UNIVERSIDADE CATÓLICA PORTUGUESA

Does industry concentration explain the profits of the Robust minus Weak strategy?

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Católica Porto Business School
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«Success is not final, failure is not fatal: it is the courage to continue that counts.»

(Winston Churchill)

Abstract

This thesis aims to better understand the Robust Minus Weak (RMW) strategy by looking at how profitability and industry competition work together from 1959 to 2023. The study uses the industry momentum tests from Moskowitz and Grinblatt (1999) to do this.

The study is divided into three steps: first, repeating the original momentum tests for 1963-1995; second, expanding the analysis to 1926-2023; and third, using the same tests to see how much industry competition affects the RMW strategy's profits.

The first step works well, matching the original findings. The second step shows similar results over a longer period, proving that momentum patterns last over time. In the third step, the RMW strategy gives a monthly profit of 2.41% when looking at all companies. When focusing only on companies within the same industry, the profit drops to 1.10%, showing that industry competition plays a small role in these profits. Other tests show even smaller or negative profits, at 0.46% and -1.39%, suggesting industry effects can vary.

Keywords: Robust Minus Weak (RMW), industry momentum, profitability, industry concentration, asset pricing, Moskowitz and Grinblatt, Fama and French.

Word counting: 8546 words

Resumo

Esta tese tem por objetivo compreender melhor a estratégia Robust Minus Weak (RMW), analisando a forma como a profitabilidade e a concorrência no sector funcionam em conjunto de 1959 a 2023. Para o efeito, o estudo utiliza os testes de *momentum* de indústria de Moskowitz e Grinblatt (1999).

O estudo divide-se em três etapas: primeiro, repetição dos testes de *momentum* originais para 1963-1995; segundo, expansão da análise para 1926-2023; e terceiro, utilização dos mesmos testes para verificar em que medida a concorrência na indústria afeta os lucros da estratégia RMW.

O primeiro passo funciona bem, correspondendo às conclusões originais. A segunda etapa apresenta resultados semelhantes num período mais longo, provando que os padrões de *momentum* perduram no tempo. No terceiro passo, a estratégia RMW dá um lucro mensal de 2,41% quando se olha para todas as empresas. Quando se concentra apenas em empresas do mesmo sector, o lucro desce para 1,10%, mostrando que a concorrência na indústria desempenha um pequeno papel nestes lucros. Outros testes mostram lucros ainda mais pequenos ou negativos, de 0,46% e -1,39%, sugerindo que os efeitos de indústria podem variar.

Palavras-chave: Robust Minus Weak (RMW), dinâmica de indústria, profitabilidade, concentração de indústria, Moskowitz e Grinblatt, Fama e French.

Contagem de palavras: 8546 palavras

Table of Contents

Table of Figures

Table of Tables

Introduction

This thesis examines an important question in asset pricing: does industry concentration explain the profitability of the Robust Minus Weak (RMW) strategy? The RMW strategy involves taking a long position in companies with high operating profitability and a short position in companies with low operating profitability, aiming to generate financial gains for investors. The goal is to see if this strategy is well-diversified across industries. If profits come mainly from a few industries, the strategy may not be well diversified, which can increase risk for investors.

The study builds on the industry momentum tests of Moskowitz and Grinblatt (1999) and has three stages. In the first stage, the replication of their tests for 1963–1995 validates their findings, confirming that industry momentum drives stock returns, with an average monthly profit of 0.38%. In the second stage, the analysis is extended to 1926–2023, showing a similar profit of 0.32%, which suggests momentum patterns hold over a longer period.

After replicating and extending the momentum tests, the study moves to the RMW strategy in the third stage. The RMW strategy is created for the period 1959–2023, using data from Compustat and WRDS, as profitability data is only available from 1959 onward. This strategy yields an average monthly profit of 2.41%, indicating that companies with high profitability consistently outperform those with low profitability.

To assess whether this profit is driven by industry concentration, three industry-specific tests are conducted, focusing on how industry effects influence RMW returns. These tests are adapted from Moskowitz and Grinblatt's paper

(1999) and they aim to analyze stock returns in different ways to determine if RMW profits are concentrated in specific industries or driven by broader market trends, providing a comprehensive view of how industry structure influences the RMW strategy.

The three industry-specific tests examine the role of industry concentration in RMW profits. The first test looks at profitability differences within each industry, producing a monthly profit of 1.10%, suggesting that within-industry effects contribute less to RMW profits. The second test adjusts for the average profitability of each industry, resulting in a lower profit of 0.46%, indicating that industry trends play a significant role in overall RMW returns. The third test compares weaker companies in high-profitability industries to stronger companies in low-profitability industries, yielding a negative profit of -1.39%, highlighting that industry strength can sometimes reduce RMW profits. These results suggest that industry concentration affects RMW profits in varied ways, depending on the industry context.

This study fits into the asset pricing literature. Fama and French (2015) and Novy-Marx (2013) showed that profitability strategies, like RMW, can be profitable, with Novy-Marx (2013) finding that high-profitability firms outperform by about 0.31% per month. Novy-Marx examines gross profitability, which is revenue minus the cost of goods sold, scaled by total assets, whereas Fama and French (2015) and this study use operating profitability, which further deducts expenses like interest and administrative costs, scaled by book equity. Hou et al. (2021) also confirmed profitability as a key driver of returns.

However, a gap remains in the literature. While studies like Fama and French (2015) and Novy-Marx (2013) focus on firm-level profitability and broad market factors, they do not explore how industry structure, such as concentration, affects profitability strategies. Similarly, Moskowitz and Grinblatt (1999) examine industry effects in momentum but not in profitability strategies like RMW. Hou et al. (2021) note some industry differences in profitability but do not specifically study the role of industry concentration. This study fills this gap by examining if industry concentration affects RMW profits, providing fresh insights into how industry structure influences profitability strategies and their diversification.

The thesis has four chapters. Chapter 1 reviews the literature on momentum, profitability, and the industry tests to be taken. Chapter 2 describes the data and preparation process. Chapter 3 explains the empirical analysis, including how to replicate, extend, and adapt the tests. Chapter 4 presents the RMW results, their meaning, and the response to the research question.

This thesis's intended contribution is to deepen the understanding of how industry concentration shapes profitability strategies in asset pricing, shedding light on their performance across industries.

1. Literature Review

1.1 Evolution of Asset Pricing Theory

Asset pricing theory seeks to explain why some stocks perform better than others by identifying consistent return patterns. This pursuit gained formal grounding with the introduction of the Capital Asset Pricing Model (CAPM) by Lintner (1965) and Sharpe (1964), a foundational framework that redefined the relationship between risk and return. The CAPM proposed that the market portfolio, representing the aggregate of all investable assets, constitutes the optimal vehicle for bearing risk, with a stock's expected return determined exclusively by its beta—its sensitivity to market fluctuations. This model's elegance lies in its assertion that systematic risk alone governs anticipated gains. Yet, as empirical scrutiny intensified, anomalies emerged that the CAPM struggled to explain, revealing limitations in its predictive capacity and prompting a reevaluation of its assumptions (FAMA & FRENCH, 1992).

In response to these deficiencies, Fama & French (1996) developed the Three-Factor Model (FF3F), marking a pivotal expansion of asset pricing theory. This model augmented the market factor with two additional dimensions: company size, measured as Small Minus Big (SMB), and value, captured by High Minus Low (HML). These factors addressed the persistent outperformance of small-cap stocks and those with high book-to-market ratios, phenomena previously documented by Banz (1981). The FF3F demonstrated that return disparities arise from multiple sources of systematic risk, challenging the CAPM's singular focus on beta.

The framework evolved further when Jegadeesh & Titman (1993) identified momentum—the tendency of stocks with recent strong performance to sustain their gains—later formalized by Carhart (1997) as a fourth factor. This addition highlighted a behavioral or structural persistence in returns, complicating traditional efficiency narratives.

Subsequently, Fama and French (2015) extended their model into the Five-Factor Model (FF5F), incorporating profitability (Robust Minus Weak, RMW) and investment style (Conservative Minus Aggressive, CMA), asserting that firms with robust profitability and conservative investment strategies exhibit distinct return premiums.

1.2 Moskowitz and Grinblatt (1999): Do Industries Explain Momentum?

While the momentum factor from Carhart (1997) and the profitability factor from Fama and French (2015) reveal important drivers of stock returns, they focus mainly on individual stock traits. This raises the question of whether industry-level dynamics also influence these factors, especially beyond momentum. The research by Moskowitz and Grinblatt (1999) addresses this by examining the role of industries in momentum, suggesting that industry effects might also apply to other anomalies like profitability.

Their study uncovers that industry momentum significantly contributes to individual stock momentum, challenging the conventional belief that momentum is primarily a firm-specific phenomenon. By constructing industry momentum portfolios and controlling for variables such as firm size, book-to-market equity, and individual stock momentum, they demonstrate that industry-based momentum strategies yield remarkably profitable returns, even after adjusting for multiple risk factors.

Their findings suggest that a substantial portion of individual stock momentum can be attributed to broader industry trends rather than specific firm-level characteristics. This insight carries profound implications, indicating that investors employing momentum strategies may be capitalizing on industry-wide movements rather than purely stock-specific patterns.

1.3 RMW: Fama-French's profitability strategy

The Robust Minus Weak (RMW) strategy involves buying companies with high profitability, called robust, and selling companies with low profitability, called weak, to capture the difference in their returns. Profitability is measured as operating profitability, calculated as annual revenue minus the cost of goods sold, interest expense, and selling, general, and administrative expenses, all divided by book equity. This measure shows how well a company earns profits from its main operations compared to its capital, making it a consistent way to compare companies across industries.

The RMW strategy is rooted in research showing that profitability affects stock returns. Novy-Marx (2013) found that high-profitability companies outperform low-profitability ones by about 0.31% per month, suggesting that profitability reflects a company's strength and lower risk of financial trouble. Novy-Marx examines gross profitability, defined as revenue minus the cost of goods sold, scaled by total assets, whereas Fama and French (2015) and this study use operating profitability, which further deducts expenses like interest and administrative costs, scaled by book equity, as described above. Fama and French (2015) built on this idea in their Five-Factor Model, showing that the return difference between robust and weak companies holds even after adjusting for market risk, company size, value, and investment patterns. Their work highlights the RMW strategy as a way to capture this profitability effect systematically. Hou et al. (2021) also confirmed that profitability drives stock returns, providing further support for strategies like RMW that focus on this trait.

The RMW strategy's success is often explained by high-profitability companies being more stable. Novy-Marx (2013) argued that these companies are less likely to face financial distress, which investors reward with higher returns. Fama and French (2015) suggested that the profitability effect captured by the RMW strategy reflects a systematic difference between robust and weak companies, possibly tied to their ability to handle economic challenges.

However, the exact reasons for the strategy's profits are not fully clear, which raises questions about other possible influences, such as the role of industries. Industry concentration, which refers to how competitive or dominated an industry is, might explain RMW returns. Less competitive industries may allow high-profitability companies to sustain earnings while making it harder for low-profitability firms to survive, widening the return gap between robust and weak companies.

Moskowitz and Grinblatt (1999) found that industries significantly influence stock returns through momentum, with industry momentum accounting for a significant part of momentum strategy profits. They also noted that industries matter more for returns based on past performance rather than average returns over time, suggesting that industry-level effects like concentration could also impact profitability strategies.

Research on industry effects supports this idea. Hou (2007) found that industry information spreads slowly, causing large firms to lead smaller ones in stock returns by about 0.20% per month, possibly because investors overlook industry-wide news. Similarly, Cohen (2008) showed that economic links, like customer-supplier relationships, lead to predictable stock returns of 0.50% per month due to investors missing these connections. George and Hwang (2004) also found that investors underreact to stocks near their 52-week high, creating momentum profits of 0.45% per month, a pattern that might apply to profitability signals in concentrated industries where investors may be slow to notice the strength of robust firms or the weakness of struggling ones, further increasing the RMW return gap.

1.4 Structure of research work

To address the research question, the study follows a three-step methodology. First, some parts of Table II from Moskowitz and Grinblatt's (1999) paper are replicated. This table includes critical tests that examine the profitability of momentum strategies within and across various industries. The replication checks if the original findings are robust and reliable by carefully reconstructing their methodologies and data analysis techniques, ensuring the results are comparable to the original study.

Second, the analysis is extended to include data up to 2023. This extension tests whether the momentum patterns and profitability observed at the end of the 20th century persist in modern financial markets, revealing if these strategies remain profitable in a different market environment.

Finally, the paper's original momentum tests are adapted to the RMW strategy, replacing momentum with profitability to determine whether industry concentration plays a similar role in explaining profitability-based returns. If the results align with those found in momentum studies, this would suggest that industry concentration is a key driver of the profitability strategy.

To pursue these three stages, the study uses three industry tests from Moskowitz and Grinblatt (1999) to investigate the role of industry concentration in RMW profits. These tests, originally designed for momentum, are adapted to focus on profitability and include:

- Industry Neutral Test: This test examines profitability within each industry by forming zero-cost portfolios that compare the top and bottom 30% of stocks within an industry. It separates firm-specific profitability from industry-wide trends.

- Excess Industry Test: This test sorts stocks based on their returns over the past six months relative to their industry average. It then forms a long-short portfolio by buying the top 30% of stocks with the highest excess returns and selling the bottom 30% with the lowest excess returns. This test isolates firm-specific profitability by removing industry averages.

- High Industry Losers – Low Industry Winners Test: This test sorts industries by their recent performance and examines whether industry concentration affects profitability. It involves taking a long position in the worst-performing 30% of stocks in the best-performing industries and a short position in the best-performing 30% of stocks in the worst-performing industries. It evaluates whether industry strength drives profitability over firm-specific factors.

To carry out these tests and the three-stage methodology, a large and detailed dataset is required, as the analysis spans multiple time periods and industries. The dataset and its preparation are explained in the next chapter.

2. Data

In gathering data for this thesis, the CRSP/Compustat and Wharton Research Data Services (WRDS) databases were used for companies listed on NASDAQ, NYSE, and AMEX. These databases are well-known worldwide for providing detailed finance and market data, which is essential for empirical finance research.

Wharton Research Data Services (WRDS) is an online data platform specializing in corporate finance databases. It provides access to a host of research areas, including finance, accounting, banking, economics, and public policy. WRDS has combined over 600 databases from more than 50 providers sequentially, helping researchers use complex data much more easily and effectively.

Compustat, a unit of S&P Global Market Intelligence, is an extensive database of financial, statistical, and market information on both active and inactive companies globally. Compustat’s extensive coverage and uniform data make it an indispensable tool for financial analysis and research.

2.1 Data Characteristics

This dataset serves as the foundation for the replication and extension of momentum tests (steps one and two from 1.4), while for the RMW analysis (step three from 1.4), it is combined with RMW-specific data detailed in section 2.2.

The data gathered is constituted by many companies from numerous different industries, for the period between the years of 1925 and 2023. It contains the monthly returns of those companies during that time as well as their shares outstanding, price (or bid/ask average), and other indicators.

However, some data treatment had to be conducted before reaching the final dataset. To begin, it was necessary to filter the replication dataset to include only stocks from NYSE, AMEX, and Nasdaq, identified by exchange codes 1, 2, and 3, and restrict the dataset to common shares (share codes 10 and 11), to match the original study's scope of the United States listed equities. Also, values indicating missing return codes of CRSP were eliminated to ensure reliability (returns of -66, -77, -88, and -99). After pursuing these steps, the data was ready to be analyzed.

Bellow, Table 1 illustrates a comparative picture of important indicators of the dataset, indicators that will play a part in the methodology.

First, it is possible to organize the dataset by industry. The major and well-known industries each have their sections, while any industry that doesn't fit into these categories is grouped under "other." Note that all industries have a code – a SIC[1] code – and as such, every individual company is grouped by the SIC code of the industry they fit into.

In terms of the average number of firms, the financial industry is the largest in the average number of companies per month (excluding "other" as it is an agglomeration of industries), reflecting a stable market leader. It suggests financial firms are a large part of the initial replication window and in the extended dataset.

When examining market capitalization on average, the petroleum industry has the highest rankings. The finding is not surprising because the petroleum industry has been characterized in the past by having high market valuations and being made up of large multinationals.

[1] SIC Code is used to group companies with similar products or services. The Standard Industrial Classification Manual contains descriptions of categories recognized by the US Government.

Industry	SIC Codes	Avg. No. of Comp.	Avg. Market Cap ($)
1. Apparel	22-23	79,29	370 905,95
2. Chemical	28	247,89	3 832 790,96
3. Construction	32	37,97	585 332,20
4. Dept. Stores	53	40,22	5 384 028,42
5. Electrical Eq.	36	302,94	1 817 794,10
6. Fab. Metals	34	86,86	674 014,93
7. Financial	60-65	741,26	1 927 685,71
8. Food	20	102,39	3 014 891,93
9. Machinery	35	240,89	2 820 039,76
10. Manufacturing	38-39	247,02	1 472 920,98
11. Mining	10-14	202,45	1 381 425,22
12. Other	Other	1 130,14	2 159 088,64
13. Other Transport	41-47	80,27	1 445 769,23
14. Paper	26	41,18	1 604 028,55
15. Petroleum	29	27,79	10 487 350,12
16. Primary Metals	33	68,59	842 863,82
17. Railroads	40	15,56	3 739 521,20
18. Retails	50-52, 54-59	381,80	1 465 311,27
19. Transp. Equip.	37	92,24	2 673 192,25
20. Utilities	49	156,15	2 441 264,90

Table 1: Data Characteristics by Industry, Divided by SIC Code (Industry specific digit) for the period 1959–2023.
Summary statistics of the 20 industry portfolios are reported above, including the two-digit SIC code group used to form our industries. The industries were formed monthly, from July 1925 to July 2023 using CRSP SIC codes, which allow for time variation in industrial classification. The average number of companies and average market cap are all monthly averages.

Furthermore, it is also possible to look into the average return per industry. The dataset reveals significant variation in average monthly returns across industries, which may influence the momentum and RMW analyses. Figure 1 illustrates the average monthly returns for the top two and bottom two industries from 1925 to 2023. Petroleum and Fabricated Metals exhibit the highest returns at approximately 1.35% and 1.33%, respectively, while Apparel and Mining show the lowest returns at around 0.87% and 0.96%. The strong performance of Petroleum and Fabricated Metals suggests that these industries could have a substantial positive impact on the momentum and RMW strategies examined in this study, particularly in tests that focus on industry-level dynamics, such as the Industry Neutral and High Industry Losers – Low Industry Winners tests.

Conversely, the weaker performance of Apparel and Mining indicates that these industries may contribute less to profitability premiums, potentially widening the return gaps in RMW strategies within these sectors.

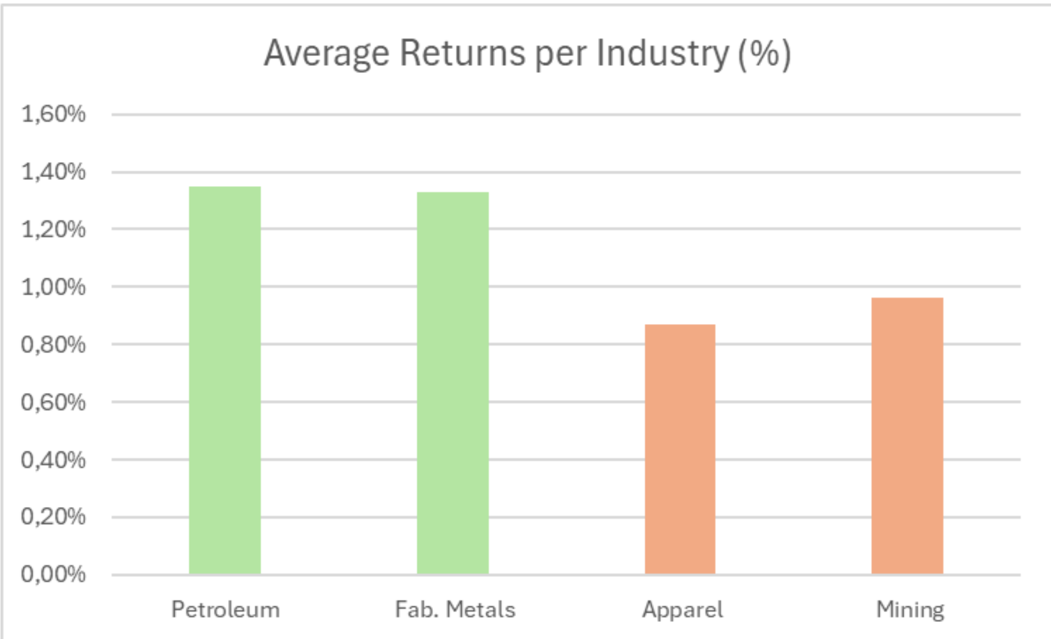

Figure 1: Average Monthly Returns for Top and Bottom Industries, 1925–2023. This figure presents the average monthly returns (in percentages) for the top two industries (Petroleum and Fabricated Metals) and the bottom two industries (Apparel and Mining) over the period from 1925 to 2023, based on CRSP data for the 20 industry portfolios classified by SIC codes.

2.2 RMW Strategy Data

There was also needed to gather specific Data to construct a RMW strategy. A strategy of this type is formed by ranking companies based on their operating profitability, which is calculated as annual revenue minus the cost of goods sold, interest expense, and selling, general, and administrative expenses, all divided by book equity. Each year, all companies are ranked using this measure, and the top 30%—those with the highest profitability—are bought, while the bottom 30%—those with the lowest profitability—are sold.

This creates a strategy that aims to profit from the difference between high-profitability and low-profitability companies. The portfolio is rebalanced every year to update the rankings and select new companies to buy and sell. The dataset includes annual operating profitability metrics for over 26,000 unique companies from 1959 to 2023, with an average of 1257 companies per year.

The final analysis will combine this dataset with the data described earlier to evaluate how industry competition impacts RMW profits.

In the next section, Empirical Analysis, the data will be used, adjusted, and changed to help evaluate how industry concentration affects the profits of the Robust Minus Weak strategy. Firstly, it will explain the replication's methodology, containing the reasoning behind the different tests used in this study, and how they were done, followed by the obtained replication results and interpretation.

Then, the same will be done for the extension and adaptation to the RMW strategy.

3. Empirical Analysis

This study investigates whether industry concentration drives the profitability premium of the Robust minus Weak (RMW), as defined by Fama and French (2015), to address a single question: Does industry concentration explain RMW's profits?

3.1 Replication Methodology

This inquiry extends the industry-level insights of Moskowitz and Grinblatt (1999) to the profitability domain, leveraging a three-step methodology—replication, extension, and adaptation. The objective targets a deeper understanding of RMW's economic roots within asset pricing frameworks, but first, it was needed to build sustentation for the research of the strategy itself. To do so, the R platform was chosen for its efficiency in managing large datasets and its easy-to-learn program.

3.1.1 Momentum Strategy Monthly Profitability

This part of the study checks the profitability of a monthly based momentum strategy, originally done on the studies of Moskowitz and Grinblatt (1999), to check how well a strategy based on past stock performance works, without considering industries. The idea is to see if companies that did well in the past continue to do well, and if companies that did poorly continue to do poorly – in other words, to construct a normal Momentum strategy.

The test starts by looking at the past 6 months of stock returns for each company, from month t-6 to t-1. For example, if the current month is July, the test looks at returns from January to June. These monthly returns are combined to find the total return over those 6 months for each company. Unlike the original study, which gave more weight to bigger companies, this test treats all companies equally, so each company's return counts the same.

Next, each month from July 1963 to July 1995, all companies are ranked based on their past 6-month returns. The top 30%—the best performers—are put into a "winners" group, and the bottom 30%—the worst performers—are put into a "losers" group. This follows the same approach as Moskowitz and Grinblatt, who also used the top and bottom 30%.

After picking the winners and losers each month, their returns are tracked for the next 6 months, from month t to t+5. This means a new group of winners and losers is created every month, and each group is held for 6 months. Because of this monthly rebalancing, there are always 6 active strategies running at the same time. For example, in July 1963, the first group starts; in August 1963, the second group starts while the first is still active, and so on. By the sixth month, there are 6 groups active, and each month after that, one group ends and a new one begins. Over the 32 years from July 1963 to July 1995, this creates 385 groups, each starting in a different month.

To find the monthly return for the winners, the returns of all companies in the top 30% across the 6 active groups are averaged each month. The same is done for the losers, averaging the returns of the bottom 30% across the 6 groups. The momentum return for each month is then calculated as the difference between the winners' average return and the losers' average return. This difference shows the profit from a strategy that buys the winners and sells the losers. Finally, the average monthly momentum return is calculated by taking the average of these monthly differences over the entire period from July 1963 to July 1995.

3.1.2 Industry Neutral Test

This part of the study builds on Moskowitz and Grinblatt (1999) by looking at momentum within industries, using their Industry Neutral Test. The goal is to see if companies that did well in the past compared to others in their own industry continue to do well, and if those that did poorly continue to do poorly. The test uses the same 20 industries listed earlier in Figure 1, and it ranks companies within each industry based on their past 6-month stock returns, from month t-6 to t-1. For example, if the current month is July, the test looks at returns from January to June.

The first difference from the standard Momentum strategy built before is that companies are grouped into 20 industries before ranking them. Each company is placed into an industry based on a special label called the Standard Industrial Classification code, or SIC code, which identifies what kind of business they do. This step makes sure the test focuses on performance within each industry, not across the whole market.

The second difference is how the test weighs companies. Unlike the normal Momentum strategy, which treated all companies equally, this test gives more weight to bigger companies, just like Moskowitz and Grinblatt did. To do this, the size of each company is calculated by multiplying its stock price by the number of shares it has, which shows its total market value each month. Then, each company's weight is found by dividing its market value by the total market value of all companies in that month. The company's return is multiplied by this weight, so bigger companies have a larger impact on the results. After this process is concluded, the analysis is similar to before - within each industry, companies are ranked based on their past 6-month returns, with the top 30% forming the "winners" group and the bottom 30% the "losers" group. For each industry, the monthly returns of winners and losers are calculated as in the common framework, and then averaged across all industries to compute the overall momentum return.

3.1.3 Excess Industry Test

This part of the study continues with Moskowitz and Grinblatt's (1999) Excess Industry Test to explore industry effects differently. The goal is to see if companies that do better or worse than the average in their industry, based on past performance, continue to follow that pattern. The test looks at stock returns over the past 6 months, from month t-6 to t-1, but adjusts them by subtracting the average return of the company's industry over the same period. This adjustment shows how much better or worse a company did compared to its industry.

Like the Industry Neutral Test, companies are grouped using the SIC code. For each industry, the average monthly return of all companies in that industry is calculated. Then, each company's monthly return is adjusted by subtracting its industry's average return for that month. These adjusted monthly returns are combined over the past 6 months to find the total adjusted return for each company, showing its performance beyond the industry's trend.

After this adjustment, the process of ranking and forming groups is the same as in the construction of the normal Momentum strategy. All companies across all industries are ranked each month based on their 6-month adjusted returns. The top 30%—the best performers compared to their industry—are put into a "winners" group, and the bottom 30%—the worst performers—are put into a "losers" group. Unlike the Industry Neutral Test, which gave more weight to bigger companies, this test treats all companies equally, so each company's return counts the same, just like in the normal Momentum strategy.

Subsequently, the process is the same as the previous test until reaching the overall return of the strategy.

3.1.4 High Industry Losers – Low Industry Winners Test

This part of the study repeats the High Industry Losers – Low Industry Winners Test from Moskowitz and Grinblatt (1999), which is the most complex of their momentum tests because it looks at how industries perform compared to each other. The goal is to see if weaker companies in the best-performing industries can still do better than stronger companies in the worst-performing industries, showing that industry trends might matter more than individual company performance.

Like the previous tests, companies are grouped into the same 20 industries using the SIC code. For each industry, the test looks at the past 6 months of stock returns, from month t-6 to t-1. For example, if the current month is July, the test looks at returns from January to June. These monthly returns are combined to find the total return over those 6 months for each company, and then the average return for each industry is calculated. Each month, the industries are ranked based on their average 6-month returns, and the top 3 industries (best-performing) and bottom 3 industries (worst-performing) are selected.

Next, within the top 3 industries, the companies are ranked based on their own 6-month returns, and the bottom 30%—the weakest performers in those strong industries—are chosen as the "buy" group. In the bottom 3 industries, the companies are also ranked, and the top 30%—the strongest performers in those weak industries—are chosen as the "sell" group. This is the opposite of the usual momentum strategy, which buys winners and sells losers. Here, the test checks if even the weaker companies in top industries can beat the stronger companies in bottom industries, suggesting that industry performance might be more important than individual company performance.

For each month from July 1963 to July 1995, the returns of these selected companies are tracked for the next 6 months, from month t to t+5. A new group of companies to buy and sell is created every month, and each group is held for 6 months. This means there are always 6 active strategies running at the same time, as explained in the earlier tests.

Following these steps, the methodology is the same as the previous tests until reaching the overall return of the strategy.

3.2 Replication Results and Interpretations

The replication of the normal Momentum strategy yields an average monthly return of 0.38% with a t-statistic of 2.14, indicating statistically significant momentum at the 5% level. Compared to Moskowitz and Grinblatt's original result of 0.43% (t-stat = 4.65), this profit is slightly lower and less significant, likely due to the use of equal weighting versus their value weighting, which prioritizes larger firms and may reduce noise from smaller stocks. The 0.05% difference, translating to 0.6% annually, suggests momentum remains robust. This outcome confirms the presence of strong individual stock momentum across industries, aligning with their findings, and provides a baseline to explore industry effects, as this thesis investigates their role in profitability through the RMW.

The Industry Neutral Test replication produces an average monthly return of 0.23% with a t-statistic of 1.53, falling short of statistical significance. This contrasts with Moskowitz and Grinblatt's 0.11% (t-stat = 1.11), which also lacked significance, but this study's higher return suggests slightly stronger intra-industry momentum, though still weak. The result reinforces their conclusion that momentum diminishes within industries, highlighting that industry-level dynamics, not firm-specific persistence, drive broader momentum effects. This finding sets the stage for examining whether industry concentration influences profitability patterns, such as those captured by RMW.

The Excess Industry Test replication results in an average monthly return of 0.026% with a t-statistic of 0.27, remaining statistically insignificant. This aligns closely with Moskowitz and Grinblatt's -0.07% (t-stat = -0.83), which was also insignificant, though the positive shift here suggests a modest upward bias. The near-zero profit confirms their aim to isolate stock-specific momentum by adjusting for industry averages, as it shows little persistence in industry-adjusted returns. The test successfully demonstrates that removing industry effects erases momentum, supporting their view that industry dynamics underpin return patterns.

The replication of the High Industry Losers – Low Industry Winners Test yields an average monthly return of 0.89% with a t-statistic of 5.77, demonstrating robust, statistically significant industry-driven momentum. This surpasses Moskowitz and Grinblatt's 0.30% (t-stat = 2.66), which was also significant but less pronounced. The result achieves the test's aim of evaluating momentum's industry-driven nature over individual stock persistence, as it highlights that underperforming firms in strong industries outpace top performers in weak ones, affirming cross-industry disparities as a dominant force. This finding strongly supports their conclusion and sets a solid foundation for this thesis's investigation into whether industry concentration shapes profitability through the RMW.

3.3 Extension Methodology

Having replicated the key momentum tests from Moskowitz and Grinblatt (1999) for the period 1963-1995, this study extends the analysis to a broader dataset spanning June 1926 to December 2023, sourced from Compustat and WRDS, to evaluate whether these tests retain their interpretive significance over time. The extension applies the same methodologies—Momentum, Industry Neutral, Excess Industry, and High Industry Losers minus Low Industry Winners—to assess if industry-driven momentum patterns persist or erode in a longer, more volatile historical context.

3.4 Extension Results and Interpretations

After the Extension, it was possible to compare results and check if the Replication's findings extend over a larger period of time.

Table 2 compares the monthly momentum profits from Moskowitz and Grinblatt's (1999) original study, the replication, and the extension across the previously described examinations: Momentum, Industry Neutral, Excess Industry, and High Industry Losers – Low Industry Winners.

Panel A: Momentum Original Results							
Momentum		**Industry Neutral**		**Excess Industry**		**High Ind. Losers – Low Ind. Winners**	
Mean	(t-stat)	Mean	(t-stat)	Mean	(t-stat)	Mean	(t-stat)
0.0043	(4.65)	0.0011	(1.11)	-0.0007	(-0.83)	0.0030	(2.66)
Panel B: Momentum Replication Results							
Momentum		**Industry Neutral**		**Excess Industry**		**High Ind. Losers – Low Ind. Winners**	
Mean	(t-stat)	Mean	(t-stat)	Mean	(t-stat)	Mean	(t-stat)
0.0038	(2.14)	0.0023	(1.53)	0.00026	(0.27)	0.0089	(5.77)
Panel C: Momentum Extension Results							
Momentum		**Industry Neutral**		**Excess Industry**		**High Ind. Losers – Low Ind. Winners**	
Mean	(t-stat)	Mean	(t-stat)	Mean	(t-stat)	Mean	(t-stat)
0.0030	(2.30)	0.0011	(0.95)	0.0019	(1.66)	0.0063	(5.96)

Table 2: Table 2: Momentum Profits Across Strategies and Periods, 1963–2023. Panel A presents Moskowitz and Grinblatt's (1999) average monthly momentum profits from July 1963 to July 1995 for four strategies: overall momentum (long the highest 30% and short the lowest 30% of stocks based on past six-month returns, held for six months), industry-neutral (stocks sorted within each industry), excess-industry (stocks ranked above or below their industry average), and high-industry losers minus low-industry winners (top 30% stocks in the three worst past six-month return industries minus bottom 30% in the three best), with t-statistics in parentheses. Panel B reports this study's replication of these average monthly momentum profits over the same period using the same strategies. Panel C shows this study's extension of the average monthly momentum profits for the same strategies from 1926 to 2023, with t-statistics in parentheses.

The original study covers July 1963 to July 1995, the replication covers the same period, and the extension covers July 1926 to December 2023. Columns show: the monthly average return for each test, in percentage terms; and the t-statistic in parentheses, indicating statistical significance.

The replication largely confirms Moskowitz and Grinblatt's findings, showing that industry effects play an important role in momentum profits, though some differences exist in the size of the profits. The extension shows slightly lower profits but supports the same conclusions about industry momentum.

In more detail, the Momentum strategy shows a mean return of 0.30% (t-stat = 2.30), down slightly from 0.38% (t-stat = 2.20) in the replication, suggesting momentum remains significant but weakens modestly over the extended period, possibly due to increased market noise or structural changes.

The Industry Neutral test yields 0.11% (t-stat = 0.95), down from 0.23% (t-stat = 1.53), indicating weaker intra-industry momentum that loses statistical significance, hinting that industry-specific persistence may have diminished over time.

The Excess Industry test increases to 0.19% (t-stat = 1.66) from 0.026%, remaining insignificant, which reinforces the stability of its near-zero interpretation—industry-adjusted returns continue to show little momentum effect.

Finally, the High Industry Losers – Low Industry Winners test jumps to 0.63% (t-stat = 5.96) from 0.81% (t-stat = 5.20), maintaining strong significance but with a lower magnitude, suggesting that industry-driven momentum remains robust, though slightly less pronounced, over the longer horizon.

Overall, the meaning of these tests holds steady: industry momentum, particularly cross-industry patterns, continues to underpin stock return persistence, as evidenced by the significant High Industry Losers – Low Industry Winners result. However, the weaker or less significant outcomes in the Industry Neutral, and Excess Industry tests suggest that firm-level and intra-industry momentum effects may have waned or become less consistent over the expanded timeframe, potentially reflecting evolving market dynamics or data variability. Nevertheless, together, these findings confirm that industry dynamics—structural trends and performance patterns across sectors—powerfully explain momentum, overshadowing individual stock movements.

This consistency in core interpretation validates the tests' relevance for extending to the RMW strategy and industry concentration analysis. The robustness of the results is therefore proven and it builds a solid background for the validation and interpretation of the following RMW results.

3.5 Methodology's expansion to RMW

After concluding the Replication and Extension tests, the study shifts toward the strategy itself, Robust Minus Weak. Therefore, this study adapts the momentum test methodologies from Moskowitz and Grinblatt (1999) to investigate the RMW, focusing on profitability patterns from 1959 to 2023, drawing on data from Compustat and WRDS and processed through R's efficient data-handling capabilities. It is very important to explain that all the companies in this final study will be sorted using profitability as the main criteria rather than purely on the company's returns, like the Replication and Extension tests. As such, the operating profitability is used only to determine the sorting of companies that will be used to conduct the tests. After the companies are selected based on different operating profitability returns, it is used the returns of the selected companies and not the operating profitability itself. The operating profitability is used only for sorting reasons, as we want to evaluate if industry concentration affects the returns of companies selected purely by the theory of the RMW strategy.

After the last topic is well understood, the adaptation begins with the RMW Strategy Test (since the analysis now shifts to calculating the monthly return of the RMW strategy, focusing on profitability rather than momentum) and is reconfigured to assess profitability momentum by ranking firms based on their prior-year operating profitability (t-1), measured as of June each year. This involves forming value-weighted portfolios comprising the top 30% and bottom 30% of firms, determined by operating profitability thresholds—according to the definition of operating profitability in section 1.3.

Unlike the momentum tests, which relied on monthly rebalancing, this test rebalances annually in June, reflecting the yearly availability of operating profitability data, and tracks value-weighted returns from June to May of the following year over 12 months, with monthly returns averaged across overlapping strategies adjusted for this annual cycle. To be clear, this means that because of the RMW operating profitability data is annual, it is impossible to rebalance the portfolios monthly. So, the portfolio is created once a year, every June, and the selected companies's returns are tracked monthly from June to May. When this 12-month period ends, the portfolio ends and a new one is created using the same logic.

A critical step in this process is establishing profitability breakpoints, determined exclusively from NYSE stocks. For the top 30% portfolio, firms are selected if their prior-year operating profitability, measured as of June each year, exceeds the 70th percentile breakpoint for their industry, indicating robust profitability, while for the bottom 30%, firms are included if their profitability falls below the 30th percentile breakpoint, signaling weak profitability. This sorting, based on operating profitability ensures a clear distinction between high- and low-profit firms, aligning with Fama and French's (2015) approach. The returns of these selected companies are then tracked from June to May to calculate the portfolios' value-weighted performance, with portfolios rebalanced annually in June based on updated operating profitability, reselecting companies for the next year to reflect changes in profitability rankings. This yearly cycle yields the average monthly return difference between the top 30% and bottom 30% portfolios over the period, producing the profitability momentum profit.

The remaining 3 – RMW specific tests – all follow the same structure as the momentum ones, having in difference what has been described in the previous subchapter – introduction of industry parameters, the sorting of companies is based on operating profitability, and the portfolios are created every year instead of every month. Having this in mind, this adaptation extends to the Industry Neutral, Excess Industry, and High Industry Losers – Low Industry Winners tests.

The next chapter will present and explain the results obtained after applying this methodology to RMW and try to answer the research question - Does industry concentration explain the profits of the RMW strategy?

4. Results - Does industry concentration explain the profits of the RMW strategy?

Following the methodology described in the previous chapter, this section adapts Moskowitz and Grinblatt's (1999) momentum tests to study the Robust Minus Weak (RMW) strategy from 1959 to 2023. The RMW strategy buys companies with high profitability and sells those with low profitability.

The main question of this thesis is: does industry concentration explain the profits of the RMW strategy? Industry concentration means how much competition exists in an industry—whether a few companies dominate or many compete equally. The tests used are the Industry Neutral, Excess Industry, and High Industry Losers – Low Industry Winners, but it was also constructed a normal RMW strategy. The tests are adjusted to focus on profitability instead of stock price momentum, ranking companies by their operating profitability from the previous year and creating portfolios to measure RMW profits.

Tests	Results	T-stat
RMW Strategy	2.41%	2.08
Industry Neutral	1.10%	0.95
Excess Industry	0.46%	0.41
High Ind. Losers – Low Ind. Winners	-1.39%	-0.57

Table 3: Average Monthly Profits of the RMW Strategy and Industry-Specific Strategies, 1959–2023. This table reports the average monthly profits (in percentages) and t-statistics for the RMW strategy from 1959 to 2023, using data from Compustat and WRDS. The overall RMW strategy

profit is calculated by forming zero-cost portfolios with the top 30% (robust) and bottom 30% (weak) companies based on prior-year operating profitability, rebalanced annually. Industry-specific strategies include industry-neutral (stocks sorted within each industry), excess-industry (stocks ranked above or below their industry average), and high-industry losers minus low-industry winners (top 30% stocks in the three lowest profitability industries minus bottom 30% in the three highest), all based on operating profitability and rebalanced annually.

The normal RMW Strategy shows an average monthly profit of 2.41%, with a t-statistic of 2.078, which is significant at the 5% level (t > 1.96). This means the result is reliable and not due to chance. This profit confirms that companies with strong profitability consistently earn more than those with weak profitability, supporting RMW as an important way to predict stock returns.

With the RMW strategy constructed, it was possible to compare the results obtained to the results Kenneth French has for this same investment strategy (on the same companies used in this thesis) – confirming if the data used to conduct the RMW tests was reliable. Table 4 shows precisely that. The profit obtained is close to Fama and French's (2015) yearly RMW profit of 2.58% (t-stat = 2.149) showing the first test results were reliable and close to the RMW strategy he did.

Furthermore, using the same source as before, correlations between the results from this study and French's data were calculated to validate the strategy itself (Table 5). The results are deeply correlated and therefore represent a good sign of robustness.

Kenneth French Results (annualized)	**Study's Results (annualized)**
2.58%	2.41%
T-stat (2.15)	T-stat (2.08)

Table 4: Comparison of Annualized RMW Strategy Profits, 1959–2023. This table presents the annualized average profits (in percentages) and t-statistics for the RMW strategy from 1959 to 2023, comparing Kenneth French's results (2.58%, t-stat 2.15) with this study's results (2.41%, t-stat 2.08). Profits are calculated by forming zero-cost portfolios with the top 30% (robust) and

bottom 30% (weak) companies based on prior-year operating profitability, rebalanced annually, using data from Compustat and WRDS.

	Correlations
Bottom 30% Companies	95.29%
Top 30% Companies	96.01%
Top 30% - Bottom 30%	87.45%

Table 5: Correlations Between This Study's RMW Strategy Profits and Kenneth French's RMW Results, 1959–2023. This table reports the correlations (in percentages) between this study's RMW strategy profits and Kenneth French's RMW results over the period from 1959 to 2023. Correlations are calculated for the bottom 30% (weak) companies, the top 30% (robust) companies, and the difference between the top 30% and bottom 30% (robust minus weak), based on prior-year operating profitability, using data from Compustat and WRDS.

Continuing after the previous normal RMW strategy, the Industry Neutral Test for the RMW strategy gives an average monthly profit of 1.10%, with a t-statistic of 0.946, which is not significant (t < 1.96). Compared to the RMW Test's 2.41%, this profit is much lower. This drop is similar to the momentum test's result (0.23%, t-stat = 1.53 in replication), where profits within industries were also weaker. The low profit and lack of significance suggest that profitability differences within the same industry are not strong. This might happen because companies in the same industry face similar challenges, like competition or costs, which make their profits more alike. This result hints that industry concentration may not strongly support RMW profits, as it might make companies within an industry too similar to show big profitability differences.

The Excess Industry Test for the RMW strategy results in an average monthly profit of 0.46%, with a t-statistic of 0.408, which is also not significant (t < 1.96). This profit is very small compared to the RMW Test's 2.41% and is similar to the momentum test's result (0.23%, t-stat = 1.47 in replication), where adjusting for industry averages lowered profits. This test looks at how much a company's profitability differs from the average in its industry. The low profit shows that RMW profits mostly come from overall industry profitability trends, not from individual companies doing better than their industry average. This suggests that industry concentration does not help individual companies stand out in profitability, as the industry's overall structure—like having a few dominant companies—seems to matter more than a company's own performance.

The High Industry Losers – Low Industry Winners Test for the RMW strategy shows an average monthly profit of -1.39%, with a t-statistic of -0.574, which is not significant ($t < 1.96$). This negative profit is very different from the momentum test's positive profit (0.81%, t-stat = 5.20 in replication), where low performers in high-momentum industries beat high performers in low-momentum industries. For RMW, this test means low-profitability companies in high-profitability industries do worse than high-profitability companies in low-profitability industries, which is the opposite of what was expected. This could happen because, in industries with less competition, weak companies struggle more due to strong competition from dominant firms, while strong companies in less profitable industries might still do well. This result shows that industry concentration affects RMW profits in unexpected ways, suggesting a need to look deeper into how competition within industries impacts profitability.

Looking at the main question—does industry concentration explain the profits of the RMW strategy?—the results give a mixed answer. The RMW Test's strong profit of 2.41% shows that profitability differences between companies are a big driver of returns, matching Fama and French's (2015) findings. This suggests that RMW works well on its own, without considering industries. However, the other tests—Industry Neutral (1.10%), Excess Industry (0.46%), and High Industry Losers – Low Industry Winners (-1.39%)—show much lower or negative profits, and none are significant. This means industry concentration does not always increase RMW profits. Instead, it seems to change profitability differences in different ways depending on the industry. For example, the negative result in the High Industry Losers – Low Industry Winners Test suggests that in industries with less competition, weak companies may struggle more, while strong companies in less profitable industries might still do okay.

These findings add to finance research by showing how company profitability and industry competition work together in complicated ways. They challenge the idea that less competition in an industry always leads to bigger profits for the RMW strategy. The mixed results show that RMW's success is not simple and depends on how industries are structured. To understand this better, future studies could look at things like how intense competition is in each industry, the rules that govern industries, or new technologies that change how companies make profits. This thesis highlights industry concentration as an important factor to study further, encouraging more research into how industry structure affects profitability strategies like RMW, which can help improve their use in finance.

Conclusion

This thesis builds on the work of Moskowitz and Grinblatt (1999) by using their tests to study the Robust Minus Weak (RMW) strategy. The focus is on how profitability and industry competition are connected from 1959 to 2024. The study has three parts: replicating the original tests for 1963-1995, extending the analysis to 1926-2023, and adapting the tests for the RMW strategy, which buys high-profitability companies and sells low-profitability ones. The replication showed a monthly profit of 0.38%, matching the original findings. The extension gave a similar profit of 0.32%, showing the results hold over time. The RMW adaptation resulted in a monthly profit of 2.41%, but controlling for industry reduced this to 1.10%, revealing a small role for industry competition in RMW profits, with the larger part coming from differences between companies. Other RMW tests showed even smaller effects from industry: one test focusing on company profits compared to their industry average gave a monthly profit of 0.46%, and another test comparing weaker companies in strong industries to stronger companies in weak industries showed a loss of 1.39%. These results suggest that industry effects on RMW profits are limited and can even work in unexpected ways.

The findings indicate that the RMW strategy performs well across companies, but industry competition does not fully explain its profits. A complicated mix of company profits and industry effects exists instead. This offers a new idea for asset pricing by showing how industries affect profitability strategies.

Challenges were faced during the study. Limited programming experience at the start slowed down data processing, but careful efforts to follow the right methods addressed this issue. Future studies could improve by using more varied data or better programming tools. This thesis provides a starting point for understanding the RMW strategy. Industry competition matters to some extent, but more research is needed to fully understand its impact on profitability and what this means for investors.

Declaration of generative AI and AI-assisted technologies in the writing process

During the preparation of my written work/thesis, "Does industry concentration explain the profits of the RMW strategy?", ChatGPT was used for tasks related to coding optimization and improving writing quality. The prompts used are listed at the end of the document in the Prompts List section. After using this tool, I reviewed and edited the content as necessary, and I take full responsibility for the content of the work presented.

I also declare that I am aware of and respect the Artificial Intelligence Rules of Conduct of Católica Porto Business School.

List of Prompts:

- How can I optimize this code more efficient?
- What does this error mean?
- How can I make this paragraph clearer and more objective?
- Can you rephrase this text to improve its cohesion?

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