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In search of beta

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ABSTRACT

Despite its limitations, the CAPM is a popular asset pricing model. However, the estimation of beta in the CAPM is affected by the choice of the returns frequency and firm characteristics. This study undertakes a detailed examination of the evidence for the UK and we find that the differences in beta computed from returns of various frequencies are related to size, liquidity, book-to-market and to some degree, opacity factors. One area where our conclusions might have important implications is in the regulatory use of the CAPM. Our results imply that low frequency beta estimates should, in most cases, be preferred to high frequency beta estimates.

1. Introduction

Whilst the CAPM has been subject to considerable criticism (most recently by Dempsey (2013a), who catalogues the empirical failings of the model), the model retains a core role in modern finance.

Whether or not this is desirable is clearly debateable. One can argue, as in Dempsey (2013a, 2013b), Cai, Clacher, and Keasey (2013) and Moosa (2013) that it is time to move on to another paradigm altogether, or one can argue the case for an alternative factor model, such as the Fama-French model (Fama & French, 1993, 1996) or some form of conditional asset pricing model (Durack, Durand, & Maller, 2004; Fletcher & Kihanda, 2005; Schrimpf, Schroder, & Stehle, 2007). Alternatively, one can adopt the position of Brown & Walter (2013) and Smith & Walsh (2013) that the CAPM is defensible, and indeed according to the latter, despite being "half right" is "the only game in town". Whatever one's views on this, pragmatically it is hard to disagree with Partington (2013) who predicts that "the reign of the CAPM is unlikely to end anytime soon".

Discussions of the techniques of beta estimation, the suitability of alternative analogues for beta and the treatment of leverage in deriving asset betas are standard fare in both textbooks and regulatory reports. Early research also considered issues such as the effects of non-synchronous trading (Dimson, 1979; Scholes & Williams, 1977) and intertemporal parameter stability (Blume, 1971, 1975). In relation to the influence of the return frequency on beta estimation, an early work by Levhari and Levy (1977) showed that the impact on beta of lengthening the investment horizon (i.e. the return frequency) depends on the riskiness of stock. They find that the systematic risk (β) of defensive stocks tends to decline while for aggressive stocks tends to increase with increases in investment horizon. Wood, McInish and Ord (1985) however, note that the results of Levhari & Levy (1977) are possibly affected by non-synchronous trading. Cohen, Hawawini, Mayer, Schwartz, and Whitcomb (1980) show that the effect of the decreasing of the return frequency may depend on the severity of thin trading problems. An added complication is the phenomenon known as "reference-day risk" (Acker & Duck, 2007). They find that, when using monthly returns, the choice of the reference day i.e. the particular day of the month and following month on the basis of which the monthly returns are calculated (difference in prices between those two days) affects estimates of the properties of monthly returns including the betas estimated from those returns. These effects exist for both

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individual stocks and market indices. They further note that the reference-day risk is a variant of sampling variation, albeit the effect of which had been previously underestimated.

Reinganum (1982) considers whether the size effect (Banz, 1981) is affected by the estimate of risk, and finds that the size effect is driven by underestimated risk and that the effect is larger when the risk is estimated using returns measured over shorter intervals. Hawawini (1983) finds that betas estimated on the basis of daily, weekly or monthly returns vary substantially and in particular, that for firms with market values less than the average market value of all firms, the beta will decrease when the interval is shortened, while the opposite is observed for firms with market values greater than the average market value of all firms. Handa, Kothari, and Wasley (1989) specifically consider firm size and show that portfolio betas of small (large) market capitalisation firms rise (fall) as the return frequency is decreased.

As discussed above, much of the early literature that considered the effect of returns frequency on beta estimation has focussed on trading frictions and non-synchronous trading as potential explanations for the differences in betas estimated using different return intervals. Apart from a few exceptions, there appears to have been relatively less interest in investigating what firm-specific characteristics, apart from size and liquidity, might influence the way in which beta estimates vary with the frequency of their estimation. We add to this literature by considering how opacity (Gilbert, Hrdlicka, Kalodimos, & Siegel, 2014), in addition to other firm characteristics such as size, leverage, BE/ME, illiquidity and industry affiliation are related to the betas estimated using different frequency returns.

Gilbert et al. (2014), show that estimates of beta are frequency-dependent, and that differences between high and low frequency betas can be explained by proxies for opacity of the firm. Opaqueness creates uncertainty about the effect of systematic news on the firm and this uncertainty affects how quickly such information is impounded into the prices. This, coupled with the risk averseness of investors, affects the returns of opaque firms at higher frequencies. At lower frequencies however, the effect of the systematic news is reflected in the returns of all firms (Gilbert et al., 2014). The consequence is that high frequency betas are particularly problematic in that they do not fully reflect risk characteristics. By contrast, low frequency betas will not suffer from this difficulty. Consequently, for opaque firms, using shorter return intervals results in a beta estimate that does not accurately reflect the riskiness of the stock. We add to the Gilbert et al. (2014) investigation in two ways. First, we consider whether other firm-specific risk factors such as gearing (leverage) and BE/ME apart from opacity, might make it more difficult to quickly interpret the impact of systematic news on the firm. Additionally, we consider whether these risk factors have explanatory power in the presence of controls for industry membership. Second, in addition to investigating the differences between high and low frequency betas, as in Gilbert et al. (2014), we also run the F-test of Gibbons, Ross, and Shanken (1989, hereafter GRS) in order to check whether or not the pricing errors from the CAPM at each beta frequency are jointly zero.

While the academic debate continues on the how best to estimate the parameters of the CAPM, in practice the CAPM is widely used. Evidence from surveys of practitioners, for example, Graham & Harvey, 2001; Brounen, de Jong, & Koedijk, 2004; McLaney, Pointon, &Tucker, 2004; Coleman, Maheswaran, & Pinder, 2008), suggest that the CAPM is the preferred model for cost of equity computations. In relation to the regulatory use of the CAPM, in the UK, the CAPM is the only model currently accepted by the regulatory authorities. These include the Competition and Markets Authority (CMA), Ofcom, Ofwat, Ofgem and the CAA.[1] The implication of this widespread use of the CAPM in the regulation of utilities is that fairly small variations in beta can have a very large economic impact when multiplied by the CAPM risk premium. For example, Buckland, Williams, and Beecher (2015) cite an Ofwat report that "in the case of water, it has been estimated that a 0.5 percentage point variation in the cost of capital might translate into a change of £10.00 in the average annual bills of the 28 million households served by water companies in England and Wales (Ofwat, 2004: 2)." With a market risk premium of 5%, such a variation is equivalent to a change of only 0.1 in the estimate of the beta for a firm financed entirely by equity. Not surprisingly, regulated firms invest heavily in consultants and academics who argue the case for variations in the beta estimates, and regulatory bodies often employ others who argue for variations in the other direction.[2] Consequently, research that objectively establishes how beta should be estimated has important policy implications and considerable economic impact. Whilst Gilbert et al. (2014) have analysed the position in the USA, given that in the UK regulators have expressed a preference for higher frequency returns over lower frequency returns in estimating betas, our study using UK data is potentially of added practical importance as it provides an out of (US) sample test. Additionally, we have a much longer run of data for the UK than for the other countries where Sudarshanam, Kaltenbronn, & Park (2011) show that the CAPM is the preferred model used by regulators.

The first objective of this paper is, therefore, to examine whether firm betas vary with the frequency of estimation in the UK. The second objective is to examine whether any differences in beta estimated using low versus high return frequencies can be explained. If they can be explained, and the explanatory variables can be construed as proxies for omitted systematic risk variables, then the implication is that some frequency estimates may be under-stating the true beta. The third objective is to examine the evidence on whether beta estimation frequency has an impact on asset pricing tests of the CAPM.

Consistent with previous evidence, we find that there are systematic differences in betas estimated from low versus high

[1] In the UK, monopoly utility services are subject to price regulation: telecommunications access prices are set by Ofcom, water and sewerage prices are set by Ofwat, electricity and gas network prices are set by Ofgem and monopoly airport landing charges are set by the CAA in conjunction with the CMA. The CMA has the role of being the appeals body for the regulated utility companies. Additionally, it has a key role in undertaking market investigations. For a full description see: https://www.gov.uk/government/organisations/competition-and-markets-authority (last accessed 4th April 2016).

[2] Note that in the UK, cost of capital is an important parameter in market investigations. The UK's approach to such investigations differs from that in many other countries. See, for example, the UK and Australian positions set out in the OECD paper on excessive prices: http://www.oecd.org/competition/abuse/49604207.pdf (last accessed 4th April 2016).