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Abstract

A plethora of research exists on the Capital Asset Pricing Model and how to tackle the unobservability of the true market portfolio. We contribute to this debate by providing an overview of commonly used proxies for the market portfolio embedded into a critical evaluation of these proxies. In particular, we evaluate equal- and value-weighted equity market proxies, a multi-asset approach, and a macroeconomic method. Since all proxies have strengths and weaknesses, we propose doing a case-by-case evaluation to reconcile the underlying goal of the analysis with the choice of the appropriate market proxy.

Keywords: Capital asset pricing model, Market portfolio, Market proxy, Asset pricing

1 Introduction

Asset pricing theory reached a milestone with the development of the Capital Asset Pricing Model (CAPM) by Sharpe (1964), Lintner (1965), Treynor (1961), and Mossin (1966). Extending the model of portfolio selection by Markowitz (1952), the CAPM revolutionized the practice of explaining cross-sectional variation in expected asset returns, particularly stocks. The CAPM describes the expected returns as a linear function of the risk-free rate and the exposure (market beta) to the risk premium of the market (e.g., Sharpe, 1964). It is used to estimate the required returns of investments or mutual fund performance (Carhart, 1997). Going beyond asset pricing theory, the CAPM is used in a variety of areas. Calculating the costs of capital in bottom-up valuation or using the costs of capital to calculate the minimum hurdle rate to evaluate firm performance (e.g. by assessing value creation) are only two examples among many (Damodaran, 2010; Stewart, 1991). The widespread acceptance in academia and practice of the CAPM is explainable by its strong practicality and intuitiveness (Bouzzine, Müller-Bosse, Steen, Trautberg, & Wöhlert, 2019; Chen & Dodd, 2002; Toft & Lueg, 2015).

The introduction of the CAPM triggered a wave of further asset pricing models measuring market risk and explaining expected returns in the cross section. Arbitrage pricing models (APM) expand the potential to measure market risk beyond the single beta approach in the CAPM by examining patterns that affect a broad range of stocks (Damodaran, 2010; Ross, 1976). Factors of the APM remain theoretically unspecified as they are exclusively empirically motivated (Damodaran, 2010). The development of macroeconomic models (e.g.,

liquidity-based models) occurred to specify these empirically motivated factors. However, macroeconomic models remain exposed to empirical scrutiny as they fail to deliver robust predictions of expected returns. To mitigate the criticisms, proxy models were developed, reflecting risk sources in cross-sectional returns by identifying common asset characteristics that yield higher risk-adjusted returns in the cross-section (Damodaran, 2010). Besides fundamental extensions of the CAPM such as the three-factor model (Fama & French, 1993), the four-factor model (Carhart, 1997), and the five-factor model (Fama & French, 2015), a myriad of other factors have been analyzed ostensibly explaining expected asset returns (Feng, Giglio, & Xiu, 2019). However, recent literature sticks to the market factor which is already captured in the CAPM as the most important factor in explaining expected returns across different asset pricing models (Harvey & Liu, 2018; Ibbotson & Fall, 1979).
In order to quantify the systematic market factor loading of any asset, it is necessary to construct a holistic market portfolio with replicable returns. In theory, this portfolio is efficient and captures all traded and non-traded assets, including financial securities (e.g., stocks, bonds) and non-financials (e.g., real estate, human capital) (Cochrane, 2009).

The strong underlying assumptions of the CAPM (e.g., market efficiency) are far beyond the practicality of the model (Rosenberg, 1981). As the true market portfolio is unobservable, more easily calculable proxies are used to mimic the value of the universe of assets (Roll, 1977). Brown and Brown (1987) infer that the composition of the market portfolio proxy influences the calculated expected returns. Up to now, it remains a challenge to find the 'right' market portfolio to capture the systematic risk by the CAPM. We contribute to this challenge by discussing commonly used approaches to capture the market portfolio.

We start by reviewing previous asset pricing literature to identify commonly used proxies to replicate the market portfolio. In particular, we evaluate single-index-, equal- and value-weighted market proxies, a multi-asset approach, and a macroeconomic method. After discussing the benefits and shortcomings of these proxies, we derive a recommendation for a 'good' proxy. This essay closes by touching future developments of asset pricing research.

2 The 'right' choice of the market portfolio

Commonly used proxies for the underlying market portfolio in the CAPM are generally regional or global stock market indices such as the United States (U.S.) based regional proxy of the market portfolio Standard and Poor's 500 (S&P 500) index or the Morgan Stanley Capital International (MSCI) World as a global index (Clark & Kassimatis, 2011; Vassalou, 2000). The S&P 500 mainly consists of large-cap organizations resulting in an unbalanced inclusion of large enterprises (Indices & Jones, 2019). The composition of the S&P 500, for example, results in a large-cap bias increasing the likelihood of distorted calculations of the systematic risk. The market beta of small-cap organizations is, on average larger than the market beta of large-cap organizations as these corporations reflect a riskier investment (Asness, Frazzini, Israel, Moskowitz, & Pedersen, 2018). Since the S&P 500 only contains large-cap firms, estimated returns reflect the systematic risk of small firms limitedly. The same holds for the MSCI World as the MSCI World index mainly consists of large-cap companies (MSCI, 2019). Besides a large-cap bias, other distortions (e.g., momentum bias) are conceivable to occur when using a single index, which only replicates a fragment of the market.

Such biases can be mitigated by expanding the underlying stock universe of various indexes. For example, Fama and French (1992, 1993) replace the S&P 500 index with a value-weighted portfolio consisting of all common stocks listed on the New York Stock Exchange (NYSE), American Express Company (AMEX), and National Association of Securities Dealers Automated Quotations (NASDAQ). Compared to single-index proxies, this method enables a more granular representation of the market portfolio because all listed common shares at the NYSE, AMEX, and NASDAQ are considered instead of only the largest ones. Distortions toward large-cap organizations may also arise by weighting the portfolio according to the market capitalization. This time, however, such a bias is not artificially created through the exclusion of specific types of shares (e.g., small-cap shares) as all common shares are included. Fama and French (1993) transfer their original methodology to construct a global market proxy. However, researchers disagree on the applicability of this approach beyond the American market. Griffin (2002) and Fama and French (2012) find that local factors outperform global ones in terms of explanatory power. Cakici (2015) does not find significant differences in the goodness of fit between global and local factors. The results are not generalizable to Asia as he finds that the global- and local factors perform poorly in this area. Bruner, Li, Kritzman, Myrgren, and Page (2008) find that the use of a global- or local index depends on the degree of market integration. The results do not change significantly when using a global- or local index in integrated markets (Bruner et al., 2008). The transfer of these findings to the choice of a global- or local market proxy remains questionable as Bruner et al. (2008) use custom value-weighted indices instead of commonly used published market indices.

Based on these results and in contrast to the original methodology of Fama and French (1993), we suggest differentiating between an organization's country of domicile (e.g., country of a company's primary listing) and country of risk (country of a company's significant operations) when manually reconstructing the market portfolio

(Barclays, 2017). We propose that the country of systematic risk instead of the country of domicile of a company is decisive for the choice of the market portfolio. For instance, the systematic risk of a German company that mainly operates in the U.S. market might be better reflected when using a U.S. based proxy for the market factor. We suggest using a global market proxy when a corporation's significant operations are spread across different countries and a local factor when the systematic risk is agglomerated in one country.

The market proxy of Fama and French (1992, 1993) includes historical returns in US-Dollars. The market proxy cannot be chosen unequivocally if the country of risk does not have the US-Dollar as its base currency. Otherwise, the returns will be biased by currency effects. It remains up to debate how to address this difficulty appropriately. We suggest two different solutions. First, the conversion of the market factor into the respective currency using spot exchange rates as it is done by Fama and French (2012). Second, echoing the market factor for this specific country. We recommend deciding on a case-by-case basis on the most convenient approach.

Besides the value-weighted market portfolio, an equally weighted market portfolio consisting of stocks listed on the NYSE is empirically used as a market proxy (Fama & MacBeth, 1973; Fisher, 1966). We stick to the practical state-of-the-art definition of the market as being market-cap weighted. Following this perspective, an equal-weighting is a form of a rules-based deviation from the market (e.g., smart beta), and we, therefore, do not propose using this procedure (Philips, Bennyhoff, Kinniry Jr, Schlanger, & Chin, 2015; Siracusano, 2014).

All latter methodologies only capture equities in the market proxy. Another approach to cover the value of the market portfolio is by including different asset classes such as bonds, or real estate (Brown & Brown, 1987; Stambaugh, 1982). Brown and Brown (1987) create an index to mimic the market portfolio by including corporate bonds, government bonds, Treasury bills, or real estate, to quantify a larger proportion of the economic value and, therefore, converging more closely to the true market portfolio. Stambaugh (1982) concludes that CAPM delivers almost similar results with an all-stock market factor and a market portfolio consisting of different asset classes and only ten percent stocks. Brown and Brown (1987) contradict this inference and conclude that expected returns do change when including different asset classes in the market proxy. In line with this finding, Kamara and Young (2018) argue that the calculation of the cost of equity is highly sensitive to the change of the included asset classes in the market proxy. Doeswijk, Lam, and Swinkels (2014) construct an investable value-weighted multi-asset market portfolio by including ten different asset classes, which are then aggregated into five different categories. They conclude that their approach covers the investable market from 1960 to 2012. However, building a multi-asset class market proxy suffers from data availability impeding the implementation of this procedure. For example, transaction data of bonds often face unreliability occurred through frequent over-the-counter transactions (Clark & Kassimatis, 2011; Doeswijk et al., 2014; Houweling, Mentink, & Vorst, 2003).

An alternative framework is the approximation of the market portfolio using a macroeconomic concept. Clark and Kassimatis (2011) construct a value-weighted international market proxy by discounting future macroeconomic cash flows of different sovereign country's economies. In simple terms, the macroeconomic cash flow mainly consists of the total income of sold goods and services of an economy reduced by the purchased goods and services of that economy in a given period. The results indicate no significant deviation of traditional multi-asset approximations. Therefore, we suggest preferably using a physically replicable multi-asset approach (e.g., value-weighted market portfolio or multi-asset index portfolios) as a more straightforward method than using a synthetical macroeconomic proxy for the market portfolio. Moreover, further research is needed to make a final evaluation of the applicability of macroeconomic models to proxy the market.

3 Discussion and Conclusion

As outlined in the previous section, a plethora of studies analyzes different proxies of the market factor to mimic the market portfolio. The market factor is the pivotal element of CAPM explaining expected returns. Based on the current literature, we suggest using a value-weighted portfolio as it is a commonly used and straightforward approach to proxy the market for several reasons. First, it overcomes typical single-index biases (e.g., large-cap bias) evolved through an unbalanced inclusion of stocks. A value-weighted index considers the market capitalization of all common stocks and therefore reflects the proportion of the stock universe more accurately. Second, good data availability and preparation combined with extensive data history enables a comprehensive analysis. We believe that this aspect outperforms a market factor consisting of multi-asset classes as other asset classes are more likely to be exposed to over-the-counter transactions (e.g., bond market), impairing the data reliability. Third, macroeconomic models are used to proxy the value of the economy but are far from practicality because the low additional explanatory power is hardly justified by the more complex creation of this market proxy.

In general, the value-weighted market portfolio of common stocks of Fama and French (1993) is a commonly employed proxy for the market. However, we also recommend deciding on the appropriate proxy on a case-by-case basis to reconcile the overall goal of the analysis with the appropriate market proxy. Since different studies converge apart regarding the use of local- or global factors, we propose using a market factor based on the country that reflects the systematic risk of the underlying asset best.

A holistic view of recent developments in finance research during the last decades showcases a constant change in emerging methodologies following the overall approach of estimating expected returns of assets. A trend of current research in this field goes toward intermediary asset pricing challenging the fundamental assumption of CAPM of the households as marginal investors. The intermediary asset pricing theory changes the former discourse by replacing the households as marginal investors with the financial intermediaries (e.g., commercial banks, investment banks, hedge funds) as marginal investors (He, Kelly, & Manela, 2017; He & Krishnamurthy, 2013). New single-factor models likely emerge as a result and might be able to compete with state-of-the-art factor models. This, however, could give rise to new market proxies. Future research will show whether this discourse will revolutionize asset pricing debates and associated debates about the choice of the 'right' market portfolio.

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