The Cross-Section of Stock Returns: Out of sample evidence from the early New Zealand stock market

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Abstract

In this thesis, I analyse the pricing ability of major asset pricing models using an out of sample data set from the New Zealand stock market in 1899-1929. Previous literature argues that the observed predictive ability of models is a result of the research design and database used to conduct the research. This unique dataset provides a way to test these models on data that has not been a component in previous models and testing. I find evidence of positive returns in the value and size portfolios, with high returns in momentum. There is strong evidence that Carhart's (1997) four factor model captures variation in returns, with observed size and weaker book-to-market effects. Cross-sectional tests identify existence of a strong positive relation to momentum and profitability.

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Attestation of Authorship

I hereby declare that this submission is my own work and that, to the best of my knowledge and belief, it contains no material previously published or written by another person (except where explicitly defined in the acknowledgements), nor material which to a substantial extent has been submitted for the award of any other degree or diploma of a university or other institution of higher learning.

Signed ______________________________ Date______________

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1. Introduction

The quantification of the trade-off between risk and expected return is one of the most important problems of modern finance. When investors are deciding whether to invest in a particular stock, they want to know how the asset will contribute to the risk and return of their portfolio. This relationship is very important for understanding portfolio performance, measuring the impact of active management, portfolio construction, and estimating future returns. Given the fundamental role of asset prices, what can be said about their determinants?

Developing and testing asset pricing models has a long history in finance and many of the key models have been developed over the last six decades. The efficient market hypothesis and asset pricing frameworks provide a worldview for financiers to determine decision-making in the financial markets. The efficient market hypothesis has preceded finance and economics as the fundamental theory explaining movements in asset prices. It deals with the one of the most fundamental and exciting issues in finance – why prices change in security markets and how those changes take place. The view is that markets operate efficiently and stock prices instantly reflect all available information. Since all participants are privy to the same information, price fluctuations are unpredictable and respond immediately to genuinely new information. As a result, efficient markets do not allow investors to earn above average returns without accepting additional risks. This has very important implications for investors as well as financial managers. Fundamentally, all investments in efficient markets are fairly priced, and according to capital market theory, the expected return from a security is primarily a function of its risk. The aim of asset pricing models is to determine the fundamental value of an asset, and therefore an appropriate return. These models portray how financial markets price securities and thereby determine expected returns on capital investments.

The Capital Asset Pricing Model (CAPM) of Sharpe (1964), Lintner (1965) and Black (1972) marks the birth of such theories, and is still widely used in applications such as estimating the cost of capital for firms and evaluating the performance of managed portfolios. This model describes the relationship between systematic risk and expected return for assets, to determine security prices. Although widely taught in finance, the CAPM has had contradictory findings, with the empirical record of the model being relatively poor. Studies then moved to better predict the fundamental prices documenting the ability of certain variables to explain the cross-sectional variation in realized returns. These studies introduced new models such as the three factor model (Fama & French, 1992) and four factor model (Carhart, 1997), most notably, improving the explanatory power of such variables. The cross-sectional literature examines both rational investor based theory and behavioural theory to interpret new findings, and gave rise to a shift in recent years from determining the fundamental value to explaining predictability and prices.

As Davis (1994) recounts, there is a number of reasons for the observed predictive ability of asset pricing models that have been suggested. The first explanation is that certain variables are measuring the riskiness of stocks, so that the correlation between the variables and subsequent returns reflects the compensation for bearing risk (Fama & French, 1993). Another is that variables allow investors to identify stocks that are mispriced, creating opportunities for returns in excess of what is required to compensate investors for risk (Lakonishok, Shleifer, & Vishny, 1994). Whilst a third explanation is that the observed predictive ability is a result of the research design and database used to conduct the study (Kothari, Shanken, & Sloan, 1995). This could lead to a self-fulfilling prophecy whereby the prediction itself could indirectly cause itself to be true. This can be presented by uncovering patterns in the data that can be statistically significant, without first devising a specific hypothesis as to the underlying causality.

There is much debate about the discovery of asset pricing models and correlating factors relating to possible data snooping. This implies that the ability of certain variables would be reduced if different methodology, periods, or data were used, which this study aims to address. This idea of poor and contradictory performance of asset pricing models, poses an issue to the usefulness of the models itself. The theories themselves are something that are widely used and taught in finance, but empirically, perhaps the best performing model may be the worst in another sample?

We can address these concerns by applying multiple models to an out of sample dataset, and by doing so, eliminate some of the concerns and minimize the effects of others. The sample used in this research is unique New Zealand stock market data, from close to its inception in 1899. Most of the literature surrounding asset pricing is conducted in the United States. There was little to no integration with the United States in New Zealand during our sample period of 1899-1929. Tests using this out of sample historical data can provide us with more information on the early determinants before many of these theories were introduced, and the unique dataset provides a way to test these models on data that has not been a component in previous models and testing.

Therefore, the main contribution of this paper is to find the determinants of the cross-sectional returns using out of sample stock market data.

To find the determinants of returns, we test well-known and widely used asset pricing models including the CAPM, Fama and French's three and five factor models (1992, 2015) and the four factor model (Carhart, 1997). The out of sample dataset is all stocks on the New Zealand Stock Exchange during the period 1899-1929.

We create factor-mimicking portfolios to test each of the variables against stock returns, and sort the stocks into value-weighted test portfolios formed on common factors to expected return. The factor mimicking portfolios observe strong returns, most notably in the momentum portfolio of 23% annually. Other factors exhibit positive returns including the value and profitability portfolios.

Sorted test portfolios are then regressed against the factor mimicking portfolios in traditional time-series tests using the various asset pricing models. To assess the goodness of fit and explanatory power of the models, I assess them using their adjusted R^2 models and perform the Gibbons, Ross and Shanken (GRS) (1989) test. Cross-sectional regressions are then performed in the style of Fama and MacBeth (1973), Fama, and French (1993), using individual stock returns.

We find strong evidence across the test portfolios that the four factor model explains variation in returns, passing the GRS test over all of the test portfolios, regardless of sort. We find evidence of size and BTM effects, captured by both the three and four factor models. Our cross-sectional results see further evidence of a strong relation between momentum and average returns, followed by a weaker but significant positive relationship with profitability.

By confirming the explanatory power of these models over our data set, this has implications in supporting the plethora of empirical evidence on asset pricing models. By addressing the data snooping concerns using an out-of-sample data set, this research helps eliminate concerns on the validity of the observed pricing ability of asset pricing models. In addition, this research builds on previous empirical research on asset pricing tests in New Zealand, and adds to the discussion on further understanding market efficiency in historic and out of sample data.

This thesis is organised as follows: Chapter 2 reviews the literature in asset pricing. Chapter 3 gives a history of the New Zealand Stock Exchange, and describes the data used in this study. Chapter 4 details the asset pricing factors used including factor construction and characteristics. Chapter 5 discusses and presents the empirical results, while Chapter 6 concludes the study and details further research.

2. Literature Review

This chapter reviews the extensive literature on asset pricing and detailed history on the New Zealand Stock Exchange. First, I explore three different dimensions of asset pricing literature Davis (1994) proposes, surrounding the predictability of asset prices; risk factors, anomalies, and data snooping. Section 2.1 explores different risk factors and the theories and models behind measuring the predictive ability of stocks using risk variables. Section 2.2 looks at anomalies as variables that allow mispricing in stocks, creating opportunities above the excess returns, while Section 2.3 highlights the literature and empirical results that argue the predictive ability observed is a result of the design and data used in the research. Section 2.4 gives background to the history of the early New Zealand Stock Exchange.

2.1 Risk Factors

The Sharpe (1964), Lintner (1965), and Black (1972) Capital Asset Pricing Model (CAPM) is the most prominent risk-based model in asset pricing and was developed in the 1960's in part as a means to identify the optimal portfolio of risky assets in the Markowitz framework (Markowitz, 1959). The CAPM is a model used to determine a theoretically appropriate required rate of return of an asset and asserts that the expected return for any security is a function of three variables – expected beta, expected market return, and the risk-free rate. The efficiency of the market portfolio implies that expected returns on securities are a positive linear function of their market betas, and that the market betas suffice to describe the cross-section of returns. Early investigations mainly supported the CAPM but other earlier results show that the CAPM is not able to explain the observed returns (Roll, 1977; Lakonishok & Shapiro, 1986). A critical point in the concept of the CAPM is the aggregation of all risks into a single risk factor, market risk. This may be useful for optimal or well-diversified portfolios, but for individual assets, this may be problematic. It is well observable that assets are not only driven by market factors but also industry or country specific factors (Krause, 2001).

As an alternative to the CAPM, Ross (1976) developed the arbitrage pricing theory (APT) in 1976, which was the next major asset pricing model to appear. The APT introduced a framework that explains the expected theoretical rate of return of an asset, or portfolio, in equilibrium is a linear function of the risk of the asset with respect to a set of factors capturing systematic risk (Ross, 1976). It can be more general than the CAPM and with better explanatory power, since it permits for multiple risk factors (Groenewold & Fraser, 1997). The intuitive idea behind APT is that asset prices are formulated by several factors, which have some fundamental and plausible relationship to the underlying company (Maringer, 2004). Also focusing on systematic risk, the APT recognizes that several different broad risk sources may combine to influence security returns. The APT includes other sources of risks than only the market risk e.g. industry specific factors and studies find evidence that other variables are able to explain the observed returns better than the market risk (Fama & French, 1992; Fama & French 1993). Unlike the CAPM, however, the individual factors, although precisely quantified, are not specifically associated with readily identifiable variables. The APT therefore causes difficulties because it does not identify the number of important factors or define them, and from here the appeal of factor models to define these factors became apparent.

Factor models have existed for many years even before the introduction of the popular CAPM and APT (Markowitz, 1959). These models rely on the use of factor analysis to identify factors that influence security returns. According to a factor model, the returngenerating process for a security is driven by the presence of various common factors and the security's unique sensitivities to each factor (factor loadings). Common factors may be readily identifiable factors such as price to earnings ratio, size, and growth. These models can help evaluate how much return was attributable to each of the factor exposures and consequently factor models offer a useful extension of the CAPM and APT to further understand how key factors influence risk and return. As the CAPM is clear about the source of risk (the market) but suffers because no practical measure of the market exists.

This introduced several other early empirical alternatives to the CAPM using the ability of certain other risk factors (like in APT) to explain the cross-sectional variation in realized stock returns. Banz (1981) and Basu (1983) focus on the size effect, while Bhandari (1988), and Rosenberg, Reid & Lanstein (1985) document a relationship between book to market equity and stock returns. However, one of the most important studies contradicting the CAPM is Fama and French (1992), who show that in the period 1963-1990, the correlation between stocks returns and their betas was very small, while the correlation with the company's size and their BTM was greater. They conclude, "Our tests do not support the most basic prediction of the Sharpe-Lintner-Black CAPM that average stock returns are positively related to market betas" (Fama & French, 1992). The authors divided the shares into portfolios and found that the cross-sectional variation in expected returns may be captured within a three factor model, including the market factor, a factor related to size, and a factor related to book to market. However, the study comes under controversy, as the explanatory power of other variables vanish when BTM and size are included in the cross-sectional regression.

Not as commonly used as the CAPM and Fama French three factor model, the Carhart (1997) four factor model extends the three factor model with the addition of a momentum factor. The momentum effect was first documented by Jegadeesh and Titman (1993), who found that US stocks that performed well over the past three to twelve months continued to perform well over the succeeding three to twelve months. Momentum was never identified as a risk factor, but was introduced as a means to explain fund behaviour. Fama and French (1996) observe that the three factor model falls short in capturing the momentum effects of Jegadeesh and Titman's (1993) model. Carhart (1997) argues that the profitability of momentum portfolios may be a compensation for systematic risk, and therefore the four factor model may then possess incremental ability over the Fama-French three factor model in describing returns if momentum is a relevant factor.

Evidence from Novy-Marx (2013) and Titman, Wei, and Xie (2004) highlight that the Fama and French three factor model is an incomplete model for expected returns because it's three factors miss much of the variation in average returns related to profitability. As a result, most recently, Fama and French (2015) introduce a five factor model directed at capturing the size, value, profitability, and investment patterns in average stock returns, and find it performs better than their three factor model. The five factor model's main issue however is its failure to capture the low average returns on small stocks whose returns behave like those of firms that invest a lot despite low profitability, and thus the book to market factor is redundant for describing average returns, at least in U.S data for 1963-2013. Fama and French (2015) note however that the five factor (including HML) may be a better choice in application, as although captured by exposures to other factors, "there is a large value premium in average returns that is often targeted by money managers" (Fama & French 2015). A similar study closest to the Fama and French five factor model is Hou, Xue and Zhang (2015) who propose a new four factor model that, in addition to market risk, includes size, profitability, and investment factors (which they call the *q*-factor model). They document that the *q*-factor model outperforms the Fama

French three factor model and the Carhart (1997) four factor model in explaining anomalies related to earnings surprise, idiosyncratic volatility, financial distress, equity issue, as well as investment and profitability. They find it performs similarly as the Carhart (1997) model in pricing portfolios on momentum as well as size and book to market, but underperforms in pricing the total accrual deciles.

From a different frame of thought, Daniel and Titman (1997) conversely argue that the Fama and French tests of their three factor model and other risk-based models lack power against an alternative hypothesis, they call the "Characteristic Model". This model indicates that the expected returns of assets are directly related to their characteristics for reasons such as behavioural biases or liquidity, which may have nothing to do with the covariance structure of returns. Using alternative tests applied to U.S. stock returns between 1973 and 1993, they reject the Fama and French three factor model but not the characteristic model. Their results are again controversial, by rejecting a model that captures the central intuition of traditional asset pricing models in favour of a model that is almost completely ad hoc. Cochrane (1999) explains that if predictability reflects risk, it is likely to persist "even if the opportunity is widely publicized, investors will not change their portfolio decisions, and the relatively high average return will remain". Another alternative explanation argued is that the variables allow investors to identify stocks that are mispriced, referred to as anomalies.

2.2 Anomalies

According to Schwert (2003), "anomalies are empirical results that seem to be inconsistent with maintained theories of asset pricing". Over many decades, empirical research has discovered many cross-sectional asset pricing anomalies, wherein predetermined security characteristics predict future stock returns. Chu, Hirshleifer and Ma (2016) maintain that such patterns can derive from either risk premiums or market mispricing. Mispricing leads to the idea that there are limits to arbitrage which delay the flow of wealth from irrational to sophisticated investors (Shliefer & Vishny, 1997) i.e. prevent these sophisticated market participants from quickly exploiting these inefficiencies.

Apart from the well-documented anomalies such as value, momentum and size effects, some studies find evidence of seasonality in the explanatory power of certain variables (Jaffe, Keim, & Westerfield, 1989; Fama & French 1992), while De Bondt & Thaler (1985) find a reversal effect in long-term returns. LeRoy & Porter (1981) and Shiller (1981) document high volatility of asset prices relative to measures of discounted future payoff streams, and Bernard & Thomas (1989) for post-earnings-announcement drift. Many of these anomalies concern the predictability of asset returns based on past prices and earning, therefore identifying anomalies can help understand the price discovery process. Jacobs (2015) identifies 100 anomalies related to momentum, reversal, calendar and lead lag effects, among others, and finds that most anomalies produce economically large abnormal returns relative to the Fama and French (1993) model with a data set that is partially out of sample, suggesting that perhaps most of the returns may not be primarily driven by statistical biases.

McLean and Pontiff (2014) argue that certain stock market anomalies are less anomalous after being published, as their findings suggest that investors learn about mispricing from academic publications. Jegadeesh and Titman (2001) show that relative returns to high momentum stocks increased after their publication of their 1993 paper, while Schwert

(2003) argues that since the publication of the value and size effects, index funds based on these variables fail to generate alpha. If return predictability reflects mispricing and publication leads investors to learn and trade on this mispricing, then we expect returns associated with this predictor should disappear. Fama and French (1996) find that some of these anomalies largely disappear in their three factor model, stating consistency with APT asset pricing, however they also consider irrational pricing and data problems as possible explanations. Data issues offer a third explanation to both risk and anomalies in asset pricing models.

2.3 Data Snooping

A problem associated with the existing literature is related to the concept of data snooping. Bossaerts and Hillion (1999) refer to this as "model overfitting", the tendency to discover spurious relationships when applying tests that are inspired by evidence from prior visits of the data sets. Foster, Smith and Whaley (1997) note that recent research raises concern about whether insights into return predictability are real or whether perhaps researchers have simply become too familiar with the available data. Merton (1987) first warns researchers they may find return anomalies because they are too close to the data, while Lo and MacKinlay (1990) investigate the extent to which tests of financial asset pricing models may be biased by using properties of the data to construct the test statistics. They point out that grouping stocks into portfolios induces bias in statistical tests. Black (1993) then discusses a variety of other data-snooping biases and highlights the relative roles of theory and data in understanding how one can estimate expected security returns.

In regards specifically to factor models, Black (1993) and MacKinlay (1995) note that the positive relation between book to market factors is a result unlikely to be observed out of sample. Out of sample evidence is provided by Chan, Hamao and Lakonishok (1991), Capaul, Rowley and Sharpe (1993), and Fama & French (1998). They document strong relations between average return and BTM in markets outside of the U.S using data post-1970. Davis (1994) addresses the common hypothesis that "observed predictive ability is an artifact of the research design and database used to conduct the study" therefore; the predictive ability of said variables would be reduced if different methodology and data were used. Kothari, Shanken and Sloan (1995) conjecture that past studies are affected by a selection bias and provides indirect evidence, while Foster et al. (1997) discusses that past work using data from a similar time period makes the predictability very nettlesome.

Conversely, out of sample evidence from Grinblatt and Moskowitz (1999) suggests that the documented relation between past and expected returns cannot entirely be due to data snooping biases. For example, Bianchi (2010) proposes that the explanatory power of the Intertemporal CAPM model relies on including the stock market crash that opened the Great Depression, showing that rare events indeed matter for the cross-section of asset returns.

Empirical researchers have indeed largely focused on the same datasets of stock returns over the last few decades. Very few studies have been published testing the asset pricing models in early out of sample stock markets. There are early studies using data pre-1969, that do find a positive simple relation between average stock returns and market betas supporting the CAPM (Black, Jensen, & Scholes, 1972; Fama & MacBeth, 1973) with some that find the relationship disappears during a more recent 1963-1990 period (Fama

& French, 1992; Lakonishok & Shapiro, 1986). Davis, Fama & French (2000) explore the size and book to market effects over the 1929-1997 period in the U.S. and document that the three factor model does not completely describe expected returns but find it explains value premium better than the characteristic model of Daniel and Titman (1997). Bossaerts and Hillion (1999) use different model selection criteria to choose the best model of returns for a number of industrialized countries over the post-war period, and find no out of sample predictability.

Goyal and Welch (2003) employ tests over the 1926-2000 period to look at dividend/price ratio and exhibit evidence of predictive ability in in-sample tests, but find little out of sample predictive ability compared to a model of constant returns. Rapach and Wohar (2006) suggest "the negative results typically generated by out of sample tests suggest that the in-sample evidence of return predictability is spurious". One method to overcome data snooping claims discussed in literature could be best achieved by using different time periods of observations and different countries or out of sample evidence.

These studies highlight the difficulties in contradictory findings but also enforce the idea that often these models are hard to detangle, to find the causal variables. If return predictability in studies results solely from statistical and data biases, then predictability should theoretically disappear out of the sample. An out of sample study from a unique dataset should be able to test these models and theories in detail, addressing the issue of data snooping in predictability of asset pricing. Although many studies have comprehensively tested anomalies, very few have focused on a comprehensive approach to include all of the major factor models on the same unique dataset. Using out of sample evidence from the early New Zealand stock market, this study aims to address this asset pricing contention. It is therefore important to understand how capital markets in New Zealand operated during this time.

2.4 The New Zealand Stock Exchange

A stock exchange has two primary functions; firstly, it acts as a financial intermediary in the movement of capital for businesses in either public or private sectors. Secondly, it acts as a facilitator, helping individuals and institutions to buy and sell shares, debentures, and government securities in order to influence the company's direction, raise capital, and as a liquid investment to increase personal assets. In New Zealand, the beginning of such a stock exchange follows how a simple organisation developed into a sophisticated bureaucracy which has directly impacted the country's economic structure and also many New Zealanders. The main discussion on this is provided by Grant (1997) who gives a detailed account on the history of the New Zealand stock exchange from its inception around 1839. The discussion below builds on his work and highlights the history of the New Zealand stock exchange from the late 1800's to 1929.

The London Stock Exchange was one of the most important early Exchanges, and the largest, founded in 1801, with a set of rules established by 1812. In Britain, as later in New Zealand, there were provincial exchanges, although they did not have a monopoly. In the first decades of European settlement in New Zealand, a local capital market was not even considered. There was neither a need nor the number of people to undertake anything other than small commercial enterprises. The colony's dependence on Britain was charged by the need of injections of British capital. This need was accepted in 1840, as New Zealand's annexation, was in part, as Grant (1997) writes, an act of British economic imperialism.

Stockbroking evolved in New Zealand from private buying and selling of shares in early businesses among their promoters, associates and friends in order to raise capital to establish or expand their operations. Banks were the first capital venture of any size in New Zealand, and the most prominent of the early public companies. The New Zealand Banking Company, established in 1839 was the first initial offering, raising £50,000, in 5,000 £10 shares. Of these 5,000 shares, 3,000 were sold locally with the remainder quickly sold in Sydney. The second bank to gain a foothold was the branch of the Union Bank of Australia, established in 1840, becoming the first trading bank for both the colonial government and the New Zealand Company, raising £500,000 (in £25 shares), indeed showing a speculative market for investment in banks in Australia and New Zealand. Banks grew from the 1860s, with at least seven banks opening branches before 1874. During this time, most of the directors were British or American, and with shares relatively expensive at £5 to £100 each, shareholders were at first constrained to the wealthy with many banks floated overseas, principally in London.

Following banks growth in 1860s, other commercial ventures followed. The first was the establishment of the New Zealand Insurance Company in 1859 followed by other insurance rivals listed in the early 1870s. Prior to this, there was very little commercial activity in New Zealand.

At this stage, joint-stock companies were restricted to a very limited number of activities, requiring routine and uniformity, such as banking, insurance, and timber. Many local body floats went offshore as equivalents to an interest bearing form of foreign exchange. The passing of the Joint Stock Companies Act in October 1860 enabled seven or more people to combine to set up and float a public company by issuing shares for sale to the public. This act permitted interests to be transferred more easily, and incorporated limited liability, thus laying the foundation of modern trading.

From the 1860s, business became increasingly sophisticated, with commercial development in Auckland and Dunedin, and less in Christchurch and Wellington. The gold fields created a huge demand in areas such as Dunedin for more creation of credit for private investment. Banks bought gold from the miners and shipped it overseas – the Bank of New Zealand for example returned a dividend of 17 per cent in during the late 1860s. This new growth in population required more capital to set up business. Loan companies, such as New Zealand Loan and Mercantile, began to extend their operations into public offerings, followed closely by large freezing companies and shipping companies in the early 1880s. Grant (1997) stresses that New Zealand's sustainable wealth depended largely on agriculture, which was not included in publicly funded business enterprises. Therefore, NZ differed from more industrialised countries whose economic improvement rested on large capital development through the stock market. Fundamentally, the NZ Exchange and stock market was not an indicator nor reflective of the economy at this time, as primary production was a key determinant in growth and occurred outside the scope of the stock market.

Before the establishment of the formal Stock Exchanges, shares were bought and sold privately through wealthy promotors, directors, and associates. Early capital groupings were groups of settlers or partnerships, through ‘sleeping partners’ supplying capital from their own savings. Therefore, the total number of securities available to trade was not that large, and because of the high price of the shares, the potential investors were a small group with limited turnover. Speculation of the exploitation of gold by people setting themselves up as brokers, led to the Sharebrokers’ Act, passed in 1871, providing tighter State controls and licensing of share brokers. Through the 1880’s, further Bills aimed at tightening these rules were met with disagreements from politicians citing that stock brokers needed freedom to work their craft.

Up until the late 1860’s stock brokers were minor players, however gold-mining exploitation, quartz and dredging booms followed providing an important boost for the market in shares, leading to the establishment of the country’s first formal Stock Exchanges. The New Zealand stock exchange began as a number of regional stock exchanges during the gold rush of the 1870s as the current capital raising method proved insufficient. This lead to the setting up of groups of people, effectively becoming share brokers who met together to form a point of trade and exchange shares for companies to raise capital. Brokers’ Associations started in Dunedin Brokers’ Association in 1876, Otago in 1868, Auckland in 1872 and Wellington in 1882. The Dunedin Brokers Association was set up in the interests of efficiency, and in an effort to counteract the growing speculative image of broking in mining shares particularly. The shares listed were twelve companies in the alluvial mining group, and twelve quartz mining companies, with the group additionally offering debentures (one for a local harbour board to raise 50,000 for development, and the other for a local government at 8 percent). The members paid a subscription to cover the expenses of the Association, and potential members were “vetted” before obtaining entry. The Auckland Association’s initiation of a ‘call-over’ system became the dominant system used on NZ Exchanges until 1960. It involved the matching of buy and sell orders in the form of an auction, in which each security was ‘called’ in order. On each side quotations were offered and a sale completed when the two prices were brought together. The advantage here was the opportunity to deal regularly in every stock and share listed on the Exchange.

During the gold boom, stockbroking became more accessible to a wider community of investors. This creating a need for new industries including timber milling, engineering and coastal shipping. In 1891, the Auckland Association moved to standardise brokerage fees and policies to tighten controls and penalties were also entered into rule. As the infrastructure of the Exchanges developed, the precedent for correct and appropriate regulation and control would continue. From the beginning of 1896, the press was allowed to attend the call-overs and report the details of the trading.

In the 1890s, many of the Broker Associations made the move to establish Exchanges, establishing six Stock Exchanges in three different cities. These Exchanges by this stage had similar protocols, call-overs and rules governing the frequency of calls and the payment of dividends. The Dunedin Association became a Stock Exchange in 1893, and Christchurch gained an exchange in 1900. By 1900, the Dunedin Stock Exchange had 43 members and seat fees had reached over £250 per seat. The role of the brokers during the next gold boom was crucial. In addition to their brokerage duties, they were key players in forming gold-dredging companies. After being persuaded to pursue the claim, they valued and set up the company including its worth and how many shares would be allocated. By this time, more generous brokerage fees were also in place at 2 ½ per cent on the nominal capital of the company plus a further commission. In July 1900, there was at least 270 gold-dredging ventures listed in Dunedin with another 107 on the West Coast. Prospectuses were offered to investors with glowing surety of wealth, including all dividends guaranteed.

Call overs eventually had a routine whereby the companies would be split into three sections – national, international and gold mining. The caller shouts out the name of the company in chronological order, and then the sellers/buyers would make bids. However, after the gold boom began to fall away, investors look to other types of capital raising – such as debentures. When debenture issues failed, directors persuaded shareholders to authorise the sale of preference shares. Of course, many people argued that this would create issues for the ordinary shareholder, many companies during the bust could not afford to wholly pay the preferential shareholders either. As a result, these arrears were carried forward, as a permanent liability of the company.

After the gold booms had run their course, regional Exchanges entered a much more stable period, yet gold mining shares continued to dominate the local market for much of the period up until the First World War, remaining important in the 1920s and re-emerging as a real force on the market during the depression in the 1930s. All of the Exchanges struggled after the gold dredging crash, and from 1903 mining returns in NZ experienced a slow decline. However, by 1909 many of the stock exchanges had reconvened with amended regulations including the re-enactment of the Sharebrokers Act in 1908. During this time Exchanges discussed the idea of a national Exchange to formulate general rules, fix rates, and act as a final court of appeal, which led to the Stock Exchange Association of New Zealand coming into being in 1915, to promote uniformity and provide a governing authority. Auckland, Christchurch, Dunedin, Thames and Wellington formed the Stock Association of New Zealand in 1915, joined by Taranaki in 1916, Invercargill in 1920 and Gisborne in 1922. This umbrella organisation promoted uniformity in broking transactions and regulated the dealings of the exchanges with the public. In 1929, the Stock Association began the NZ Stock Exchange Gazette, which was a monthly journal to promote investment in securities and to list shares of all public companies. The Official Record of Stock Exchanges in New Zealand replaced it in 1931.

Brokers survived the 1930s depression well, there was frantic resurgence in gold stocks and investment continue in municipal loans. In 1933, shares were sought in a massive government float for the Reserve Bank of New Zealand and from the late 1930's; different political schemes played a hand in the development of the Exchange. The Labour Government in 1935-49 brought many capitalist enterprises, and controls were placed over imports and foreign currency. Government loans, war bonds, and municipal debentures kept the exchanges afloat during this time. When the National Government came in in 1949, they repealed many regulations and introduced more liberal tax and import schemes. In 1960, unit trusts were formed and an act was passed requiring them to be public companies and hold its trustees to hold reputable positions in organisations approved by the Minister of Justice. Such ventures have been an integral part of the share broking market in NZ since. As demand increased, the call over system was replaced by 'chalkies', whereby clerks recorded and wrote up the new stock price on a board. This was a faster and more accurate means of determining true market value. Pressure from other regions for centralisation in the 1970's led to the New Zealand Stock Exchange being set up in 1983, and replaced the Stock Exchange Association as the profession's elected body.

New Zealand specifically, is a small illiquid country, with unique characteristics including being one of the least regulated stock markets in the world (Gan, Lee, Hwa, & Zhang, 2005), making it an interesting and unique country to study. Nartea, Ward and Djajadikerta (2009) also suggest that New Zealand did not have much integration with the US stock market during this time, leading to more independent price movement, and less connection to previously studied events.

3. Data

This section explains the data and various research methods and models used to generate the results in this study. A substantial part is devoted to an overview of the procedures in obtaining and cleaning the historical data used for analysis.

3.1 Data

Following Frijns and Tourani-Rad (2016) stock price data and dividends for individual companies are collected from the records of the Wellington Stock Exchange (1899-1904 and 1911-1929) and the Christchurch Stock Exchange (1905-1910). These records were obtained in print from the archives of the National Library. We focus on two exchanges, as they offer the most complete series of share price and dividend data. As the period 1905-1910 is missing from the records of the Wellington Stock Exchange, data are used from the Christchurch Stock Exchange to construct a continuous data series. The quality and readability of the share listings varies with some that are barely legible. In cases where the data is not clear, the field has been left blank. By collecting all official data from this period, we hope to alleviate concerns about selection bias and utilise a new database for future research. The stock data included in this study was presented in monthly share listings of the entire exchange. The data extracted for each of the companies is listed in more detail below.

3.1.1 Share Listings

Both exchanges produced monthly share lists and reports under the authority of their respective Exchange Committees. These reports include the name of the company, the price of the share, the interest on investment (i.e. dividend yield of current market price), the number of shares outstanding, latest dividend payments and various other details and announcements about the companies involved. Share reports for overlapping periods show that both exchanges provided price quotations on the same companies. Additionally, after September 1918, further information was added on war bonds, debentures, bank deposit rates and a few commodities quotations. See Appendix 8.3 for an example of the share listing.

The Stock Exchanges quote share prices and dividends in Pounds (£), Shillings (s) and Dimes (d) for the period up to the early 20th century. Although the initial circulation of British coinage began around early 1840, it became legal currency in 1858 through the English Laws Act (Reserve Bank of New Zealand, 2012). For the purpose of analysis and calculation of returns, these amounts are converted into decimal values. The calculation to convert these quotations into decimal price is as follows:

$$Decimal\ Price\ = Pounds\ (£) + \frac{Shillings\ (s)}{20} + \frac{Dimes\ (d)}{240} \qquad (3.1)$$

Different style quotations were used between 1899 and 1929. For example, up until September 1918, stock lists were presented with only one market price listed (no specification as to bid or ask price). After 1918, the quotation style split the bid and ask price to include a spread. There are several gaps in the share prices noted, most commonly in December months, April 1920, and a few other isolated months.

Goetzmann, Ibbotson and Peng (2001) report that there are several categories of equity shares that were trading on stock exchanges in the early 20th century. Shares listed as "old" and "new" were traded concurrently and with the same company name, so the assumption here is that they are different classes of stock of the same company. We presume "preferred" shares to be the same as they are meant today. There are twelve companies with listed "preferred" shares that are included in this study. There are a few cases of share splits, although a rare occurrence during this period, the majority of these are relatively straightforward as they contained only one class of shares.

During this period, the New Zealand market hosted more than 200 different firms. At the start of 1899, there were 45 listings. The number of listings grew steadily over time and peaked at 119 listings in 1910. After this period, there was a gradual decline in the number of listings until about 1920, when the number of listings settled at about 90 companies. All companies on the Wellington Stock Exchange are categorised into 11 different industries before 1925 including: Banking, Coal, Finance, Frozen Meat, Gas, Insurance, Mining, Miscellaneous, Timber, Transport, and Woollens. Breweries became the 12th industry in 1925. Monthly holding period returns are calculated from the decimal prices as:

$$HPR = \frac{D_1 + (P_1 - P_0)}{P_0} \tag{3.2}$$

Where *HPR* is the monthly holding period return, D_1 is the dividend received over the period, P_1 is the end of period share price, and P_0 is the initial price of the share.

Firms with returns of over 150% were removed from the dataset as outliers, as well as stocks whose price was under $0.20. Previous literature typically notes that stocks under $1 are removed (classed as "penny stocks") however due to the prices for shares in the New Zealand market at this time we cannot remove all and not significantly limit the data set, any large movements in returns are removed as outliers.

3.1.2 Dividends

Dividend records were included as part of the monthly share listings. Dividends are quoted as a percentage (%), or quoted in Pounds (£), Shillings (s) and Dimes (d). Similar to bonds where interest (coupon) payments are made on a coupon rate or percentage of par value, the percentage quotes are from the face value of the shares. In terms of the percentage quotations, it is essential to differentiate between per annum or semi-annual dividends. Due to the gaps noted in the data set, there is also no dividend information for those months. Any firms with outlier dividends are removed due to the variability in measurement or error.

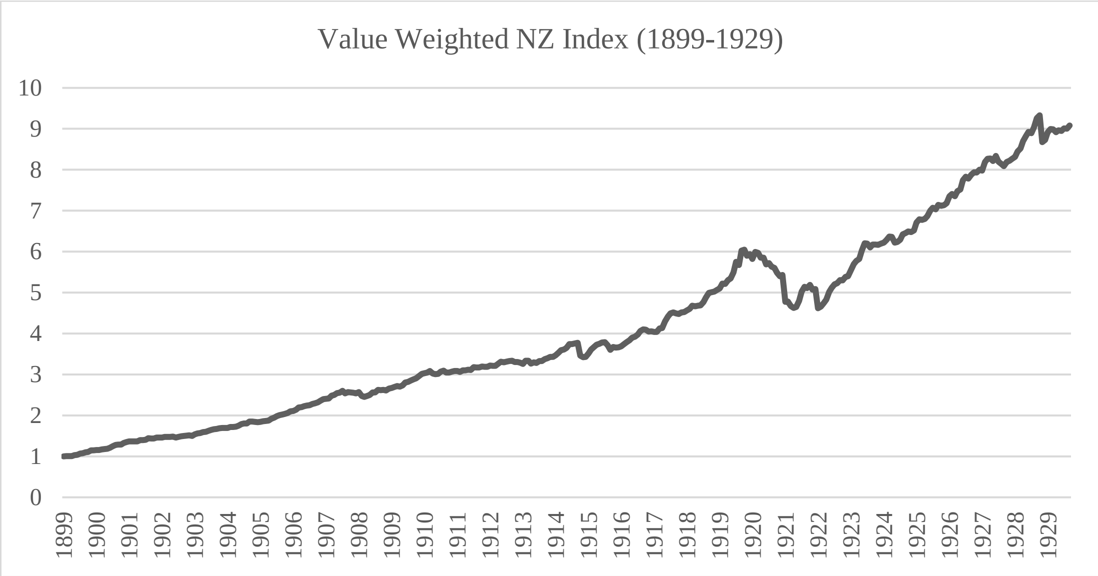
3.1.3 Government Bonds

The New Zealand 10-year government bond is used as a proxy for the risk-free rate, and is obtained from Global Financial Data for the period 1899-1929. Following Frijns and Tourani-Rad (2016), a gap between 1915-1925 is covered using the Australian 10-year government bond yield to compute estimated values of the NZ bond yield over the missing period. Frijns and Tourani-Rad (2016) performed a regression of the NZ bond yields against the Australian bond yields prior to the gap to ensure it is an appropriate proxy. Their regression produced an R^2 of 0.73 over the period 1906-1915, and coefficients of 1.71 and 0.47 respectively. These coefficients are employed to compute estimated values over the missing period, returning a continuous time series of the risk-free rate during this period.

3.1.4 New Zealand Market Index

The data collected is the New Zealand stock exchange market in its entirety. A value-weighted index and returns have been calculated based on market value. The individual stocks are weighted according to their market capitalisation, therefore the larger components carry higher percentage weightings, while the smaller components in the index have lower weights. Figure 1 shows the value weighted market index from 1899-1929 for the New Zealand market.

Figure 1: Value Weighted NZ Index



From looking at Figure 1, we can see the market has an increasing upwards trend, reaching the highest point in 1928. There are several drops in the upwards trend, most recognisably in 1914, 1921 and 1922. In 1914, the military history of New Zealand's participation in WW1 began. A post-war economic boom followed reaching its peak around 1920 before economic recession hit in late 1921. The end of Britain's wartime commandeer of New Zealand farm exports and a worldwide glut of primary produce sparked a "short, sharp recession" (The New Zealand Ministry for Culture and Heritage, 2017). During this period, income from wool exports fell from £19.6 million in 1919 to a mere £5.2 million in 1921, along with meat returns.

Equally weighted and price weighted indices were also constructed and are graphically represented in Figure 2. The value-weighted index reports the highest index out of the three, with the equally weighted index showing the lowest return. There is little variance between the three indices until 1905 where the value weighted index climbs at a higher rate. Both recessionary troughs are seen throughout all the indices with more sensitivity in movements shown in the value-weighted index.

Figure 2: New Zealand Market Indexes

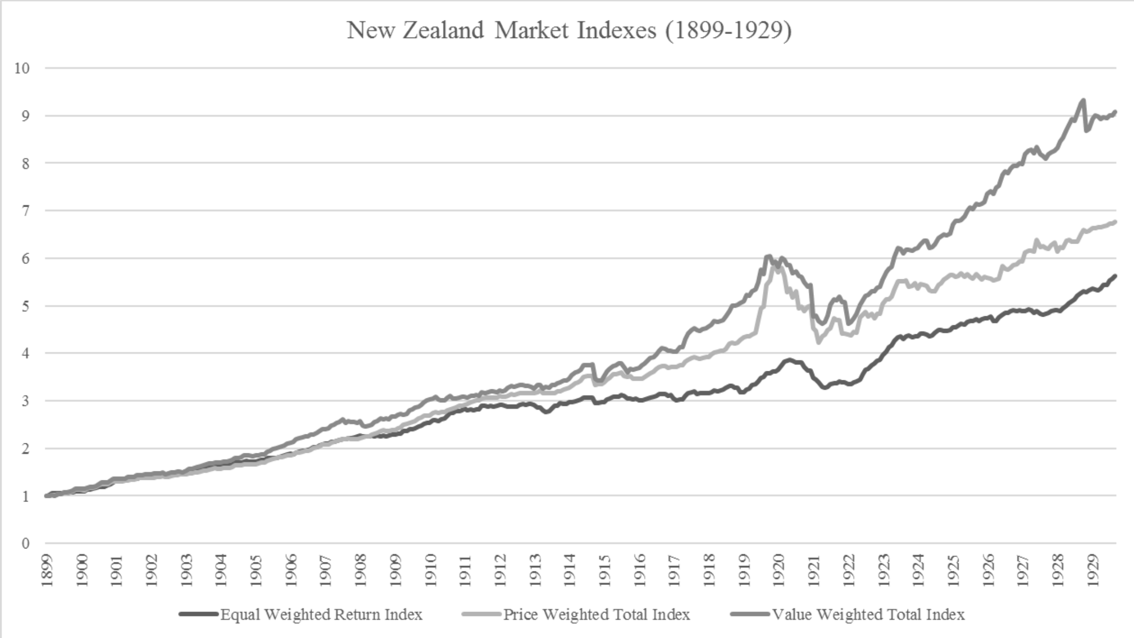


Table 3.1 Monthly Descriptive Statistics of the NZ Market

	EWR	*PWR*	*VWR*	*RF*
Mean	0.51%	0.33%	0.47%	0.35%
Standard Deviation	1.26%	2.06%	1.75%	0.10%
Kurtosis	2.98	8.24	8.43	-0.22
Skewness	0.36	-1.03	-1.21	0.95
Minimum	-4.09%	-11.02%	-10.04%	0.24%
Maximum	6.66%	9.73%	6.32%	0.62%

As Table 3.1 indicates, equally weighted return (EWR) has the highest average return of the period of 0.51%, equating to 6.35% annually. The price weighted return (PWR) has the lowest annualized return of 4.08%. The value weighted return (VWR) sits in between the both in relation to average return (5.73% annually) and standard deviation (risk). The risk-free rate (RF) provides a higher mean than price-weighted return but with minimum and maximum values between 0 and 1% monthly, providing an annual risk free mean of 4.28%.

3.1.5 Industries

Between 1899 and 1929, stocks were classified within twelve industries. In 1899, there were seven industries including Banking, Finance, Coal, Insurance, Gas, and Transport. The remainder of companies were classified as Miscellaneous and include companies such as Colonial Sugar Co., New Zealand Drug Co., and Otago Daily Times. From 1905, the Preserved Meat industry was added and was updated further in the sample to represent Frozen Meat as the industry advanced. This is represented and referred to as the "Meat" industry for the remainder of this study. In 1910, Breweries, Mining and Timber industries were introduced as standalone sectors. The Woollens industry is accounted for from 1899, however the availability of data is missing over 1905-1910.

Table 3.2 Average Market Cap and No. of Companies

Industry	BANK	TRAN	MISC	FIN	INS	GAS
Average Market Cap ($)	30,448,383	10,310,043	5,870,687	4,205,600	3,314,421	2,463,229
No. of Firms	15	18	41	21	9	29

Industry	MINING	MEAT	COAL	TIMB	BREW	WOOL
Average Market Cap ($)	2,264,393	1,156,446	796,238	617,271	558,806	409,632
No. of Firms	32	14	6	8	5	7

Table 3.2 reports the average market capitalisation and average number of firms across the whole sample period (1899-1929) for each of the twelve industries. The Banking industry on average has the highest market value of over $30 million, with Transport having the second largest average market capitalisation of over $10 million. The smallest sector, Woollens, has an average market capitalisation of $409,632 with Breweries having

the second smallest market cap of $558,000. Coal and Timber are the other industries under $1 million, while the rest range up to $5 million on average. Table 3.2 details the average market cap, and highlights the number of companies in each sector. Miscellaneous has the highest number of companies with Mining and Gas following with 32, and 29 companies, respectively. The smallest number of companies can be found in Breweries with only five companies, followed by Timber and Woollen. The Banking industry has a relatively average number of companies compared to other sectors, while retaining the highest average market cap indicating the companies are large firms. On the other end of the scale, Miscellaneous has an average market cap of one sixth of Banking however almost has three times the amount of firms, indicating it is largely made up of small firms.

Figure 3: Industry Percentage of Market Value

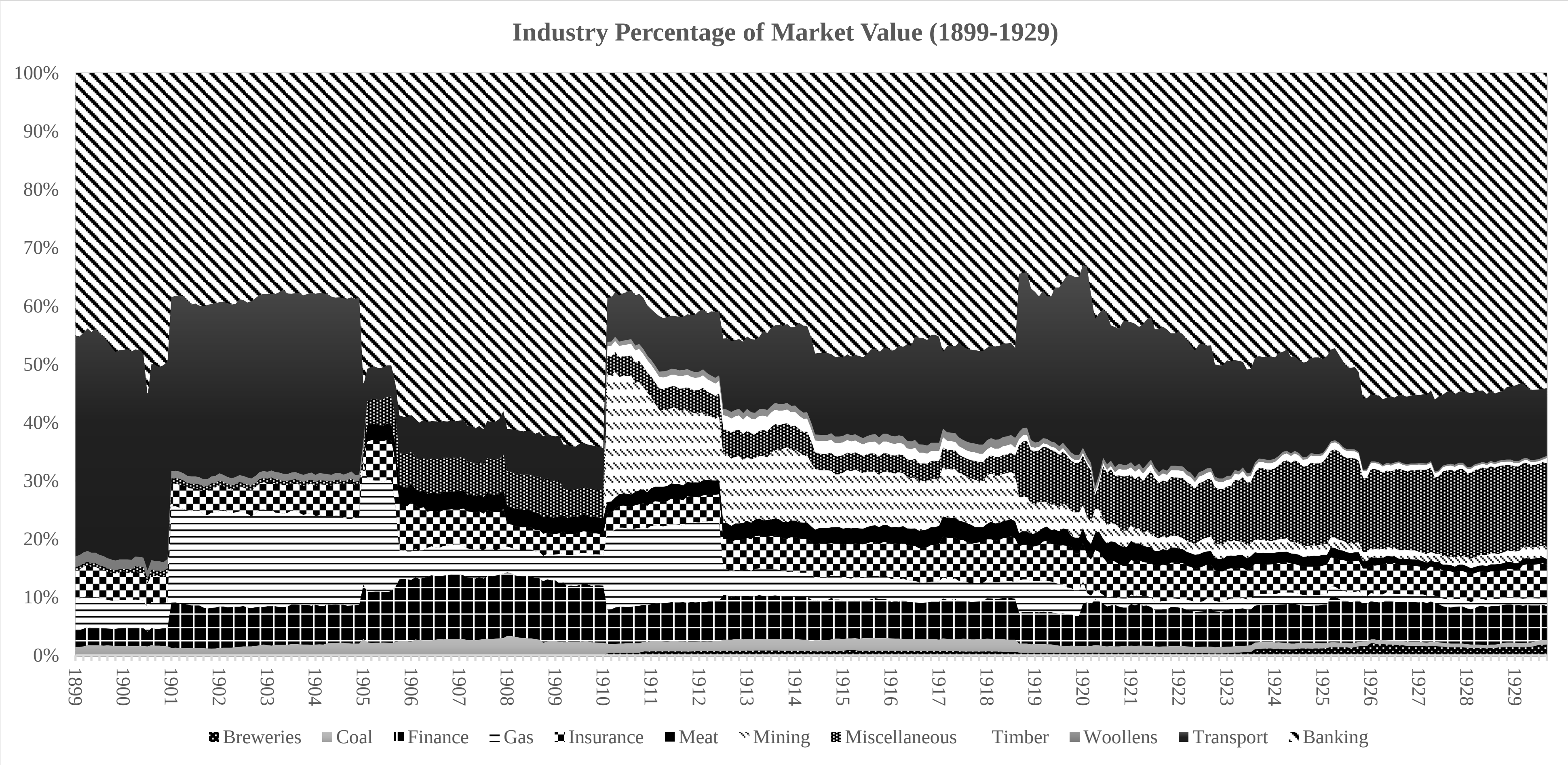
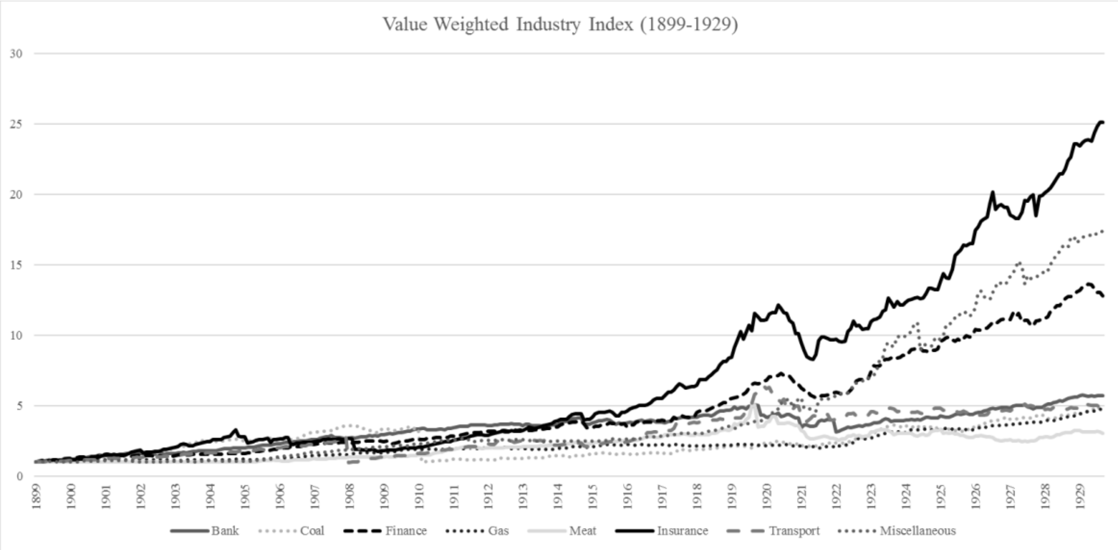


Figure 3 illustrates the percentage of market value of the different industries over the 1899-1929 period, here we can see the growth and value of the industries over time. This is a good indicator of importance in the economy and in the stock market. Banking can clearly be seen as the largest percentage of market value, continuing strongly over the entire sample period. As shown in Figure 3, Transport can also be seen holding a large percentage excluding a decline in the period 1905-1910. During this period, two large Transport companies have missing data, picking up again in 1910. This lack of data leads to a shift in value to the Banking industry.

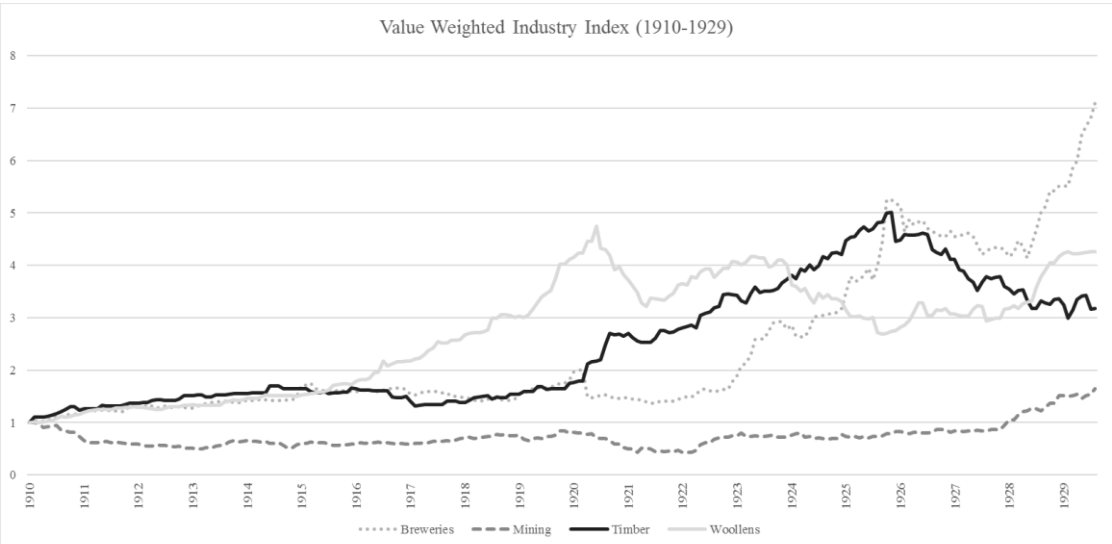
In 1910, Mining is introduced and takes over a larger share before declining slowly towards the end of the sample. This shadows the decline of Mining as an industry following the move away from mining in the New Zealand economic landscape at that time. Gas follows a similar pattern, with large positions from 1901, before declining in value from 1913 onwards, while Miscellaneous follows an inverse relationship to Mining and grows rapidly from 1919 onwards. Transport spikes again in 1919 with the addition of the Adelaide Steamship Company listing with a large market capitalisation of over two million dollars while Finance, Insurance, Coal, and Woollens remain relatively steady in market share over the full sample period.

Figure 4: Value Weighted Industry Index (1899-1929)



Value weighted indexes are constructed in Figure 4 & 5, as alternative indicators of their weighted performance over time. For clarity, the industries from the beginning of the sample are included in Figure 4, while Figure 5 details the four industries starting in 1910. The key performing industries in Figure 4 are Insurance, Miscellaneous and Finance with dramatic upward trends. The remainder of industries appear to be situated closely together experiencing minor growth with the exception of Gas and Coal which remain low seeing little growth over the sample.

Figure 5: Value Weighted Industry Index (1910-1929)



In Figure 5, we see Breweries have a large spike both in 1920 and towards in 1929, although at its peak, it is still less than half of the level of top performing industries in Figure 4. Mining remains low, producing negative value weighted returns over the sample, with Timber and Woollens following an upward trend.

Detailed summary statistics and weighted indexes and total returns are available for all twelve industries in the Appendix (Section 8.1 & 8.2). After understanding the components of the New Zealand stock market and data used, the next section looks at the methodology and factors used to investigate the research problem.

4. Asset Pricing Factors

After detailing the data used in the study, this section focusses on the construction and application of the factor models, and details the asset-pricing tests applied and analysed using the data set. The first part details how the factors are constructed and resulting portfolio properties. The factors are then tested using different portfolio sorts using time-series and cross-sectional regression analysis.

4.1 Factor Construction

To construct the factors used in the asset pricing models, we follow similarly the methodology outlined in Fama and French (1992, 2015) and Carhart (1997). The book-to-market (BTM) ratio is defined as the book value of equity divided by the company's market capitalisation. Common equity can be defined as using the balance sheet accounting equation however we refer to equity calculated as share capital plus retained earnings. There are no annual reports available for the firms in our data set; however, the share listings report components of the balance sheet, which can be applied with small adjustments to construct the factors. This information is located on monthly share listings from the Wellington and Christchurch Stock Exchanges. We define the share capital as "Paid-Up Capital" (£) for each company, and retained earnings as "Reserve Funds and Balance Carried Forward" (£). Following Fama and French, firm size is measured as the total market capitalisation of the firm – total number of shares outstanding multiplied by the share price.

Following Fama and French (1993) factor portfolios are formed using value-weighted portfolios sorted on size and other factors such as BTM, momentum, profitability or investment. We use median breakpoints for 2 x 2 sorts, and the small minus big (SMB) factors are constructed to be neutral to BTM, profitability, momentum and investment factors. The number of stocks in our sample is small, so by using 2 x 2 sorts we can guarantee that the number of stocks in each portfolio is satisfactorily large. When Fama and French developed the three factor model, they did not consider alternative definitions of SMB and HML factors. The choice of a 2 x 3 sort on Size and BTM was arbitrary. In their 2015 paper, they introduced the five factor asset pricing model and tested the sensitivity of the results by this choice constructing versions of the SMB, HML, RMW and CMA in the same way as in the 2 x 3 sorts with 2 x 2 sorts on Size and BTM, profitability and investment using NYSE medians as breakpoints. They conclude that the 2 x 2 sorts on Size and BTM, Size-Op, and Size-Inv is preferred over the 2 x 3 sorts. Since the 2 x 3 sort excludes the middle 40% of the sample, the 2 x 2 sorts produce better-diversified portfolios by using all stocks. We follow a 2 x 2 factor construction in this study for the three, four and five factor model.

The typical assumption is that accounting data should be available six months after the end of the fiscal year, however we do not have consistent records of the company's fiscal year. During the sample period, there appears to be no standardised fiscal year ending, with company's reporting different "Half Year or Year Closes" on the monthly share listings. These "Year Closes" change not only from firm to firm, but are not consistent across each year, changing during the duration of the sample period. For the purpose of this study, we have assumed the fiscal year end of December, which by most accounts appears to be the most common across the period. Therefore, portfolios involved in factor construction are formed annually in most of our analyses with the book to market factor from December (t-1) and size using June accounting values to calculate t. The six-month gap between returns and financial reporting follows Fama and French (1992) to ensure reflection of all of the pricing information. This lag prevents the look-ahead bias, which can be the result of using the data that would not have been available at that period of time.

The factors are rebalanced annually per year from 1900-1929, producing four portfolios that are based on size and book to market ratio, size and investment, size and momentum, and size and profitability. The factors are all constructed using a 2 x 2 sort, assigning each asset into one of two size and factor portfolios.

Table 4.1 Factor Portfolio No. Firms & Average Monthly Returns

The below table separates the portfolios by their assigned classification before they are subtracted to complete the factor portfolios and reports the average number of firms in each portfolio, and the average monthly return.

	Size-BTM		Size-Investment		Size-Profitability		Size-Momentum	
	Low	High	Conservative	Aggressive	Robust	Weak	Winners	Losers
Panel A: Average Number of Firms								
Small	16	25	16	14	22	13	23	17
Big	25	16	13	17	13	23	17	25
Panel B: Average Monthly Return								
Small	0.57%	0.56%	0.48%	0.28%	0.38%	0.78%	1.54%	-0.55%
Big	0.54%	1.04%	0.16%	0.25%	0.62%	0.58%	1.37%	-0.62%

Panel A of Table 4.1 shows the average number of firms across in each factor portfolio range from 13-25. The Size-BTM and Size-Momentum portfolios hold the largest number of stocks with 82 stocks across the four portfolios, while Size-Investment holds the smallest number of 60 stocks. Size-Profitability sits in the middle with 71 firms included across the four portfolios.

Panel B identifies momentum as having strong returns in both small and big portfolios, with low momentum portfolios providing negative returns over the sample period. Intuitively, recent poor performing stocks therefore offer a lower return, while recent good performing stocks return considerably high rates of returns. Our high BTM and large size portfolio indicate high returns of 13.22% annually, with the remainder of size and BTM portfolios offering returns of almost half of the high BTM and large size portfolio. This is not a standard BTM effect nor size effect, with only the high BTM and large size portfolio providing sizeable returns and no consistent difference between the high BTM and low BTM stocks or size. The Size-Profitability portfolios show the small size and robust profitability portfolio offering the highest return at 9.77% per year, while the small and weak portfolio observes a lower annual return of 4.66%. This supports Fama and French's (2015) research that suggests more robust profitability is related to higher returns. The Size-Investment portfolios offer the smallest of the factor returns with the bigger portfolios offering the lowest annual returns comparably of 1.94% and 3.04%, showing aggressive investment and size does not appear to contribute sizeably to returns. The conservative and small CMA portfolio holds the highest annual mean for investment at 5.91%. Fama and French (2015) theorise here that high investment is related to low return, and inversely that low investment is related to higher return. This is not evident in both the low CMA portfolios.

4.1.1 Value (HML)

High Minus Low (HML) is also referred to as the value premium and is one of the three factors in the Fama French three factor model. HML accounts for the spread in returns between value and growth stocks, measured using the book-to-market ratio. Companies with high book-to-market ratios are known as value stocks while low book-to-market stocks are known as growth stocks.

Stocks are first classified by size based on their market capitalisation using a median breakpoint. The small size percentile represents 3% of the total market capitalisation starting in December 1899, while the large percentile represents 97% of the market capitalisation. Secondly, the stocks are sorted based on their book-to-market ratio using a median breakpoint. Stocks in the top 50th percentile are categorised as Value companies, while the bottom 50% are Growth companies. This provides four size and BTM sorted portfolios: Small-Growth, Small-Value, Big-Growth and Big-Value. Using the monthly returns from January 1900 to September 1929, we construct value-weighted portfolio returns.

HML as defined by Fama and French (1992) is the average return on the value portfolios minus the average return on the growth portfolios. We have applied this equation using 2 x 2 sorts:

$$HML = \frac{1}{2}(Small\,Value + Big\,Value) - \frac{1}{2}(Small\,Growth + Big\,Growth) \quad (4.1)$$

4.1.2 Size (SMB)

Small Minus Big (SMB) is another factor from the Fama and French three factor model, and accounts for the spread in returns between small and large sized firms, based on the company's market capitalisation.

SMB is calculated as the average return on the small portfolios minus the average return on the big portfolios included in the model. As such, the SMB factor for the three factor model differs to that of the four- and five factor model as other factor variables are included. The SMB factor in the three factor model therefore uses the same portfolios included in the HML factor but instead subtracts the "Big" portfolios from the "Small" portfolios.

$$SMB = \frac{1}{2}\ (Small\ High + \ Small\ Low) - \frac{1}{2}(Big\ High + Big\ Low) \tag{4.2}$$

When testing the four factor model, the size and momentum portfolios created are included in the SMB factor:

$$SMB = \frac{1}{4}\ (Small\ High + \ Small\ Low + Small\ Winners + Small\ Losers) - \\ \frac{1}{4}\ (Big\ High + Big\ Low + Big\ Winners + Big\ Losers) \tag{4.3}$$

The five factor model includes size portfolios for both the investment and profitability in the SMB factor:

$$SMB = \frac{1}{6}\begin{pmatrix} Small\ High + \ Small\ Low + Small\ Robust + \\ Small\ Weak + Small\ Conservative + Small\ Aggressive \end{pmatrix} - \\ \frac{1}{6}\begin{pmatrix} Big\ High + Big\ Low + Big\ Winners + Big\ Losers + Big\ Robust + \\ Big\ Weak + Big\ Conservative + Big\ Aggressive \end{pmatrix} \tag{4.4}$$

4.1.3 Momentum (WML)

Carhart (1997) constructs the four factor model (the three factor model with a momentum factor) as the equal weight of average firms with the highest 30 percent eleven-month returns lagged one month minus the equal weight average of firms with the lowest 30 percent eleven-month returns lagged one month. We apply a 2 x 2 sort, thus the median value of the ranked previous 11-month returns lagged one month is used to divide all stocks into two groups, Winners (W) and Losers (L). We follow Fama and French (2012) in creating value weighted size-momentum portfolios, and reform them monthly. Longing winners' portfolios and shorting losers' portfolios produce the momentum portfolios, and are calculated as the difference between average monthly returns on the two winners' portfolios and the two losers' portfolios:

$$MOM = \frac{1}{2}(Small\ Winners + Big\ Winners) - \frac{1}{2}(Small\ Losers + Big\ Losers) \quad (4.5)$$

The first momentum sort absorbs a year of the data, so the sample period for all tests is from January 1900 to September 1929.

4.1.4 Profitability (RMW)

There are two measures of profitability previously used in literature. Fama and French (2015) measure profitability as operating profits, defined as revenues minus COGS, minus SG&A, minus interest expense, scaled by book equity (OP/BE) while Novy-Marx (2013) employ gross profitability, defined as revenues, minus COGS, scaled by total assets (GP/TA). Due to restrictions in accounting data, we employ net profitability scaled by book equity (NP/BE) using the change in "Reserve Funds and Balance Carried Forward" from the monthly share listings.

Wahal (2016) highlights historical inconsistency in reporting and accounting treatment of expenses including COGS and SG&A in a similar age dataset. Wahal (2016) finds up to 40 percent of firms in the US with book equity do not have COGs, therefore missing income statement data becomes more problematic. The lack of accounting standards and non-availability of the data in NZ, contribute to net profitability being employed in this study. Linnainmaa & Roberts (2016) placed different profitability and investment factors in an approximate order based on how sensitive they are to the quality of such accounting data. They believe that some anomalies, such as those based on the growth in total sales or assets, are more robust to noise in data than others, such as those based on the book value of equity. However, Fama and French (2006) show the value premium exists in pre-1963 data, and Linnainmaa and Roberts (2016) show in their study that the asset and sales growth anomalies, by contrast, are absent. On this basis, net profitability is scaled by book equity for the purpose of this study.

The profitability factor "robust minus weak" (RMW) in Fama and French (2015) is defined as: the average return on the two "robust profitability" portfolios minus the average return on the two "weak profitability" portfolios. The firms are classified in size portfolios as the other factors, and are assigned a profitability portfolio using a median breakpoint to distinguish high profitability "robust" vs low profitability "weak".

$$RMW = \frac{1}{2}(Small\ Robust + Big\ Robust) - \frac{1}{2}(Small\ Weak + Big\ Weak) \quad (4.6)$$

4.1.5 Investment (CMA)

Fama and French (2015) and Hou, Xue, and Zhang (2015) define the investment measure as the change in book value of total assets over the previous fiscal year. Cooper, Gulen, and Schill (2008) also identify it as the asset-growth anomaly, however Li (2015) notes that strategies based on asset growth also generate profitability and value related premiums, weakening the investment factor's ability in describing returns. Wahal (2016) identifies a second measure of investment based on previous findings as the growth in book equity, which is employed in this study.

The investment factor is sorted similarly to the other factors, assigned into size portfolios and into low investment "Conservative" and high investment "Aggressive" portfolios using median values.

The investment factor CMA “conservative minus aggressive” therefore is defined as:

$$CMA = \frac{1}{2}(Small\ Conservative + Big\ Conservative) - \frac{1}{2}(Small\ Aggressive + Big\ Aggressive) \quad (4.7)$$

4.2 Factor Characteristics

Table 4.3 reports monthly descriptive statistics on the factors for the period 1900-1929. We also report the market risk premium in New Zealand, which is calculated as the value-weighted monthly market return less the ten-year NZ government bond proxy (risk-free rate).

Table 4.3 Descriptive Characteristics of the Factors

	MRP	SMB 3F	SMB 4F	SMB 5F	HML	RMW	CMA	WML
Mean	0.24%	-0.22%	-0.05%	-0.02%	0.24%	0.18%	0.06%	1.75%
Median	0.26%	-0.23%	-0.08%	-0.06%	0.14%	0.25%	0.02%	1.55%
Standard Deviation	1.65%	1.78%	1.80%	1.38%	1.60%	1.75%	1.36%	1.44%
Kurtosis	17.06	7.36	8.01	3.85	4.79	3.81	8.46	4.89
Skewness	-2.61	0.40	1.54	0.51	1.05	-0.46	0.36	1.27
Minimum	-12.80%	-9.62%	-5.92%	-5.89%	-5.72%	-8.66%	-7.26%	-3.68%
Maximum	5.68%	10.56%	9.96%	7.14%	9.54%	6.63%	8.97%	9.63%

The market risk premium (MRP) has a positive mean return of 2.92% annually, same as the book-to-market factor (HML) and close to the profitability factor (RMW) of 2.22% per year. The SMB factors show negative means over the sample period with the three factor reporting the lowest mean return of -0.22% each month, and the four and five factor means higher at -0.05% and -0.02%, respectively. Fama and French (2015) report a slightly higher monthly mean on HML (2 x 2 sorts) at 0.28%, while the SMB factors are inverse to our means, producing a positive monthly mean of 0.30% (for the five factor model) and 0.27% for the SMB three factor. The MRP reported in Fama and French (1993) is almost double that of our market in this sample.

WML has the largest mean return at 1.75% per month over the sample period, providing 23.13% annually, considerably higher than all other factors. Carhart (1997) reports similar means for SMB and HML as Fama and French (1993), and report a higher momentum factor at 0.82% per month, indicating a strong positive return portfolio, as also observed in our sample. Griffin, Ji & Martin (2003) find a more comparable momentum factor in the New Zealand market looking at data from 1988 to 2000, and report momentum profits of 1.03% per month, while Nartea et al. (2009) observe a mean return on average closest to our results of 1.83% per month. This shows evidence of momentum in the NZ market, whereby a strategy of buying recent winners and selling recent losers, reforming the portfolios monthly, earns positive momentum profits as shown by the strongly positive WML factor reported in Table 4.3.

The investment factor (CMA) is the lowest positive return on the factors at 0.06% (0.72% annually), a lower figure compared to Fama and French's (2015) monthly mean of 0.22%. They find the RMW factor has a monthly mean of 0.17%, almost identical to our own RMW results of 0.18%. Novy-Marx (2013) tests both the HML and a different profitability factor (referred to as UMD) reporting 5.03% and 3.78% annual means, respectively, both significantly higher than our observed means for HML and RMW.

Monthly standard deviation remains under 2% for all factors with SMB 3F, 4F, and RMW providing the highest sources of risk. MRP and HML show similar risk around 1.60% per month (20.98% annually), with the lowest risk identified in SMB 5F and CMA. Fama and French (2015) observe higher monthly standard deviation in relation to our sample of 3.13% for SMB, and 2.16% on HML, however report similar risk to our RMW and CMA factors of 1.52% and 1.48%. Novy Marx (2013) presents higher risk on profitability at 2.94%, with very high risk associated with the HML factor at 3.27%. WML has monthly risk of 1.44% (18.72% annualised), the only factor relatively close to the corresponding return, as the remainder of factor returns are very low. Carhart's (1997) MOM factor shows a substantially higher annual standard deviation of 50.93%

The MRP shows leptokurtic kurtosis indicating that the MRP distribution has fatter tails than a normal distribution. This indicates that there is a higher than normal probability of big positive and negative returns realizations during our sample after the risk free rate has been subtracted from the market return. The mean of the MRP is smaller than the median, which shows the data is skewed to the left - showing negative skewness. It is possible this is related to some volatility in the risk-free rate, showing some tumultuous climbs and declines over the sample, coinciding with various events in the NZ economic market over this time, in particularly the war in 1914, inciting regional and global insecurity.

Table 4.4 Correlation between the Factors

MRP is the value-weighted New Zealand stock exchange minus the ten-year NZ government bond return. SMB and HML are Fama and French's (1993) portfolios for size and BTM equity. MOM is Carhart's factor mimicking portfolio for one-year return momentum. CMA and RMW are adjustments of Fama and French's (2015) factors for investment and profitability.

	MRP	SMB	HML	MOM	CMA	RMW
MRP	1.00					
SMB	-0.62	1.00				
HML	-0.30	-0.09	1.00			
MOM	-0.02	0.08	0.16	1.00		
CMA	0.05	0.05	0.13	0.10	1.00	
RMW	0.21	-0.23	-0.23	-0.06	-0.05	1.00

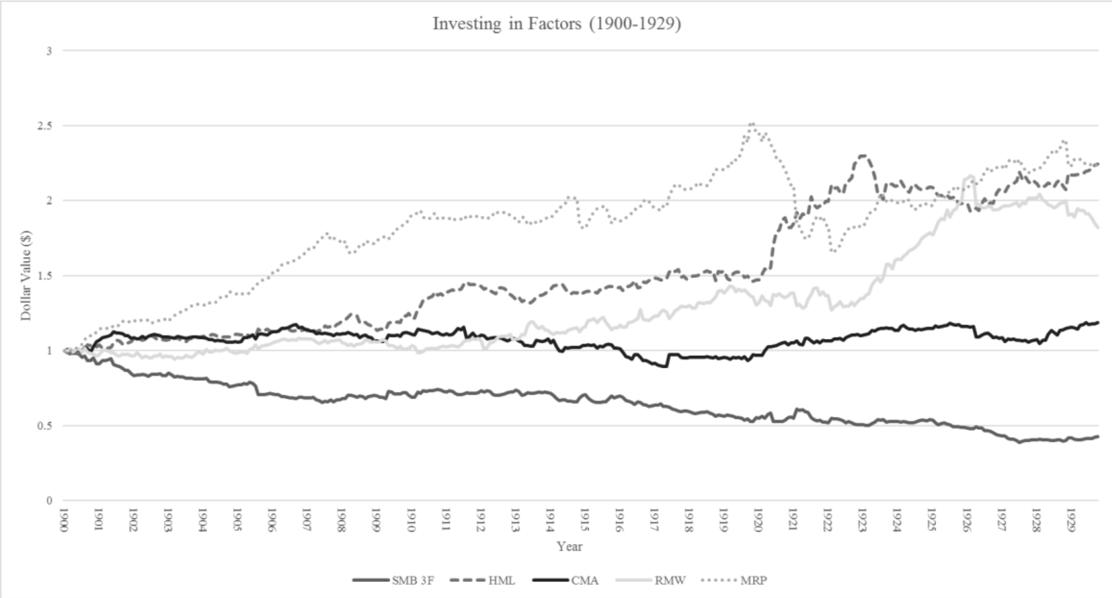
The correlation coefficients indicate that there is negative correlation between the MRP and the SMB, HML and MOM factors. SMB has a strong downhill linear relationship with MRP at -0.62, followed by HML with a weak negative relationship of -0.30. The RMW factor has a negative correlation with all the factors, apart from a relatively weak linear relationship with the MRP. The CMA factor shows almost no correlation with all factors.

Our results are consistent with Fama and French's (2015) HML factor showing a negative relationship to both MRP and SMB, however CMA is documented as having a strong relation to HML which is not replicated in our results. Carhart's (1997) MOM factor identifies a similar weak relationship with the MRP, however produces negative coefficients for both SMB and HML. Low cross-correlations across the factors here imply that multi-collinearity does not substantially affect the individual factor model loadings.

Figure 6 displays the returns that would be generated if one dollar was invested in each of the factors from 1900 to 1929. To calculate this, a monthly-compounded return was used:

$$P_t = 1 * (1 + r_{t-1})^t \tag{4.8}$$

Figure 6: Investing In Factors



In Figure 6, the market features the highest returns over the course of the sample period with both profitability and value offering high returns. The investment factor stays relatively consistent over the sample while the size factor (SMB 3F) diminishes in value over the period as interpreted by it's negative monthly mean in Table 4.3. Momentum is omitted from Figure 6 for clarity. The equivalent of investing $1 in the momentum factor returns $470 in 1929, indicating a 470% return.

In creating and evaluating the factors, we can clearly see a momentum strategy is strong in the New Zealand market. Size offers negative loadings to the market, and does not provide positive returns as seen in Figure 6. HML shows positive returns, similar to the market, while profitability surprisingly also shows significant monthly returns in line with previous literature, compared to investment, which remains low. Negative coefficients of HML against the market is surprising considering their identical monthly return. The next section in this research works to detangle the factors and tests whether the asset pricing models built using these factors do indeed capture the variation in returns.

5. Asset Pricing Tests

5.1 Time Series Tests

In this study, we evaluate multiple asset pricing models, including the traditional risk-factor models, and alternative multi-factor models. These models stipulate that the return from a stock or portfolio are a linear function of market return and range of other empirically motivated factors such as size, value, momentum, profitability and investment. The models are shown as follows:

The Capital Asset Pricing Model (CAPM):

$$RP(t) - RF(t) = a + b[RM(t) - RF(t)] + e(t) \tag{5.1}$$

Fama and French’s (1993) three factor model:

$$RP(t) - RF(t) = a + b[RM(t) - RF(t)] + sSMB(t) + hHML(t) + e(t) \tag{5.2}$$

Carhart’s (1997) four factor model:

$$\begin{aligned} RP(t) - RF(t) = a + b[RM(t) - RF(t)] + sSMB(t) \\ + hHML(t) + mMOM(t) + e(t) \end{aligned} \tag{5.3}$$

Fama and French’s (2015) five factor model:

$$\begin{aligned} RP(t) - RF(t) = a + b[RM(t) - RF(t)] + sSMB(t) \\ + hHML(t) + rRMW(t) + cCMA(t) + e(t) \end{aligned} \tag{5.4}$$

Whereby *RP(t)* is the return on security of portfolio for period *t*, *RF(t)* is the risk-free return, and *RM(t)* is the return on the value-weight (VW) market portfolio. *SMB*, *HML*, *MOM* are the factors constructed from the test portfolios, and *e(t)* is the regression residual.

The five factor model will be tested with the profitability factor as change in profitability scaled by book equity (*RMW*), while the investment factor will tested following Wahal (2016) using growth in book equity (*CMA*).

We test the CAPM, the Carhart model and the Fama French 3-/5- factor models using different sets of test assets. We use a time-series approach similar to Black, Jensen, and Scholes (1972) and Fama French (1993) to test the models. A time series approach is suited to evaluate the performance of asset pricing models, while the cross-sectional approach of Fama and MacBeth (1973) and Fama and French (1992) is suited to determine the factor risk premia.

The time series regressions are run from January 1900 to September 1929 using the returns of sorted portfolios as the dependent variable and factor returns as explanatory variables:

$$r_t = a + \beta F_t + \varepsilon_t \tag{5.5}$$

Where r_t denotes the return of the test portfolio in month t, and F_t denotes the vector of factor returns. We run regressions (4.13) for each test portfolio and thus get a cross section of a. If an asset pricing model captures the cross-section of average returns, we should find that all intercepts are jointly indistinguishable from zero. In order to test this, we apply the Gibbons, Ross, and Shanken (GRS) (1989) test.

Although there maybe high goodness of fit, models can still not perform well as an explanatory model. The Gibbons, Ross and Shanken's (1989) F-statistic is computed as a supportive approach in determining the power of the asset pricing model. The GRS test is conducted using the regression intercepts (the measure of the model's magnitude with respect to mispricing) to test the null H_0: $\alpha_i = 0$ for all of i, or simply test the intercepts jointly. If the assets are correctly priced and there is no mispricing, the intercepts should be zero. The GRS test states that should all of the intercepts or α's jointly equal zero, then the statistic will also be zero. As the α's increase in absolute value so too will the value of the GRS statistic. Therefore, the GRS tests on the intercepts enable us to judge the power of these asset-pricing models further. A failure to reject the null hypothesis represents statistical evidence that the model captures the variation of asset or portfolio returns.

The equation for the single factor model is:

$$\frac{T-N-1}{N}\left[1+\left(\frac{E_T\,(f)}{\hat{\sigma}(f)}\right)^2\right]^{-1}\hat{\alpha}'\,\hat{\Sigma}^{-1}\hat{\alpha}\sim F_{N,T-N_1} \qquad (5.6)$$

Where *T* is the number of observations in the time-series, *N* is the number of assets, $E_T(f)$ denotes the sample mean, and $\hat{\sigma}$ the standard deviation. $\hat{\alpha}$ is the vector of estimated intercepts (alphas), and Σ is the covariance matrix computed from residuals.

An extension of Equation 4.14 incorporates multiple factors:

$$\frac{T-N-K}{N}\left(1+E_T(f)'\hat{\Omega}^{-1}E_T\right)^{-1}\hat{\alpha}'\,\hat{\Sigma}^{-1}\hat{\alpha}\sim F_{N,T-N-K} \qquad (5.7)$$

Where Ω is the *K x K* covariance matrix of the factor returns and the alphas are sourced from a multivariate regression.

A large value of the GRS test is undesirable as it indicates the value of the intercepts are different and therefore the factor models are not effective in explaining variation of returns for a portfolio. We use the p-values to indicate whether we can reject the null hypothesis.

5.1.1 Single Sorted Portfolios

In this section, portfolios of stocks are formed on common factors relating to expected return. Sorting by size, book-to-market equity, and dividend yield performance is estimated on the resulting portfolios. To check the inferences about the role of size and book-to-market risk factors in returns is to examine whether these variables explain the returns on portfolios formed on other variables known to be informative about average returns.

The portfolios are held for one year then re-formed. This creates a time series of monthly returns on each decile portfolio from 1900 to 1929. If assets are priced rationally, variables that are related to average returns, such as size and book to market equity, must proxy for sensitivity to common risk factors returns (Fama and French 1993). The slopes and adjusted R^2 values show whether mimicking portfolios for risk factors related to common factors capture variation in stock returns not explained by other factors. If the models correctly measures risk, both the high and low portfolios loadings will be different. If the model explains cross-sectional variation in average returns, the intercepts will be zero when the returns are regressed on the factors.

Table 5.1 Characteristics of Test Portfolios

Portfolios:	1 (Low)	2	3	4	5 (High)	1- 5
Panel A: Portfolios Formed on Book-to-Market Equity						
Monthly Return	0.07%	0.03%	0.16%	-0.01%	0.00%	0.07%
St Dev	1.91%	1.35%	0.87%	1.35%	1.13%	0.79%
No. of Firms	17	15	16	16	15	
Panel B: Portfolios Formed on Size						
Monthly Return	0.31%	0.25%	0.19%	0.50%	0.24%	0.06%
St Dev	2.43%	1.52%	1.44%	1.89%	2.04%	0.39%
No. of Firms	15	16	16	16	16	
Panel C: Portfolios Formed on Dividend Yield						
Monthly Return	0.19%	0.00%	0.19%	0.12%	0.45%	-0.26%
St Dev	1.99%	1.59%	1.12%	1.49%	1.92%	0.07%
No. of Firms	12	12	12	12	11	

Table 5.1 reports the value weighted monthly excess returns in Panel A of the portfolios formed on BTM equity. Stocks are classified into portfolios based on their BTM equity with Portfolio 1 holding the lowest BTM (growth) stocks up to Portfolio 5 which holds the highest BTM (value) stocks. Portfolio 4 reports a small negative return of -0.01% while portfolio 5 observes almost zero return. Portfolio 3 reports the best return of 0.16% per month over the sample period, while also holding the least risk of the five portfolios at 0.87%. The spread of returns is 0.07%, while the standard deviation shows a spread of 0.79%. The highest risk in the BTM portfolios is found in the lowest BTM portfolio of 1.91%. This portfolio also holds one more firm on average comparatively to the other BTM portfolios.

In Panel B, the stocks are sorted into five portfolios ranging from the smallest firms in Portfolio 1 to the largest firms in Portfolio 5. Stronger excess returns are found in three sorts across the five portfolios with a spread of 0.06% between the smallest and largest firms. Portfolio 4 holds the highest return of 0.50%, while Portfolio 3 offers the lowest return of 0.19%. Standard deviation is higher across all portfolios with Portfolio 1 carrying the highest risk of 2.43%. The number of firms in each portfolio shows little variation, only Portfolio 1 having one less firm than the others.

Panel C sees the stocks sorted into five portfolios based on their dividend yield. Portfolio 1 holds the firms with the lowest dividend yields up to Portfolio 5 which holds the stocks with the highest dividend yields. Portfolio 2 shows no excess return over the market, while Portfolio 5 has the highest excess return. This indicates no pattern in dividend yields and returns. The standard deviation is highest for Portfolio 1 carrying risk of 1.99%, while Portfolio 3 holds the least risk at 1.12%, despite having the same excess monthly return. The number of firms is smaller than the two other sorts and is attributable to not all firms paying dividends over the sample period.

These sorted value weighted portfolios on size, BTM and dividend yield are regressed against the factor portfolios including the three factor, four factor and five factor models in Table 5.2.

Table 5.2 One Dimensional Test Portfolios

The stocks are sorted each year in December into quintile portfolios based on their previous calendar year's book-to-market equity (BE/ME), size and dividend yield. The portfolios are value weighted. Stocks with the highest BE/ME comprise quintile 1 and stocks with the lowest comprise quintile 5. The size (dividend yield) sorted portfolios comprise of the large (high) stocks in quintile 5, and the smallest stocks (low) in portfolio 1. RMRF is the excess return on the market, while SMB and HML are Fama and French's (1993) factor mimicking portfolios for size and book-to-market equity. MOM is a factor mimicking portfolio for one-year return momentum. CMA amd RMW are Fama and French's (2015) factor portfolios for investment and profitability. Alpha is the intercept of the model. Average return is the time-series average of the monthly returns in percent. The Gibbons, Ross, and Shanken (1979) test statistic is presented each of the size, BTM and dividend yield portfolios. The p-values are reported for each of the models. ***, ** and * indicate significance at 1%, 5% and 10% levels.

	CAPM			3-Factor Model					4-Factor Model						5-Factor Model						
Portfolio	Alpha	MRP	Adj. R-sq	Alpha	RMRF	HML	SMB	Adj. R-sq	Alpha	MRP	HML	SMB	MOM	Adj. R-Sq	Alpha	MRP	HML	SMB	CMA	RMW	Adj. R-sq
Panel A: Portfolios Formed on Book-to-Market Equity (BE/ME)																					
1 low	-0.05%	0.48***	0.169	-0.04%	0.54***	0.01	0.08	0.168	-0.17%	0.70***	0.01	0.28***	0.05	0.201	-0.04%	0.50***	-0.03	0.04	0.06	-0.04	0.16
	(-0.49)	(8.58)		(-0.46)	(6.72)	(0.17)	(1.17)		(-1.16)	(8.07)	(0.23)	(3.54)	(0.68)		(-0.38)	(6.72)	(-0.51)	(0.46)	(0.84)	(-0.80)	
2	-0.03%	0.25***	0.088	-0.09%	0.38***	0.22***	0.10**	0.135	-0.30%***	0.40***	0.18***	0.12**	0.11**	0.158	-0.09%	0.34***	0.17***	0.06	0.03	-0.04	0.13
	(-0.46)	(5.95)		(-1.34)	(6.56)	(4.60)	(2.03)		(-2.79)	(6.28)	(4.03)	(2.14)	(2.19)		(-1.24)	(6.28)	(3.80)	(1.03)	(0.52)	(-1.12)	
3	0.13%***	0.15***	0.082	0.10%**	0.26***	0.12***	0.11***	0.125	0.01%	0.31***	0.10***	0.16***	0.03	0.161	0.09%*	0.24***	0.10***	0.13***	-0.03	0.01	0.12
	(2.88)	(5.72)		(2.21)	(6.96)	(3.93)	(3.26)		(0.22)	(7.56)	(3.46)	(4.33)	(1.08)		(1.94)	(6.99)	(3.30)	(3.23)	(-0.91)	(0.36)	
4	-0.03%	0.08*	0.007	-0.06%	0.37***	0.15***	0.37***	0.127	-0.06%	0.45***	0.10**	0.43***	-0.04	0.148	-0.07%	0.32***	0.06	0.41***	-0.12**	-0.08*	0.12
	(-0.43)	(1.91)		(-0.81)	(6.40)	(3.27)	(7.07)		(-0.52)	(7.03)	(2.15)	(7.49)	(-0.73)		(-1.02)	(5.96)	(1.28)	(6.78)	(-2.35)	(-1.88)	
5 high	-0.04%	0.17**	0.057	-0.04%	0.22***	0.04	0.07	0.058	-0.05%	0.26***	0.03	0.11**	-0.01	0.062	-0.04%	0.19***	0.02	0.02	-0.03	-0.02	0.05
	(-0.63)	(4.72)		(-0.73)	(4.45)	(0.90)	(1.58)		(-0.52)	(4.61)	(0.73)	(2.09)	(-0.15)		(-0.66)	(4.01)	(0.38)	(0.43)	(-0.62)	(-0.46)	
1-5 spread	-0.01%	0.31***	0.056	0.00%	0.31***	-0.03	0.01	0.051	-0.12%	0.45***	-0.01	0.17*	0.05	0.063	0.00%	0.31***	-0.05	0.02	0.09	-0.03	0.05
	(-0.08)	(4.71)		(0.00)	(3.29)	(-0.34)	(0.15)		(-0.69)	(4.23)	(-0.19)	(1.82)	(0.64)		(0.03)	(3.53)	(-0.63)	(0.16)	(1.04)	(-0.43)	
GRS F-Test	2.12			1.77					1.83						1.52						
p-value	0.06			0.12					0.11						0.18						
Panel B: Portfolios Formed on Size																					
1 (small)	0.28%**	0.11	0.00	0.16%	0.82***	0.57***	0.82***	0.22	-0.11%	0.90***	0.40***	0.86***	0.08	0.24	0.17%	0.58***	0.29***	0.68***	-0.04	-0.26***	0.15
	(2.17)	(1.37)		(1.35)	(8.32)	(7.06)	(9.38)		(-0.59)	(8.31)	(5.16)	(8.82)	(0.90)		(1.35)	(6.07)	(3.54)	(6.34)	(-0.45)	(-3.64)	
2	0.19%**	0.25***	0.07	0.15%**	0.81***	0.26***	0.72***	0.45	0.04%	0.88***	0.12***	0.75***	0.00	0.45	0.14%**	0.65***	0.00	0.73***	0.07	-0.23***	0.43
	(2.38)	(5.39)		(2.46)	(15.59)	(6.08)	(15.60)		(0.41)	(15.17)	(2.90)	(14.40)	(0.08)		(2.28)	(13.37)	(0.08)	(13.19)	(1.58)	(-6.23)	
3	0.15%*	0.19***	0.05	0.09%	0.38***	0.22***	0.18***	0.10	-0.02%	0.53***	0.20***	0.35***	0.03	0.17	0.04%	0.35***	0.18***	0.28***	0.14**	0.12***	0.16
	(1.93)	(4.29)		(1.20)	(5.99)	(4.21)	(3.23)		(-0.18)	(7.87)	(4.17)	(4.17)	(0.59)		(0.59)	(6.19)	(3.73)	(4.41)	(2.53)	(2.92)	
4	0.42%***	0.33***	0.08	0.33%***	0.47***	0.31***	0.08	0.13	0.13%	0.50***	0.28***	0.12	0.10	0.14	0.33%***	0.50***	0.27***	0.14	-0.01	-0.09*	0.13
	(4.31)	(5.66)		(3.41)	(5.84)	(4.66)	(1.13)		(0.90)	(5.64)	(4.40)	(1.44)	(1.47)		(3.45)	(6.66)	(4.30)	(1.64)	(-0.17)	(-1.65)	
5 (large)	-0.05%**	1.22***	0.96	-0.04%*	1.14***	-0.06***	-0.09***	0.97	-0.07%**	1.12***	-0.05***	-0.10***	0.03**	0.97	-0.04%*	1.15***	-0.03*	-0.11***	0.01	0.04***	0.97
	(-2.24)	(95.26)		(-1.73)	(65.50)	(-4.08)	(-5.93)		(-2.28)	(58.12)	(-3.35)	(-5.90)	(2.04)		(-1.74)	(72.85)	(-1.93)	(-6.18)	(0.43)	(3.72)	
1-5 spread	0.33%**	-1.11***	0.35	0.19%*	-0.32***	0.62***	0.91***	0.52	-0.03%	-0.22**	0.44***	0.97***	0.05	0.53	0.20%	-0.57***	0.31***	0.79***	-0.05	-0.30***	0.47
	(2.47)	(-13.83)		(1.65)	(-3.21)	(7.77)	(10.40)		(-0.18)	(-2.06)	(5.74)	(9.84)	(0.62)		(1.63)	(-5.98)	(3.85)	(7.34)	(-0.51)	(-4.24)	
GRS F-Test	5.28			4.14					1.11						3.71						
p-value	0.00			0.00					0.36						0.00						

Table 5.2 Continued

Panel C: Portfolios Formed on Dividend Yield																					
1 (low)	0.02%	0.73***	0.36	-0.03%	0.81***	0.17***	0.04	0.38	-0.13%	0.88***	0.16***	0.12*	0.05	0.38	-0.02%	0.76***	0.14**	-0.04	-0.01	-0.04	0.37
	(0.19)	(14.34)		(-0.39)	(11.17)	(2.85)	(0.65)		(-0.99)	(10.97)	(2.88)	(1.71)	(0.73)		(-0.22)	(11.47)	(2.54)	(-0.50)	(-0.09)	(-0.84)	
2	-0.06%	0.27***	0.08	-0.11%	0.50***	0.21***	0.25***	0.13	-0.03%	0.53***	0.18***	0.27***	-0.07	0.12	-0.13%	0.45***	0.15***	0.28***	-0.05	-0.01	0.12
	(-0.73)	(5.53)		(-1.35)	(7.29)	(3.81)	(4.05)		(-0.21)	(6.98)	(3.27)	(3.88)	(-1.18)		(-1.54)	(7.17)	(2.80)	(3.84)	(-0.88)	(-0.28)	
3	0.14%**	0.21***	0.09	0.09%	0.38***	0.20***	0.17***	0.16	-0.03%	0.35***	0.16***	0.12**	0.06	0.15	0.07%	0.33***	0.16***	0.18***	0.02	0.02	0.16
	(2.49)	(5.97)		(1.61)	(7.94)	(5.30)	(3.94)		(-0.31)	(6.59)	(4.16)	(2.56)	(1.45)		(1.30)	(7.63)	(4.32)	(3.61)	(0.40)	(0.55)	
4	0.06%	0.24***	0.07	-0.02%	0.43***	0.28***	0.16***	0.13	-0.01%	0.55***	0.27***	0.29***	-0.03	0.17	-0.06%	0.43***	0.25***	0.29***	0.05	0.08**	0.18
	(0.75)	(5.16)		(-0.23)	(6.72)	(5.34)	(2.88)		(-0.09)	(7.88)	(5.42)	(4.70)	(-0.58)		(-0.79)	(7.52)	(5.13)	(4.52)	(0.86)	(1.98)	
5 (high)	0.37%***	0.30***	0.06	0.37%***	0.61***	0.09	0.42***	0.14	-0.04%	0.74***	-0.01	0.56***	0.19***	0.25	0.35%***	0.55***	-0.04	0.50***	-0.04	-0.09	0.14
	(3.75)	(5.05)		(3.84)	(7.47)	(1.31)	(5.84)		(-0.32)	(8.77)	(-0.12)	(7.34)	(2.93)		(3.60)	(7.34)	(-0.60)	(5.87)	(-0.50)	(-1.58)	
1-5 spread	-0.36%***	0.43***	0.07	-0.40%***	0.20*	0.08	-0.38***	0.12	-0.09%	0.13	0.17**	-0.44***	-0.15	0.15	-0.37%***	0.21**	0.18**	-0.54***	0.03	0.05	0.14
	(-2.71)	(5.46)		(-3.10)	(1.81)	(0.90)	(-3.91)		(-0.44)	(1.12)	(1.99)	(-4.03)	(-1.57)		(-2.84)	(2.14)	(2.14)	(-4.72)	(0.32)	(0.62)	
GRS F-Test	4.03			3.79					0.26						3.49						
p-value	0.00			0.00					0.94						0.00						

Panel A of Table 5.2 presents the performance and loadings of the models in the five BTM sorted portfolios. The CAPM presents minimal significance in the intercepts for the BTM portfolios with Portfolio 3 returning an alpha of 0.13% for the one factor model. The portfolios show variation in the coefficients as the decrease from 0.48 to 0.17 for the highest BTM portfolio. This shows the one factor model can partially explain the relation between average return and BTM and can capture some of the variation in returns. This is consistent for the MRP through the models with the coefficients for both the three and five factor model producing the same spread of 0.31, and the four factor observing a spread in loading of 0.45. The R^2 of the one factor model holds an inverse relationship to the BTM portfolios, decreasing in value as the BTM portfolio's increase.

The addition of the SML and HML factors show similar non-significance in the intercepts, leaving no residual BTM effect in average returns. We see little variation in the factor loadings for both the HML and SMB factors, with the first and last portfolios producing insignificant results. There is no pattern in the HML coefficients, which is not what should be expected when formed by BTM equity, observing a minimal spread of -0.03 between the high and low BTM portfolios. This indicates no strong relation between BTM and average returns. The adjusted R^2 decreases by a few basis points at the most across the models as factors are added, and continues to decrease as the BTM portfolios increase. It is possible that the CAPM model captures or includes some of the HML factor.

The addition of the MOM factor indicates insignificance at a 90% confidence level for all but one of the BTM portfolios (Portfolio 2). The four factor model does have the largest spread in the intercepts of -0.12% indicating a residual effect in average returns. The adjusted R^2 is the highest for the four factor growth portfolio, suggesting the MOM factor improves the model more than would be expected by chance. SMB provides some variation in significant factor loadings with a spread of 0.17, while HML again shows no movement in the coefficients. The MRP factor shows a stronger association in the four factor model with a factor loading of 0.70 in Portfolio 1.

The five factor model (including CMA and RMW) indicate the majority of coefficients are statistically insignificant. HML, SMB, CMA and RMW are all insignificantly different for the highest and lowest BTM portfolios. CMA and RMW observe negative factor loadings for Portfolio 4 of -0.12 and -0.08, respectively. The spread in alpha is not significantly different from zero, but again seems captured by market risk.

All four of the asset pricing models pass the GRS test statistic with p-values above the 5% level. This means we cannot reject the null hypothesis that the alphas are jointly equal to zero, the models produce only one significant alpha when sorted on BTM. Interestingly, the five factor GRS statistic is the lowest across the models, at a value of 1.52 and a p-value of 0.183, generally deeming superiority of the model, with similar values for both the three and four factor models. The CAPM shows the highest test statistic of 2.12, with a p-value significant at a 5% level of 0.062.

Panel B of Table 5.2 implements the size portfolios regressed against the factor models. The CAPM intercepts initially decrease in value, until Portfolio 4 observes a large alpha of 0.42%, before decreasing to a negative alpha in the largest size portfolio of -0.05%. The coefficients in the one-factor model provide a large variation of -1.11 in the coefficient spread, increasing in value as firm size grows.

In the three factor model, we see the SMB coefficients decrease steadily into the large portfolios from a loading of 0.82 to -0.09 in Portfolio 5, which captures the relation between size and return. When introducing the HML and SMB factors, MRP shows less variation with a spread of -0.32. The HML factor seems to generally decrease (with the exception of Portfolio 4) producing a coefficient spread of 0.62. The adjusted R^2 increases from 0.22 to 0.97 for the largest size portfolio indicating the model explains 97% of the variability of excess returns. The large size portfolio returns the highest adjusted R^2 of 0.97 across all of the models, with a 1% increase from the one-factor model. Like Fama and French (1992) and Chan and Chen (1998), we find that when portfolios are formed on size alone, there are relations between average returns and either size and beta. Average return generally increases with beta and decreases with size.

When the MOM factor is added to the model, we observe some insignificant results with little variation in the MOM factor loadings however the intercepts are the lowest across all the size-sorted portfolios with a spread of -0.03%. SMB and HML show similar coefficients to the three factor model with the addition of MOM capturing much of the variation in intercepts. The R^2 again shows small improvement in the explanatory power of the four factor, apart from the large size portfolio which is stable across the models at 0.97. The five factor model sees little variation or significance in the CMA factor, while the RMW factor shows the loading increase from -0.26 from the smallest size portfolio to 0.04 for the largest portfolio, with a spread of -0.30 indicating a weak association with RMW.

The GRS test statistic in Table 4.7 identifies that the null hypothesis cannot be rejected for the four factor model on the size test portfolios. The GRS test statistic for the four factor model is 1.11 with a p-value of 0.355. The CAPM, three factor, and five factor models on size portfolios can reject the null hypothesis that all intercepts are equal to zero, at a 1% level.

Panel C shows results for the same factor model regressions applied to portfolio sorts based on dividend yield, with the lowest dividend yields in Portfolio 1 and the highest in Portfolio 5. The CAPM model shows variation in betas of 0.43, indicating average returns can be partially explained by the one-factor model. Alphas show a spread of -0.36% but with a majority statistically insignificant. The adjusted R^2 decreases dramatically from the 1st to 2nd portfolio before slowing to a one percent change as the dividend yields rise in portfolios. The three factor model lends little variation to the HML factor while SMB provides a factor loading spread of -0.38. The intercept observed in Portfolio 5 is high at 0.37% and statistically significant. The adjusted R^2 increases showing the three factor does have more explanatory power across all portfolios compared to the one-factor model.

Alphas tend to increase to positive across the models sorted by dividend yield excluding the four factor model. The addition of the MOM factor does not provide much variation of intercepts, suggesting the four factor model captures much of the variation. The adjusted R^2 shows more explanatory power in the higher portfolios, with the variables explaining 25% of the returns in Portfolio 5 – the highest compared to the other factor models. The CMA and RMW factors do not provide any additionally significant information, with weak variation in the coefficients, and a slightly lowered adjusted R^2. Portfolio 5 shows a high positive intercept of 0.35% with a spread of -0.37%, similar to the CAPM, and three factor models. All but the four factor model fail the GRS test with p-values close to zero. Carhart's (1997) model passes with a test statistic of 0.26, and probability of 0.935 therefore we cannot reject the null hypothesis.

The single sorted portfolios identify a few key inferences about the variation in returns. Interestingly, the CAPM model performs well in portfolios sorted by BTM equity, with the three factor model not picking up any variation in the HML and SMB factor loadings. This suggests the relation between BTM and average returns is weak. The intercepts across all the models are for the majority insignificant, while all models pass the GRS test statistic. The size portfolios conversely show that size captures some of the variation in returns, similar to previous literature. The p-values for all but the four factor model are effectively zero, which doesn't bode well for the effectiveness of the models, while the four factor model passes with a low GRS statistic. The dividend yield portfolios show similar results to the size portfolios, and once again support superiority of the four factor model with the lowest GRS value of 0.26. This provides strong evidence across multiple portfolio sorts that the four factor model can indeed explain average returns.

5.1.2 Double Sorted Portfolios

To test the asset pricing models, we follow the portfolio formation technique of Fama and French (1993) with some adjustments. Due to the size of the New Zealand market over our sample period, we construct nine portfolios. Each December all stocks in our sample are ranked by their book-to-market value and each stock is assigned to one of three book to market portfolios. The first portfolio (growth) contains the first third of stocks with the lowest book-to-market ratio, with the second portfolio containing the average mid-range book-to-market ratio, while the third portfolio (value) contains stocks which on average have the highest book-to-market value.

Separately, the stocks are also ranked by market capitalisation and assigned one of three size groups. The first portfolio contains the third of the stocks with the smallest market capitalisation through to the third portfolio which contains the third of the stocks with the largest market capitalisation. Therefore, each stock is assigned a classification to one size portfolio and one book-to-market portfolio, giving us a total of nine double sorted size and book-to-market portfolios (3 x 3). Each portfolio is held for 12 months and value weighted returns are calculated. This is repeated for all stocks across the sample.

Table 5.3 Characteristics of the portfolios

The table below presents the average number of firms, mean and standard deviation during the period 1900-1929 of the nine size and book-to-market portfolios (portfolios are reformed in December each year). The nine portfolios are formed by independently ranking all stocks on their book-to-market value and size. The intersection of the three book-to-market portfolios and three size portfolios leads to the creation of the nine portfolios.

	1 (low)	2	3 (high)	1 (low)	2	3 (high)	1 (low)	2	3 (high)
	Panel A: Average Return			Panel B: Standard Deviation			Panel C: Average No. of Firms		
1 (small)	0.21%	0.02%	0.36%	3.32%	1.54%	3.43%	6	8	13
2	0.30%	0.07%	0.27%	2.32%	2.04%	1.95%	8	10	10
3 (big)	0.14%	0.47%	0.78%	2.28%	2.84%	3.33%	13	10	4

Looking at the performance of the nine portfolios in Table 5.3, we can see that the value tertiles overall have the higher returns of the nine portfolios. This premium to value stocks is consistent with other studies in New Zealand (Bryant & Eleswarapu, 1997, Nartea et al (2009)). The big stocks earn a higher return observed through the book-to-market portfolios with the largest stocks and high book-to-market value earning the highest average monthly return.

Panel B reports the standard deviation of the nine portfolios. The standard deviations are relatively similar with the highest standard deviation found intuitively in the value portfolios. The small size and low BTM portfolio also report a relatively high standard deviation in comparison to the average monthly return, while the middle size tertile and high BTM value return a smaller standard deviation compared to the level of average return reported in Panel A.

Panel C reports the average number of companies within each of the nine size-BTM portfolios. The value stocks are underrepresented in the big stocks, with only 14% of classified big stocks classified as value stocks. As we move down the big tertile, the average number of firms decreases to an average of six firms in smallest growth portfolio.

Table 5.4 Performance of Portfolios Formed on Size and Book-to-Market Equity

The stocks are double sorted each year in December into nine portfolios based on their previous calendar year's size and book-to-market classification. The portfolios are value weighted. Stocks with the lowest BE/ME comprise tertile 1 and stocks with the highest comprise tertile 3. The size sorted portfolios comprise of the largest stocks in tertile 3, and the smallest stocks in tertile 1. The intersection of the three size and three BE/ME creates nine double sorted portfolios. The market beta coefficient is *b* and the intercept is *a*, with t-statistics provided in the second column for each factor. The adjusted R^2 of the nine portfolios are found in Table 5.5. *s* and *h* are Fama and French's (1993) factor mimicking portfolios for size and book-to-market equity. *m* is a factor mimicking portfolio for one-year return momentum and *c* and *r* are Fama and French's (2015) factor portfolios for investment and profitability with adjustments. ***, ** and * indicate significance at 1%, 5% and 10% levels.

Panel A: CAPM	Book-to-market equity (BE/ME) tertiles					
Size Tertiles	1 (low)	2	3 (high)	1 (low)	2	3 (high)
		b			t (b)	
1 (small)	0.257**	0.197***	0.162	2.43	4.08	1.47
2	0.091	0.220***	0.334***	1.22	3.41	5.53
3 (big)	1.236***	0.887***	0.466***	37.25	11.320	4.46
		a			t (a)	
1 (small)	0.0015	-0.0003	0.0032*	0.85	-0.39	1.74
2	0.0028***	0.0002	0.0019*	2.24	0.19	1.90
3 (big)	-0.0016***	0.0025*	0.0067***	-2.90	1.95	3.86
GRS F-Test	3.57					
p-value	0.00					

Panel B: 3 Factor	Book-to-market equity (BE/ME) tertiles					
Size Tertiles	1 (low)	2	3 (high)	1 (low)	2	3 (high)
		b			t (b)	
1 (small)	0.561***	0.431***	1.613***	3.93	6.41	14.16
2	0.130	0.471***	0.601***	1.21	5.22	7.35
3 (big)	1.194***	0.776***	0.436***	25.44	6.96	3.31
		h			t (h)	
1 (small)	-0.334***	0.153***	1.264***	-2.88	2.80	13.66
2	0.014	0.088	0.435***	0.16	1.20	6.56
3 (big)	-0.119***	0.061	0.825***	-3.12	0.67	7.72
		s			t (s)	
1 (small)	0.599***	0.282***	1.618***	4.72	4.73	16.01
2	0.052	0.337***	0.210***	0.55	4.21	2.89
3 (big)	-0.011	-0.192*	-0.404***	-0.27	-1.94	-3.46
		a			t (a)	
1 (small)	0.0029*	-0.0006	0.0003	1.72	-0.77	0.21
2	0.0028**	0.0001	0.0007	2.19	0.14	0.72
3 (big)	-0.0012**	0.0022*	0.0039**	-2.23	1.69	2.51
GRS F-Test	2.07					
p-value	0.03					

Panel C: 4 Factor

Size Tertiles	Book-to-market equity (BE/ME) tertiles 1 (low)	2	3 (high)	1 (low)	2	3 (high)
		b			t (b)	
1 (small)	0.657***	0.543***	1.639***	4.19	7.45	12.18
2	0.301***	0.590***	0.721***	2.57	5.97	8.06
3 (big)	1.228***	0.667***	0.430***	23.64	5.45	2.95
		h			t (h)	
1 (small)	-0.461***	0.117**	0.937***	-4.14	2.26	9.79
2	0.023	0.044	0.417***	0.28	0.62	6.55
3 (big)	-0.119***	0.097	0.852***	-3.21	1.12	8.22
		s			t (s)	
1 (small)	0.679***	0.399***	1.538***	4.80	6.05	12.66
2	0.259**	0.458***	0.340***	2.44	5.12	4.21
3 (big)	0.032	-0.314***	-0.372***	0.68	-2.85	-2.82
		m			t (m)	
1 (small)	0.132	-0.022	-0.010	1.07	-0.39	-0.09
2	0.059	-0.037	-0.028	0.64	-0.47	-0.39
3 (big)	0.052	-0.100	0.370***	1.28	-1.04	3.22
		a			t (a)	
1 (small)	-0.0003	-0.0008	-0.0017	-0.12	-0.68	-0.73
2	0.0013	0.0001	0.0006	0.67	0.05	0.43
3 (big)	-0.0022**	0.0044**	-0.0019	-2.52	2.16	-0.78
GRS F-Test	1.02					
p-value	0.42					

Panel D: 5 Factor

Size Tertiles	Book-to-market equity (BE/ME) tertiles 1 (low)	2	3 (high)	1 (low)	2	3 (high)
		b			t (b)	
1 (small)	0.292**	0.403***	1.128***	2.21	6.56	9.70
2	0.164*	0.401***	0.532***	1.67	4.88	7.20
3 (big)	1.210***	0.846***	0.472***	27.97	8.24	3.91
		h			t (h)	
1 (small)	-0.600***	0.097*	0.716***	-5.34	1.87	7.26
2	0.026	-0.017	0.313***	0.31	-0.25	4.98
3 (big)	-0.106***	0.154*	0.912***	-2.90	1.77	8.92
		s			t (s)	
1 (small)	0.247*	0.372***	1.438***	1.65	5.34	10.92
2	0.167	0.413***	0.136	1.51	4.44	1.63
3 (big)	0.019	-0.120	-0.549***	0.38	-1.03	-4.02
		r			t (r)	
1 (small)	-0.405***	0.022	-0.338***	-4.10	0.48	-3.90
2	0.074	0.024	-0.214***	1.01	0.38	-3.87
3 (big)	-0.019	0.137	-0.028	0.79	1.80	-0.31
		c			t (c)	
1 (small)	-0.005	-0.090	0.173	-0.04	-1.54	1.56

2	-0.041	0.154**	0.131*	-0.44	1.96	1.86
3 (big)	0.025	-0.062	0.073	-0.46	-0.63	0.64
		a			t (a)	
1 (small)	0.0037**	-0.0009	0.0000	2.12	-1.17	0.02
2	0.0025**	-0.0002	0.0010	1.94	-0.20	1.07
3 (big)	-0.0013***	0.0020	0.0044***	-2.33	1.52	2.80
GRS F-Test	2.59					
p-value	0.007					

Table 5.5 Adjusted R^2 of Double Sorted Portfolios

	BE/ME			BE/ME		
Size Tertiles	1 (low)	2	3 (high)	1 (low)	2	3 (high)
		CAPM			*3 Factor*	
1 (small)	1.30%	4.20%	0.30%	12.40%	9.70%	47.90%
2	0.10%	2.80%	7.60%	-0.30%	7.00%	17.20%
3 (big)	79.50%	26.30%	5.00%	80.00%	27.10%	26.40%
		4 Factor			*5 Factor*	
1 (small)	14.50%	13.70%	40.90%	11.10%	10.90%	35.90%
2	1.70%	9.40%	19.50%	0.00%	9.10%	19.90%
3 (big)	80.10%	28.80%	26.50%	79.90%	26.90%	26.90%

In Table 5.4, we regress the double-sorted portfolios against the factors. Panel A shows the CAPM results which see a high coefficient for the largest size portfolio, decreasing in effect as the BTM portfolios increase. The large size and low BTM portfolio carries the highest coefficient of 1.24 showing strong influence on the excess returns, with strong explanatory value in the adjusted R^2 of 79.50%. The betas in the high BTM portfolios increase with size showing a direct relationship. Significant negative alphas are reported for the large size and low BTM portfolio however, increase as the BTM values increase. This is in line with earlier size sorted portfolios observing negative intercepts for the largest size portfolios. The high BTM portfolios show positive alphas consistently across the portfolios at a 90% confidence level, indicating a BTM effect is present, suggesting the CAPM does not explain all the variation in returns.

The three factor model show a strong relationship to the HML factor with loadings increasing positively to the high BTM portfolios, irrespective of the size. This is further supported by Nartea et al (2009) who also document a monotonic increase in the HML factor loadings from small to high BTM portfolios and similarly report a negative HML coefficient for low BTM portfolios, indicating in line with our results, that high BTM stocks have higher expected returns than low BTM stocks. Small size and high BTM portfolio shows the strongest linear relationship of 1.26, while the smallest and largest size portfolios show a negative loading to the HML factor. The SMB factor observes a negative relationship with all of the large size portfolios, decreasing further as the BTM portfolios rise, while the strongest SMB loading is found in the small size and high BTM portfolio. Intercepts in the largest size portfolios increase as the BTM value increases identifying further the BTM effect. The adjusted R^2 shows similar patterns to the CAPM in the size portfolios, with the large size and low BTM portfolio showing the three factor model can explain 80% of the variation in excess returns. The largest size and mid value portfolio exhibits similar explanatory power as the one-factor model, while the largest size and high BTM portfolio increases by over 21% when the HML and SMB factors are included indicating that the three factor model does capture more of the variation in returns. The small size and high BTM portfolio sees the adjusted R^2 shift from 0.30% in the one-factor model to 47.90% when the additional two variables are added to the model.

Panel C shows very little statistical significance once MOM is added to complete the four factor model. The majority of the alphas are insignificantly different from zero, which would suggest the four factor model captures much of the variation in the size and BTM sorted portfolios. The adjusted R^2's show little change in explanatory power. The low

BTM portfolios provide positive loadings on the MOM factor however show no significance at a 10% level.

The profitability and investment factors added in Panel D deem the intercepts insignificant for over half of the portfolios. The profitability factor in the high BTM portfolios have negative loadings, while the investment factor shows weak coefficients in the middle portfolios. The alphas show pricing errors decrease in the low BTM portfolio, decreasing to a negative intercept as size increases, while the high value portfolios intercepts increase to 0.44% in the largest size portfolio. The adjusted R^2 for the five factor model shows no large adjustments in explanatory power indicating that the profitability and investment factors do not aid in explaining excess returns.

The CAPM and five factor model fail the GRS test (Table 4.10) and reject the null hypothesis that the pricing errors are jointly equal to zero. The three factor model cannot reject this at a 5% level; however, the four factor model cannot be rejected at 1% confidence indicating the model prices all assets in the tests with a low test statistic of 1.02 and a p-value of 0.42. The three factor model observes a GRS statistic of 2.07 with a p-value of 0.03, showing it is inferior to the four factor model as the larger the value of the GRS statistic, the larger the joint values those alphas and therefore the poorer the asset pricing model performs.

The results from double sorting on size and BTM portfolios indicate that both the three factor and four factor models are able to explain the size and BM effects. The small stock's factor loadings are higher on SML than big stock portfolios with big stock portfolios generally producing negative factor loadings. The high BTM portfolios produce higher factor loadings on HML than the low BTM portfolios, with two thirds of the BTM portfolios observing negative factor loadings.

5.1.3 Industry Test Portfolios

In this section, the stocks are sorted into their industry classification, providing value-weighted industry portfolios, which are then regressed against the factors using time-series analysis. Excess returns of 12 industry portfolios are used in Table 5.6 as dependent variable in regressions for all the factor models. These industry portfolios are composed of: 1) Banking, 2) Breweries, 3) Coal, 4) Finance, 5) Preserved & Frozen Meat, 6) Gas, 7) Insurance, 8) Mining, 9) Miscellaneous, 10) Timber, 11) Transport, 12) Woollens. For more detailed summary statistics of the industries in the appendices, see Section 7.2.

Table 5.6 Industry Test Portfolios

The stocks are sorted in portfolios from their respective industries in the NZ stock exchange. The portfolios are value weighted. RMRF is the excess return on the market, while SMB and HML are Fama and French's (1993) factor mimicking portfolios for size and book-to-market equity. MOM is a factor mimicking portfolio for one-year return momentum. CMA amd RMW are Fama and French's (2015) factor portfolios for investment and profitability. Alpha is the intercept of the model. Test statistics are provided in parentheses below the values. ***, ** and * indicate significance at 1%, 5% and 10% levels.

	CAPM			3-Factor Model					4-Factor Model						5-Factor Model						
Portfolio	Alpha	MRP	Adj R-sq	Alpha	MRP	HML	SMB	Adj. R-sq	Alpha	MRP	HML	SMB	MOM	Adj. R-Sq	Alpha	MRP	HML	SMB	CMA	RMW	Adj. R-sq
BANK	-0.15%*	1.16***	0.623	-0.13%*	1.05***	-0.08	-0.13**	0.626	-0.03%	1.05***	-0.05	-0.12*	-0.05	0.627	-0.13%	1.01***	-0.04	-0.23***	0.02	0.07	0.6330
	(-1.92)	(24.28)		(-1.66)	(15.44)	(-1.50)	(-2.09)		(-0.23)	(13.92)	(-0.92)	(-1.74)	(-0.88)		(-1.59)	(16.40)	(-0.83)	(-3.32)	(0.39)	(1.56)	
BREW	0.54%*	0.29*	0.010	0.78%***	0.97***	-0.24	1.17***	0.176	0.44%	1.09***	-0.51***	1.25***	0.12	0.200	0.78%***	0.64***	-0.69***	1.04***	0.08	-0.36**	0.1582
	(1.82)	(1.83)		(2.87)	(4.26)	(-1.25)	(5.40)		(1.00)	(4.49)	(-2.95)	(5.53)	(0.66)		(2.77)	(3.24)	(-4.06)	(4.39)	(0.45)	(-2.47)	
COAL	0.02%	0.05	-0.002	-0.02%	0.38***	0.19*	0.42***	0.026	0.03%	0.41***	0.12	0.42***	-0.06	0.018	-0.07%	0.41***	0.15	0.64***	-0.37***	0.01	0.0601
	(0.00)	(0.50)		(-0.11)	(2.84)	(1.77)	(3.47)		(0.14)	(2.72)	(1.14)	(3.08)	(-0.54)		(-0.44)	(3.38)	(1.40)	(4.65)	(-3.18)	(0.11)	
FINANCE	0.21%**	0.44***	0.116	0.17%	0.39***	0.13*	-0.12	0.132	-0.05%	0.39***	0.13*	-0.12	0.13*	0.132	0.17%	0.49***	0.16**	-0.02	-0.03	-0.06	0.1237
	(2.02)	(6.89)		(1.55)	(4.36)	(1.77)	(-1.54)		(-0.28)	(3.89)	(1.89)	(-1.28)	(1.71)		(1.60)	(5.91)	(2.30)	(-0.18)	(-0.38)	(-0.95)	
MEAT	-0.02%	0.19*	0.009	-0.04%	0.36***	0.12	0.20	0.012	-0.18%	0.25	0.05	0.06	0.08	0.003	-0.07%	0.50***	0.12	0.50***	-0.37***	-0.11	0.0590
	(-0.10)	(1.93)		(-0.23)	(2.57)	(1.06)	(1.63)		(-0.65)	(1.63)	(0.44)	(0.45)	(0.62)		(-0.41)	(4.01)	(1.08)	(3.49)	(-3.06)	(-1.16)	
GAS	-0.23%	0.44***	0.070	-0.26%*	0.56***	0.14	0.13	0.072	-0.18%	0.71***	0.15	0.29***	-0.07	0.082	-0.28%**	0.57***	0.06	0.26**	0.31***	-0.04	0.1071
	(-1.64)	(5.29)		(-1.87)	(4.78)	(1.48)	(1.24)		(-0.83)	(5.44)	(1.62)	(2.50)	(-0.73)		(-2.01)	(5.39)	(0.71)	(2.16)	(3.05)	(-0.44)	
INS	0.21%	0.92***	0.118	0.09%	1.06***	0.37**	0.05	0.128	-0.04%	1.09***	0.36**	0.09	0.07	0.127	0.11%	0.95***	0.32**	-0.12	0.17	-0.01	0.1263
	(0.94)	(6.96)		(0.42)	(5.66)	(2.44)	(0.31)		(-0.12)	(5.23)	(2.40)	(0.46)	(0.44)		(0.49)	(5.49)	(2.20)	(-0.61)	(1.05)	(-0.05)	
MINING	-0.25%	0.83***	0.111	-0.36%	1.38***	0.68***	0.53**	0.151	-0.48%	1.63***	0.61***	0.79***	0.02	0.176	-0.33%	1.33***	0.48***	0.57**	-0.05	-0.32**	0.1596
	(-0.90)	(5.51)		(-1.30)	(5.95)	(3.52)	(2.39)		(-1.07)	(6.55)	(3.41)	(3.43)	(0.12)		(-1.17)	(6.66)	(2.79)	(2.40)	(-0.27)	(-2.20)	
MISC	0.49%**	0.03	-0.002	0.49%***	0.21	0.05	0.24**	0.005	0.18%	0.14	-0.04	0.14	0.17	0.005	0.49%***	0.13	-0.05	0.21	0.12	-0.08	0.0015
	(3.29)	(0.38)		(3.24)	(1.62)	(0.45)	(2.10)		(0.76)	(0.96)	(-0.40)	(1.10)	(1.54)		(3.21)	(1.12)	(-0.54)	(1.57)	(1.09)	(-0.93)	
TIM	0.00%	0.25**	0.012	-0.15%	0.29	0.45***	-0.16	0.059	-0.21%	0.41*	0.51***	-0.01	0.04	0.053	-0.13%	0.24	0.47***	-0.32	0.24	0.03	0.0648
	(0.02)	(1.99)		(-0.61)	(1.48)	(2.73)	(-0.84)		(-0.54)	(1.90)	(3.32)	(-0.04)	(0.22)		(-0.53)	(1.39)	(3.26)	(-1.58)	(1.47)	(0.26)	
TRAN	-0.21%	1.66***	0.224	-0.11%	1.52***	-0.35*	-0.06	0.227	0.77%*	1.46***	-0.27	-0.14	-0.50**	0.244	-0.11%	1.58***	-0.30*	0.01	-0.20	0.01	0.2246
	(-0.78)	(10.17)		(-0.39)	(6.51)	(-1.85)	(-0.29)		(1.81)	(5.73)	(-1.50)	(-0.59)	(-2.50)		(-0.40)	(7.38)	(-1.65)	(0.04)	(-0.99)	(0.03)	
WOOL	0.10%	0.23*	0.008	0.06%	0.45***	0.25	0.24	0.011	-0.55%	0.54***	0.18	0.34	0.32**	0.039	0.09%	0.36**	0.13	0.12	-0.04	-0.18	0.0063
	(0.45)	(1.83)		(0.27)	(2.37)	(1.57)	(1.31)		(-1.60)	(2.63)	(1.21)	(1.79)	(2.04)		(0.40)	(2.18)	(0.95)	(0.59)	(-0.24)	(-1.48)	

Table 5.6 observes the Transport and Banking industries showing strong market betas of 1.66 and 1.16, respectively. Insurance observes a strong beta of 0.92, indicating the market influences the returns within the portfolio theoretically perfectly, but this is also attributable to the size of the companies in these larger industries. Mining follows with a beta of 0.83 showing it is less volatile, an interesting result in terms of the industry. Both Timber and Gas observe betas lower than one, as expected in commodity and utility industries, with the remainder of industries observing similar betas.

Banking has the highest adjusted R^2 of 0.623 indicating that the CAPM model explains 62.3% of the excess return portfolio. Intuitively, Transport has the second highest R^2 of 22.4%, while the remainder across the other industries show less than 12%. Negative R^2's are reported for the coal and miscellaneous industries, although identified as statistically insignificant. Breweries are identified as producing the highest alpha for the CAPM at 0.54%, although nearly half of the portfolios reported observe a negative alpha. Miscellaneous observes a high excess return of 0.49% with finance and insurance portfolios similarly observed at 0.21%.

The addition of the SMB and HML factors see some movements in coefficients for the industry portfolios. The SMB factor has a negative loading for the banking and finance industries, which constructed of relatively large companies, indicates a size effect. Mining has a loading with the SMB factor of 0.53, and has the strongest association with the HML factor of 0.68. Timber and Insurance also have stronger factor loadings with HML at 0.45 and 0.37, respectively. Mining's market beta increases to 1.38 when the additional SMB and HML factors are added, indicating a more volatile relationship with the market. The Transport industry sees the only significant negative loading on HML at -0.35.

There are minimal adjustments made in relation to the adjusted R^2, with minimal increases across all industries. The Banking portfolio consistently remains the highest, moving a mere three basis points to 62.6%. The Brewery portfolio increases to 17.6% (from 1%), with its market beta increasing to 0.97. The SMB loading for the brewery portfolio is 1.17 also indicating a stronger association with size. The closer to the absolute value of one the coefficient is, the stronger the effect of that independent variable on the portfolio's excess returns.

When adding a fourth factor (MOM) to test Carhart's model, we see little significance in relation to the MOM factor, with next to no significance across all of the intercepts. Transport has a negative loading on MOM at -0.50, and Woollens show a positive coefficient of 0.32, while the other industries show weak relation. Loadings are not dramatically different for SMB and HML from the three factor model and show similar loadings.

The five factor model adds the CMA and RMW to the time-series tests on the industry portfolios. RMW provides weak coefficients in terms of statistical significance apart from the Brewery and Mining portfolios, which show negative effects of -0.36 and -0.32, respectively. The investment factor shows a similar negative relationship of -0.37 for both Coal and Meat portfolios. Gas reports a positive CMA factor loading of 0.31. The adjusted R^2 of the Banking portfolio increases slightly to 63.3%, while the Coal and Meat portfolios increase in explanatory power by around 5%.

In these industry portfolios, the four factor model appears to have the least pricing errors, with only two significant intercepts found in the Transport and Woollen industries. This is followed by the five factor model and three factor model. The CAPM appears to underperform the other factor models with just over half of the intercepts significant.

5.2 Cross-sectional Tests

Traditional asset pricing theories such as the CAPM (Sharpe, Linter, Black 1972), and the APT (Ross, 1976) imply that the difference in expected returns across assets should be explained by their covariances with systematic risk factors or factor loadings. When returns are generated from a factor model, their expected returns are represented by a linear combination of the loadings or betas. Since the loadings are not directly observable, we test the relation between the returns and the loadings in two stages. This follows what is known as Fama and MacBeth (1973) regressions, where you firstly regress each asset against the risk factors to determine the asset's beta for that risk factor, before you then regress all asset returns for a fixed time period against the estimated betas to determine the risk premium in each factor.

In our first stage, we estimate the beta for each asset in a linear time series equation. We use three-year (t – 36) rolling windows to give us beta for each of the assets in a continuous time series over our sample (1904-1929). The Dimson Correction (1979) is applied to these betas, and our beta estimates are obtained.

The Dimson approach treats thin trading problems as being caused by asynchronous movements in individual stock returns as compared to the market return (Dimson, 1979). This is overcome by the inclusion of lead and lag terms. Due to illiquidity in the New Zealand market over our sample period, we have adopted the following Dimson correction with two lags and two leads in the three year rolling regression:

$$r_{i,t} = a_i + B_{i-2}Rm_{t-2} + B_{i-1}Rm_{t-1} + B_{i+2}Rm_{t+2} + B_{i+1}Rm_{t+1} + e_{i,t} \qquad (5.8)$$

The adjusted beta is therefore equal to the sum of the estimates of the beta coefficients:

$$B^{DIM} = \sum_{k=-2}^{k=+2} B \qquad (5.9)$$

These estimates are then used as independent variables using the annual returns for each stock as dependent variables. The coefficients estimated in this regression are the factor risk premia. The prediction of a factor model is that the pricing errors are zero for each asset. In the case of cross-sectional regressions, this is a single parameter for which the null hypothesis is zero in the population.

The purpose of the cross-sectional results are to test whether the pricing errors (α_i=0, for all of *i*) are significant. The factors should exhibit a strong relationship to expected returns. Presented in Table 5.7 are the results of cross-sectional regressions of annual beta estimates, firm size, BTM, investment and profitability on individual stock returns. Bryant and Eleswarapu (1997) highlight emphasis on the use of individual stock returns over portfolio returns to study the cross-sectional estimates. Other studies, such as Brennan and Subrahmanyam (1996) show that results are highly sensitive to the particular portfolio formation used.

Table 5.7 Average Slopes (*t*-statistics) from Annual Regressions of Stock Returns on Beta (Dimson), Size, BTM Equity, Momentum, Investment and Profitability

Stocks are assigned the betas constructed from the Fama-MacBeth three year rolling regressions with the Dimson correction including two lags and two leads. Book value equity and is for the fiscal year ending t–1 in December. The accounting ratios are measured using market equity in December of year t-1. Book value of equity divided by market equity is denoted as BTM. Momentum (MOM) is the eleven month lagged return in December of year t-1. Investment (INV) is the growth in BE, and profitability is the change in profit scaled by BE for December of year t-1. ***, ** and * indicate significance at 1%, 5% and 10% levels.

β	ME	BE/ME	MOM	INV	PRF
0.013					
(0.14)					
	0.000				
	(0.27)				
0.011	0.000				
(0.45)	(0.08)				
		-0.010			
		(-1.22)			
0.012		-0.009			
(0.54)		(-0.75)			
	0.000	-0.010			
	(0.13)	(-1.19)			
			1.120***		
			(49.09)		
				0.040	
				(0.19)	
					0.359*
					(1.85)
				-0.132	0.442*
				(-0.69)	(1.90)

Table 5.7 shows time-series averages of the slopes from the annual Fama-MacBeth regressions of the cross-section of returns. This yields 24 cross-sectional regressions which average 84 observations for a combined sample of 2,016 observations. The average slopes provide standard FM tests for determining which explanatory variables on average have non-zero expected premiums during our sample period.

The results show that beta does not help explain average stock returns for the period 1904-1928, with only 0.14 standard errors from zero. There is very little evidence to support the hypothesised relation between beta and average returns in New Zealand, and this is further supported by Fama and French’s (1992) paper and their evidence that beta holds no explanatory power for average returns. To further support this, when combined with ME and BTM, the explanatory power of beta does not improve. Size (ME) shows no power in explaining average returns, with an indistinguishable premium from zero. This evidence is supported by Bryant and Eleswarapu (1997), who identify no significant relation of size with security returns in NZ over their sample period. They observe negative premiums early in the sample, which can support our negative SMB returns, but establish overall they are not confident that there has been a consistent size effect in New Zealand.

The average slope for BTM is negative, however does not help explain the average returns, only -1.22 standard errors from zero. This does not improve if size and beta are included, both decreasing insignificance and negative premiums. Pinfold, Wilson and Li (2001) note that low statistical significance of size and BTM effects of their study is attributable to very large variations over time with almost no consistency from period to period. In addition, our size and BTM effects have negative correlation coefficients, when as Fama and French (1992) identify, they should theoretically reinforce one another.

In the regressions of returns on momentum, we can see momentum has explanatory power with a coefficient of 1.12. This implies that for every 100 basis point increase in momentum portfolios, annual abnormal return increases by 121 basis points. This is strong evidence of momentum in the New Zealand market.

Investment is insignificantly related to the cross section of average returns. When profitability is added to investment, investment turns to a negative loading as the correlation coefficient between the two is negative, however both still possess no explanatory power. Profitability itself shows explanatory power at a 10% level, implying that for every 100 basis point increase in profitability, the annual abnormal return increases by 36 basis points. A similar significant finding is observed when the investment factor is included, with profitability increasing abnormal returns by 44 basis points for every 100 basis point move in returns. There is no evidence to support the investment and profitability factors in New Zealand, however Fama and French (2008) show similar cross-sectional results for momentum and profitability. They show in line with our results, that momentum is a clear winner in terms of strong average regression slopes, and weaker evidence that finds a positive relation between profitability and average returns.

6. Conclusion

This study uses out of sample data from the early New Zealand stock market to analyse the pricing ability of major asset pricing models. The observed predictive ability of asset pricing models could be a result of the design study and database used to conduct the research. This study addresses the implication that the ability of certain variables would be reduced if different periods, or data were used to evaluate the effectiveness of asset pricing models.

To find the determinants of return we regressed returns on factors using time series and cross sectional asset pricing tests. We find strong evidence of the four factor model capturing the variation in returns, and observe strong positive returns on factor-mimicking portfolios constructed on value, momentum and profitability. We find evidence on the existence of strong factor premia on momentum, and a positive relation on profitability.

For an asset-pricing model to be truly superior and effective, it must be demonstrated across different groupings and new time periods. These tests performed therefore provide us with more information on the early determinants in average returns.

The effectiveness of such an asset pricing model is one that produces consistent results, captures variation in the returns, and with intercepts close to zero. Running tests on separate groupings of portfolios, all sorted according to different criteria answers the question as to whether the effectiveness of the model is sample specific. In our sorted portfolios, we observe strong evidence of the four factor model performing better empirically compared to the other factor models. Across the portfolios, the four factor model offers lower pricing errors, and performs no worse than the three factor model, in its ability to explain size and BTM effects. This is supported by the four factor model passing the GRS test across multiple portfolios sorted on different criteria.

Size and BTM effects are observed in both the three factor and four factor model although BTM is weak in some sorts. The size theory holds then that companies with a small market capitalization outperform larger companies, while the value premium observed in our sample posits that companies with high BTM ratios typically outperform lower BTM ratios. The five factor model possesses little evidence throughout the asset pricing tests apart from the cross-sectional regressions, where we observe significance in profitability. Momentum provides a strong relationship to average returns in the cross-sectional tests, although size and BTM offer no significant premia.

This study adds further information to the debate on market efficiency and provides some evidence of factor models being able to explain the variation in returns. Ultimately, our evidence purports that using only a single factor model, or the three and five factor models, may not capture the characteristics and price industries across portfolios. The importance of using out of sample data is highlighted and brings to our attention further discussions on market efficiency in our sample.

To further investigate asset pricing in this data set, future research could conduct deeper analysis into the efficiency of the market. In the case of an inefficient market, securities may not be priced accurately and deviate from their true value. This can be an important assessment considering the economic landscape and historical time period setting. As previously discussed, accurate fiscal year ends were unavailable for the majority of stocks through the sample. Using different fiscal year end tests and alternative illiquidity corrections could lend further insight into the debate and contention around factor model effectiveness.

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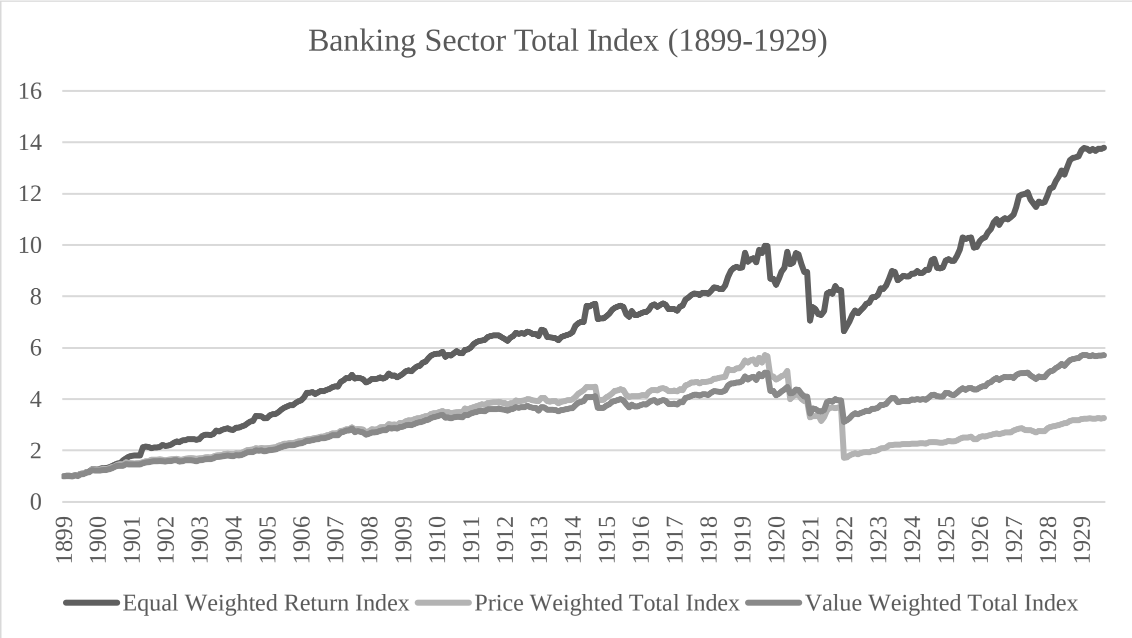
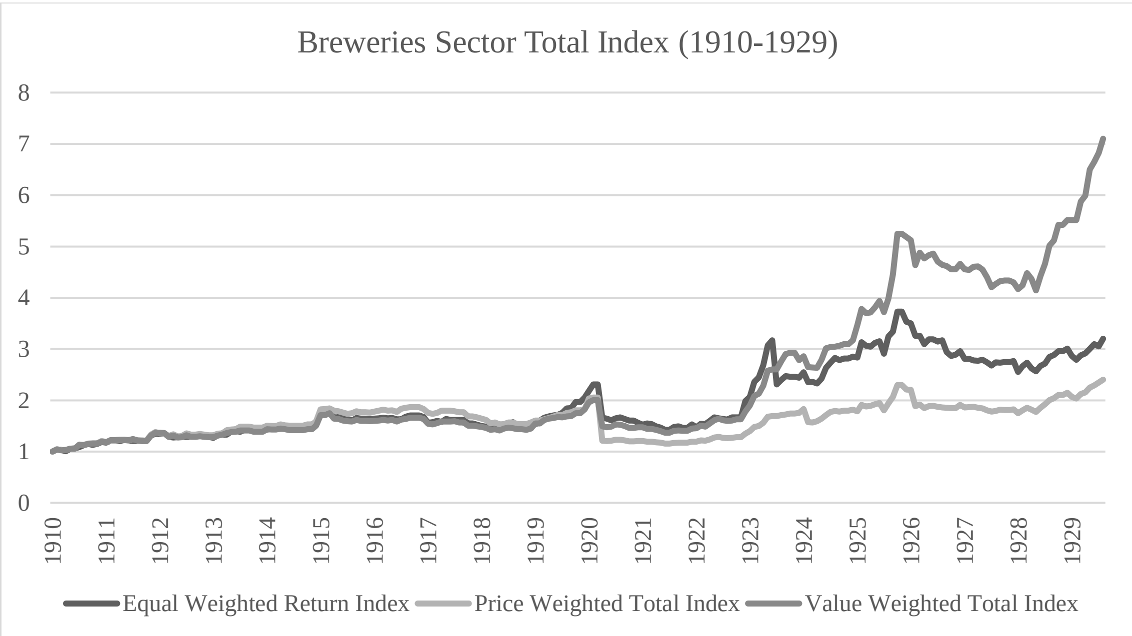
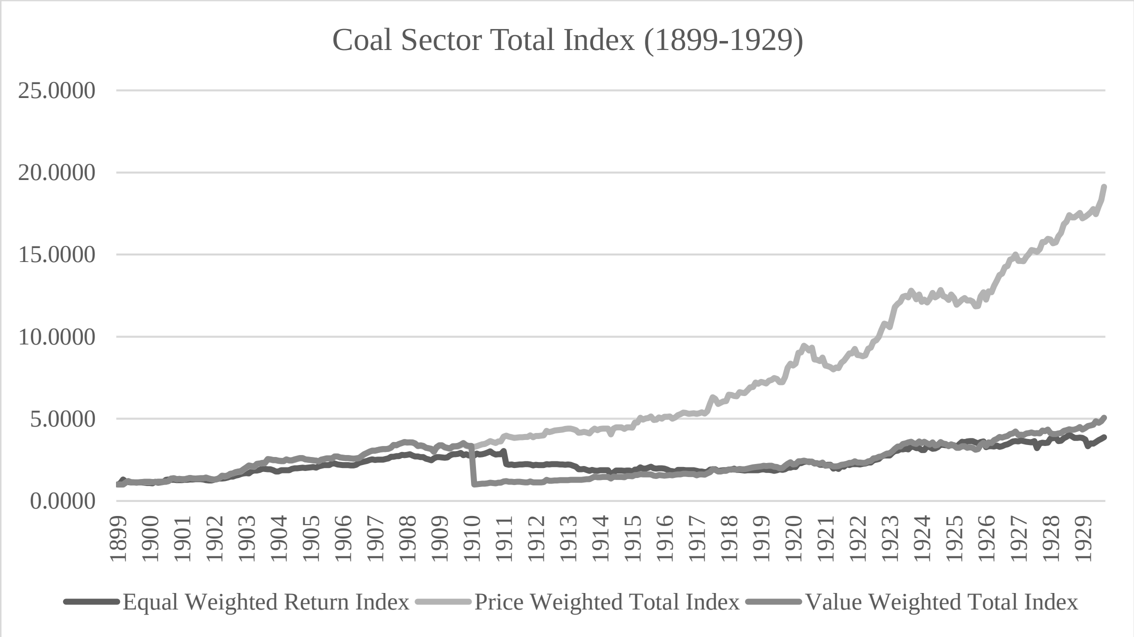
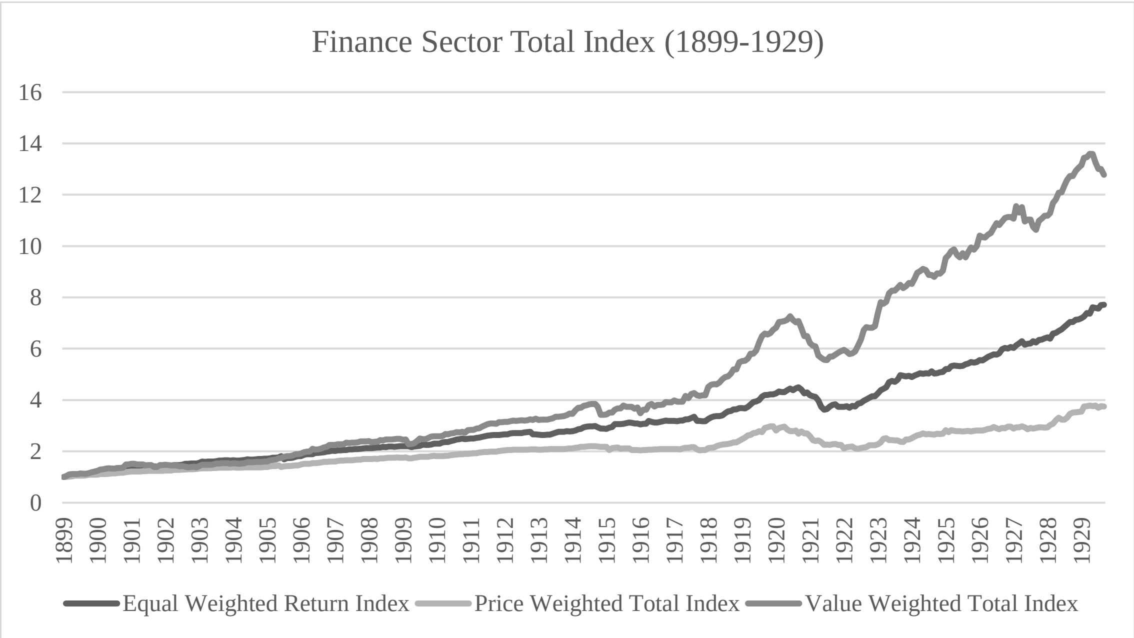
8. Appendices

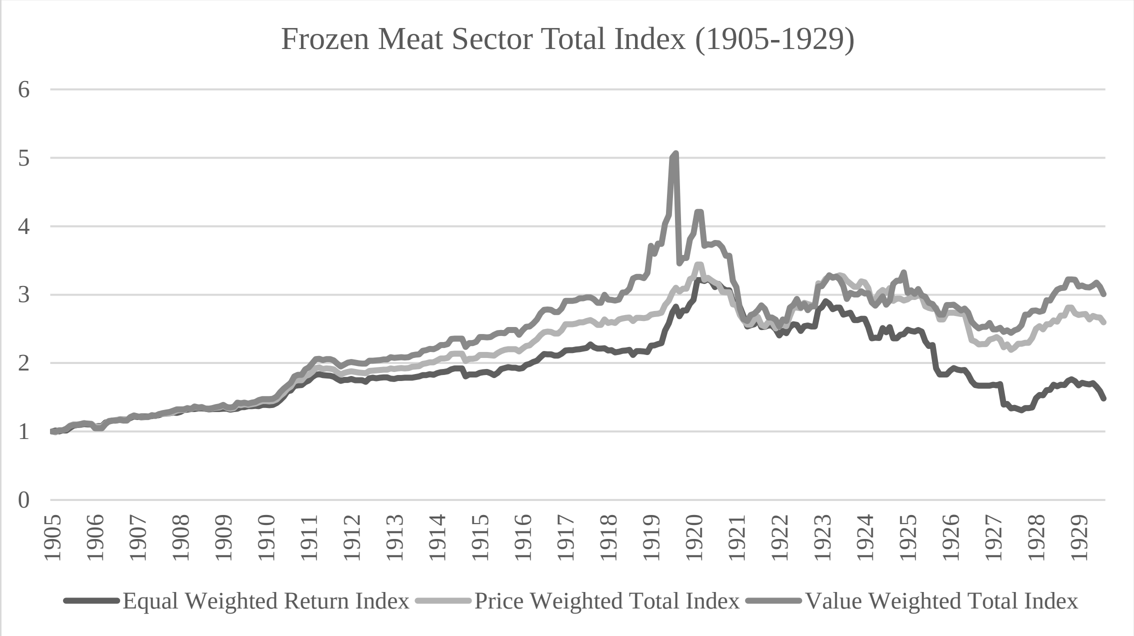
8.1 Industry Indexes

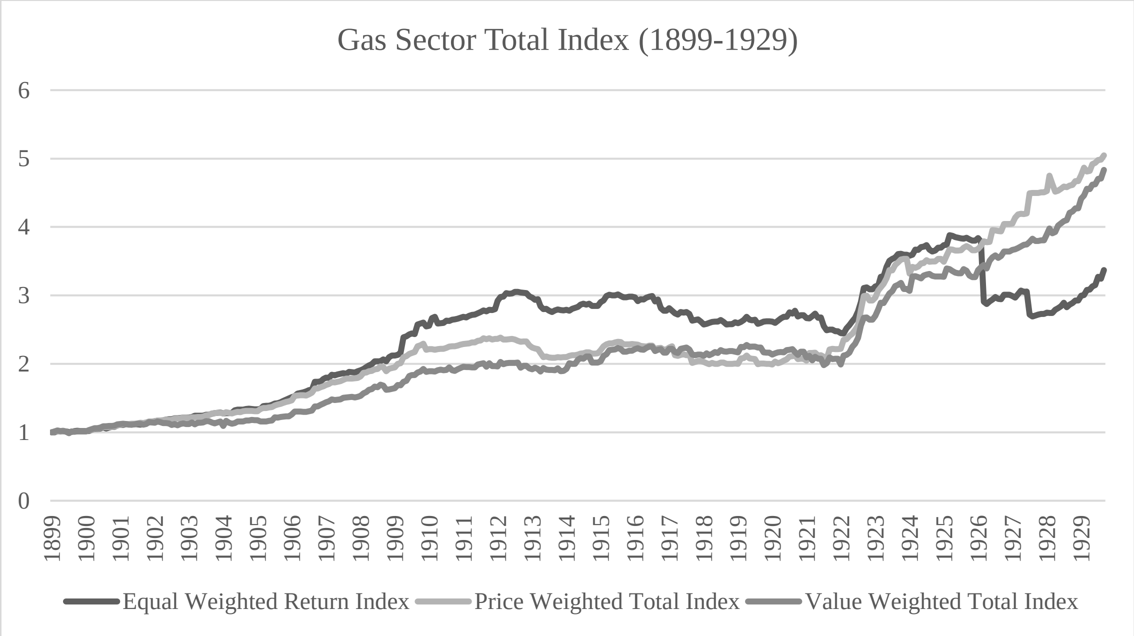


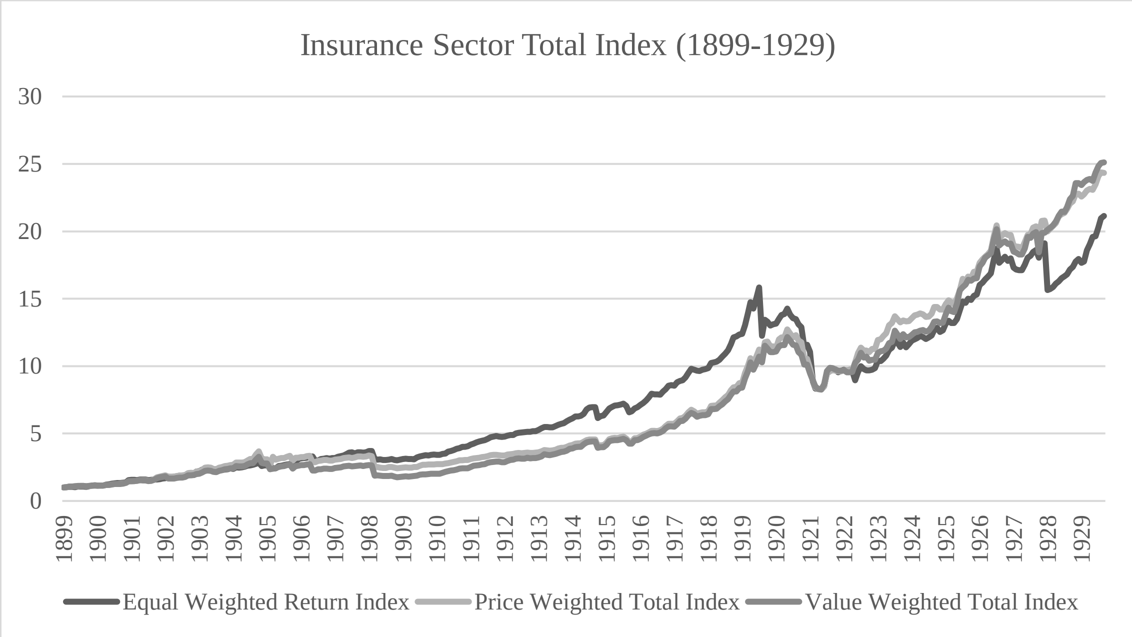


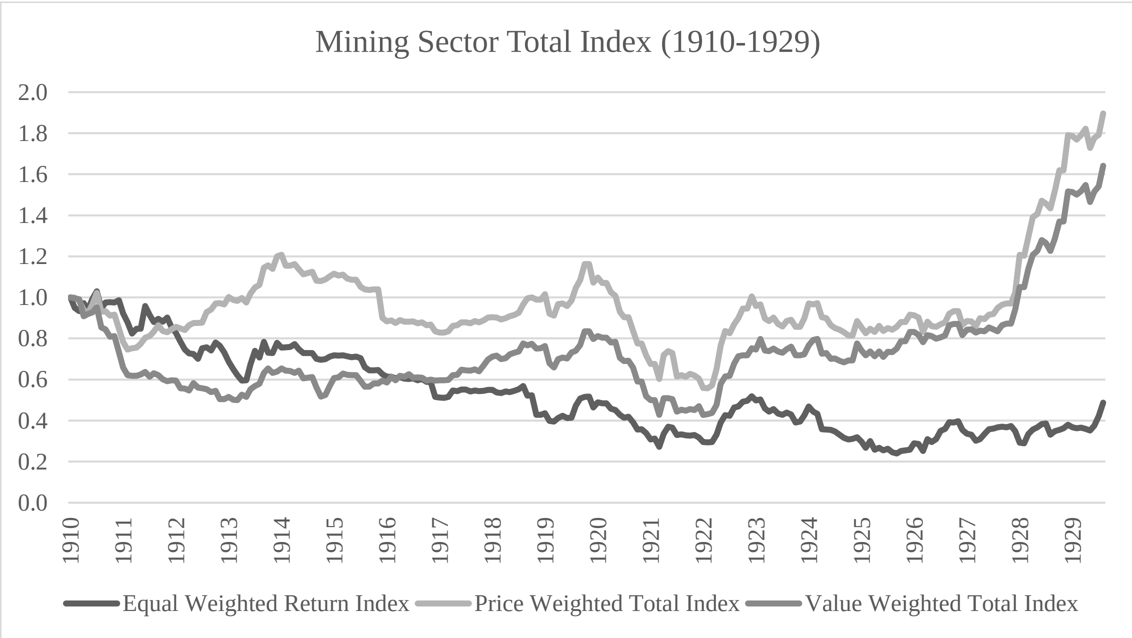

Coal Sector Total Index (1899-1929)
25.0000
20.0000
15.0000
10.0000
5.0000
0.0000
1899 1900 1901 1902 1903 1904 1905 1906 1907 1908 1909 1910 1911 1912 1913 1914 1915 1916 1917 1918 1919 1920 1921 1922 1923 1924 1925 1926 1927 1928 1929
Equal Weighted Return Index
Price Weighted Total Index
Value Weighted Total Index

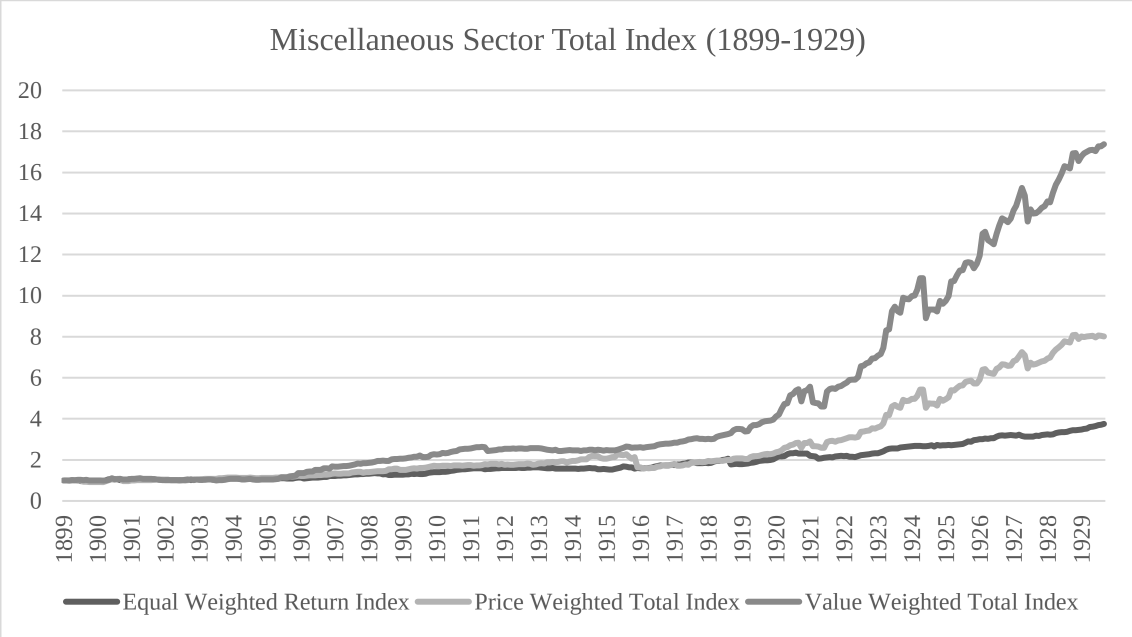

Finance Sector Total Index (1899-1929)
16
14
12
10
8
6
4
2
0
1899 1900 1901 1902 1903 1904 1905 1906 1907 1908 1909 1910 1911 1912 1913 1914 1915 1916 1917 1918 1919 1920 1921 1922 1923 1924 1925 1926 1927 1928 1929
Equal Weighted Return Index
Price Weighted Total Index
Value Weighted Total Index

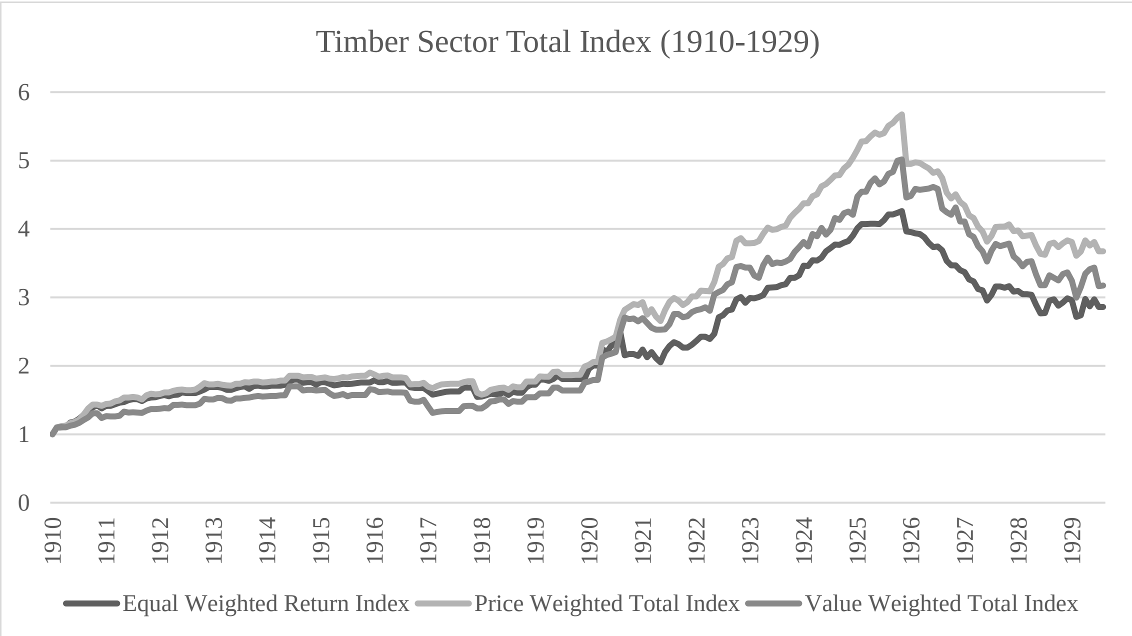

Frozen Meat Sector Total Index (1905-1929)
0
1
2
3
4
5
6
1905
1906
1907
1908
1909
1910
1911
1912
1913
1914
1915
1916
1917
1918
1919
1920
1921
1922
1923
1924
1925
1926
1927
1928
1929
Equal Weighted Return Index
Price Weighted Total Index
Value Weighted Total Index

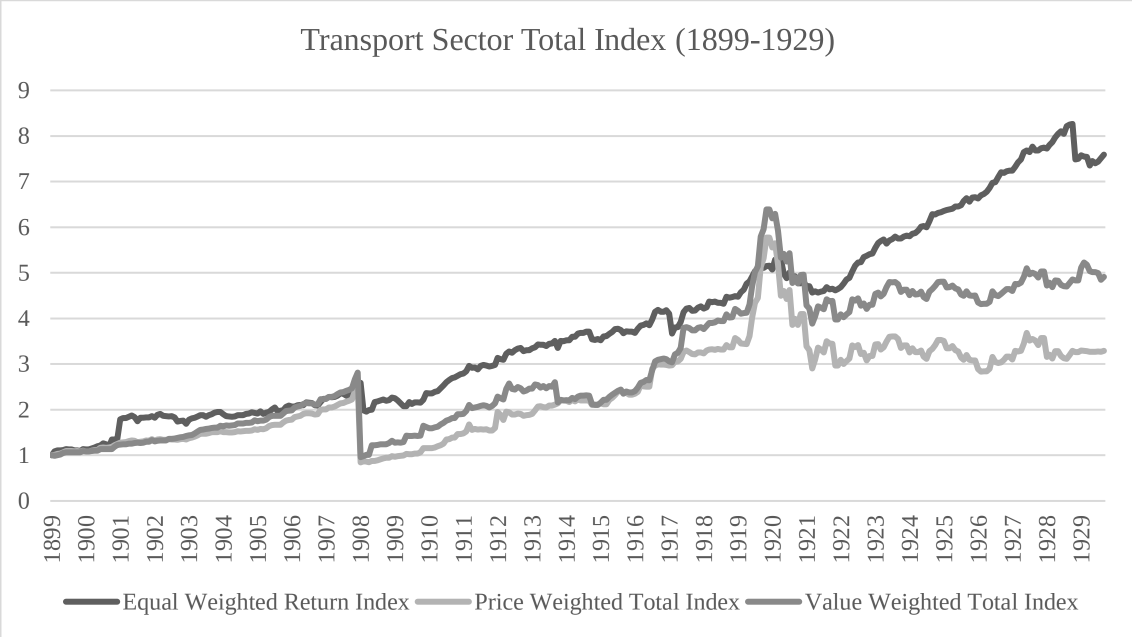

Gas Sector Total Index (1899-1929)
0
1
2
3
4
5
6
1899
1900
1901
1902
1903
1904
1905
1906
1907
1908
1909
1910
1911
1912
1913
1914
1915
1916
1917
1918
1919
1920
1921
1922
1923
1924
1925
1926
1927
1928
1929
Equal Weighted Return Index
Price Weighted Total Index
Value Weighted Total Index

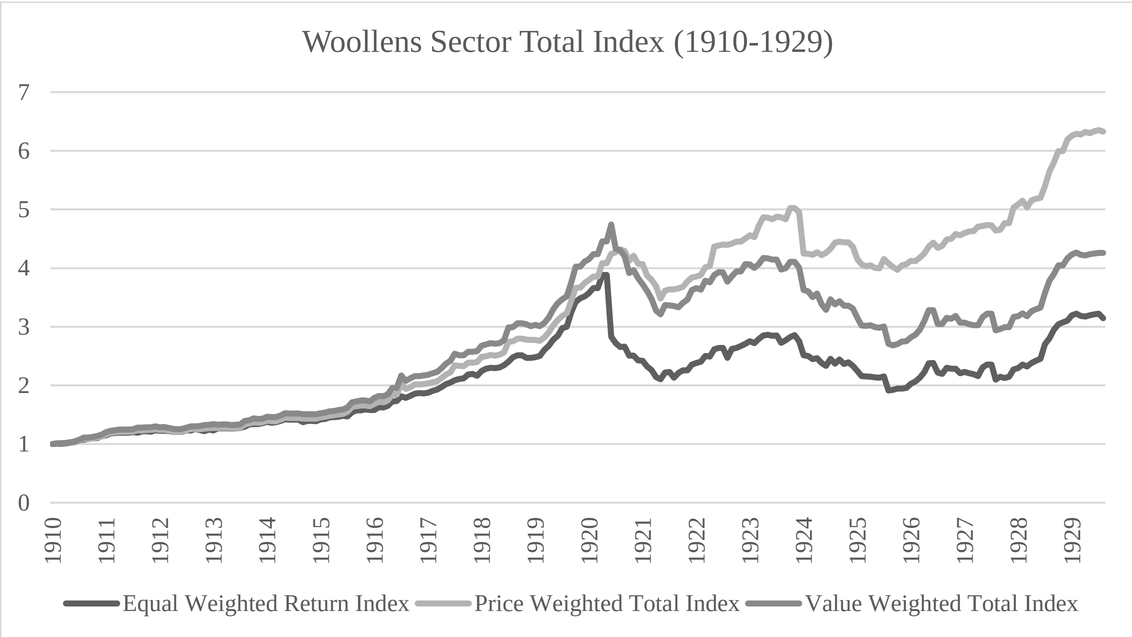

Insurance Sector Total Index (1899-1929)
30
25
20
15
10
5
0
1899
1900
1901
1902
1903
1904
1905
1906
1907
1908
1909
1910
1911
1912
1913
1914
1915
1916
1917
1918
1919
1920
1921
1922
1923
1924
1925
1926
1927
1928
1929
Equal Weighted Return Index
Price Weighted Total Index
Value Weighted Total Index


Mining Sector Total Index (1910-1929)
2.0
1.8
1.6
1.4
1.2
1.0
0.8
0.6
0.4
0.2
0.0
1910
1911
1912
1913
1914
1915
1916
1917
1918
1919
1920
1921
1922
1923
1924
1925
1926
1927
1928
1929
Equal Weighted Return Index
Price Weighted Total Index
Value Weighted Total Index


Miscellaneous Sector Total Index (1899-1929)
0
2
4
6
8
10
12
14
16
18
20
1899 1900 1901 1902 1903 1904 1905 1906 1907 1908 1909 1910 1911 1912 1913 1914 1915 1916 1917 1918 1919 1920 1921 1922 1923 1924 1925 1926 1927 1928 1929
Equal Weighted Return Index
Price Weighted Total Index
Value Weighted Total Index


Timber Sector Total Index (1910-1929)
0
1
2
3
4
5
6
1910 1911 1912 1913 1914 1915 1916 1917 1918 1919 1920 1921 1922 1923 1924 1925 1926 1927 1928 1929
Equal Weighted Return Index
Price Weighted Total Index
Value Weighted Total Index


Transport Sector Total Index (1899-1929)
9
8
7
6
5
4
3
2
1
0
1899
1900
1901
1902
1903
1904
1905
1906
1907
1908
1909
1910
1911
1912
1913
1914
1915
1916
1917
1918
1919
1920
1921
1922
1923
1924
1925
1926
1927
1928
1929
Equal Weighted Return Index
Price Weighted Total Index
Value Weighted Total Index


Woollens Sector Total Index (1910-1929)
7
6
5
4
3
2
1
0
1910
1911
1912
1913
1914
1915
1916
1917
1918
1919
1920
1921
1922
1923
1924
1925
1926
1927
1928
1929
Equal Weighted Return Index
Price Weighted Total Index
Value Weighted Total Index

8.2 Industry Summary Statistics

Summary statistics for equal-weighted return (EWR), price-weighted return (PWR), and value-weighted return (VWR) are available for each industry below.

	Banking			Breweries		
	EWR	*PWR*	*VWR*	*EWR*	*PWR*	*VWR*
Mean	0.76%	0.42%	0.51%	0.60%	0.47%	0.91%
Standard Deviation	2.77%	3.72%	2.43%	4.46%	4.00%	3.82%
Kurtosis	23.01	121.76	27.01	14.28	50.02	11.72
Skewness	-1.82	-9.16	-3.56	-1.35	-4.63	-0.51
Minimum	-21.16%	-53.16%	-21.15%	-27.92%	-40.83%	-25.68%
Maximum	18.18%	8.32%	8.85%	19.12%	15.06%	17.67%

	Insurance			Mining		
	EWR	*PWR*	*VWR*	*EWR*	*PWR*	*VWR*
Mean	1.07%	0.95%	0.94%	-0.12%	0.37%	0.32%
Standard Deviation	2.79%	3.78%	3.67%	6.12%	4.35%	4.62%
Kurtosis	10.73	18.93	23.32	2.20	4.23	3.22
Skewness	-1.38	-1.20	-3.60	0.52	0.53	0.32
Minimum	-15.93%	-24.88%	-28.88%	-18.26%	-15.68%	-14.35%
Maximum	12.95%	24.93%	9.23%	23.53%	19.40%	21.53%

	Coal			Finance		
	EWR	*PWR*	*VWR*	*EWR*	*PWR*	*VWR*
Mean	0.34%	0.84%	0.85%	0.55%	0.36%	0.70%
Standard Deviation	3.69%	2.86%	2.86%	1.15%	0.92%	1.90%
Kurtosis	17.88	2.44	2.41	9.28	13.24	5.26
Skewness	-0.74	0.99	0.98	-0.81	-1.79	-0.24
Minimum	-26.15%	-8.03%	-8.03%	-6.56%	-5.69%	-8.31%
Maximum	22.66%	12.00%	12.00%	5.01%	3.80%	8.38%

	Meat (Frozen & Preserved)			Gas		
	EWR	*PWR*	*VWR*	*EWR*	*PWR*	*VWR*
Mean	0.34%	0.43%	0.49%	0.42%	0.31%	0.34%
Standard Deviation	1.11%	1.23%	1.42%	1.40%	1.17%	1.54%
Kurtosis	7.27	3.87	3.90	14.84	8.56	2.26
Skewness	0.36	0.59	0.48	2.03	-1.02	0.08
Minimum	-6.03%	-5.09%	-5.55%	-4.37%	-5.97%	-5.51%
Maximum	4.91%	4.94%	5.83%	10.40%	4.58%	6.86%

	Miscellaneous			Timber		
	EWR	*PWR*	*VWR*	*EWR*	*PWR*	*VWR*
Mean	0.32%	0.33%	0.52%	0.47%	0.51%	0.39%
Standard Deviation	1.43%	2.49%	1.78%	2.09%	2.14%	2.52%
Kurtosis	2.17	38.06	6.68	6.07	7.81	3.98
Skewness	-0.30	-4.16	1.06	0.42	0.08	0.31
Minimum	-4.76%	-23.65%	-7.15%	-8.00%	-9.56%	-7.42%
Maximum	5.05%	7.06%	9.71%	9.88%	9.63%	10.19%

	Transport			Woollens		
	EWR	*PWR*	*VWR*	*EWR*	*PWR*	*VWR*
Mean	0.68%	0.73%	0.81%	0.75%	0.81%	0.83%
Standard Deviation	3.43%	5.16%	5.28%	1.39%	1.58%	1.66%
Kurtosis	36.99	126.55	110.06	0.49	7.62	8.84
Skewness	1.74	-9.14	-8.39	0.48	1.86	1.94
Minimum	-23.27%	-66.68%	-65.87%	-3.03%	-4.00%	-4.15%
Maximum	31.27%	21.68%	20.33%	4.80%	9.80%	10.75%

8.3 Example of Monthly Share Listings

14th June, 1923.

WELLINGTON STOCK EXCHANGE

BUYER	SELLER	COMPANIES	NUMBER	INTEREST ON INVESTMENT AT QUOTED PRICE	LATEST DIVIDEND OR DIV. & BONUS % PER ANN.	RESERVE FUNDS AND BALANCE CARRIED FORWARD	SHARES: No. Issued	SHARES: Am't	SHARES: Paid-up	SHARES: Liab'ty per Share	CAPITAL: Auth'ised	CAPITAL: Sub-scribed	CAPITAL: Paid-up	NUMBER	DIVIDENDS RECEIVABLE IN WEL'GTON	HALF YEAR OR YEAR CLOSES *When two months are mentioned in this column the first is the Interim Half-Year*
£ s. d.	£ s. d.	**BANKS.**		£ s. d.		£		£	£ s. d.	£	£	£	£			
13 16 0	14 0 0	Australasia ... ... Ord.	1	4 13 2	13M	3,646,869	300,000	5	5 0 0	5e	4,000,000	4,000,000	4,000,000	1	Oct., April	April, Oct.
7 0 0	7 10 0	Com. Bank of Australia Cum. Pref.	1½	5 1 4	4	42,209	211,735	10	10 0 0	Nil.	3,150,000	2,468,877	2,117,350	1½	Feb., Aug.	Dec. June 30.
1 18 9	...	" " Ord.		3 17 0	15		703,054	10/-	various	...			336,593			
6 16 9	6 17 6	National ... " ... "	2	5 2 1	14a	1,392,121	500,000	7½	2 10 0	12½e	4,500,000	3,750,000	1,250,000	2	Jan., July	Sep. 30, Mar. 31
39 15 0	40 0 0	New South Wales	3	5 0 4	10	4,086,645	300,000	20	20 0 0	20e	6,000,000	6,000,000	6,000,000	3	Feb., May Aug., Nov.	Mar. 31, Sep. 30
3 2 3	3 2 9c	New Zealand ... ... Ord.	4	4 5 4	13⅓	2,246,957	3,000,000	1	1 0 0	Nil.	3,750,000	3,000,000	3,000,000	4	Dec., June	Sep. 30, Mar. 31
		4% Guaranteed Stock		...	4	...	...	...	...	...	529,988h	529,988	529,988			
		Preference "A" Shares		...	10	...	500,000	1	1 0 0	Nil.	500,000	500,000	500,000			
		do. "B" do.		...	10	...	1,000,000	1	1 0 0	Nil.	1,375,000	1,000,000	1,000,000			
14 19 0	15 1 0	Union of Australia	5	5 0 0	15	3,336,818	600,000	15	5 0 0	10k	9,000,000	9,000,000	3,000,000	5	Jan., July	Aug. 31, Feb. 28
14 6 0	...	P. & O. Banking Corporation ...		3 16 11	5½	90,000	259,416	10	10 0 0	Nil.	5,000,000	2,594,160	2,594,160		Sept.	Sep. 30, Mar. 31
		FINANCIAL.														
3 18 0	...	Abraham & Williams ... Ord.	6	...		21,448	42,444	5	various	...	500,000	293,290	293,290	6	April, Nov.	Mch. 31, Sept. 30
...	...	Pref.		...	6		16,404	5	5 0 0	Nil.						
12 15 0	...	Dalgety & Co., ... Ord.	7	5 17 9	15M	1,101901	200,000	20	5 0 0	15	4,000,000D	4,000,000	1,000,000	7	May, Nov.	Dec. 31, June 30
...	...	" " ... ... Pref.		...	5	...	50,000	10	10 0 0	Nil.	1,000,000	500,000	500,000		Feb. Aug.	
8 10 0	...	Equitable Building, Wellington ...	8	2 19 6	5	81,826	12,000	10	5 0 0	5	150,000	120,000	60,000	8	July, Feb.	June 30, Dec. 31
2 8 6	2 9 6c	Goldsbrough Mort.	8½	6 2 6	15	651,296	916,849	1	1 0 0	Nil	1 000,000D	916,849	916,849	8½	Dec., June	Sept. 30, Mar. 31
...	...	Metropolitan Permanent, Wellington	9	...	8	19,250	3,000	10	10 0 0	Nil.	100,000	30,000	30,000	9	Sept., Mar.	Aug. 15, Feb. 15
...	...	Manawatu Perm. Equit. Bldg. and Invest. Soc.	9½	...	8	4,000	1,438	10	10 0 0	Nil.	14,380	14,380	14,380	9½	April	Feb. 28
4 1 6	...	Nat. Mortgage & Agency N.Z. ...	10	4 18 3	10M	291,631	125,000	10	2 0 0	8	1,500,000D	1,250,000	250,000	10	July, Mch.	Mar. 31, Sep. 30
1 1 9	...	N.Z. & River Plate Land Mortgage ...	11	6 9 2	7‖	282,407	700,000	1	1 0 0	Nil.	700,000D	700,000	700,000	11	July, Jan.	April 30, Oct. 31
80 0 0	83 0 0	N.Z. Loan & Mercantile Ord. Stock	12	2 8 8	2M	518,448			...	...	1,000,000	1,000,000	1,000,000	12	June, Dec.	Dec. 31, June 30
78 0 0	...	" " 5% Cum. Pref Stock		6 8 2	5‖					...	1,000,000	1,000,000	1,000,000			
9 6	10 0	The W'gton Invst. Trst. & Agcy. ...	13	6 3 0	6	21,229	124,000	1	0 10 0	10/-	200,000	124,000	62,000	13	Jan., July	Dec. 31, June 30
5 16 0	...	W'gton. Trust Loan & Invst. Co., Ld.	14	5 12 0	6½	73,789	24,500	10	5 0 0	5	300,000	247,500	125,000	14	July, Feb.	June 30, Dec. 31
...	...	do. do. do. ...		...	6½	...	250	10	10 0 0	Nil.						
...	...	Masterton Perm. Invst. & Building Soc.	15	...	7	2,127	1,650	10	10 0 0	Nil.	16,500	16,500	16,500	15	Mar., Oct.	Feb. 28, Aug. 31
9 6	...	Wellington Deposit, Mortgage & Building Association.	16	6 8 5	6	4,131	50,000	1	0 10 0	10/-	50,000	50,000	25,000	16	May	Mar. 31
		GAS.														
1 6 0	...	Auckland	17	6 3 1	8	50,018l	696,604	1	1 0 0	Nil.	1,000,000D	868,244	833,916	17	July, Feb.	June 30, Dec. 31
...	...	" contributing		...	...		171,640	1	1 18 0/	2/0g	...	...	...			...
8 8 0	8 10 0	Christchurch	18	5 18 3	10	184,210l&d	46,327	5	5 0 0	Nil.	320,000D	231,635	231,635	18	Aug., Feb.	June 30, Dec. 31
		... ...														
...	...	Feilding	20	...		...	12,000	1	1 0 0	Nil.	12,000D	12,000	12,000	20	... ...	Feb. 28
14 6c	...	Gisborne	21	6 17 10	5	5,313	53,402	1	1 0 0	Nil.	70,000D	53,402	53,402	21	Oct., June	Sep. 30, Mar. 31
...	...	Hokitika	22	...	2½	504	2,000	6	6 0 0	Nil.	12,000	12,000	12,000	22	Nov., June	Oct. 31, April 30
...	...	do.		...	...	...	2,000	1	1 0 0	Nil.	2,000	1,425	1,425			
10 15 0	...	Napier ... ... Ord.	23	7 8 10	8	29,642o	5,000	10	10 0 0	Nil.	100,000	100,000	75,000	23	Aug., Feb.	June 30, Dec. 31
5 7 6	...			7 8 10			5,000	10	5 0 0	5						
...	...	" ... ... Pref.		...	6	...	5,000	10	10 0 0	Nil.	50,000	24,760	24,760			
							2,000	5	5 0 0	Nil.						
...	...	~~New Plymouth ... ...~~	~~24~~	~~...~~	~~8½~~	~~2,158~~	~~2,000~~	~~5~~	~~4 0 0~~	~~1~~	~~40,000D~~	~~30,000~~	~~18,500~~	~~24~~	~~Jan., July~~	~~Dec. 31, June 30~~
							2,000	5	0 5 0	4¾						
...	...	Timaru	25	...	10	30,335	2,000	5	2 10 0	2½	30,000	30,000	25,000	25	Aug. Feb.	June 30, Dec 31
...	...	"		...			4,000	5	5 0 0	Nil.						
12 12 0	13 0 0	Wellington	26	6 5 0	8	68,212l	27,805	10	10 0 0	Nil.	550,000	363,370	363,370	26	Aug. Feb., June Dec.	June 30, Dec. 31
17 0	...	" ... ... Pref.		5 17 8	5		84,560	1	1 0 0	Nil						June 15, Dec. 15
105 5 0	106 0 0	" Debenture Stock		7 11 6	8	...	...	100	100 0 0							
		INSURANCE.														
3 19 0	4 0 6	National	27	4 1 3	16¼	446,398j	200,000	5	1 0 0	4	2,000,000	1,000,000	200,000	27	May, Nov.	Mar 31, Sept. 30
1 9 3	1 9 6	New Zealand	28	4 10 0	13¼	1,156,401	1,500,000	1	0 10 0	10/-	1,500,000	1,500,000	750,000	28	Feb., Aug.	Nov. 30, May 31
1 18 6	1 19 3	South British	29	4 5 6	11⅓	1,176,647	1,000,000	1	0 15 0	5/-	2,000,000	1,000,000	750,000	29	April, Oct.	Feb. 28, Aug. 31
1 18 6	1 19 6	Standard	30	3 16 1	15	236,939j	200,000	5	0 10 0	4½	1,000,000	1,000,000	100,000	30	Mar., Sept.	Dec 31, June 30
		FROZEN MEATS.														
15 17 6	16 2 6	Canterb'y Frozen ... ... Ord.	31	6 11 3	14b	220,525	15,000	10	7 10 0	2½	275,000	250,000	212,500	31	June, Dec.	May 31, Nov. 30
5 3 0	...	Pref.		5 16 6	6		20,000	5	5 0 0	Nil.	...	...	...			...
1 6 0	1 6 6	New Zealand Refrigerating	32	4 15 3	6½	125,773	300,000	1	1 0 0	Nil	1,000,000D	900,000	600,000	32	Aug., Feb.	April 30, Oct. 31
13 0	13 6			4 13 7			600,000	1	0 10 0	10/-						
...	2 4 6x	Gear Meat Preserving and Freezing	33	3 18 9	8⅔	371,951d	460,000	1	1 0 0	Nil.	460,000	460,000	460,000	33	June, Dec.	May 31, Nov. 30
...	...	Wellington Meat Export	34	...		105,763n	7,350	5	5 0 0	Nil.	300,000	300,000	227,606	34	Mar., Nov.	Mar. 31, Sept. 30
...	2 12 0	" " " "		...			52,650	5	3 12 6	1¼						
		TRANSPORT.														
...	...	Adelaide Steamship	35	...	7½	129,960	2,325,135	1	1 0 0	Nil	3,000,000	2,325,135	2,325,135	35	Mar. Sept.	Dec. 31, June 30
...	...	Kelburne & Karori Tramway Ord	37	...	8	4,650	20,000	1	1 0 0	Nil.	30,000	30,000	30,000	37	July Feb.,	June 30, Dec. 31
...	...	Pref.		...	8	...	10,000	1	1 0 0	Nil.						
9 2 6	9 7 6	N.Z. Shipping Co. ... Cum. Pref.	38	6 9 7	6	B	22,668	10	10 0 0	Nil.	1,000,000	226,680	226,680	38	Jany, July	Dec. 31, June 30
1 0 4	1 0 8	Union Steamship of N.Z. Cum. Pref.	39	5 7 3	5½	B	1,000,000	1	1 0 0	Nil.	1,000,000	1,000,000	1,000,000	39	May, Dec.	Mar. 31, Sep. 30
2 5 6	2 6 6	Huddart Parker ... ... Ord.	40	6 10 4*	15E	909,253s	750,000	1	1 0 0	Nil.	750,000	750,000	750,000	40	Sept., Mch.	June 30, Dec. 31
1 0 0	...	" " " " Pref.		6 0 0	6		500,000	1	1 0 0	Nil.	750,000	500,000	500,000			
...	...	Devonport Steam Ferry	41	...	7½	26,023s	103,365	1	1 0 0	Nil.	150,000	104,241	104,241	41	Dec., July	Oct. 31, April 30
...	...	Silverton Tramway	42	...	2½	48,315	500,000	1	1 0 0	Nil.	500,000	500,000	500,000	42	...	June 30
330 0 0	340 0 0	P.&O. Defer'd Stock (Col.) Trust ...	43	3 11 8	12	5,708,255	...	100	100 0 0	Nil.	...	3,391,120	3,391,120	43	May, Dec.	Mar. 31, Sep. 30
		COAL.														
14 6	...	Hikurangi Coal ... ... Ord.	44	...		5,873c	45,000	10/-	0 10 0	Nil.	45,000	45,000	45,000	44	July, Jan.	June 30, Dec. 31
14 6	...	" " ... ... Pref.		5 10 4	8	...	45,000	10/-	0 10 0	Nil.	...	...	...	...	...	...
18 9	1 0 3	Taupiri Coal ... ... Ord.	45	7 13 10	7½	17,098sdo	121,000	1	1 0 0	Nil.	150,000	121,000	121,000	45	May	Mar. 31
1 3 6	...	" " ... 8% Cum. Pref.		6 16 2	8	...	20,000	1	various	...		20,000	20,000	...	Oct., April	Sept. 30, Mar. 31
1 19 9	2 0 6	Westport Coal Co.	46	6 5 0	12½	234,896r	450,000	1	1 0 0	Nil.	500,000	450,000	450,000	46	May, Nov.	Mar. 31, Sept. 30
5 10	...	Westport Stockton Coal	47	...	...	9,343	262,940	10/-	0 10 0	Nil.	150,000D	131,470	131,470	47	Feb.	Dec. 31
8 9	...	do. do. do. 8% Pref.		9 2 10	8	...	132,631	10/-	0 10 0	Nil.	68,530	66,315	66,315	...	Feb.	Dec. 31
16 9	...	Waipa Railway and Collieries ... Ord	48	9 11 0	8	7,929o	79,905	1	1 0 0	Nil.	80,000	79,905	79,905	48	April	Jan. 31

a Includes Bonus.
c Cum Dividend.
cr Cum Rights.
xr X Rights
d Includes Renewal Fund & for. Marine, Accident, Fire Insurance Reserves.
e Includes Reserve Liability equal to amount of share—only to be called up in case of liquidation.
f Including Premium.
g Issued at a Premium of £1.
h 4% Stock Guaranteed by the N.Z. Government
i 250 Shares fully-paid.
Includes Re-insurance Reserve Fund etc

k Only to be called up in case of liquidation
l Includes premium on shares.
n Includes Insurance and special reserves for equalisation of dividends.
o Includes Income Tax Reserve, and /or Plant Reserve.
p Only preference as regards capital and dividends, but will not increase with higher dividend on ordinary shares.
q Preference as to dividend only.
r Includes Sinking and (or) Insurance Fund.
s Includes Insurance Fund.
w 200 are fully paid.
x Ex Dividend.
y Of which part only are fully paid up

A Nominal.
B Not available.
D Debentures, see back page.
E Less Commonwealth Absentees Income Tax.
F Includes Property Depreciation Account.
G Includes Renewal and Depreciation Fund.
H Includes Renewal and Replacements Reserve.
K Includes Employers Liability and Fire Insurance Reserves.
M Free of Income Tax.
N Only Ordinary Shares shown.
‖ Less English Income Tax.
* 15% was paid on capital of £500,000.

CHRISTCHURCH STOCK EXCHANGE

3rd November, 1913

INVESTMENT STOCKS

No. of Shares	Shares Issued	CAPITAL. Authorised	CAPITAL. S'bscribed	CAPITAL. Paid-up	Reserves & Balance Carried Forward	SHARE VALUE Amount of Sh're	SHARE VALUE Paid up per Share	Share-holders' Liability	COMPANIES.	Latest Quotations	Dividend per Centum per Annum	Return upon Investment at Latest Quotation	Half Year or Year Closes	Dividends Receivable in Christchurch	REMARKS
		£	£	£	£	£	£ s. d.	£ s. d.	**BANKS—**	£ s. d.		£ s. d.			
50,000‡	50,000	2,000,000	2,000,000	2,000,000	2,660,000	40	40 0 0	40 0 0A	Australasia	§116 0 0	17	5 17 0	Oct. 31, Apr. 30	April, Oct,	
400,000‡	300,000	3,000,000	2,250,000	750,000	681,756	7½	2 10 0	15 0 0A	National of New Zealand Ltd.	5 7 9	13	6 0 0	Sep. 30, Mar. 31	Jan., July	Sales—£5/7/9, £5/7/9
175,000‡	175,000	3,500,000	3,500,000	3,500,000	2,337,504	20	20 0 0	20 0 0A	New South Wales	40 0 0	10	5 0 0	Mar. 31, Sep. 30	May Nov.	Sales—£10/18/6, £10/18/6
150,000	150,000	1,000,000	1,000,000	500,000	1,418,117	6⅔	3 6 8	3 6 8	New Zealand Shareholders	10 15 0	15	4 13 0	Mar. 31, Sep. 30	June. Dec.	
..	..	1,000,000	1,000,000	1,000,000		..	..		" " Guaranteed Stock	..	4	..			
..	75,000J	500,000	500,000	500,000		6⅔	6 13 4	Nil	" " Preference Shares	..	..	..			
80,000‡	80,000	6,000,000	6,000,000	2,000,000	1,544,002	75	25 0 0	50 0 0	Union of Australia Ltd.	56 0 0	14	6 5 0	Feb. 28, Aug. 31	Jan., July	
19,238	191,238	3,150,000	2,212,969	1,401,135	7,675	10/-	0 10 0	Nil	Commercial of Australia Ltd.	0 17 0	Nil	Nil	Dec. 31, June 30	Feb. & Aug.	
211,735J	211,735					10	10 0 0	Nil	" " Cumulative Preference	5 16 6	3	5 7 6			
									INSURANCE—						
400,000	200,000	2,000,000	1,000,000	100,000	363,908	5	0 10 0	4 10 0	National Ltd.	2 8 0	25	5 4 3	Sep. 30, Mch 31	May, Nov.	Sales—48/3, 48/3, 48/3
150,000	150,000	1,500,000	1,500,000	450,000	441,260	10	3 0 0	7 0 0	New Zealand Ltd.	5 6 0	15	5 12 6	Nov. 30, May 31	Feb., Aug.	Sales—£5/5/6
400,000	200,000	2,000,000	1,000,000	300,000	454,365	5	1 10 0	3 10 0	South British Ltd.	4 0 0	13⅓	5 0 0	Aug. 31	April, Oct.	
100,000	100,000	1,000,000	1,000,000	75,000	126,249	10	0 15 0	9 5 0	Standard Ltd.	1 11 9	12	5 13 0	Dec. 31, June 30	Mar., Aug.	
32,000	9,598	100,000	75,997	49,800	35,426	5	2 10 0	2 10 0	Farmers' Co-operative Ltd.	2 15 0	7	6 6 0	June 30	August	
	30						0 10 0	4 10 0		5 10 0		6 6 0			
	475						1 0 0	4 0 0		..					
	5,051						5 0 0	Nil							
	35						0 5 0	4 15 0							
	52					1	1 0 0	Nil							
									GAS—						
500,000	473,379	750,000	645,019	520,580	118,168	1	1 0 0	Nil	Auckland	1 8 6	18⅓B	..	Dec. 31, June 30	July, Feb.	
250,000	171,640					1	0 11 0	0 9 0							
6,000	6,000	30,000	30,000	9,000	2,670	5	4 10 0	0 10 0	Ashburton	5 17 6	8	6 2 6	Sep. 30	Nov.	**WESTPORT COAL—** The Directors propose capitalizing £50,000 from the Reserve Fund and allotting 50,000 shares to the present shareholders in the proportion of 1 new share for every 8 shares held at present.
				2,000		5	2 0 0	3 0 0		2 10 0		6 6 8			
				2,000		5	0 13 4	4 6 8		0 15 0		6 13 4			
64,000	40,000	320,000	200,000	200,000	82,208	5	5 0 0	Nil	Christchurch	6 17 6	10	7 5 6	June 30, Dec. 31	Aug., Feb.	
	8,000	40,000	Q	Q		5	2 0 0	3 0 0	" New Issue	..	10	..			
12,000	12,000	12,000	12,000	12,000	2,699	1	1 0 0	Nil	Feilding	0 15 0	5	6 13 4	Feb. 28	April	
25,000	24,760	25,000	24,760	24,760	21,648	1	1 0 0	Nil	Gisborne	2 2 0	15	7 2 9	Mar. 31	May, Oct.	
2,000	2,000	12,000	12,000	12,000	1,087	6	6 0 0	Nil	Hokitika	5 10 0	7$\frac{1}{12}$	7 10 0	April 30	May, Nov.	
10,000	4,000	100,000	99,570	73,785	23,945	10	10 0 0	Nil	Napier	16 0 0	12½	7 16 4	Dec. 31	Aug., Feb.	
	1,000					10	9 0 0	1 0 0	"	14 7 6		7 16 6			
	4,957					10	5 0 0	5 0 0	"	8 0 0	..	7 16 4			
8,000	6,000	40,000	30,000	18,500	3,738	5	5 0 0	Nil	New Plymouth	7 5 0	10	6 18 2	June 30, Dec. 31	July, Jan.	
6,000	6,000	30,000	30,000	30,000	30,232	5	5 0 0	Nil	Palmerston North	9 0 0	10	5 11 0	Jan. 31	March, Aug.	
6,000	5,060	6,000	5,060	5,060	2,021	1	1 0 0	Nil	Port Chalmers	0 15 0	5	6 13 4	Aug. 31	Oct.	
4,000	4,000	20,000	20,000	20,000	21,227	5	5 0 0	Nil	Timaru	8 17 6	10	5 12 6	Dec. 31	Aug., Feb.	
40,000	23,578	550,000	235,780	308,311	124,972	10	10 0 0	Nil	Wellington	16 10 0	10	6 2 6	Dec. 31, June 30	Aug.	
150,000	72,531		72,531			1	1 0 0	Nil	" Cumulative Preference	1 0 0	5	5 0 0			
									SHIPPING—						
100,000	90,672	800,000	725,366	725,366	430,671	8	8 0 0	Nil	New Zealand	17 10 0	10	4 11 ..	June 30, Dec. 31	April, Oct.	
3,000,000	1,000,000	1,000,000	1,000,000	1,000,000	Q	1	1 0 0	Nil	Union Steamship	1 5 6	11	..	Sep. 30, Mch 31	May, Dec.	Sales—25/3, 25/-, 25/-, 25/-, 25/-, 25/-, 20/-, 20/-, 20/-, 19/9, 19/7½, 19/9, 19/9
	1,000,000	1,000,000	1,000,000	1,000,000		1	1 0 0	Nil	" " Cumulative Preference	0 19 9	5½				
750,000	500,000	750,000	500,000	500,000	28,201	1	1 0 0	Nil	Huddart-Parker	1 1 6	7	5 15 0	Mar. and Sep.	May, Dec.	
750,000J	500,000	750,000	500,000	500,000		1	1 0 0	Nil	" Cumulative Preference	1 1 9	6	5 5 0			
300,000	172,291	217,500	200,520	161,412	50,312	14/6	0 14 6	Nil	Northern Steam A	0 15 0	7	6 15 0	Mar. 31, Sep. 30	May, Nov.	
	104,289					14/6	0 7 0	0 7 6	" " B	0 7 3		6 17 0			
									COAL—						
400,000	400,000	400,000	400,000	400,000	117,459	1	1 0 0	Nil	Westport	1 10 6	10	6 11 4	Sept. 30	Nov., May	Sales—30/6, 30/9
150,000	121,000	150,000	121,000	121,000	18,997	1	1 0 0	Nil	Taupiri	§1 1 3	8¾	8 2 9	Mar. 31, Sep. 30	April, Oct.	Sales—21/9, 21/9, 22/6, 22/10½
400,000Z	262,940	150,000	131,470	131,470	1,033	½	0 10 0	Nil	Westport-Stockton	0 4 0	..	..	Dec. 31		Sales—4/1½, 4/-, 4/-, 4/-
	100,000J	50,000	50,000	45,000		½	0 9 0	0 1	" " (8% non-Cumulative Preference)	..	..	..			
*446,585	183,155	230,000	104,992½	104,992½	Q	1	0 10 0	Nil	Paparoa	..	..	..	Mar. 31		
	13,415						1 0 0	Nil	" Cumulative Preference	..	..	..			
35,000Y	28,330	35,000	28,330	28,330Y	9,426	1	1 0 0	Nil	Blackball	..	5	..	Dec. 31	May	
									BREWERIES—						
24,000	24,000	120,000	120,000	96,000	63,636	5	4 0 0	1 0 0	S. Manning & Co.	§4 3 6	10	9 5 0	Mar. 31, Sept. 30	May, Oct.	Sales—87/6
20,000	20,000	100,000	100,000	80,000	51,630	5	4 0 0	1 0 0	Ward & Co.	5 0 0	10	8 0 0	June 30, Dec 31	Jan., Aug.	Sales- £5
72,000	72,000	72,000	72,000	72,000	73,912	1	1 0 0	Nil	Crown Brewery Co. Ltd.	1 14 0	10	5 17 6	Dec. 31, June 30	Jan., July	Sales--34/-
									WOOLLENS—						
40,000	24,661	200,000	200,000	200,000	51,014	5	5 0 0	Nil	Kaiapoi	5 2 6	7	6 16 6	July 31, Jan. 31	Sep., Mar.	
..	15,339	..	..	..		5	5 0 0	Nil	" Cumulative Preference	5 2 6	6¼J	6 6 9			
25,000	23,845	125,000	119,225	83,457½	18,787	5	3 10 0	1 10 0	Mosgiel	3 14 0	7	6 12 6	October	Nov.	
20,000	20,000	200,000	170,700	115,350	30,258	5	4 0 0	1 0 0	Wellington	4 0 0	8	8 0 0	July 31, Jan. 31	Sep., Mar.	
20,000J	14,140J					5	2 10 0	2 10 0	" Cumulative Preference	3 0 0	8J	6 13 4			
50,000	28,534	50,000	32,852	32,441	11,944	1	1 0 0	Nil	Oamaru	1 7 0	9	6 13 4	Oct. 31	June, Dec.	
	4,318J					1	1 0 0	Nil	" Preference	1 7 0	8J	5 18 6			