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Financial diversification strategies before World War I: Buy-and-hold versus naïve portfolio selection.

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Abstract: This study contributes to a growing volume of scholarship that highlights the importance of financial diversification in business history. It shows that, pre-WWI, financial advice for equal portfolio weighting, the so-called naïve diversification, then called scientific investment or geographical distribution of risk, was a sophisticated strategy for Victorian investors and not suboptimal to Markowitz optimization. Drawing upon a unique dataset of 507 individual portfolios at death, this study shows that, although Victorian investors, in particular wealthy investors, did diversify investment risk across a number of securities, they did not hold equally weighted portfolios. It explores possible reasons for the unbalanced nature of investor portfolios and dismisses socio economic factors, illiquidity, passive ‘buy the market’ and market timing strategies as possible explanatory factors. The results rather point to a strategy of naïve diversification spread over time, a ‘buy as you go and hold strategy’, buying new securities as savings allowed and holding them until death.

Keywords: Diversification, Victorian investors, portfolio theory, risk management, Markowitz.

JEL Classifications: N23, N83, G11.

1. Introduction

This study is focused on portfolio diversification by UK individual investors for the period from 1870 to WWI, a period when investors were faced with significant investment choice, both domestically and across the globe. Leslie Hannah's most recent work has been a significant influence. Hannah has underlined in a number of ways how financial innovation has been immanent in the workings of financial markets and has emphasized the importance of diversity of (national) institutional forms in the rich palette of historical analysis of financial markets.¹ For instance, he has argued that, after the introduction of limited liability, Britain became an early pioneer in the divorce of shareholders from management, something that took decades in the US to fully develop.² The early adoption of the corporate form generally boosted economic growth,³ and corporate finance differed significantly between developed economies before WWI.⁴

In the case of Britain, the early 'managerial revolution' and the existence of dispersed shareholdings beg the question of portfolio diversification at the individual level. In a financial market which was dominated by individual investors⁵ and in which ownership was gradually detached from managerial control,⁶ how did investors manage financial risk and allocate their wealth among alternative risky financial assets? To what extent was financial innovation in corporate governance coupled or accompanied by a parallel financial innovation in portfolio selection strategies at the individual level? Was investment management before modern portfolio theory rudderless and unsophisticated or was it, also, able to benefit from innovation? Did individual investors follow experts' recommendations and, if not, why not?

Portfolio diversification was a popular investment strategy recommendation made by UK financial advisers at least from the 1870s, in particular arguing for equally-weighted portfolios, or so-called naïve diversification. Over time, investors were gradually introduced to more sophisticated versions of naïve diversification and were shown how to use correlation to reduce overall portfolio risk by spreading their savings worldwide. By 1914 only the mathematical optimisation of Markowitz' model was lacking in terms of portfolio practice.

¹ Hannah, "The divorce."

² Hannah, "The divorce," and Foreman-Peck and Hannah, "Managerial revolution."

³ Hannah, "Corporate census," and Foreman-Peck and Hannah, "The diffusion."

⁴ Hannah, "Corporate finance."

⁵ Individual investors were by far the most important category of investor before WWI. See Rutterford and Hannah, "Institutional Investors".

⁶ Foreman-Peck and Hannah, "Managerial revolution."

There is a growing consensus in recent business history research that diversification played an important role in the structure of financial markets before WWI. This insight adds a fresh analytical layer to the long-standing debates relating to the workings of capital markets in the past, with a particular focus on the UK. Despite the fact that empirical research on individual shareholdings has been hampered by data scarcity, two studies specifically investigate Victorian portfolios at the micro level.⁷ Other research attempts to explain some stylized facts in UK financial history on the basis of modern portfolio theory at the macro or stock market level.⁸ This line of thought leads to a research hypothesis, already posited by C. K. Hobson on the eve of WWI. Describing wealthy investors, C. K. Hobson argued that cross-country capital flows were affected by wealth distribution, investment expertise, and risk preference:

[...] These expert investors, who have a large capital at their disposal, are in an advantageous position for spreading their investments, geographically or otherwise, so as to obtain a high return, while running no greater risks on their aggregate holdings than the individual who obtains a lower return from a small investment in some gilt-edged stock. Differences in the knowledge possessed by investors, in their wealth, and in their willingness to bear risks, may result in cross investment between countries.⁹

Hobson's argument reflects a commonly held viewpoint within the discussions of his time. For instance, in 1916, Powell also acknowledged that diversification, in the form described by Henry Lowenfeld and others as the geographical distribution of risk, was well established before WWI among wealthy investors.¹⁰ Correlation between security prices and returns, in the light of financial advice at the time, may have played a role in the explanation of several financial developments before WWI.

In this paper, we provide some evidence that the global naïve diversification strategy recommended by advisers in the late nineteenth and early twentieth centuries compared well in performance terms relative to naïve diversification. We argue that, as a result, naïve diversification is a more useful benchmark with which to measure the efficiency of actual portfolio selection during this period than is Markowitz

⁷ See Rutterford and Sotiropoulos, "Portfolio diversification" and "Individual investors" for a comprehensive discussion of diversification in England and Wales from 1870 to WWI.

⁸ See Goetzmann and Ukhov, "British investment," Le Bris "Benefits from diversification," Edlinger et al. "World portfolio," Mitchell *et al.*, "British railways," Chabot Kurz, "Foreign bias."

⁹ Hobson, *Export of Capital*, 234.

¹⁰ Powell, *The Evolution*, 464-478.

optimization.¹¹ This result shows that pre-WWI financial advice to adopt equal and global portfolio weighting was neither simplistic nor unsophisticated. Experts' recommendations offered a well-organized, comprehensive, and rather handy practical paradigm of risk management during the era of the gold standard, in which exchange risk could effectively be ignored (when investing in overseas securities) and computation capacities did not allow optimisation according to the Markowitz model.

Drawing upon a unique dataset of 507 individual probate portfolios, we also argue that investors' portfolio choices at death differed from those recommended by experts due to the adoption of a 'buy and hold' strategy. Investors with enough wealth to be able to diversify gradually acquired securities from the available choices in the market without divesting existing holdings. This investment strategy was related to investors' new social status as rentiers with no particular ownership interest in specific companies. The Victorian investor did not transform their wealth into influence over British industrial and commercial enterprises, as their US counterparts did over US companies, but rather chose to diversify over time, leading to apparently unbalanced portfolios. This rise of the diversified investor was tied to the coterminous separation of corporate ownership from control.

2. The rationale for diversification

According to the mainstream research in finance, the original portfolio diversification strategy is associated with the seminal intervention of Markowitz in the 1950s.¹² The standard story is that not until Markowitz' paper on diversification in 1952, and in practice not until the advent of fast computers in the 1970s, were these modern approaches to portfolio management fully implemented.¹³ Prior to this, investors are thought to have made inefficient, unsophisticated portfolio selections.¹⁴

Markowitz derived an optimal rule for allocating wealth across risky assets in a static setting when investors are assumed to be risk averse, wanting to maximize their expected investment return (generally agreed to be the total of income and capital gain over a particular period) for a given level of risk (or, alternatively, to

¹¹ This differs from existing studies that use Markowitz optimization as sophistication benchmark: Goetzmann and Ukhov, "British investment," Edlinger *et al.* "World portfolio," Mitchell *et al.*, "British railways."

¹² Markowitz, "Portfolio theory," 5. See also Markowitz, "Portfolio selection." The main insights into mean-variance portfolio selection were anticipated in the 1940s by de Finetti (see Barone, "Bruno de Finetti") and developed independently by Roy, "Safety first."

¹³ Read, *The Rise*.

¹⁴ See, for example, Bernstein, *Against the Gods*.

minimize risk relative to the return they seek). The measure most commonly used to quantify risk is the variance of returns. This application of a mean-variance model to the portfolio selection problem laid the ground for modern portfolio theory (hereafter MPT), triggering, inspiring and influencing a vast amount of research in finance. The main insight is simple: if individual security risk is captured by the expected variance of returns, portfolio risk requires a set of variances and covariances in order to be fully described. In other words, when it comes to the analysis of portfolio risk, one needs to take into account not only the individual components' risks but also their interactions. The optimization solution leads to a hyperbola depicting all the possible maximum returns for a given level of risk in the risk-expected return space. From all possible combinations in the hyperbola curve, the optimal portfolio is the one that maximizes the so-called Sharpe ratio, which is equal to the expected excess return of the portfolio relative to the risk-free asset, divided by the expected standard deviation of the portfolio.¹⁵

There are two main problems with this train of thought. On the one hand, implementation of mean-variance optimal portfolio selection in practice is not that straightforward. For example, the optimal solution is very sensitive to initial assumptions with regard to investors' expectations and future returns. This usually leads to significant estimation errors, due to which optimized portfolios are rarely optimal in practice.¹⁶ We further discuss this point below. On the other hand, and more importantly, investors were not helpless nor did they lack investment advice on how to diversify their portfolios before the rise of MPT.¹⁷ The investment approach of spreading risk across a number of different securities worldwide was widely and consistently promoted within the UK financial community at least from the 1870s. Financial advisers and analysts offered detailed recommendations on how best to combine a number of investments in a portfolio in order to enhance yield without increasing portfolio volatility. A series of investment books, magazines, pamphlets, and newspaper articles made investors aware of the benefits of spreading risks at home and abroad through naïve diversification, that is, through equally weighting their portfolios across risky assets.

¹⁵ Markowitz's mean-variance model was designed for a single period: an investor is assumed to estimate the mean and the variance of return for each asset being considered for the portfolio over the single period. Subsequent research has attempted to generalize the single period model to a multi-period one under various assumptions about investor utility functions and dependency of returns between periods, see Elton and Gruber, "Portfolio theory."

¹⁶ For a general discussion of the problems in the implementation of the mean-variance portfolio selection and its practical performance see: DeMiguel et al., "Optimal Versus Naive," Michaud, "Markowitz optimization," Litterman, *Investment Management*, and Black and Litterman, "Portfolio Optimization."

¹⁷ For an extensive analysis of this point see Rutterford and Sotiropoulos, "Financial diversification."

Financial advice on how to best structure investment portfolios in the UK increased in sophistication over time. By 1914 only the mathematical optimisation of Markowitz' model was lacking in terms of portfolio best practice in the UK. More emphasis was gradually placed on the idea of correlation and on reducing portfolio risk by proper selection of poorly correlated but equally volatile securities. Sophisticated diversification strategies were actively promoted by a number of contributors to the *Financial Review of Reviews*, a monthly magazine aimed at retail investors first published in 1905, and in textbooks aimed at individual investors such as *Investment an Exact Science*, authored by Henry Lowenfeld, and were also promulgated by other authors.¹⁸ These studies did not identify an efficient set of portfolios according to mean-variance optimization, nonetheless they offered an insightful and practical framework for the main principles and building blocks of financial diversification. Historical analysis of returns, price volatility, and correlation were all taken into account in the portfolio selection. Investors were advised how to target a particular level of yield at the portfolio level *and* reduce capital risk through the choice of relatively uncorrelated securities. While portfolios were supposed to be equally-weighted, portfolio selection was not passive but driven by identification of low correlation between securities.

This top-down approach argued for international diversification. Securities from the same (domestic) market were thought of as more likely to be positively correlated. Domestic diversification was not ruled out but the selection of domestic securities was argued to be more difficult and demanding for the ordinary investor than choosing, say, overseas government bonds, while the portfolio itself would be heavily reliant on domestic market movements.¹⁹ Diversification was perceived as a “systematic method of averaging risks”²⁰ or, alternatively as a method to neutralize and balance risks against each other,²¹ but in practice it became a method of “geographical distribution of capital.” International diversification was assumed to offer more beneficial covariances than domestic diversification as it allowed investors to “obtain as great a contrast as is possible in the trade influences which govern each one of his holdings”.²²

This approach of top-down international naïve diversification did not pass unnoticed, nor was it unchallenged. In a review of Lowenfeld's book, Layton argued

¹⁸ For instance, see Crozier, *First Principles*, May, “Assurance funds,” and Withers, *The Quicksands*. Lowenfeld's intervention became so popular that it also influenced French discussions, see Rutterford and Sotiropoulos “Financial diversification.”

¹⁹ Lowenfeld, *Investment*, 106-7.

²⁰ Lowenfeld, *Investment*, 61; Hobson, *Export of Capital*, 234.

²¹ Crozier, *First Principles*.

²² Crozier, *First Principles*, 90.

that discovering internationally uncorrelated securities was by no means an easy exercise for investors with small portfolios, who should seek expert advice.²³ Another review in *The Times* five years later by an anonymous correspondent made a similar point, concluding that “it is unfortunately evident that the ordinary private investor has not the means of investigating the merits of a security in a remote part of the world.”²⁴ Despite these reservations, critics did not dispute the benefits of this approach to diversification to the individual investor, which became well established through textbooks, magazine and newspaper articles as well as through investment advice on individual portfolios.²⁵

3 The case for naïve diversification over Markowitz optimization

We have shown how financial advisers in the UK before WWI introduced the concept of correlation in the context of equally weighted and globally exposed portfolio selection. We should not dismiss such portfolio selection *a priori* as unsophisticated or suboptimal in relation to Markowitz optimization. Indeed, recent investment management experience and related research have shown that the strategy of equal-weighting may significantly outperform mean-variance optimization. Unconstrained Markowitz optimization usually offers impracticable results and poor guidance to investors.²⁶

There are two reasons for this.²⁷ First, Markowitz optimization relies on expected returns, which are very difficult to estimate. In practice, historical averages provide very poor forecasts of future returns.²⁸ Second, optimization results for asset allocation are extremely sensitive to the return assumptions used. They often offer awkward portfolios with extreme positive and negative portfolio weights and, when constraints rule out short selling (an appropriate assumption for investor behaviour pre-World War I), constrained optimization often suggests ‘corner’ solutions with

²³ Layton, “About Investment.”

²⁴ *The Times*, Friday 9 January 1914, p. 13.

²⁵ See Rutterford and Sotiropoulos, “Financial diversification.”

²⁶ DeMiguel et al., “Optimal Versus Naive,” Michaud, “Markowitz optimization.”

²⁷ Black and Litterman, “Portfolio Optimization,” 28.

²⁸ Black and Litterman, “Portfolio Optimization,” 30. One should also take into consideration the lesson from the recent financial meltdown that ‘long tail’ events are not as rare as one might expect (see Mandelbrot and Hudson, *The Misbehaviour*). Even if we assume, for simplicity, that all investors hold the expectation that past returns are the best estimate of future returns, and have full information as to these returns, a very long time series of data is required in order to have reliable estimates of future mean returns and variances of returns. DeMiguel et al., “Optimal Versus Naive,” 1919; Merton, “Estimating.”

many zero portfolio weights and unreasonably large weights in assets with small market capitalizations. When expected returns are fed into input-sensitive optimization models, prescribed portfolios are unreliable in terms of their anticipated performance and practical use due to the high estimation errors. For that reason, many authors have called mean-variance optimization “estimation-error maximization”²⁹ explaining why contemporary investment managers continue to resist its full adoption. Many studies provide plenty of evidence that gains from optimal diversification are more than offset by estimation errors and thus naïve diversification (equal-weighting) strategies may significantly outperform Markowitz optimization. As a result, recent research on portfolio allocation devotes considerable effort towards finding ways of handling estimation error and thereby improving the actual performance of the Markowitz model.³⁰

This is in addition to the fact that Markowitz optimised portfolios are often counter-intuitive, since the effects of correlation between assets is not always evident. In contrast, equal weighting is both easy to understand and easy to implement. Also, both models are single period models. Rebalancing portfolios using Markowitz optimisation is complex to do in practice, as the optimal portfolio in one period may be very different from the initial weightings and require radical restructuring. On the other hand, for naïve portfolios, both building portfolios up over time or rebalancing are, in principle, relatively straightforward.

Figure 1 offers some evidence for the superiority of naïve diversification over constrained (ruling out short sales) mean-variance portfolio optimisation in practice using historical financial returns of the period 1870-1913. It depicts cumulative real returns for five different portfolios, all derived from the 19 asset classes used by Goetzmann and Ukhov in their diversification analysis.³¹ From Figure 1, we can see that naïve portfolio selection beats Markowitz optimization in four out of the five portfolios. Naïve diversification is particularly efficient when we move from domestic to more international portfolio exposure, a finding that justifies Lowenfeld and contemporary financial advice to hold a portfolio which was diversified internationally and not just nationally.

²⁹ Michaud, “Markowitz optimization,” 31.

³⁰ For a summary of this literature see DeMiguel et al., “Optimal Versus Naive,” 1916.

³¹ These five portfolios are denoted: Domestic, International 1; International 2; Aggregated by Sector; and Aggregated by Security. These five portfolios include 11, 11, 11, 7 and 5 asset classes respectively. Goetzmann and Ukhov, “British investment,” were the first to directly employ the concept of diversification in the study of Victorian financial markets. They used financial returns from Edelstein’s original research, *Overseas Investment*, regrouping them into 19 different asset classes. They calculated Markowitz optimized portfolio weights on the eve of WWI on the basis of the standard historical average approach, whereby expected excess returns (to feed the optimization exercise) are taken from their historical averages for the whole period between 1870 and 1913.

[FIGURE 1 AND TABLE 1 NEAR HERE]

Using broad asset categories instead of selection of individual securities means that we allocate financial wealth across portfolios of holdings rather than individual securities. Each asset category used in the calculations of Figure 1 is basically the unweighted average index of several individual securities in Edelstein’s initial database. In practice, however, people invested in individual securities. Markowitz optimization of individual securities is a difficult and demanding activity, and expensive in terms of resources. Naïve portfolio selection thus emerges as a more reliable and easy-to-follow strategy for the individual investor who faces severe resource constraints. The performance of naïve diversification is in general (when historic returns are used as estimates of expected returns) superior to the more complex Markowitz optimisation. Such a strategy pre-WWI was therefore by no means unsophisticated when applied in practice. In the following section, we look at the sample of 507 portfolios at death to explore the extent and type of diversification which individual investors adopted in practice.

4. How diversified were investors in practice?

Table 2 looks at the average number of holdings per portfolio and portfolio wealth as a percentage of gross wealth for our sample of 507 investor portfolios at death between 1870 and 1902. For all wealth quartiles, financial portfolio investments accounted for a significant proportion of gross wealth – between 44% and 58% of total gross wealth. However, individual investors in the top quartile of gross wealth for the sample, that is, investors who had “large capital in their disposal” according to Hobson, held on average 11 securities in their portfolios and their financial investment comprised 86% of the total financial investment.

[TABLE 2 NEAR HERE]

In Table 2, we can also see that diversification is in general related to wealth: investors in the three lower quartiles of the wealth distribution diversified their portfolios much less than did those in the top quartile, with an average of 1.5, 2.3, and 3.6 holdings from first to third quartile respectively. However, due to the extreme

wealth polarization in our sample, it was mostly the portfolio selection of the very rich that actually defined overall investment structure at the aggregate level.³² In other words, Hobson’s assumption seems quite valid: knowledge, risk preference, and wealth distribution heavily influenced portfolio selection and cross-border investment before WWI.³³

Significant portfolio diversification was thus an established practice – at least among relatively wealthy investors in the sample, who accounted for the bulk of our sample’s financial investments. Those at the top 10% of the wealth distribution held on average 14 different securities in their portfolios, and this decile accounted for almost two thirds of total portfolio wealth. These top 10% of investors in gross wealth terms held financial portfolios which ranged in value between £25,000 and £287,000.³⁴ Such individual wealth was enough to fully control a registered company. For example, according to Essex-Crosby’s estimates for 1894,³⁵ about 70% of registered joint-stock companies had total paid-up capital, including fixed income loans, below £250,000 and 42% below £100,000.³⁶ Thus, individuals in our sample who were high in the wealth distribution had enough means to buy and control whole companies. And yet they consistently chose to spread their investments across different securities, sectors and countries. Seeking out poorly correlated securities to form part of a diversified portfolio thus played a role in Victorian investors’ choices and should be part of the explanation of overall financial trends at the time.

Table 2 also explores how close the portfolios were to a benchmark naïve, equal weighting portfolio strategy. It presents information on the largest portfolio

³² Institutional investor portfolios at the time represented a relatively small part of total stock exchange capitalization: Rutterford and Hannah, “Institutional investors.”

³³ The Table 2 sample data cover the years between 1870 and 1902. There is a tendency in our sample for diversification – as measured by number of holdings – to increase with wealth and time, so the same results are expected to hold until the outbreak of war in 1914. A more detailed analysis of Victorian investor diversification can be found in Sotiropoulos and Rutterford, “Individual investors.” In the beginning of the 1900s, investors were typically advised to spend as much as £100 per different security. On the basis of that recommendation, full diversification for less wealthy investors was not that straightforward. One should also take into consideration transaction costs, which would add an additional barrier for less wealthy investors (Michie, *Stock Exchanges*, 53).

³⁴ On the basis of the data offered by the *World Wealth & Income Database*, the average individual net private wealth for 1895 was £469 as opposed to £9,898 average net wealth for the individuals in our dataset for the period 1870-1902. The average net wealth for our dataset is comparable with the average net private wealth of the top 10% of the UK wealth distribution, which was £4,361 in 1895 (in current prices), and much lower than the average net wealth of the top 1% of the UK wealth distribution, which was £32,821 in the same year. As expected, this indicates that the portfolio holders in our sample, despite their diversity in terms of wealth – for instance, 16% of our investors are below the UK average figure for net wealth – are on average closer to the top 10% of wealthy people in the UK.

³⁵ The year chosen, 1894, is the closest year in the Essex-Crosby data to 1902, the final year in our sample period.

³⁶ Essex-Crosby, *Joint Stock Companies*, 221.

weights held by investors in different parts of the wealth distribution, with respect to the largest one or two holdings. The table shows that there is significant portfolio concentration. Portfolios are unbalanced even among wealthier and more diversified investors. Investors in the top wealth quartile, for example, invested 64.5% of their portfolio wealth in just one or two holdings. We now explore possible reasons for this deviation from a naïve diversification strategy.

5. The role of personal characteristics in under-diversification

In previous research using the same sample, we have found three socio-demographic factors which influenced portfolio selection: wealth, gender, and local preference.³⁷ Wealth was related to more portfolio holdings and men held slightly more diversified portfolios than women. Less wealthy investors showed some preference for local listings (for which they might be better informed) as an alternative risk management strategy compared with more conventional spreading of risk across different securities. When it comes to how they diversified, the previous sections have argued that financial advisers at the time recommended a portfolio diversification strategy – top-down equally-weighted global portfolios – which was a sophisticated approach to risk reduction without sacrificing return. Nevertheless, even wealthy investors were reluctant to follow these recommendations. How can we explain this difference from the equally-weighted portfolio benchmark? Why did investors generally appear to ignore the experts’ advice to equally spread risk domestically or, better, worldwide?

Table 3 attempts to capture possible reasons for this divergence between a recommended investment strategy and its implementation in practice. The dependent variables are: (a) the difference between the number of holdings in the benchmark portfolio N_B and the actual portfolio holdings N , and (b) the difference between the sum of squared portfolio weights $SSPW$ and the sum of squared portfolio weights of the benchmark naïve portfolio $SSPW_B$.³⁸ Both variables capture the extent of under-diversification in relation to the equally weighted benchmark. As benchmark portfolio

³⁷ See Sotiropoulos and Rutterford, “Portfolio diversification;” Rutterford et al., “Local bias.”

³⁸ In line with similar research, the $SSPW$ captures the diversification level of a portfolio by its deviation from the market portfolio. Since, the weight of each security in the overall market portfolio is very small, this diversification measure is in practice equal to the sum of the squared portfolio weights. $SSPW$ identifies unbalanced portfolios, capturing the extent to which the value of a portfolio is concentrated in a few securities. For a given number of holdings, the more balanced the portfolio the lower the $SSPW$. Hence, the difference $SSPW-SSPW_B$ is a measure of divergence from the equally weighted benchmark portfolio (for instance, see Sotiropoulos and Rutterford, “Portfolio diversification;” Blume and Friend, “Asset structure”).

we have used the naïve portfolio structure suggested by Lowenfeld, as explained in the notes to Table 3, which assumes more securities in the naïve diversification portfolio, the greater the value of the portfolio.³⁹ The higher the dependent variable of specification (1), the lower the number of holdings in relation to the benchmark portfolio. The higher the dependent variable of specification (2), the more unbalanced the portfolio in relation to the equally weighted benchmark. The explanatory variables include personal characteristics and some sophistication proxies in line with relevant research.⁴⁰

[TABLE 3 NEAR HERE]

From Table 3 there is some evidence in specification (1) that, of the personal characteristics included, *age* and *gender* were related to under-diversification in relation to the benchmark (statistically significant at the 10% level). More sophisticated investors, who chose to include non-domestic securities or investment trust securities in their portfolios,⁴¹ selected on average more portfolio holdings than the benchmark portfolio. Wealth does not seem to play any role: wealthy investors diverged as much from the benchmark as did the less wealthy. However, the most striking finding, shown in specification (2), is that none of the independent variables in the regressions can describe the unbalanced nature of the individual portfolios.

Given the wealth background of the investors in our sample, in which the median financial portfolio is almost as high as £800, early large share denominations or transaction costs could possibly explain the under-diversification of some of the less wealthy investors, but cannot explain the divergence from the equally weighted portfolio benchmark for the full sample. The regressions in Table 3 include only portfolios higher in value than £500, to exclude possible barriers to diversification which might apply to smaller investors, such as high nominal values for securities or high transaction costs. However, these are unlikely to have been an issue for investors

³⁹ This recommendation is the only existing explicit recommendation of how to set up a naïve portfolio that we are aware of. It comes from Lowenfeld's 1907 pamphlet, which is slightly later than our sample. However, it does offer a naïve portfolio reference to compare the portfolio selection in our sample.

⁴⁰ See Sotiropoulos and Rutterford, "Portfolio diversification;" Goetzmann and Kumar, "Portfolio diversification."

⁴¹ In the regressions, we treat investment trusts as proxy for investment skills. It was mostly diversified investors in our who chose to add investment trust securities in their portfolios. The period of our dataset coincides with the rise of investment trust but their overall capitalization was negligible in relation to total market capitalization. Investment trusts offered indirect diversification but failed to attract less sophisticated investors.

at a time when nominal values were on a downward trend.⁴² Also, individual investors could buy any amount of stock, such as for Indian railway stock or Consols, and transaction costs were relatively low. Despite the fact that the London Stock Exchange Committee was reluctant to define a typical broker commission, the latter was generally not high enough to hinder transactions. The standard accepted rate for government stock was just 0.125% of the nominal value, whilst, for shares, commission ranged between 0.0625% and 0.5% of the nominal value.⁴³ The bid-ask spread, the so-called jobber's turn, was also very low under normal conditions: for instance, a typical spread for Consols was no higher than £0.125.⁴⁴ Other reasons, perhaps deeply rooted in the investment culture of the time, must explain investor divergence from equal portfolio weights.

6. The role of stock selection strategies in under diversification

We now look at whether investors adopted a particular investment strategy – different from naïve diversification – which can explain the unbalanced and variable nature of the portfolios in our sample. One possible investment strategy would have been to buy what the market offered. This can be called a passive or market approach to investment, linked to the Capital Asset Pricing Model (CAPM), which starts from Markowitz optimization and in addition assumes a common risk-free rate and homogeneous views on future risks and returns. It leads to the optimal portfolio, for all investors, being a share of the market portfolio – all securities in the market according to their market values – with more or less of the risk-free asset depending on risk preference.⁴⁵ One expectation from this 'CAPM' approach is that investors would have similar 'market' portfolios, with significant amounts of government bonds and railways which accounted for more than 70% of the value of the London Stock Exchange listed securities at the time.

⁴² See Jefferys, "The denomination," 45-6, and Jefferys, *Business organization*, 454. For the 3,720 companies that were formed between 1856 and 1865 and were still in existence in 1865: 16.06% had share denomination up to £5, 23.3% had share denomination of £5, 30.5% had share denomination between £5 and £10, 21.87% between £10 and £100, and 8.27% between £100 and £5,000. This means that about 70% of the existing shares had denomination lower than £10, which is by no means high for the investors in our sample. Acheson et al., "Denomination of shares," also argue that the average share denomination drifted downwards the whole between 1825 and 1870.

⁴³ Morgan and Thomas, *The Stock Exchange*, 153. We need to include the stamp duty to broker commission, but it does not change the argument. most retail investors paid the official LSE rate

⁴⁴ Powell, *The Mechanism*, 45.

⁴⁵ Read, *The Rise*.

Table 4, which compares the sample's average portfolio weights with the market portfolio's weights, shows that this is not the case. There is substantial variation in portfolio selection at the individual level, even for sectors in which average individual portfolio weights were comparable to corresponding overall market weights. For example, Table 4 shows that the median portfolio weight is zero for all asset categories and, in some cases (in non-UK government, non-UK railways, and in light and heavy industry), the third quartile portfolio weight is also zero or close to zero. The mean portfolio weight figures shown in the first column can thus be quite misleading when considering actual decision making at the individual level: 70% of investors did not invest in UK government stocks; 90% of portfolios did not include a single foreign railway security; 64% of investors did not select any finance-related security (broadly defined), and about 87% of investors did not invest in either foreign or empire government stock. At the same time, a non-negligible proportion of the sample portfolios included just one category of those reported in Table 4. For instance, almost one in five investors held only Consols, colonial or foreign government securities. Thus, there is no evidence that investors followed a passive, CAPM strategy which, instead of equal weights, sought to replicate the market value weights of the sectors of the London Stock Exchange.

[TABLE 4 NEAR HERE]

Alternatively, could financial returns shed light on why individual portfolios in our sample diverged from the equally weighted benchmark? Were investors keen to abandon equal portfolio weighting, instead preferring to target sectors with high real returns? Could an active, marketing timing or 'momentum' strategy have been adopted by investors? Figure 2 offers some evidence against this assumption. It shows how individual portfolio weights in the sample are related to real market returns for 15 broad asset categories.⁴⁶ From Figure 2, it is hard to identify any meaningful relationship when we relate portfolio weights to either financial returns at death or average financial returns of the last five years before death. The most intriguing finding from Figure 2 is that, for the more diversified portfolios, those with more than three holdings, weights are on average negatively related to real financial returns

⁴⁶ In our calculations we have assumed the following 15 broad asset categories: (1) UK government; (2) UK municipalities; (3) Colonial government; (4) Foreign government; (5) non-UK municipalities; (6) UK railways; (7) Colonial railways; (8) Foreign railways; (9) Finance; (10) Financial, Land and Investment; (11) Light industry; (12) Heavy industry; (13) Extraction; (14) Infrastructure; and (15) Agriculture. Our dataset is incomplete with regard to the type of the security. These 15 broad asset categories are derived from the 19 asset categories of Goetzmann and Ukhov, "British investment," when we aggregate by sector in order to eliminate any reference to security type.

(although the fit is very poor). One possible explanation for the effect captured by Figure 2 could be that investors adopted a diversification strategy on a *buy and hold* basis. Portfolios seem to have remnants from decisions made at different times in the past (that is, different stages of investors' lives) and thus appear on average much less sensitive or even entirely indifferent to recent trends in financial profitability. As a matter of fact, some of these portfolios may well have been inherited and thus remote from the existing market conditions at death.⁴⁷

[FIGURE 2 NEAR HERE]

7. Buy as you go and hold strategies

Although there is no evidence of market timing or market mirroring strategies from our sample, there is indeed some evidence supporting the assumption that Victorian investors followed a buy as you go *and* hold portfolio strategy. Table 5 looks at two diversified portfolios of wealthy investors in our dataset belonging to the top quartile of the gross wealth distribution. Portfolio (1), held by Mr George Heron, who died in 1894 at the age of 89, includes 24 securities and is worth £57,198. The portfolio is unbalanced and shows a preference for mostly domestic securities. About 80% of portfolio value is invested in railways and 13% in Consols. Portfolio (2) belongs to a female investor, Ms Elizabeth Snaith, a spinster who died in 1890 at the age of 85. She invested £36,755 in a portfolio of 14 securities. The structure of the portfolio is different from that of Mr Heron but equally unbalanced with regard to railways and government stocks. This time about 62% of the portfolio value is invested in government stocks and only 29% in railways. Portfolio (2) is less domestically focused, with 40% of the portfolio's value in non-UK securities and two small investments in philanthropic model dwelling companies. These two portfolios are snapshots in time and do not reveal traces of their past investment decisions. However, they are not dissimilar to different snapshots in time of Portfolio (3), shown in Figure 3, that follows the portfolio selection of Mr James Mott over a 47-year period between 1880 and 1927. Portfolio (3) is the result of a buy as you go and hold diversification strategy with acquisitions spread over the 1880s and early 1890s. There is a marked preference for steel companies and railways, with only two

⁴⁷ A careful look at some company share registers justifies this argument. For instance, the majority of shareholders of the Cunard Steamship Company between 1880 and 1913 did not dispose of their shares. About 10% of the shares in the ledger appeared as held by Executors and hence were part of probate portfolios (this point comes from the dataset of Rutterford et al., "Local bias").

corporation stocks which are not in these two sectors. There is a limited amount of rebalancing. Holdings in William Jessop and Sons, and Perry and Company, were sold while still going concerns, and replaced by holdings in the Patent Nut and Bolt Company (in 1885, at the time of a capital reduction) and in Cambrian Railway Company. Other apparent changes were triggered by a merger between Nettlefolds, and Guest and Keen, to form Guest, Keen and Nettlefolds, the forerunner of today's GKN. Mr Mott's portfolio trajectory, shown in Figure 3, may well be typical of many of the probate portfolios in our sample. What we actually see in the probate records could be the end result of securities acquired at different periods of one's life span and rarely sold unless affected by corporate actions. Similarly, the unbalanced portfolios shown in Table 5 reflect different performance of different securities over different periods. Even what might (but not necessarily) have started out as equally weighted portfolios, with equal amounts invested in each security, would gradually become unbalanced over time as different countries, sectors, and securities experienced different returns, expectations or waves of popularity.

[TABLE 5 NEAR HERE]

[FIGURE 3 NEAR HERE]

We have seen above that neither personal characteristics, nor wealth, nor financial sophistication can explain why Victorian investors held portfolios which were unbalanced with respect to an equally-weighted, naïve diversification, strategy. Nor do transaction costs offer a convincing alternative reason to avoid portfolio rebalancing, at least for securities listed on the official LSE list. Liquidity may have been a factor – securities were easy to buy on issue, from a prospectus, but possibly hard to sell thereafter. However, this argument has limited traction as it is clear from the portfolios in Table 5 and Figure 3 that many of the investments held were government bonds or major railway companies. Securities in steel companies, for example, held by Mr Mott, were actively traded in Sheffield as well as in London and Figure 3 shows that he was able to sell his holdings in some steel companies, generating funds with which to invest in other securities.

There is another possible argument for some shares being illiquid: those which had an element of uncalled capital. In principle, uncalled capital is a liability to the individual investors resembling the corporate structure of the unlimited liability company, albeit with a cap. If uncalled capital did indeed drive investors away from sectors with high uncalled liabilities, this could potentially offer an explanation for the unbalanced structure of the sample portfolios. Figure 4 challenges this interpretation. It shows average portfolio weights and paid-up capital as a percentage of total called

and uncalled capital for two periods: 1870-1889 (period 1) and 1890-1902 (period 2) for a number of selected sectors. There is clearly a difference in the extent of uncalled capital over time, with several sectors, including banks and insurance firms relying more heavily on uncalled capital. However, it is hard to observe any specific relationship between average sector portfolio weights and the proportion of called capital as a percentage of total capital. Figure 4 highlights examples, (e.g. banks and financial firms) in which high average portfolio weights were associated with sectors with high uncalled capital and the *vice versa*. The democratization of financial markets with the entrance of a larger number of less wealthy investors towards the turn of the century was accompanied by a gradual reduction in the average amount of uncalled capital but this does not seem to have affected investors' sector or security choices.⁴⁸

[FIGURE 4 NEAR HERE]

8. Summing up: the profile of the Victorian investor

This paper has highlighted the role of portfolio diversification before WWI, a period in which investors had access to a wide variety of international and domestic securities. Data scarcity has generally discouraged the investigation of portfolio diversification at the micro level. This study draws upon a unique sample of individual portfolio holdings in England and Wales compiled from probate data at death between 1870 and 1902 and from existing relevant studies, attempting to draw a comprehensive profile of Victorian investment behaviour.

We first note that contemporary financial advice was not an unsophisticated portfolio risk management strategy. Financial experts widely promoted a naïve top-down portfolio selection approach which was easy to implement by the individual investor and by no means suboptimal when compared with Markowitz mean-variance optimization. Indeed, given the institutional setting of financial markets in the late nineteenth century and the computational limitations, the recommended top-down naïve diversification was a powerful and practical investment strategy that sets a contemporary benchmark of portfolio efficiency for the investors in our sample.

We show that, although Victorian investors did not adopt the equal portfolio weights which are a prerequisite for naïve diversification, they did diversify their

⁴⁸ Jefferys "The denomination."

portfolios to a significant extent, particularly at the top end of the wealth distribution scale. According to our sample, investors in the top quartile of the gross wealth distribution, who were responsible for about 87% of overall portfolio investment, held on average 11 securities in their portfolios. There is thus support for Hobson's assumption at the beginning of the twentieth century that the diversification strategies and risk preferences of wealthy investors did affect the structure of the financial markets before WWI. However, we find that sample portfolios were unbalanced, relative to a naïve, equally weighted portfolio strategy, for example, with investors in the top wealth quartile holding almost two thirds of their portfolios in just one or two holdings.

In previous studies, we have argued that wealth, gender, and local preference were the main factors in individual investor portfolio selection. These factors show, for instance, that wealthy investors spread risk across more securities, that men were slightly more diversified than women, and that less wealthy investors were more comfortable with local firms, perhaps as an alternative form of risk management. However, these studies do not explain why investors appeared reluctant to equally weight their portfolios, preferring unbalanced portfolios, contrary to the recommendations of financial experts at the time. None of the above factors at the individual level seems to affect the divergence which we observe in our sample portfolios from a naïve portfolio benchmark. In addition, unbalanced portfolios cannot be explained by high nominal share values, by transaction costs, which were relatively low, nor by the prevalence of uncalled liabilities in certain sectors. Unbalanced portfolios could alternatively be explained by the fact that investors followed either a CAPM portfolio strategy mirroring the market or a market-timing and momentum strategy buying securities in sectors which had performed well in the past. However, our evidence dismisses both cases.

We therefore argue that the most plausible reason for the diversified but unbalanced portfolios – relative to a naïve diversification strategy – that we observe in the sample is that investors *did* buy and hold, and possibly in equal amounts, *but over time* (we must remember these are portfolios at death). Portfolio weights gradually altered as some securities did well and others did not. We look at the lifetime portfolio of a particular investor, James Nott, and note how he sold only two securities during his lifetime, other changes being triggered by corporate actions with limited adjustment or portfolio rebalancing over time.

This type of behaviour is in fact captured by Lowenfeld's recommendations. According to Lowenfeld, the investor should add to their portfolio over time, leading to more holdings as wealth increased. As the note to Table 3 elucidates, Lowenfeld recommended different numbers of equal holdings according to financial wealth: 5-6

for portfolios of £500 to £1,000; 5-7 for £1,000 to £2,000; 6-8 for £2,000 to £5,000, 8-10 for £5,000 to £20,000, and 10 to 30 for portfolios of over £20,000. He also recommended investing by amounts of £100 per security, adding a different geographical class each time the individual has another £100 saved.⁴⁹ Lowenfeld devotes a chapter of his book, Chapter VI, “The Treatment of Investment Lists,” in *Investment an Exact Science*, to how to rebalance portfolios, which, he argued, should be to first tabulate existing holdings against a geographically-diversified, equally weighted portfolio with the desired amount of risk and then to rebalance in order to return to the original equal weightings.⁵⁰ He argued, as do we, that transaction costs were not an issue with respect to rebalancing, with the benefits of so doing more than outweighing the costs. He additionally offered a solution to investors who were unwilling to sell loss-making investments, today called the ‘disposition effect’.⁵¹ He suggested selling the loss-making investment and replacing it with a security that appeared relatively undervalued compared to previous highs and lows and which thus offered some potential profit with which to offset the crystallised loss.⁵² Lowenfeld also commented on the fact that some investors were reluctant to invest overseas, even though this would cost them financially in terms of opportunity cost. George Heron’s portfolio, shown in Table 6, is perhaps such an example, with only two overseas holdings out of a total of 24. We found, for our sample, that those who did invest overseas, directly or via investment trusts, had portfolios which were less unbalanced and closer to the benchmark than those who did not invest overseas. Lowenfeld also acknowledged that there is a natural reluctance to rebalance portfolios with the wealthy “especially dilatory.”⁵³ It was easier for those who accumulated wealth over their lifetimes and hence invested over periods of time, to rebalance, although our lack of panel data does not allow us to test this for our sample.

Thus the most plausible factor for the unbalanced structure of individual portfolios in our sample is the buy as you go and hold approach of the individual investors. To the extent that our sample is representative of the UK investor population as a whole, the investors were on average closer to the top 10% of the wealth distribution. Instead of controlling single firms, they spread their financial wealth unevenly across a number of securities and sectors. This finding is consistent with Rubinstein’s analysis of the Victorian super rich: they did not transform their wealth into influence over important British industrial and commercial enterprises, as

⁴⁹ Lowenfeld, *Investment*, 85, 90.

⁵⁰ Lowenfeld, *Investment*, 99-109.

⁵¹ See, for example, Richards *et al.*, “Disposition effect.”

⁵² Lowenfeld, *Investment*, 104-5

⁵³ Lowenfeld, *Investments*, 107.

did their US counterparts.⁵⁴ Portfolio diversification is thus the other side of the gradual divorce between ownership and control in listed companies.

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⁵⁴ Rubinstein, *Men of Property*, 224.

References

- Acheson, G. G., Turner, J. D., and Q. Ye. "The character and denomination of shares in the Victorian equity market." *Economic History Review* 65, no. 3(2012): 862-886.
- Bernstein, P. L. *Against the Gods: The Remarkable Story of Risk*. New York: John Wiley & Sons, Inc., 1996.
- Black, F., and R. Litterman. "Global Portfolio Optimization." *Financial Analysts Journal* 48, no. 5 (1992): 28-43.
- Blume, M. E., and I. Friend. "The asset structure of individual portfolios and some implications for utility functions." *The Journal of Finance* XXX, no. 2 (1975): 585-603.
- Bris, Le D. "Why did French savers buy foreign assets before 1914? A decomposition of the benefits from diversification." *Recherches Économiques de Louvain* 79, no. 3 (2013): 71-89.
- Capie, F., and A. Webber. *A Monetary History of the United Kingdom, 1870-1982*. London and New York: Routledge, 1985.
- Chabot, B. R., and C. J. Kurz. "That's where the money was: Foreign bias and English investment abroad, 1866-1907." *The Economic Journal* 120, September (2010): 1056-1079.
- Crozier, J. B. *Notes on the First Principles of Investment*. London: *The Financial Review of Reviews*, 1910.
- DeMiguel, V., Garlappi, L., and R. Uppal. "Optimal versus naïve diversification: How inefficient is the 1/N portfolio strategy?" *The Review of Financial Studies* 22, no. 5 (2009): 1915-1953.
- Edelstein, M. *Overseas Investment in the Age of High Imperialism: The United Kingdom, 1850-1914*. New York: Columbia University Press, 1982.
- Edlinger, C., M. Merli, and A. Parent. "An optimal world portfolio on the eve of World War I: Was there a bias to investing in the new world rather than in Europe?" *The Journal of Economic History* 73, no. 2 (2013): 498-530.
- Elton, E. J., and M. J. Gruber. "Modern portfolio theory, 1950 to date." *Journal of Banking & Finance* 21 (1997): 1743-1759.
- Foreman-Peck, J., and L. Hannah. "Extreme divorce: The managerial revolution in UK companies before 1914." *Economic History Review* 65, no. 4 (2012): 1217-1238.
- Foreman-Peck, J., and L. Hannah. "The diffusion and impact of the corporation in 1910." *Economic History Review* 68, no. 3 (2015): 962-984.
- Goetzmann, W., and A. D. Ukhov. "British investment overseas 1870-1913: A modern portfolio theory approach." *Review of Finance* 10 (2006): 161-300.
- Goetzmann, W. N., and A. Kumar. "Equity portfolio diversification." *Review of Finance* 12 (2008): 433-463.
- Green, D., A. Owens, J. Maltby, and J. Rutterford. "Lives in the balance? Gender, age and assets in the late nineteenth century England and Wales." *Continuity and Change* 24, no. 2 (2009): 307-335.
- Green, D. R., A. Owens, C. Swan, and C. van Lieshout. "Assets of the Dead: Wealth, Investment, and Modernity in Nineteenth and Early Twentieth-Century England and Wales." In *Men, Women, and Money: Perspectives on Gender, Wealth, and Investment, 1850-1930*, edited by D. R. Green, J. M. Maltby, A. Owens, and J. Rutterford, 54-80. Oxford: Oxford University Press, 2011.
- Grossman, R. S. "Bloody foreigners! Overseas equity on London Stock Exchange, 1869-1929." *Economic History Review* 68, no. 2 (2015): 471-521.
- Hannah, L. "The 'divorce' of ownership from control from 1900 onwards: Re-calibrating imagined global trends." *Business History* 49, no. 4 (2007): 404-438.
- Hannah, L. "A global corporate census: Publicly traded and close companies in 1910." *Economic History Review* 68, no. 2 (2015): 548-573.

- Hannah, L. "The London Stock Exchange 1869-1929: New bloody statistics for old?" *Economic History Review*, forthcoming.
- Hobson, C. K. *The Export of Capital*. London: Constable and Company, Ltd., 1914.
- Jefferys, J. B. "The denomination and character of shares, 1855-1885." *Economic History Review* 16, no. 1(1946): 45-55.
- Jefferys, J. B. *Business Organization in Great Britain 1865-1914*. New York: Arno Press, 1977.
- Layton, W. T. "Book Review: 'All about Investment' and 'Investment an Exact Science'." *The Economic Journal* 19, no. 74 (1909): 255-259.
- Litterman, B. *Modern Investment Management: An Equilibrium Approach*. New Jersey: John Wiley & Sons, Inc., 2003.
- Lowenfeld, H. *Investment an Exact Science*. London: *The Financial Review of Reviews*, 1907.
- Mandelbrot, B. B., and R. L. Hudson. *The Misbehaviour of Markets*. London: Profile Books, 2008.
- Markowitz, H. "Portfolio selection." *Journal of Finance* 7, no. 1 (1952): 77-91.
- Markowitz, H. "The early history of portfolio theory: 1600-1960." *Financial Analysts Journal* 55, no. 4 (1999): 5-16.
- May, G. "The investment of life assurance funds." *Journal of the Institute of Actuaries* 46 (1912): 134-168.
- Merton, R. C. "On estimating the expected return on the market: An exploratory investigation." *Journal of Financial Economics* 8 (1980): 323-361.
- Michaud, R. O. "The Markowitz Optimization Enigma: Is 'Optimized' Optimal?" *Financial Analysts Journal* 45, (1989): 31-42.
- Michie, R. C. *The London and New York Stock Exchanges 1850-1914*. London: Allen & Unwin, 1987.
- Mitchell, B., D. Chambers, and N. Crafts. "How good was the profitability of British railways, 1870-1912?" *Economic History Review* 64, no. 3 (2012): 798-831.
- Morgan, E. V., and W. A. Thomas. *The Stock Exchange: Its History and Functions*. London: Elek Books, 1962.
- Powell, E. T. *The Mechanism of the City*. London, 1911.
- Powell, E. T. *The Evolution of the Money Market, (1385-1915), An Historical and Analytical Study of the Rise and Development of Finance as a Centralised, Co-Ordinated Force*. London: The Financial News, 1916.
- Read, C. *The Rise of the Quants*. New York: Palgrave Macmillan, 2012.
- Richards, D. W., J. Rutterford, D. Kodwani, and M. Fenton-O'Creevy. "Stock market investors' use of stop losses and the disposition effect." *The European Journal of Finance* 23, no. 2 (2017): 130-152.
- Pipley, P. *A Short History of Investment*. London: Sir Isaac Pitman & Sons, 1934.
- Roy, A. D. "Safety First and the Holding of Assets." *Econometrica* 20, no. 3 (1952): 431-449.
- Rubinstein, W. D. *Men of Property*. London: Social Affairs Unit, 2006.
- Rutterford, J., D. R. Green, J. Matlby, and A. Owens. "Who comprised the nation of shareholders? Gender and investment in Great Britain, c. 1870-1935." *Economic History Review* 64, no. 11 (2011): 157-187.
- Rutterford, J., and L. Hannah. "The rise of institutional investors." in D. Chambers and E. Dimson (eds) *Financial Market History: Reflections on the Past for Investors Today*. CFA Institute Research Foundation, 2016.
- Rutterford, J., Sotiropoulos, D. P., and C. van Lieshout. "Individual investors and local bias in the UK, 1870-1935." *Economic History Review* 70, no. 4(2017): 1291-1320.
- Rutterford, J., and D. P. Sotiropoulos. "Financial diversification before modern portfolio theory: UK financial advice documents in the late nineteenth and the beginning of the twentieth century." *The European Journal of the History of Economic Thought* 23, no. 6 (2016): 1-25.

- Rutterford, J., and D. P. Sotiropoulos. "Putting all their eggs in one basket? Portfolio diversification 1870-1902." *Accounting History Review* 26, no. 3 (2016): 285-305.
- Sotiropoulos, D. P., and J. Rutterford. "Individual Investors and Portfolio Diversification in late Victorian Britain: How Diversified Were Victorian Financial Portfolios?" *Journal of Economic History* [2018, forthcoming].
- Withers, H. *The Quicksands of the City, and a Way through for Investors*. London: Jonathan Cape, 1930.

Table 1

The portfolios used in the calculations of Figure 1.

Domestic (11 categories)	International 1 (11 categories)	International 2 (11 categories)	Aggregated by sector (8 categories)	Aggregated by security (5 categories)
UK government	UK government	UK Ord railway	UK government	UK Ord
UK Ord railway	UK Ord railway	UK Ord infrastructure	UK railway	UK Pref
UK Ord infrastructure	UK Ord infrastructure	UK Ord heavy industry	UK finance	UK Deb
UK Ord industry	UK Ord finance	UK Ord finance	UK other corp.	non-UK Ord
UK Ord finance	UK Pref railway	UK Pref railway	non-UK railway	non-UK Deb
UK Pref railway	UK Deb railway	UK Deb infrastructure	non-UK finance	
UK Pref infrastructure	non-UK Ord railway	non-UK Ord railway	non-UK other corp.	
UK Deb railway	non-UK Ord infrastr.	non-UK Ord infrastr.	non-UK government	
UK Deb infrastructure	non-UK Ord banking	non-UK Ord banking		
UK Deb industry	non-UK Deb railway	non-UK Deb railway		
UK Municipal stock	non-UK Colonial gov.	non-UK Deb infrastr.		

Table 2

Number of holdings per portfolio and percentage of portfolio wealth by gross wealth distribution.

	Gross wealth quartile				top 10%	top 5%	Total
	I	II	III	IV			
Average number of holdings	1.5	2.3	3.6	10.9	14.0	19.4	4.6
Median number of holdings	1.0	2.0	2.0	8.0	9.0	14.5	2.0
Standard deviation of holdings	0.9	2.0	3.4	11.9	16.8	21.1	7.3
% of total financial wealth held	1.1	3.2	9.7	86.0	63.5	45.2	100.0
Financial portfolio investment as % of gross wealth	58.1	48.5	44.0	49.9	48.3	46.8	49.3
Total wealth in million £	0.05	0.18	0.59	4.63	3.54	2.60	5.45
<i>Largest holding</i>							
mean portfolio weight (%)	90.8	80.8	69.9	46.4	47.9	41.2	71.9
median portfolio weight (%)	100.0	99.7	75.9	38.2	41.0	33.5	81.4
mean value (£)	192	518	1,264	6,623	12,022	14,044	2,151
median value (£)	161	384	834	3,745	9,584	11,472	535
<i>Largest 2 holdings</i>							
mean portfolio weight (%)	98.6	93.0	85.9	63.8	64.5	57.0	85.3
median portfolio weight (%)	100.0	100.0	100.0	60.5	65.2	45.8	100.0
mean value (£)	217	610	1,644	9,644	17,469	21,003	3,031
median value (£)	183	525	1,398	5,588	15,190	16,203	689

Notes: Our sample of 507 portfolios covers the period 1870-1902 (for more information about the sample see Sotiropoulos and Rutterford, “Individual investors”). Gross wealth is the gross estate including all liquid and illiquid assets: corporate securities (ordinary shares, preferred shares and debentures), real estate, cash, life assurance, and monies and interest due to deceased. Financial wealth is the liquid part of gross wealth other than cash. The average profile of our investors is closer to the top 10% of the UK population in terms of wealth.

Table 3

Investor level cross sectional OLS regressions for the extent of under-diversification.

	(1)	(2)
	<i>NB-N</i>	<i>SSPW-SSPWb</i>
Constant	5.533 (3.522)	0.884 (3.522)
decade	-0.013 (0.302)	-0.019 (0.302)
Investor characteristics		
Age	0.063* (0.036)	0.001 (0.036)
Gender dummy	1.309* (0.744)	0.068 (0.744)
Married dummy	-0.263 (1.186)	-0.001 (1.186)
Gender*married	2.351 (2.519)	0.048 (2.519)
Gross wealth (log)	-0.597 (0.545)	-0.046 (0.545)
London resident dummy	0.042 (1.029)	0.096 (1.029)
Sophistication proxies		
Foreign dummy	-4.075*** (0.648)	-0.289 (0.648)
Investment trust dummy	-11.983** (4.633)	-0.190 (4.633)
Number of observations	264	264
R-squared	0.295	0.365

* = significant at the 10% level.

** = significant at the 5% level.

*** = significant at the 1% level.

Notes: Robust standard errors in parentheses. The benchmark portfolio is defined according to the analysis of Lowenfeld (*Investment*, 85) and its holdings increase gradually but not proportionately with the portfolio value. From £500 up to £1,000 portfolio value, 5-6 holdings of equal value are advised; from £1,000 up to 2,000, 5-7 holdings of equal value; from £2,000 up to £5,000, 6-8 holdings of equal value; from £5,000 up to £20,000, 8-10 holdings of equal value; and for portfolios larger than £20,000 10-30 holdings of equal value are advised. In the regressions, we have excluded portfolios with value lower than £500.

Table 4

Portfolio weights by broad asset categories.

	mean	st. dev.	median	quartile 3	% 0	% 100	LSE weights
UK government	18.5	35.2	0.0	12.2	69.0	11.6	13.4
Empire government	6.0	19.9	0.0	0.0	85.4	2.2	3.8
Foreign government	5.4	19.7	0.0	0.0	86.6	2.8	31.9
Total government	29.9	41.2	0.0	70.7	55.2	18.5	49.1
UK railways	16.6	31.6	0.0	16.2	68.8	6.3	16.3
Empire railways	3.7	14.8	0.0	0.0	88.2	1.6	2.9
Foreign railways	3.0	12.2	0.0	0.0	90.3	0.6	14.9
Total railways	23.3	36.0	0.0	42.3	60.4	9.1	34.1
Total finance	19.4	34.6	0.0	22.0	63.9	10.1	5.5
Light industry	10.2	27.9	0.0	0.1	73.8	7.5	5.0
Heavy industry	1.6	9.1	0.0	0.0	92.3	0.2	0.7
Infrastructure	14.0	29.4	0.0	8.9	67.1	5.7	3.9

Notes: The London Stock Exchange weights are based on the *Stock Exchange Official Intelligence* nominal values, which are translated to market values using the *Bankers' Magazine* index (see Sotiropoulos and Rutterford, "Individual investors"). The LSE weights are averages for the period 1884-1902. Foreign government stocks are non-UK non-colonial stocks. 0% = percentage of portfolios with zero investment in the corresponding category. 100% = percentage of portfolios with 100% investment in the corresponding category.

Table 5

Two examples of Victorian portfolios from the sample.

Portfolio (1)

Investor details		Portfolio structure				
Name		Security description	Security type*	Sector	Country	Value (£)
Sumame	George	1 Brighton & Dyke Railway Company	Preference Share	Social overhead capital	UK	42
Gender	Heron	2 Great Western Railway (UK)	Ordinary Stock	Social overhead capital	UK	5,462
Age at death	male	3 Great Western Railway of Canada	Debenture Stock	Social overhead capital	Canada	2,153
Year	89	4 Lancashire & Yorkshire Railway	--	Social overhead capital	UK	48
Marital status	1894	5 Lancashire & Yorkshire Railway	Ordinary Share	Social overhead capital	UK	2,308
Holder geographic type	Unknown	6 Lancashire & Yorkshire Railway	Preference Share	Social overhead capital	UK	395
Gross estate (£)	Rural	7 London & North Western Railway	--	Social overhead capital	UK	7,183
Portfolio value (£)	114,609	8 London & North Western Railway	Preference Share	Social overhead capital	UK	5,305
Social overhead capital (%)	57,198	9 Midland & South Western Junction Railway Company	Debenture Stock	Social overhead capital	UK	260
Finance, Land, and Investment (%)	80.4	10 Midland Railway	Ordinary Shares	Social overhead capital	UK	13,631
Light industry and commerce (%)	6.0	11 Midland Railway	Preference Share	Social overhead capital	UK	1,151
Government (%)	0.1	12 North Staffordshire Railway	Ordinary Shares	Social overhead capital	UK	2,273
Domestic (%)	13.4	13 South Eastern Railway	Debenture Stock	Social overhead capital	UK	1,317
	94.1	14 South Eastern Railway	Deferred Share	Social overhead capital	UK	348
		15 South Eastern Railway	Ordinary Share	Social overhead capital	UK	945
		16 South Eastern Railway	Preference Share	Social overhead capital	UK	1,985
		17 Southern Lombard Venetian Railway	--	Social overhead capital	Italy	1,195
		18 Artizans, Labourers & General Dwellings Company Ltd	Ordinary Share	Finance, Land, and Investment	UK	1,896
		19 Artizans, Labourers & General Dwellings Company Ltd	Preference Share	Finance, Land, and Investment	UK	1,446
		20 National Dwellings Society Ltd	Preference Share	Finance, Land, and Investment	UK	63
		21 National Dwellings Society Ltd	--	Finance, Land, and Investment	UK	19
		22 Sackvilles Estates Company	--	Finance, Land, and Investment	UK	35
		23 John Satterfield & Company Ltd	--	Light industry and commerce	UK	50
		24 Consols 23/4 percent	Stock	Government	UK	7,687

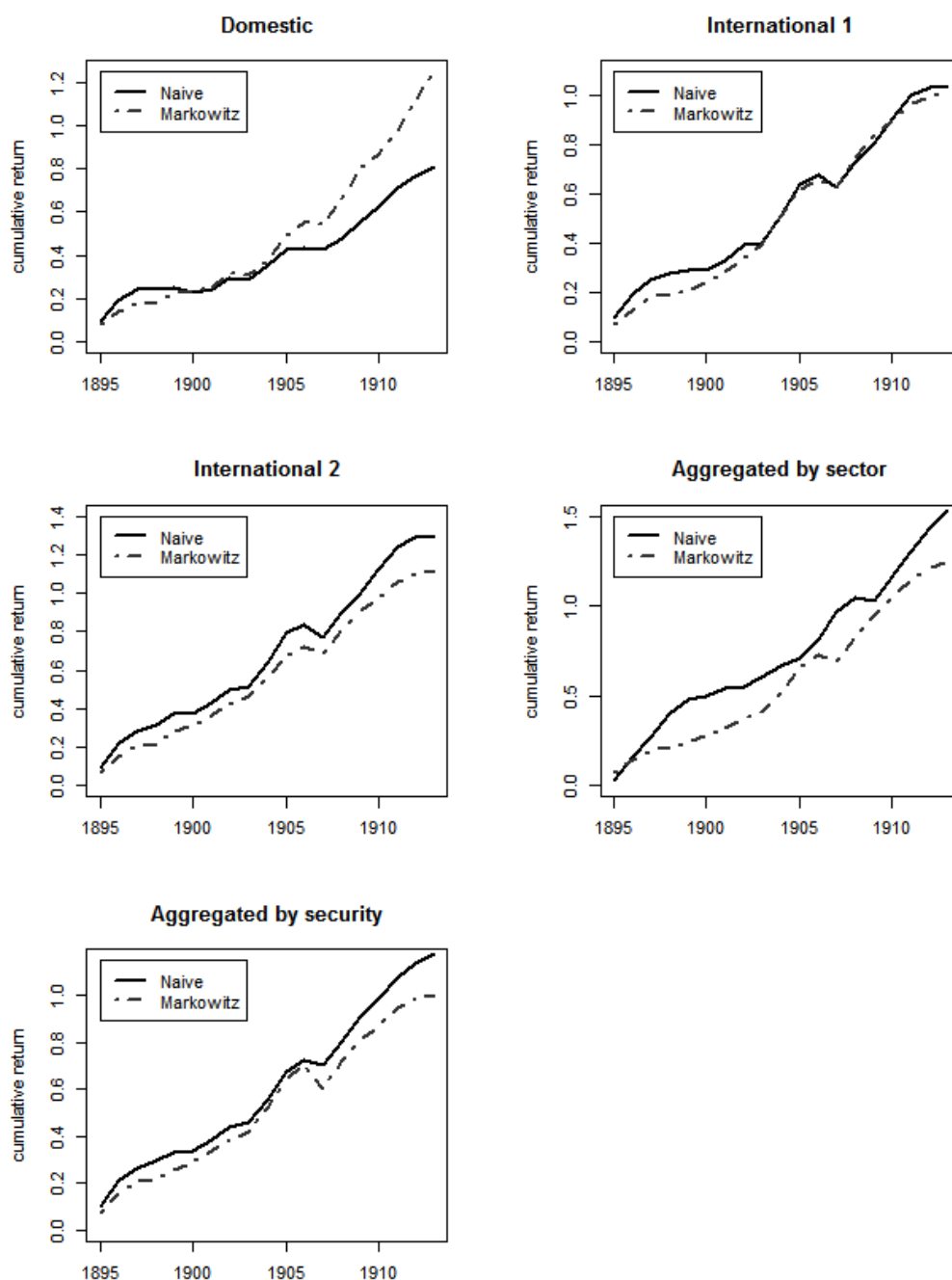
Portfolio (2)

Investor details		Portfolio structure				
		Security description	Security type*	Sector	Country	Value (£)
Name	Elizabeth	1 Canadian Pacific Railway Company	--	Social overhead capital	Canada	1,146
Surname	Snaith	2 East Indian Railway Company	--	Social overhead capital	India	1,571
Gender	Female	3 Great Indian Peninsula Railway	Debenture	Social overhead capital	India	3,085
Age at death	85	4 London Brighton & South Coast Railway	--	Social overhead capital	UK	704
Year	1890	5 London Brighton & South Coast Railway	Debenture	Social overhead capital	UK	2,560
Marital status	Spinster	6 London Brighton & South Coast Railway	Preferred share	Social overhead capital	UK	1,620
Holder geographic type	Large Urban	7 London Assurance Corporation	Ordinary share	Finance	UK	2,420
Gross estate (£)	66,885	8 London Laborers Dwelling Society	Debenture	Finance, Land, and Investment	UK	1,000
Portfolio value (£)	36,755	9 Brazilian	Stock	Government	Brazil	1,001
Social overhead capital (%)	29.1	10 New South Wales	Stock	Government	Australia	2,513
Finance (%)	6.6	11 New Zealand	Stock	Government	New Zealand	1,598
Finance, Land, and Investment (%)	2.7	12 Queensland	Stock	Government	Australia	1,080
Government (%)	61.6	13 Victoria	Stock	Government	Australia	2,713
Domestic (%)	60.0	14 Consols 2 3/4 percent	Stock	Government	UK	13,745

* The type of the security is not always known.

Figure 1

Naïve versus Markowitz portfolio selection.

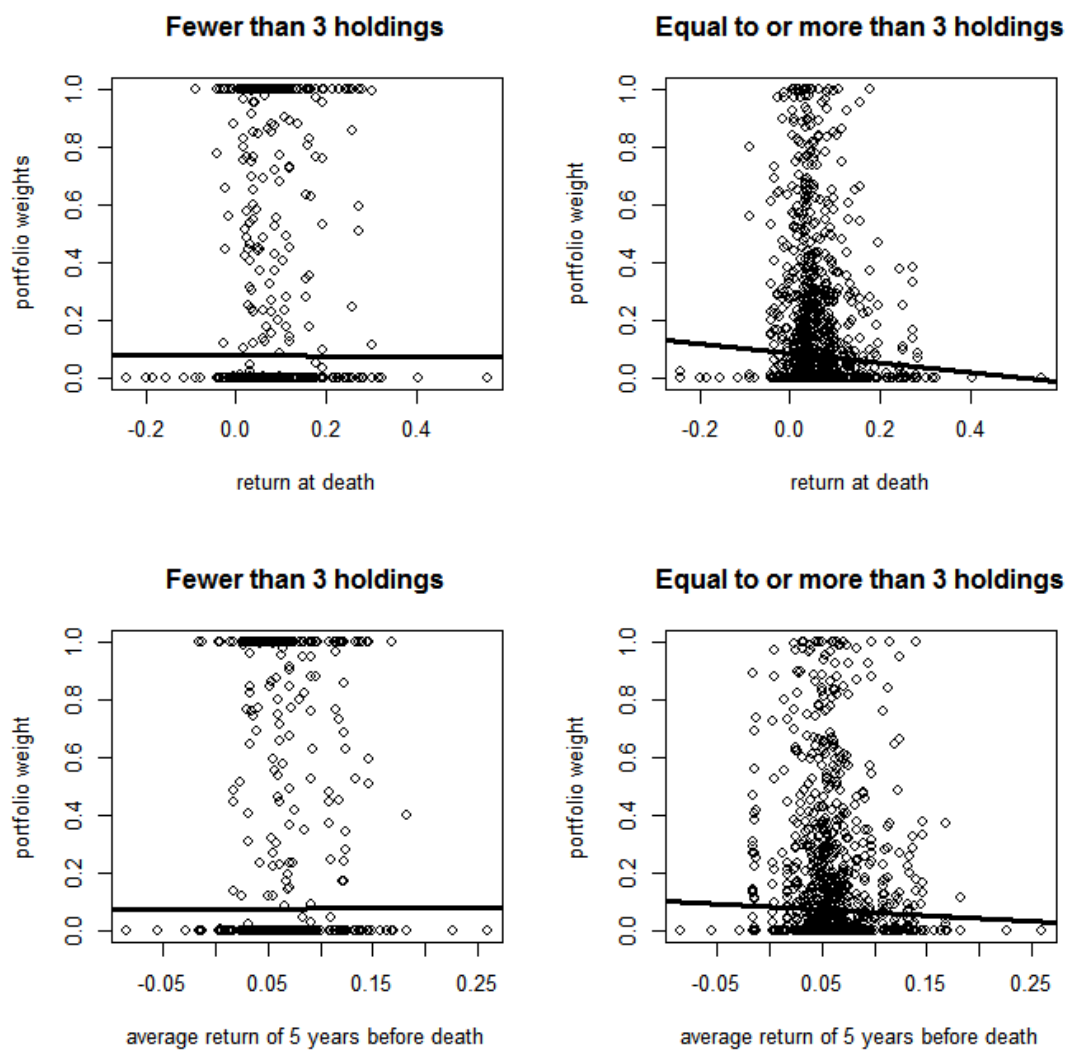


Notes: In our calculations we use Edelstein’s annual return data as grouped into broad asset categories by Goetzmann and Ukhov (“British investment”) and converted into real returns using the inflation rates provided by Mitchell et al. (“British railways”). For definitions of different portfolios see Table 1. We calculate the *actual* (as opposed to *expected*) excess portfolio return that would have accrued to the mean-variance portfolio holder, based on the

estimated portfolio weights from Markowitz's model and actual market asset returns. In each year, we update the data and repeat the calculations following a 25-year rolling window approach. In line with similar research in business history, we employ a bootstrapping procedure. The returns reported are based on the mean values of optimized portfolio weights after bootstrapping 1,000 times. We have assumed the prime bank bill rate as the risk-free rate (see Capie and Webber, *A Monetary History*).

Figure 2

The relation between individual portfolio weights and realized real returns for fifteen main asset categories of the London Stock Exchange.



Notes: The scatter charts depict the relation between the portfolio weight $w_{i,j}$ of the asset category j held in the portfolio of individual i and the real market return R_j of asset category j . Markets returns at the time of death are used in the top two charts, while the average returns of the last five years before death are used in the lower 2 charts. The fitted lines capture the average correlation between portfolio weights and the selected asset returns. The return data are the same as in Figure 1.

Figure 3

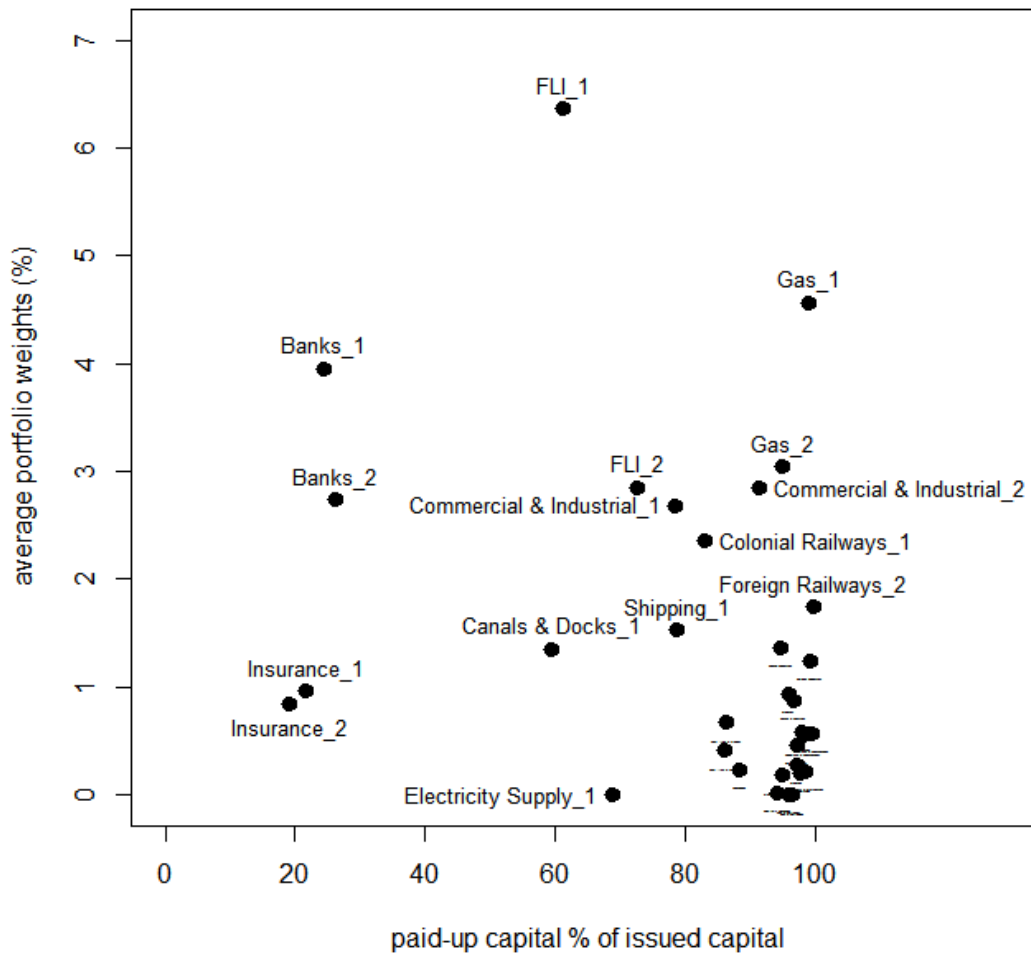
Shares and stocks held by James Mott 1880 to 1927.

	1880s										1900s										1910s										1920s									
	0	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7		
William Jessop and Sons																																								
Patent Shaft and Axeltree, Perry and Co.																																								
London and North Western Railway																																								
Great Western Railway																																								
Nettlefolds Ltd																																								
Perry Co Ltd																																								
Birmingham Canal Company																																								
Birmingham Corporation Water Annuity																																								
Isle of Man Railway Company																																								
Cambrian Railway Company																																								
Patent Nut and Bolt Company																																								
London Brighton and South Coast Railway																																								
Guest and Keen																																								
South East Railway																																								
Guest, Keen & Nettlefolds																																								
Eastbourne Stock																																								
Brighton Stock																																								

Source: Green *et al.*, "Lives in the balance," 314.

Figure 4

Average portfolio weights and paid-up capital as % of total issued capital for selected sectors in two periods: 1870-1889 (period 1) and 1890-1902 (period 2).



Notes: The data for the paid-up capital are taken from the study of Essex-Crosby, *Joint Stock Companies*. For period 1, we average individual portfolio weights of the main economic sectors between 1870 and 1889 and we use Essex-Crosby's paid-up calculations for 1885. In period 2, we average portfolio weights for 1890 and 1902 and we use Essex-Crosby's calculations for 1895. FLI means Finance, Land, and Investment companies. The scatter chart selectively reports sectors and periods.