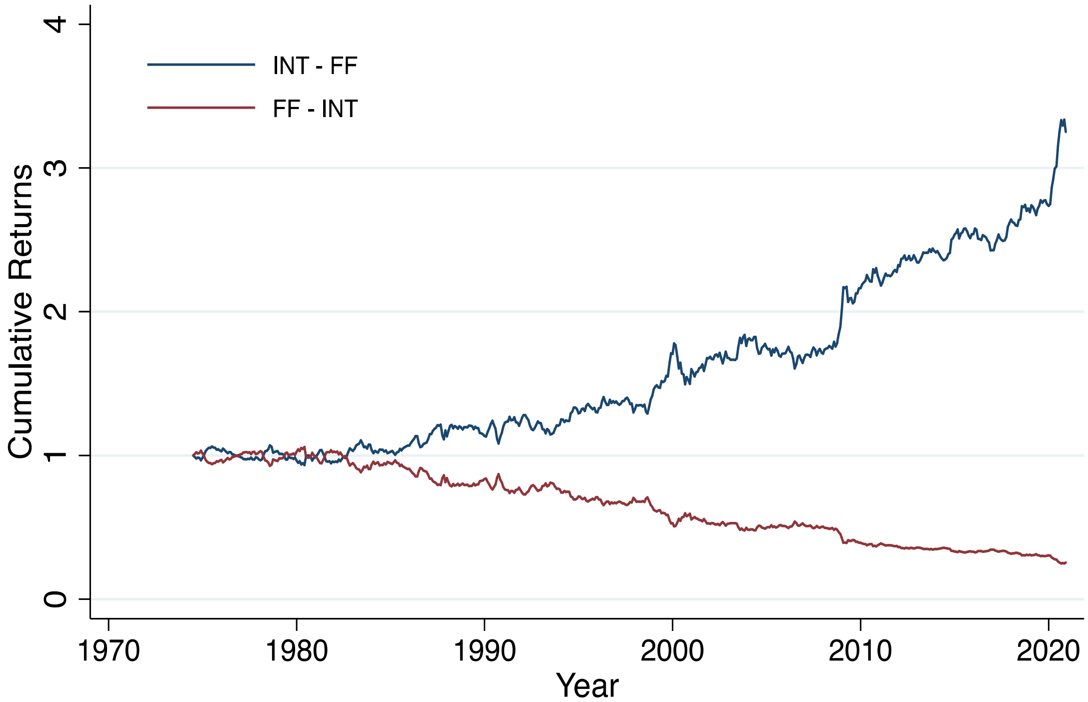
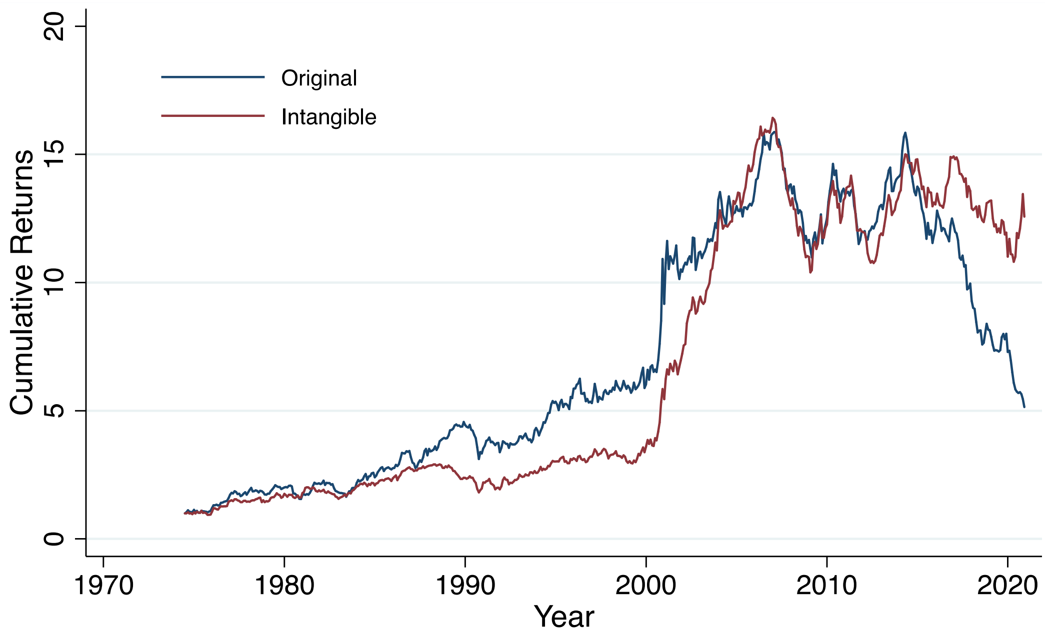


Figure 4 shows the cumulative return for the original HML factor and the intangible HML factor, when only including high-technology stocks. As explained in the data section, the classification of high-technology firms has been performed based on the SIC codes labelled as technology firms in the paper of Kile and Philips (2009). Table 1 shows these SIC codes. The figure shows a clear outperformance of the intangible value factor relative to the traditional value factor. It also displays a superior performance of both factors used when only investing in high-technology stocks versus using the HML^{FF} and HML^{INT} when investing in all industries. This has been most evident when using the newly generated intangible value factor. The cumulative return over the sample period has been 1157%, relative to the 833%, when investing in all different industries. Figure 5 in the appendix shows the cumulative returns of the different subsamples. The traditional value factor has been strongly outperforming the intangible value factor until 1995. Surprisingly, this is contrary to the cumulative returns shown in figure 7. The later periods, however, show a strong outperformance of the intangible value factor. This outperformance started just after the dot-com bubble and has lasted ever since. Since 2014, the HML^{FF} has been generating a negative return. The intangible value factor has been relatively stable for the technology stocks. This is a large reason for the outperformance.

Figure 4: Cumulative returns for the "original" HML factor and the Intangible HML factor of high-technology stocks over the entire sample ranging from 1975 to 2021. These factors are all constructed following the Fama and French (1993) methodology.



To further investigate the performance of investing based on the book-to-market ratio and investing on the intangible book-to-market ratio more thoroughly, 5x5 portfolios are constructed based on the book-to-market ratio and size (market equity) versus the intangible book-to-market ratio and the size. The same methodology to construct the different portfolios is used as explained in section 4.2.1. The annualized monthly average returns of these portfolios are given in table 5 and table 6.

Table 5 gives a simple relation of the two-dimensional variation in average annualized monthly returns when the five quintiles of book-to-market are subdivided into five size quintiles. These quintiles are both based on the ranked value of the book-to-market ratio and the size of individual stocks. Within each size quintile, the returns increase almost for every level of book-to-market value. On average, the return on high book-to-market portfolios increases by 3.74% relative to the return on low book-to-market portfolios. The table also shows the greatest outperformance of value investing, when investing in small market equity stocks. This is in line with the findings of Fama and French (1993). Overall, this table proves that investing in firms with a high book-to-market ratio manages to outperform investing in firms with a low book-to-market ratio over the sample period ranging from 1975 to 2021.

Table 5: Two-dimensional variation in average annualized monthly returns when the five quintiles of book-to-market are subdivided into five size quintiles.

	Book-to-market portfolios				
	Low	2	3	4	High
Small-ME	9.84%	16.32%	16.08%	16.44%	19.08%
2	13.08%	15.72%	16.32%	16.44%	16.56%
3	13.44%	15.48%	15.12%	15.48%	17.64%
4	14.40%	14.76%	14.88%	15.12%	15.96%
Large-ME	12.84%	13.20%	12.60%	12.96%	13.08%

Table 6 gives the simple relation of the two-dimensional variation in average monthly returns when portfolios are sorted based on the quintiles of the newly generated intangible boot-to-market ratio are subdivided into five quintiles based on size. This table followed the exact same methodology as table 5. Again, within each size portfolio, the returns increase strongly with the intangible book-to-market ratio. The average deviation between the portfolios with a low intangible book-to-market ratio versus the ones with a high one is equal to an annualized monthly return of 6.05%. This deviation between the high and low intangible book-to-market portfolios is substantially higher than the deviation between the two extremes within the traditional book-to-market sorting. Also, the monthly annualized returns for the high intangible book-to-market portfolios are higher than the ones for the high traditional book-to-market portfolios. This again proves the fact that the investment performance of investing based on the intangible book-to-market value is substantially higher than the performance of making investments according to a traditional book-to-market strategy.

Table 6: Two-dimensional variation in average annualized monthly returns when the five quintiles of intangible book-to-market are subdivided into five size quintiles.

	Intangible book-to-market portfolios				
	Low	2	3	4	High
Small-ME	9.60%	13.80%	15.24%	16.68%	20.52%
2	11.52%	14.64%	16.80%	17.28%	17.40%
3	12.36%	15.36%	15.48%	16.80%	18.24%
4	13.20%	15.12%	15.36%	15.84%	17.40%
Large-ME	11.88%	12.72%	13.56%	14.88%	15.24%

Tables 7 and 8 in the appendix show the annualized monthly returns on decile portfolios based on respectively the book-to-market ratio and the intangible book-to-market ratio. It is possible to capture from these tables that also the extreme decile of the intangible book to market portfolio generates a higher return than the traditional book-to-market portfolio. There is a substantial difference between the annualized monthly returns of 6.36%. In this case, the returns do not increase through the deciles. This is because the size effect is not captured in this instance.

Due to the seemingly high performance of the HML factor based on the sales-to-price multiple, as is displayed in figure 2, a performance analysis according to the 5x5 portfolio sorts is performed. The two-dimensional variation in average monthly returns will be analysed when sorted based on five size quintiles and five sales-to-price quintiles. The annualized monthly returns of these portfolios are shown in table 9. These returns show a strong outperformance of investing in companies with a high sales-to-price ratio. The average outperformance of the high sales-to-price portfolios relative to the low sales-to-price ratio is equal to a return 9.10% annualized per month. The increasing monthly returns through the levels of sales-to-price, again, is also very evident. When comparing the three value strategies which each other, it becomes apparent that the sales-to-price multiple generates the highest monthly return in the fifth quintile. The average of this fifth quintile, over all sizes, is equal to 19.15%. This number is higher than the averages of the fifth quintile for both the intangible and traditional book-to-market ratio, respectively 17.76% and 16.46%. This high performance is mostly driven by the higher performance of the large firms. This may seem contradicting at first but is in line with existing literature. Reinganum (1981) has found that both anomalies exist when used separately, but the two anomalies seem to be related to the same set of missing factors. The factors seem to be more related to the firm size, then to than the E/P ratio.

Table 9: Two-dimensional variation in average annualized monthly returns when the five quintiles of Sales-to-Price are subdivided into five size quintiles.

	Sales-to-Price portfolios				
	Low	2	3	4	High
Small-ME	5.76%	12.72%	13.56%	16.08%	18.36%
2	7.56%	13.80%	15.60%	17.28%	16.20%
3	11.28%	14.40%	15.24%	17.64%	18.12%
4	13.56%	14.88%	15.48%	17.28%	17.64%
Large-ME	12.12%	14.88%	15.84%	15.84%	25.44%

5.3 Fama-Macbeth regression

To now analyse the explanatory power and different risk premia for both the traditional HML and intangible HML a Fama-Macbeth (1973) regression is conducted. The results of this regression are shown in table 10. The first panel shows the asset pricing ability of the three-factor model, including the traditional value factor, plus momentum. For comparison, the second panel also shows the three-factor model plus momentum, but now instead of the traditional value factor, the newly generated intangible value factor is used. The same is done for the five-factor model, including the momentum factor, within panels 3 and 4. The same is done for the Fama and French five-factor model. The Fama-Macbeth regression in panel 3 uses the traditional value factor, and panel 4 uses the intangible value factor. When analysing table 8, it is possible to say different things about the asset pricing ability of the HML_{FF} versus the HML_{INT}.

First off, the pricing error of the models will be analysed. This is done by comparing the alphas of the different regressions. The Fama-Macbeth regressions show that the pricing error of the three-factor model, including momentum, is higher within the traditional three-factor model versus the five-factor model. This is contrary to the normal beliefs of Fama and French (2015). They did not use a Fama-Macbeth regression to test this, but instead used a Gibbons, Ross and Shanken test (1989). When comparing panels 1 and 2, it is possible to see a better pricing error, which is significant at a 10% level. When applying the same analysis to the five-factor model, including momentum, it shows a higher alpha for the model including the intangible value factor, relative to the one with the traditional value factor.

Secondly, the risk premia of the factors are considered. The HML^{INT} shows a much higher and more significant beta in both the three and five-factor models. Within the three-factor model, including momentum, the risk premia of the traditional HML factor equals 0.253 and is not significant. Contrary to this, the intangible HML factor is much higher, with a value of 0.425, and is highly significant at a 1% level. The same behaviour can be seen within the five-factor model. The beta of the HML_{FF} is equal to 0.219 and neither is significant. Again, the risk premium for the HML_{INT} is highly significant at a 1% level and is equal to 0.59. This shows that for both the traditional three and five-factor models the risk premium of the value factor increases when including this intangible value factor instead of the Fama and French (1993) value factor.

Table 10: Fama-Macbeth regression to assess the pricing ability of both the traditional HML and intangible HML within the Fama and French three and five-factor model

	(1)	(2)	(3)	(4)
$\beta_{mkt\text{-}rf}$	0.379	0.471	0.304	-0.119
	(1.01)	(1.23)	(0.78)	(-0.30)
β_{SMB}	0.232	0.256^{*}	0.305^{*}	0.242
	(1.79)	(1.98)	(2.37)	(1.88)
$\beta_{HML_{FF}}$	0.253		0.219	
	(1.95)		(1.71)	
β_{MOM}	0.0263^{***}	0.0256^{***}	0.0235^{***}	0.0240^{***}
	(3.64)	(3.60)	(3.62)	(3.86)
$\beta_{HML_{INT}}$		0.425^{***}		0.590^{***}
		(3.31)		(4.41)
B_{RMW}			0.422^{*}	0.210
			(2.25)	(1.16)
β_{CMA}			-0.0540	-0.110
			(-0.28)	(-0.69)
α	0.780^{*}	0.673^{*}	0.811^{*}	1.269^{***}
	(2.48)	(2.09)	(2.40)	(3.65)
R^2	0.553	0.574	0.653	0.653

t statistics in parentheses
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

7. Further Research and Conclusion

7.1 Further Research

The diagnosis of this research paves the way for new research in several directions. Within this section, a few possible subjects will be summed up, which will improve the understanding of the reconsideration of the value factor, especially with a focus on the intangible value factor.

Firstly, within this research, the intangible value factor of Eisfeldt, Kim and Papanikolaou (2021) has been taken as standard. Within the last decade, researchers have found more value factors which include intangible assets. It would be a good addition to the literature if all these factors are compared based on their asset pricing ability and their investment performance. Peters and Taylor (2017), for example, broke down intangible capital into knowledge capital (R&D spending) and organizational capital (expenditure on the brand, human capital and customer relations). They assumed that organizational capital is based on 30% of the SG&A expenses of a firm and 100% of the R&D expenses of a firm. Different assumptions of these ratios may result in more precise distinctions between value and growth firms. Moreover, this analysis can also be performed by only incorporating knowledge capital. Generating a good overview with for example the cumulative returns over time and an asset pricing analysis will give a good understanding of the different factors. Also, it would be an idea to perform a Monte Carlo analysis on the depreciation rate. Eisfeldt and Papanikolaou (2014) have shown that 20% per year is the most reasonable depreciation rate, but this could defer widely over different periods. This scenario analysis would give a more in-depth understanding of the impact of the depreciation rate.

Secondly, researchers could also try to deeper explain the reasoning behind the underperformance of the traditional value factor and why the intangible value factor performed this good. By now, reasoning has mostly been done based on qualitative analysis. A quantitative empirical analysis must be performed to confirm the possible reasoning behind these performances. The most obvious reasoning behind this outperformance of the intangible value factor is the transitioning economy. The underlying value of a company is increasingly more based on the intangible value of a company. Research has shown that on average 50% of the value of a company is captured within intangible assets like human capital and its brand (Ewens, Peters, and Wang, 2019). Research should be conducted on this explanation to give a definite conclusion whether this is the reason behind the superior performance of the intangible value factor.

Lastly, a good risk analysis should be performed to show whether the intangible value factor is riskier than the traditional value factor. This can be performed with multiple methods. It is possible to look at the Sharpe ratios of the different high-minus-low portfolios. This will give a good understanding of the return relative to the standard deviation of the portfolios.

7.2 Conclusion

Within the last decades, there has been a big economic transition. Historically economists saw as sources of value the traditional factors of production: land, labour, and capital (Smith, 1776). The production of goods, and thus also the value of companies, was centred around these three things. The factors have remained important, but they lost their relative importance in comparison to intangible assets. The economy has begun relying increasingly on intellectual skills, information, and technology. Take for example things like patents, brands, software, human capital, and customer relationships. Companies are not solely dependent on large workforces and engines anymore. This reasoning is supported by empirical evidence from Corrado and Hulten who found that, on average, intangible capital makes up for 34 per cent of a firm's total in 2022. Twelve years later, Belo, Gala, Salomao and Vitorine (2022) find that the estimated contribution of intangible capital to the total value already is 50%. This changes the way companies are valued. Whereas intrinsic value was mainly based on their book value, companies nowadays capture a lot of value in their knowledge and technology. This should also change the way we look at value investing these days. Intangible value is expensed and is thus not captured on the balance sheet of a company. One of the most established and best-known investment strategies, value investing, is, most of the time, based on the book value divided by the market value of a company. This was empirically tested, and superior performance was found by Fama and French in 1993. It has now been found that this factor has become redundant (Fama and French, 2015). Therefore, this research investigated the incorporation of intangible capital within the traditional Fama and French value factor.

Within this paper, it is shown that including the intangible value in the book equity of a firm, leads to better performance both in the entire sample, as well as in different subperiods. This has been tested by looking at the cumulative returns of both the factors and by regressing the factors on each other. The relative outperformance of the newly generated intangible value factor and the traditional is first shown in table 3. This table also shows the increasing superior performance of the HML^{INT}. This outperformance has been most evident within the post-internet era (1995 to 2021). This finding is supported by looking at the cumulative returns of a portfolio based on the intangible value factor versus a portfolio based on the intangible value factor. Figures two and three display this outperformance with a graph of the cumulative returns over time. It clearly shows the high performance of the HML^{INT} versus the performance of the HML^{FF}. Within these graphs, it can also clearly be seen that this outperformance was strongly growing after the dot-com bubble in 2000, and really took off after the financial crisis of 2007. This superior performance can also be seen in table 4, where the HML^{INT} had a monthly annualized return of 4.92%, relative to the 2.24% of the HML^{FF}. The findings from these analyses confirm the first and third hypotheses. This analysis has also been performed solely for the technology stocks. As can be seen in figure 4, the performance of the HML^{INT} has been higher for this industry than for the sample including all industries. The intangible value factor has reached a cumulative return of 1157% when adopted only on technology firms versus a cumulative return of 833%. According to these results, it is possible to confirm the fourth hypothesis*: "The intangible value factor works best for technology stocks."*

Moreover, to confirm the good performance of the value factor, the paper also analyses different types of portfolio sorts within section 5.2. This section showed that the second hypothesis, "*The value factor as is used in the paper from Eisfeldt et al. (2021) performs the best compared to other definitions for value",* appeared to be true. Within figure 2, the cumulative return of different types of value factors, traditional ones and the new intangible value factor, are set side by side. It shows the best performance of the intangible value factor, followed by the sales-to-price factor. This thus also confirms the hypothesis that the value factor outperforms the other factors, namely the earnings-to-price, dividend-to-price, sales-to-price, and cashflow-to-price factors. To have a better understanding of this performance, table 3 and 4 shows the returns of a 5x5 portfolio sort based on the (intangible) book-to-market ratio and the size of a company. Table 4 displays a strong performance of investing in companies with a high intangible book-to-market ratio as it generates an annualized monthly return of 20.52%. The intangible book-to-market ratio outperforms the traditional book-to-market ratio in every size quintile. These, and formerly discussed findings, provide enough evidence for the confirmation of the first hypothesis which says that the intangible value factor performs at least as good or outperforms the traditional value factor. The Fama-Macbeth regression in section 5.3 also shows that including intangible assets in the value factor, seems to provide better pricing errors within the three-factor model plus momentum. The addition of the intangible value factor, instead of the traditional value factor, worsens the pricing ability in the five-factor model plus momentum. This seems surprising as former research has also shown that the outperformance of the intangible value factor versus the traditional value factor is not statistically significant within the five-factor model (Eisfeldt, Kim and Papanikolaou, 2021).

Altogether, it is possible to state that the value factor is not outdated in the current knowledge economy, however, it does need good reconsideration. This research has shown the superior performance when intangible assets are included within the traditional value factor. It has displayed that, by accounting for intangible capital, investment strategies based on the value factor are still highly profitable. There still must be done a lot of research into this topic, but this paper has assured that we should not write off the value factor.

8. Appendix

Figure 5: The correlation of the returns on the traditional and intangible value factor over time

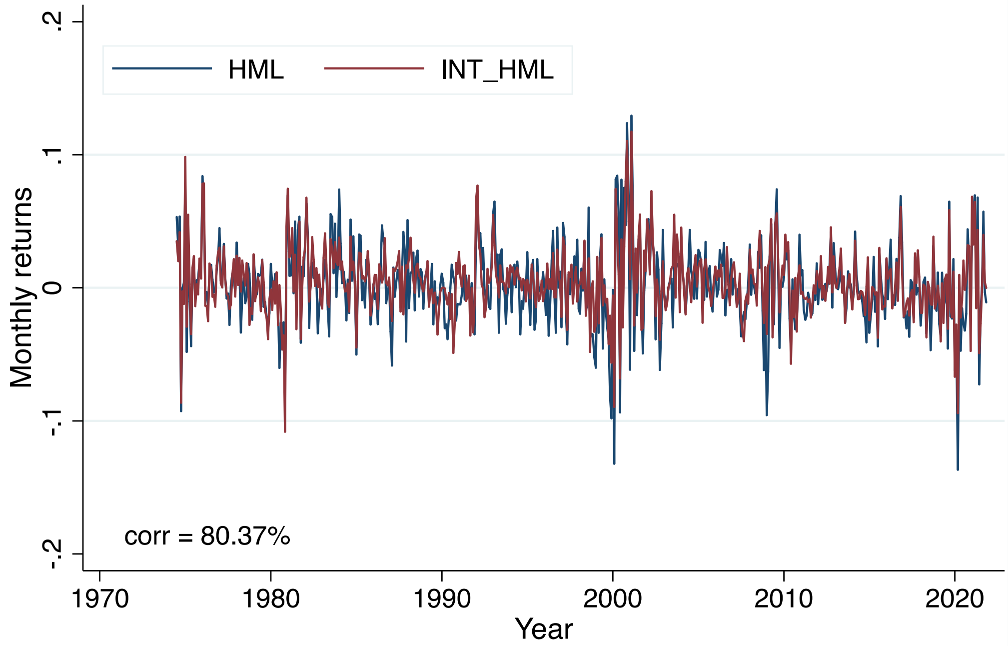


Figure 6: Cumulative returns of the "original" HML factor, intangible HML factor and HML factors constructed based on the Sales-to-Price ratio, the Cashflow-to-Price ratio, Earnings-to-Price ratio and the Dividend-to-Price ratio respectively over the subsamples 1975-1995, 1995-2021 and 2007-2022

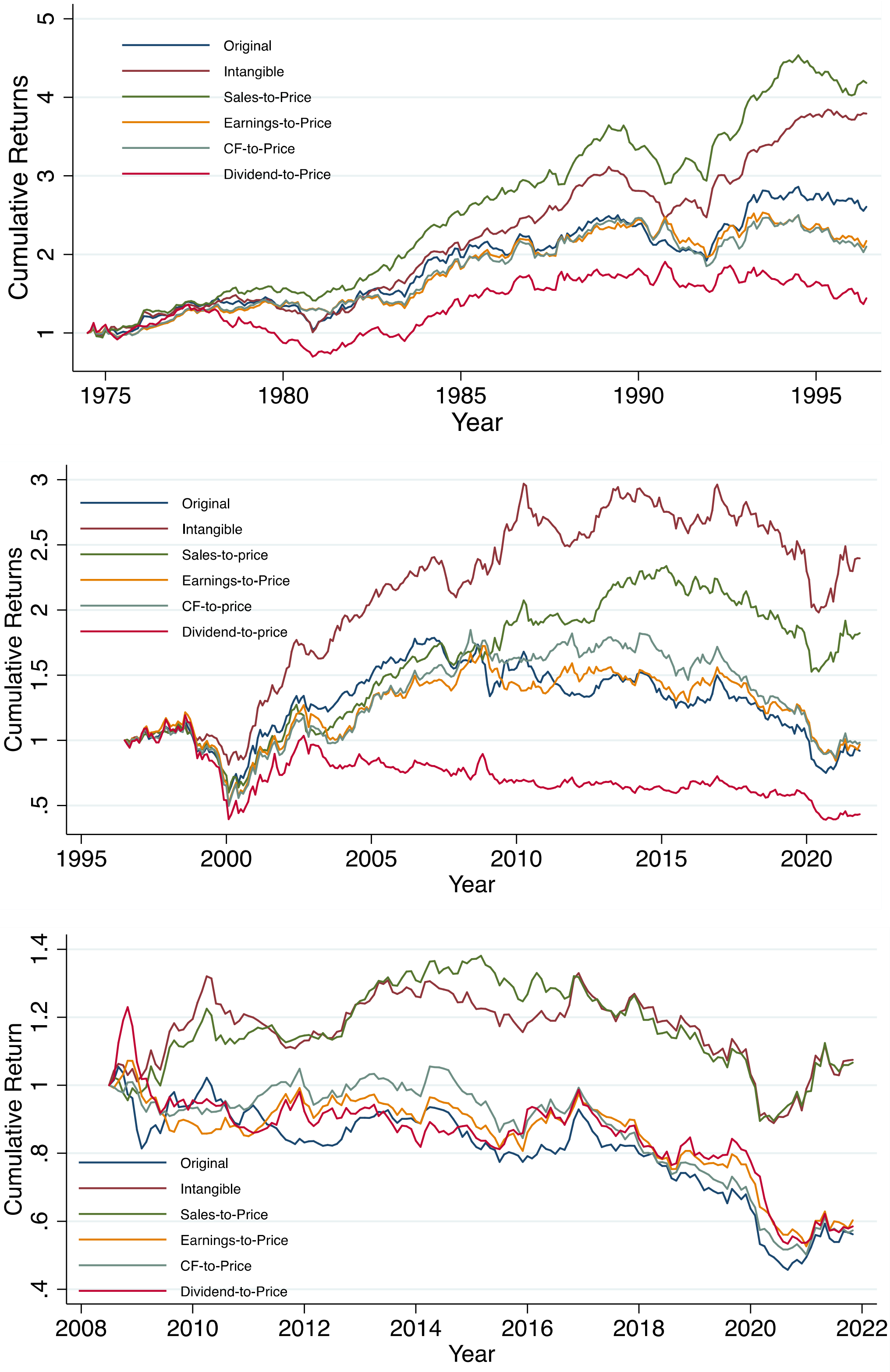


Figure 7: Cumulative returns for the "original" HML factor and the Intangible HML factor of high-technology stocks over the subsamples 1975-1995, 1995-2021 and 2007-2022.

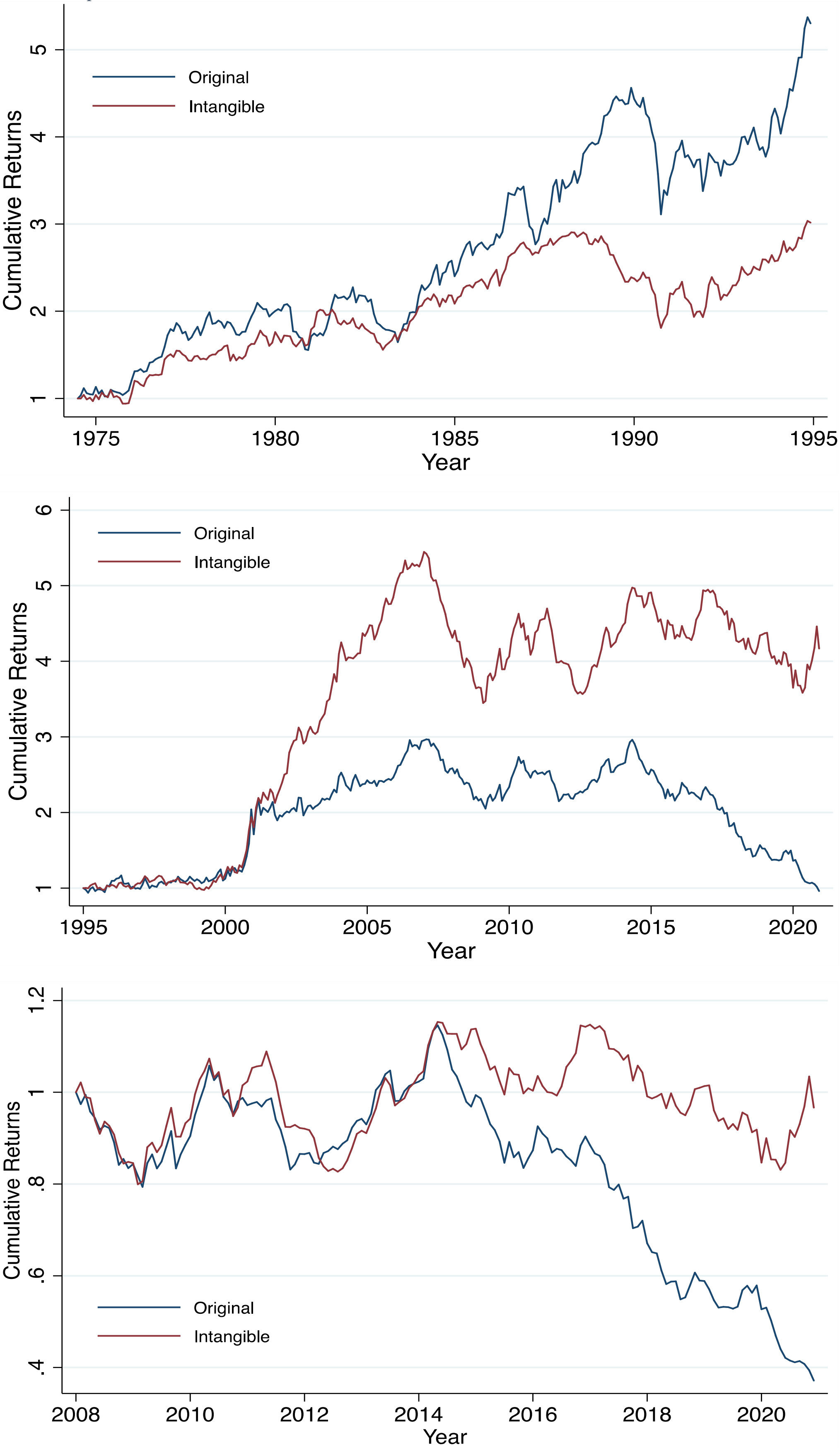


Table 3: annualized monthly returns of portfolio based on the deciles produced based on the Book-to-Market ratio.

Book-to-Market Portfolios									
Low	2	3	4	5	6	7	8	9	High
18.84%	7.92%	9.12%	7.44%	1.92%	2.88%	7.08%	6.96%	4.92%	9.24%

Table 4:annualized monthly returns of portfolio based on the deciles produced based on the intangible Book-to-Market ratio.

Intangible Book-to-Market Portfolios									
Low	2	3	4	5	6	7	8	9	High
14.40%	10.80%	11.52%	10.20%	7.08%	7.44%	3.72%	5.40%	8.04%	15.60%

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