

Momentum in Imperial Russia

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Abstract

Some of the leading theories of momentum have different empirical predictions about its profitability conditional on market composition and structure. The overconfidence explanation provided by Daniel, Hirshleifer, and Subrahmanyam (1998), for example, predicts lower momentum profits in markets with more sophisticated investors. The information-based theory of Hong and Stein (1999) predicts lower momentum profits in markets with lower informational frictions. The institutional theory of Vayanos and Woolley (2013) predicts lower momentum profits in markets with less agency. In this paper we use a dataset from a major 19th century equity market to test these predictions. Over this period there was no evidence of delegated management in Imperial Russia. A regulatory change in 1893 made speculating on the St. Petersburg stock market more accessible to small investors. We find a momentum effect that is similar in magnitude to those in modern markets, and stronger during the post-1893 period than during the pre-1893 period, consistent with the overconfidence theory of momentum.

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1 Introduction

Momentum strategies, also known as relative strength strategies, are a class of long-short trading strategies that buy past winners and sell past losers. Jegadeesh and Titman (1993) first document the profitability of momentum strategies in a sample of U.S. stocks during the period from 1965 to 1989. Many other studies extend this initial finding by documenting momentum profitability in the post-1989 period, in equity markets outside of the U.S., and in other asset classes.¹ While there is an abundance of empirical evidence for momentum, the debate on its underlying mechanism remains unsettled. For instance, Daniel, Hirshleifer, and Subrahmanyam (1998) propose a model in which investor overconfidence about the precision of private information generates the momentum effect. On the other hand, in Hong and Stein’s (1999) model, the interaction of boundedly rational agents and the slow diffusion of information generate initial underreaction and subsequent overreaction. More recently, Lou (2012) and Vayanos and Woolley (2013) propose explanations of momentum driven by flows into and between institutional money managers.

While these theories all generate the momentum effect, they have different predictions about momentum profitability conditional of market composition and structure. Tests of these predictions require significant variation for identification. In this paper we use a comprehensive dataset of monthly stock returns from the St. Petersburg Stock Exchange in the 19th and early 20th centuries to test these predictions. The St. Petersburg Stock Exchange provides an ideal setting for investigating momentum because: 1) it is, as yet, an untouched sample for finance researchers;² 2) there was no evidence of a delegated manage-

¹See, e.g., Rouwenhorst (1998), Jegadeesh and Titman (2001), and Asness, Moskowitz, and Pedersen (2013).

²The majority of academic studies of the momentum effect use the database of U.S. stocks maintained by the Center for Research in Security Prices (CRSP). The CRSP dataset starts in 1926. Even with many papers that use different samples, the issue of whether these samples are really independent remains. For instance, Asness, Moskowitz, and Pedersen (2013) finds a strong common factor structure among momentum returns from a set of diverse markets and asset classes.

ment structure in the Russian Empire over this period;³ and 3) a regulatory change in 1893 substantially reduced the costs of speculative trading for less sophisticated investors. The institutional theory predicts a muted momentum effect in such a market as the institutions that the theory relies on to generate momentum were absent. The overconfidence theory predicts lower momentum profits during the pre-1893 period than during the post-1893 period, because in the later period there was more market participation by those who are more susceptible to being overconfident. In contrast, the information diffusion theory predicts higher momentum profits during the pre-1893 period, because market participation was narrower and information flow was slower.

Our results are consistent with the investor overconfidence theory. Despite the absence of a delegated management structure in our setting, we find that past medium-term winners outperform past medium-term losers by as much as 74 basis points per month, which is similar in magnitude to momentum profits in modern markets. Exposure to the market factor cannot explain this outperformance. In addition, we find that the momentum effect is small and insignificant during the pre-1893 period, but large and highly significant during the post-1893 period. A placebo test using momentum returns from the London Stock Exchange shows that the same empirical regularity is not observed in a market that did not undergo a similar regulatory change.

Daniel and Moskowitz (2013) document that the momentum trade occasionally experiences large crashes. This suggests that, whatever the mechanism, momentum profits could compensate for an infrequently occurring risk factor. Based on this idea, they propose a method to manage this extreme left-tail risk.⁴ Interestingly, in our Russian sample extending more than 40 years, we find that while momentum returns are somewhat negatively skewed, extraordinary crashes like those that occurred in the U.S. are absent. Our evidence, therefore, is less consistent with theories that attribute high average momentum profits to

³The fund industry existed in the UK in this period but invested almost exclusively in bonds.

⁴See also Barroso and Santa-Clara (2013), Chuang and Ho (2013), Huang (2013), and Lou and Polk (2013).

compensation for bearing crash risk, and the idea that momentum trading is a destabilizing force. From a practical perspective, the evidence also suggests that momentum strategies do not necessarily require protection against left-tail risk.

The remainder of the paper is organized as follows. Section 2 reviews related literature and develops the hypotheses. Section 3 describes the data and methodology. Section 4 establishes the results. Section 5 concludes.

2 Related Literature and Hypothesis Development

Momentum strategies buy past medium-term winners and sell past medium-term losers. Motivated by the observation that mutual funds tend to buy stocks that have recently performed well, Jegadeesh and Titman (1993) systematically investigate the profitability of such strategies for U.S. common stocks. For each portfolio formation month t , they form portfolios based on cumulative stock returns from month $t - J$ to $t - 1$ and hold them for K months. They examine strategies for J ranging from 3 to 12 months and K also ranging from 3 to 12 months. Using data during the period from 1965 to 1989, they find that past winners significantly outperform past losers for all horizons considered and by as much as 1.49% a month.

Unlike a number of other anomalies examined, Fama and French (1996) find that their three-factor model cannot explain momentum profits. After controlling for the Fama and French (1993) factors, to which it is negatively correlated, momentum yields monthly alphas of 1.74%. This deepens the momentum puzzle. The inability of pre-existing asset pricing models to explain momentum has led researchers to add it as an additional risk factor (Carhart (1997)).

Momentum does not seem to be a spurious result of data mining as its effects are also present when other basis assets are used. Rouwenhorst (1998) documents momentum in developed markets stocks while Rouwenhorst (1999) finds evidence of momentum in emerging

markets. Using a U.S. sample, Moskowitz and Grinblatt (1999) demonstrate that industry momentum strategies are just as profitable as individual stock momentum strategies. Asness, Moskowitz, and Pedersen (2013) show that momentum is also present in cross-country equity index, currency, and bond futures, as well as in commodity futures.

There is an ongoing theoretical debate as to what causes momentum. Using a risk-based framework, Berk, Green, and Naik (1999), Johnson (2002), and Sagi and Seasholes (2007) contend that past winners are riskier so that momentum is due to time-varying expected returns. On the other hand, a number of behavioral models based on well-documented psychological evidence also yield momentum as an implication. Barberis, Shleifer, and Vishny (1998), Hong and Stein (1999), and Grinblatt and Han (2005) propose investor underreaction to news as an explanation of momentum. De Long et al. (1990), Daniel, Hirshleifer, and Subrahmanyam (1998), and Barberis and Shleifer (2003) argue that momentum could be the result of overreaction to information by market participants.

This paper focuses on the investor overconfidence theory of Daniel, Hirshleifer, and Subrahmanyam (1998), the information-based theory of Hong and Stein (1999), and the institutional theory of Vayanos and Woolley (2013). The Vayanos-Woolley theory is based on flows between institutional money managers. Flows are triggered by changes in fund managers' efficiency, which investors can infer from past performance. Momentum arises if flows exhibit inertia, and because rational prices underreact to expected future flows. According to this theory, since a delegated management structure is notably absent in our setting, the momentum effect should be relatively weak.⁵

The Daniel-Hirshleifer-Subrahmanyam model assumes a representative investor who is overconfident about the precision of his private signal. New public signals on average are viewed as confirming the validity of the investor's private signal, so public information triggers further overreaction to a preceding private signal. This continuing overreaction causes

⁵This prediction is not unique to the institutional theory. The data snooping critique of the momentum effect also predicts that there will be no momentum in this out-of-sample setting.

momentum in security prices. According to this theory and the basic intuition that small, less sophisticated investors are more likely to exhibit the overconfidence bias, the momentum effect should be stronger during times when there is more market participation by these investors. In our sample, the post-1893 period is such a time. The Russian law *PSZ* 3-9741 enacted on June 8, 1893 removed all restrictions prohibiting futures dealings in stocks.⁶ As a result, a speculative fever swept across Imperial Russia in the fall of 1893. According to Owen (1991), “instead of being confined, as in 1869, to the Hotel Demuth in Petersburg and, in Moscow, the Chizhov Court and the apartment of a Georgian princess, [trading activities] enveloped all the big hotels, as crowds of people who owned interest-bearing securities sold them to buy dividend-paying stocks whose values were soaring.” Taken together, the overconfidence theory predicts that the momentum effect should be stronger during the post-1893 period than during the pre-1893 period.

The prediction of the Daniel-Hirshleifer-Subrahmanyam model stands in contrast to the prediction of the Hong-Stein model. In the Hong-Stein model, two groups of boundedly rational agents interact when information diffuses gradually across the population. Prices underreact in the short run so momentum trading is profitable. As this theory argues that the momentum effect is caused by the slow diffusion of information, it predicts that momentum should be weaker during the post-1893 period than during the pre-1893 period. This is because the increased public interest in the stock market caused by *PSZ* 3-9741 and general technological progress in communication should have allowed information to flow faster in the post-1893 period.

The paper closest to ours is Chui, Titman, and Wei (2003). They focus on intra-industry momentum and on the real estate investment trust (REIT) industry in the U.S. They argue that the REIT industry experienced a structural change in 1990. They use this identification to test opposite predictions from the overconfidence theory and the information-based theory.

⁶These dealings are defined as any purchase of stock in the absence of cash and with delivery at a certain time in the future.

For chronological reasons, they do not comment on Vayanos and Woolley (2013). Our dataset is independent of the CRSP dataset that is used by Chui, Titman, and Wei (2003) as well as most other papers in this literature. Finally, their identification of the year 1990 is based on two different factors: 1) the financial difficulties of banks and savings and loans in the late 1980s and early 1990s that substantially reduced the amount of debt that was available to finance commercial real estate; and 2) the 1993 legislation that made it easier for pension funds to hold REITs in their portfolios.

Our paper is also part of an emerging literature on documenting momentum in historical equity markets. Chabot, Ghysels, and Jagannathan (2009) document momentum in the U.K. market over the period from 1866 to 1907. Geczy and Samonov (2013) compile a database of U.S. stock returns over the period from 1801 to 2012. They find that momentum is consistently profitable over this expansive period of time. Our current analysis not only supports these authors' findings that momentum is ubiquitous in pre-World War I markets, but also allows a comparative analysis with respect to international correlation of momentum returns, and documentation of the strategy's frequency of crashes over long periods.

3 Data and Methodology

The St. Petersburg Exchange was established in the early 1800's, about a hundred years after the founding of the City of St. Petersburg. From 1732 to 1918, St. Petersburg was the capital of the Russian Empire. The first stocks traded on the St. Petersburg Stock Exchange in the early 1830s.⁷ As the Russian economy developed, the numbers of corporations with shares traded on the St. Petersburg Stock Exchange grew rapidly. By 1914, more than two hundred Russian corporations had their shares listed.⁸ Market participants mostly consisted of ruling elites, company insiders, and wealthy merchants. Compared to a modern stock

⁷See Lizunov (2004).

⁸See Owen (1991). The St. Petersburg Stock Exchange closed down due to World War I in July 1914. It reopened for two months in 1917 before it closed down again for 74 years after the Revolution of 1917.

market, delegated managers such as mutual funds were notably absent.⁹

Our dataset of end-of-month stock prices for all companies listed on the St. Petersburg Stock Exchange over the period from January 1865 to July 1914 was hand-collected from five different sources. From January 1865 to December 1890, from January 1893 to December 1893, and from January 1897 to December 1904, end-of-month prices are from the Yearbook of the Finance Ministry. From January 1891 to November 1892, end-of-month prices are from the Bulletin of the Finance, the Industries and Trade. For the month of December 1892, end-of-month stock prices are from the Stock Exchange Newsletter. From January 1894 to December 1896, from January 1905 to December 1911, and from January 1914 to July 1914, end-of-month stock prices are from the Commercial and Industrial Newspaper. Finally, from January 1912 to December 1913, end-of-month stock prices are directly from the St. Petersburg Stock Exchange. The data are available for download on the website of the International Center for Finance at the Yale School of Management.

The methodology we used to process the raw data closely follows Goetzmann, Ibbotson, and Peng (2001). The month-end prices were obtained by searching the end-of-month issues for the last transaction price for each stock that month. When no transaction took place in the last week, the latest bid and ask prices were averaged. In total, we collected 43,736 end-of-month stock prices for 598 companies. From these, we calculated 38,090 monthly returns for 543 firms. There were three instances of 50% price drops and we assumed they represent stock splits.¹⁰ We only computed the returns when two adjacent prices are available, in a similar manner as CRSP. The number of firms in the universe averaged 64 firms. It reached a high point in April 1912 with 206 listed firms.¹¹ The fact that the number of firms

⁹According to Abramov and Akshentceva (2014), the first mutual funds did not appear in Russia until 1997. Over some of the period of our study, investment funds in London traded in Russian securities, raising the possibility of institutional influence via international channels. Virtually all British funds, however, held fixed income securities. See, e.g., Goetzmann and Ukhov (2006) for details.

¹⁰Assuming otherwise does not change our results.

¹¹In Goetzmann, Ibbotson, and Peng’s (2001) old NYSE dataset, the number of firms peaked at 114 in May 1883.

concurrently listed peaked at under 210, while the total number of firms in the database exceeded 540 indicates that, not only did firms appear during the sample period, they also disappeared.

We were able to obtain dividend data for the period from 1885 to 1915 from the same sources. In total, we have 4,951 annual dividend payment observations for 478 companies. Since we do not know whether these publications always reported dividends for all stocks listed on the St. Petersburg Stock Exchange, we do not know whether exclusions of dividends meant that they were not paid, or whether we failed to find them. The number of stocks for which we have an unbroken series of annual dividend payment observations is small. In analysis that follows, we assume that the dividends were paid at year-end, but changing this assumption does not change our results.

We control for market risk exposure in our asset pricing tests. Since we are limited by the fact that we lack data on shares outstanding, we use a simple procedure to construct a price-weighted market index. For each month in our sample, we calculate monthly returns for all stocks that trade in two consecutive months. We weight these returns by the price at the beginning of the two months. The return of the price-weighted index over period t , r_t^m , is defined as

$$r_t^m = \sum_{i=1}^N (r_t^i \cdot w_t^i) = \sum_{i=1}^N \left(\frac{P_t^i + D_t^i}{P_{t-1}^i} \cdot \frac{P_{t-1}^i}{\sum_{j=1}^N P_{t-1}^j} \right) = \frac{\sum_{i=1}^N (P_t^i + D_t^i)}{\sum_{j=1}^N P_{t-1}^j}. \quad (1)$$

Here r_t^i represents the return of security i over the period t and w_t^i represents the weight of security i over period t , which is equal to $P_{t-1}^i / \sum_{j=1}^N P_{t-1}^j$ since the index is price-weighted. Using a price-weighted index offers the benefit that its return closely approximates return to a “buy and hold” portfolio over the period, and as such, is not sensitive to bid-ask bounce bias (Canina et al. (1998)).

4 Results

Figure 1 shows the cumulative return of the price-weighted St. Petersburg Stock Exchange (SPSE) index shown on a log scale. Table 1 shows summary statistics for the underlying monthly return of the index for the entire period from February 1865 to July 1914 and for each decade of the period. For comparison, we also calculate summary statistics for the NYSE index constructed by Goetzmann, Ibbotson, and Peng (2001) over the same sample period.

Over the entire period, the annual geometric return of the SPSE index is 5.78%. There are periods of higher and lower growth. The annual geometric return is 9.7% in the second half of the 1860s and 1.85% in the 1900s. The long-term mean is slightly below the 5.82% annual growth experienced by the NYSE index over the same period. However, this long-term mean is not a good estimate of the equity premium provided by the St. Petersburg stock market because we know that, ex post, buy-and-hold investors lost 100% of their investments after the Revolution of 1917. Finally, we observe that the volatility of the index varies considerably. It is 11.03% over the entire sample period. It has a high of 17.06% in the 1860s and a low of 6.98% in the 1880s.

4.1 Momentum Profits

We investigate the profitability of momentum strategies in this no-delegated-management setting. The prediction based on Vayanos and Woolley’s (2013) institutional theory is that the momentum effect should be relatively weak in the St. Petersburg stock market. Put differently, we ask whether the existence of a delegated management structure is a necessary condition for price continuation patterns. This investigation is also of interest from the point of view that previously uncovered momentum profits could be a result of data snooping.

We follow Jegadeesh and Titman (1993) in forming the momentum strategies. The portfolios are formed based on J -month lagged returns and held for K months. The stocks

are ranked in ascending order on the basis of the lagged returns. An equally weighted portfolio of stocks in the lowest past return tercile is the sell portfolio and an equally weighted portfolio of the stocks in the highest return tercile is the buy portfolio. Table 2 presents the average monthly returns of these portfolios for J and K that vary from a quarter to a year. To ensure that our results are robust to the effect of non-synchronous trading and the bid-ask bounce, which can be more important in our setting than in modern markets, we also produce results where we skip the most recent month in the portfolio formation period.

Interestingly, in our Russian sample momentum strategies are consistently profitable across different values of J and K , with the exception of the case where $(J, K) = (3, 3)$. Similar to the results originally provided by Jegadeesh and Titman (1993), the most successful zero-cost strategy selects stocks based on their returns over the previous 12 months and then holds the portfolio for 3 months. As shown in Panel A, this strategy yields 68 basis points per month when there is not a lag between the portfolio formation period and the holding period; as shown in Panel B, momentum yields 77 basis points per month when there is a one-month lag between the formation period and the holding period. In general, the returns are higher when there is a lag between the formation period and the holding period (Panel B) than when the formation period and the holding period are contiguous (Panel A).

The natural question to ask next is whether exposure to the market factor can explain the observed momentum profits.¹² Table 3 shows that it is unlikely. It presents the betas of the momentum strategies with respect to the market portfolio represented by the price-weighted SPSE index. The betas are positive but low across different values of J and K . The range is from 0.04 to 0.17. It is easy to see with back-of-the-envelope calculations that exposure to the market factor cannot explain the magnitude of the momentum profits. Our evidence, therefore, suggests that institutional frictions can at most be a partial explanation

¹²Unfortunately, we do not have the data to construct the small-minus-big (SMB) and high-minus-low (HML) factors of Fama and French's (1993) three factor model.

of momentum.

Following the momentum literature, we focus the rest of the paper on the momentum strategy where $(J, K) = (6, 6)$ and the most recent month in the portfolio formation period is skipped. The results for this strategy are representative of the results for the other strategies and are available upon request. Figure 2 plots the cumulative returns of the buy portfolio and the sell portfolio of this strategy together with the cumulative return of the price-weighted SPSE index.

4.2 The Effects of a Regulatory Change

The government of Imperial Russia enacted the law *PSZ 3-9741* in June 8, 1893. It removed all restrictions prohibiting futures dealings in stocks. We presume that those restrictions were more binding for small and less sophisticated investors. As a result, market participation by those who are more likely to be overconfident increased after the law. If the momentum effect is caused by investor overconfidence as in Daniel, Hirshleifer, and Subrahmanyam (1998), then momentum profits should be higher during the post-1893 period than during the pre-1893 period. On the other hand, the information-based theory of momentum proposed by Hong and Stein (1999) would predict that the momentum effect should be stronger in the earlier period, when market participation was more narrow and information flow was slower.

To confirm the argument that market participation by less sophisticated investors increased after the enactment of *PSZ 3-9741*, we begin our analysis by looking at changes in aggregate liquidity. Less sophisticated investors tend to engage in noise trading. In Glosten and Milgrom's (1985) model, a risk-neutral market maker sets a bid-ask spread allowing expected noise-trading profits to offset expected informed-trading losses. When they believe they face a pool of more informed traders, they react by increasing the bid-ask spread. Consistent with this prediction, both Lee, Mucklow, and Ready (1993) and Greene and Smart (1999) find a positive link between noise trading and liquidity. Because we lack detailed transaction data, we use a liquidity measure that rely on the incidence of observed zero

monthly returns.¹³ Specifically, we measure illiquidity using the price-weighted proportion of zero monthly stock returns.

Table 4 reports the results from our analysis on the liquidity effects of *PSZ* 3-9741. It shows averages for the full sample and the periods before and after June 1893, as well as differences in means between the two subsamples. Over the full sample, the average incidence of zero returns is 14% for all stocks.¹⁴ We also divide each cross-section using stock price, which we use throughout this paper as a proxy for size, to investigate cross-sectional heterogeneity. Consistent with the idea that liquidity increases with size, the average incidence of zero returns is 17% for low price stocks, and 13% for high price stocks. More important, we see from the last row that liquidity improved substantially and significantly after the enactment of *PSZ* 3-9741, and that the improvement is larger among small stocks, which small investors tend to favor. The evidence thus supports the argument that average investor sophistication decreased after *PSZ* 3-9741.

Next, we compare momentum profits before and after *PSZ* 3-9741 to differentiate the overconfidence theory and the information diffusion theory. Panel A of Table 5 shows the first set of results. In the first row, we see that the winners-minus-losers momentum strategy generates small and statistically insignificant profits of 5 basis points per month during the period from February 1865 to May 1893. In contrast, the same momentum strategy delivers large and highly significant profits of 82 basis points per month during the period from June 1893 to July 1914. The difference in average momentum profits between the pre-1893 period and the post-1893 period is 77 basis points per month and significant at the 1% level. It is also interesting to note that the difference is contributed by both higher returns from the winners portfolio (89 basis points vs. 63 basis points) and lower returns from the loser portfolio (7 basis points vs. 53 basis points) in the later period.

¹³See Lesmond, Ogden, and Trzcinka (1999) for the theoretical treatment and Bekaert, Harvey, and Lundblad (2007) for an application in emerging markets.

¹⁴Bekaert, Harvey, and Lundblad (2007) report average incidence of zero *daily* returns that range from 8% for Korea to 52% for Colombia.

Panel B of Table 5 shows the results of a placebo test that we conduct using momentum returns from Britain during the period from August 1866 to December 1892.¹⁵ Britain did not undergo a similar regulatory regime change as Russia did in 1893, so we should not detect significant difference in average momentum returns between the pre-1893 period and the post-1893 period in Britain. We see that is indeed the case - the difference is 2 basis points and not statistically significant. Taken together, our results are more consistent with the overconfidence explanation to momentum.

4.3 Investigating Momentum Crashes

Daniel and Moskowitz (2013) document that, in the U.S. equity market over the period from January 1927 to March 2013, the momentum trade on many occasions experiences large crashes. These crashes are driven by the infrequent yet large-scale reversals of past losers. Specifically, Table 2 of their paper shows that the 15 worst monthly momentum returns range from -24.04% in January 1974 to -74.36% in August 1932. This raises the possibility that peso problems could explain momentum, i.e., high average momentum profits are compensation for bearing momentum crash risk (Rietz (1988); Burnside et al. (2010)). We investigate such peso events in our sample. For a deeper understanding of momentum and for risk management, it is also important to know more about the frequency as well as the magnitude of the crashes.

Table 6 presents higher-order statistics of the momentum strategies. Panels A and B present skewness and kurtosis. The momentum returns are in general negatively skewed. The skewness estimates average -0.39 and are an order of magnitude smaller than the skewness estimate of -4.7 reported by Daniel and Moskowitz (2013) for momentum in the U.S. stock market. In addition, all of the momentum strategies have leptokurtic returns. The kurtosis ranges from 2.22 to 4.95.

We target extreme outcomes of the return distributions. Panel C shows the minimum,

¹⁵We thank Ben Chabot for providing this data.

or most negative momentum return observations and Panel D shows the maximum return observations. The minimum returns are similar in magnitude to the maximum returns. More important, there is no evidence of momentum crashes like those documented by Daniel and Moskowitz (2013) for the modern U.S. stock market. The minimum ranges from -8% to -16% while the maximum ranges from 8% to 15%. These results stand in stark contrast to those from Daniel and Moskowitz (2013) and suggest that crashes may not be an inherent feature of the momentum trade. We leave it for future researchers to investigate whether momentum crashes are caused by modern features such as delegated management.

4.4 Characteristics of Momentum Strategies

The literature on momentum investing has also documented that momentum profits reverse in the long run. For example, Jegadeesh and Titman (2001) document that, while momentum portfolios yield significantly positive returns during the first 12 months following the portfolio formation period, their cumulative returns in months 12 to 60 are negative.¹⁶ They argue that this evidence is consistent with behavioral theories of momentum and reversal, but is inconsistent with the risk-based theory proposed by Conrad and Kaul (1998).

We run a similar experiment where we look at the performance of the momentum strategy in event time. Specifically, we investigate the average return on buying past winners and selling past losers in the h th month after the strategy is put into place. Table 7 gives the results in the first 36 months after portfolio formation.¹⁷ The average momentum returns are uniformly positive in the first 12 months after portfolio formation, after which time they turn negative. In untabulated results, we find some indication of time variation in the risk exposure of the event time portfolios, but it is not sufficient to explain the profits. Even though the profits turn negative in the second year after portfolio formation, they are not always statistically significant. These results are strikingly similar to the results of Jegadeesh

¹⁶See also Rouwenhorst (1998).

¹⁷Due to the limitations of our historical dataset, we do not look beyond month 36.

and Titman (1993), Rouwenhorst (1998), and Jegadeesh and Titman (2001).

Figure 3 presents cumulative momentum returns over a 36-month period after portfolio formation. It reveals a substantial reversal of profits in the second and third years. Cumulative momentum profits increase monotonically until they reach about 6% at the end of month 12. Over the next 24 months, as much as half of those profits are reversed.

Jegadeesh and Titman (1993) measure momentum profits on size-based subsamples to examine whether the profitability of the strategy is confined to any particular subsample of stocks. Later researchers generally find that momentum profits decrease with firm size, consistent with predictions from behavioral theories. The idea is that information tends to be more uncertain and diffuse more slowly for small stocks (Hong, Lim, and Stein (2000); Zhang (2006)). Again, we use price to proxy for size and present the average returns of the momentum portfolios for two price-based subsamples in Table 8. We find that momentum profits in the high-price subsample are all lower and less statistically significant than in the low-price subsample. For the strategy where $(J, K) = (12, 3)$, average return is 1% with a t -statistic of 5.51 in the low-price subsample and 0.41% with a t -statistic of 2.86 in the high-price subsample.

Jegadeesh and Titman (1993) find that the momentum strategy incurs significant losses in January but achieves positive abnormal returns in each of the other months. Grinblatt and Moskowitz (2004) study this seasonality carefully and attribute it to tax-loss selling. Since the Russian government did not tax capital gains, we can perform a placebo test for their hypothesis using our sample. Table 9 reports the average returns of the momentum strategy in each month of the year. Consistent with the tax-loss selling hypothesis, we do not find a significant seasonal effect for momentum in Russia.¹⁸ The momentum strategy has statistically insignificant losses in January. The F -statistics show that differences in momentum returns across the months are not statistically significant.

¹⁸Chabot, Ghysels, and Jagannathan (2009) also do not find a seasonal effect in momentum profits using a sample of British stocks from the Victorian era, during which capital gains were also not taxed.

Finally, Table 10 reports a robustness check to make sure that our results are not due to our treatment of missing data. Firms could drop out of the universe due to bankruptcy and the worst case scenario is that equity investors get nothing. We ask whether assuming a -100% return for exit firms would change our results. Our prior is that this grossly understates the actual returns and introduce additional noise into the estimation process. This largely bears out in the data. The average returns of the buy-minus-sell momentum portfolios are roughly the same under the alternative treatment of exit firms. The t -statistics are generally lower, but still significant at the conventional levels.

5 Conclusion

In this paper, we demonstrate momentum profitability in a novel, untouched sample. The setting of our experiment - 19th century St. Petersburg Stock Exchange - has the unique features that there was not a delegated management structure and that an exogenous shock to market composition took place. We try to distinguish between three theories of momentum that have received much attention in the academic literature: the overconfidence theory of Daniel, Hirshleifer, and Subrahmanyam (1998), the information-based theory of Hong and Stein (1999), and the institutional theory of Vayanos and Woolley (2013). Our evidence is most supportive of the behavioral theory that momentum is caused by investor overconfidence.

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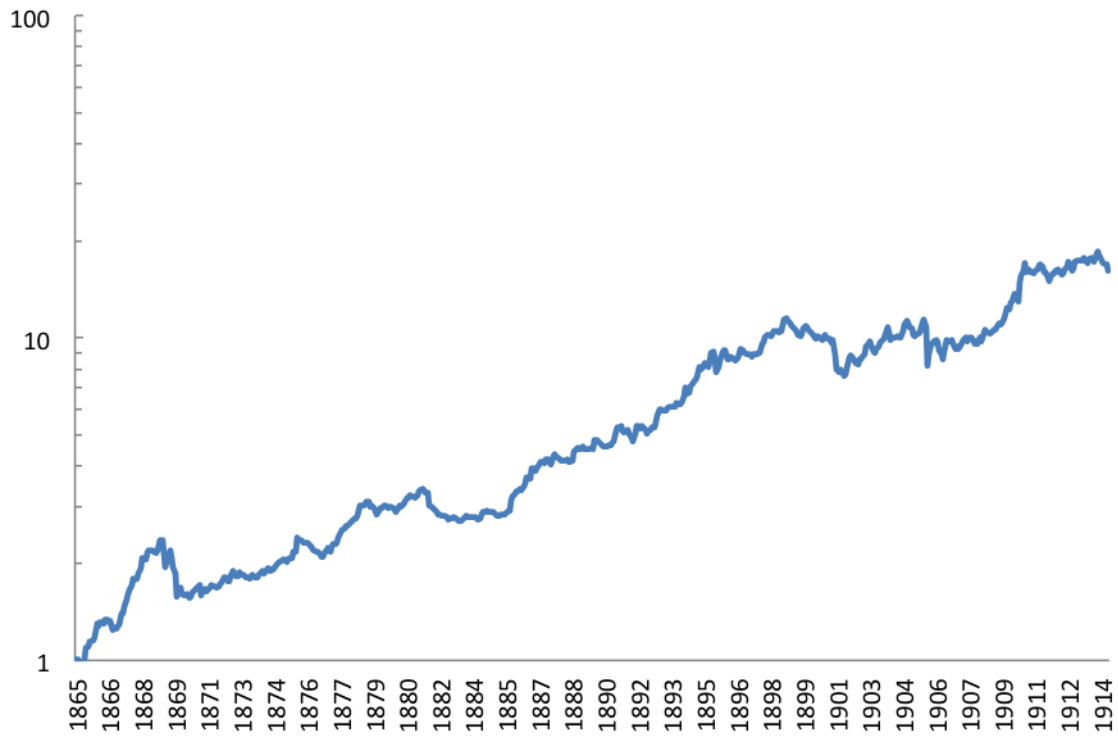


Figure 1: The Price-Weighted SPSE Index

This figure shows the cumulative return of the price-weighted SPSE index. The sample period is January 1865 to July 1914.

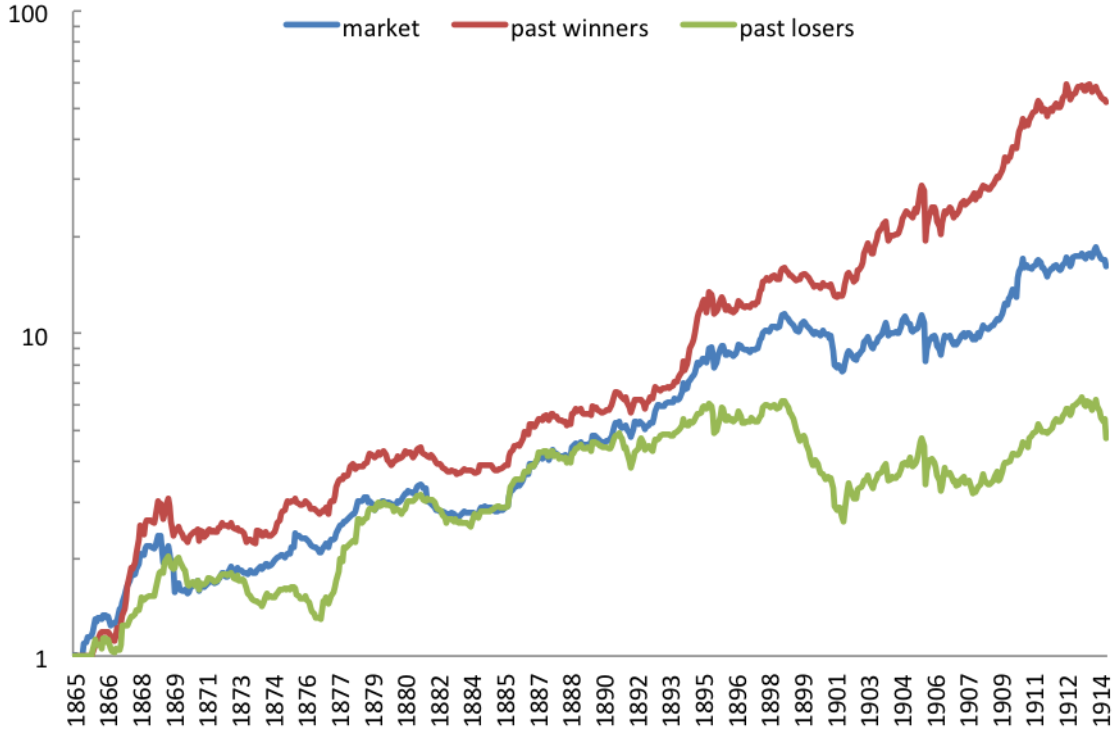


Figure 2: Momentum Performance in Imperial Russia

The momentum portfolios are formed based on J -month lagged returns and held for K months. The stocks are ranked in ascending order on the basis of the lagged returns and an equally weighted portfolio of stocks in the lowest past return tercile is the sell portfolio and an equally weighted portfolio of the stocks in the highest return tercile is the buy portfolio. This figure shows the cumulative returns of the price-weighted SPSE index, as well as the buy portfolio and the sell portfolio where $(J, K) = (6, 6)$. The sample period is January 1865 to July 1914.

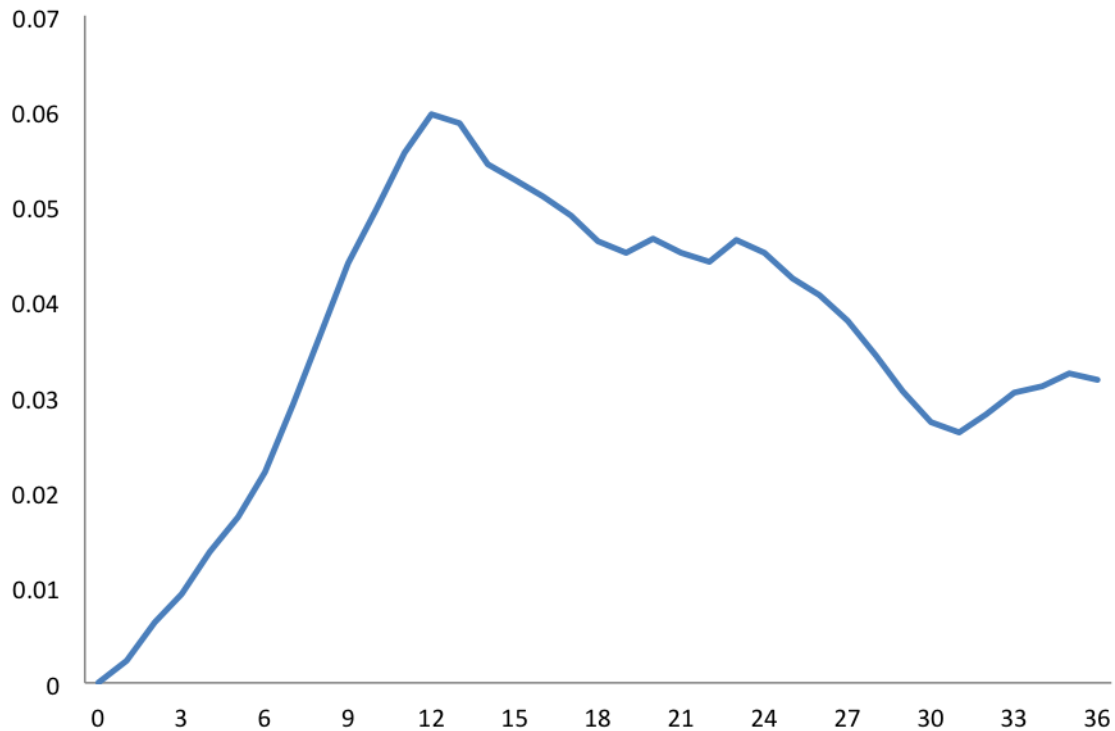


Figure 3: Cumulative Momentum Returns in Event Time

The momentum portfolios are formed based on 6-month lagged returns. The stocks are ranked in ascending order on the basis of the lagged returns and an equally weighted portfolio of stocks in the lowest past return tercile is the sell portfolio and an equally weighted portfolio of the stocks in the highest return tercile is the buy portfolio. This figure shows the average cumulative return to the zero-cost, buy minus sell, portfolio in each month following the formation period. The sample period is January 1865 to July 1914.

Table 1: Summary Statistics

This table presents summary statistics for the monthly return of the price-weighted SPSE index. The mean returns and standard deviation are in percent and annualized. The sample period is January 1865 to July 1914.

Date	Arithmetic Mean	Geometric Mean	Standard Deviation
2/1865-7/1914	6.41	5.78	11.03
2/1865-12/1869	11.24	9.70	17.06
1/1870-12/1879	7.07	6.76	7.59
1/1880-12/1889	5.02	4.77	6.98
1/1890-12/1899	8.80	8.32	9.47
1/1900-12/1909	2.85	1.85	14.26
1/1910-7/1914	5.70	4.98	11.71
<i>NYSE</i>			
2/1865-7/1914	6.94	5.82	14.52

Table 2: Returns of Momentum Portfolios in Imperial Russia

The momentum portfolios are formed based on J -month lagged returns and held for K months. The stocks are ranked in ascending order on the basis of the lagged returns and an equally weighted portfolio of stocks in the lowest past return tercile is the sell portfolio and an equally weighted portfolio of the stocks in the highest return tercile is the buy portfolio. The average monthly returns of these portfolios are presented in this table. The values of J and K for the different strategies are indicated in the first column and row, respectively. The momentum portfolios in Panel A are formed using returns over the entire portfolio formation period while the momentum portfolios in Panel B skip the most recent month in the formation period. t -statistics are in parentheses. The sample period is January 1865 to July 1914.

		Panel A				Panel B				
J	$K=$	3	6	9	12	$K=$	3	6	9	12
3	Buy	0.0058 (3.85)	0.0069 (4.81)	0.0070 (5.18)	0.0074 (5.40)		0.0063 (4.23)	0.0072 (4.98)	0.0072 (5.21)	0.0072 (5.27)
	Sell	0.0043 (3.04)	0.0041 (3.04)	0.0040 (2.99)	0.0032 (2.44)		0.0038 (2.65)	0.0041 (2.94)	0.0042 (3.11)	0.0039 (2.94)
	Buy-Sell	0.0014 (1.16)	0.0028 (2.89)	0.0030 (3.47)	0.0043 (5.35)		0.0021 (1.91)	0.0030 (3.24)	0.0030 (3.83)	0.0035 (4.94)
6	Buy	0.0066 (4.36)	0.0073 (5.06)	0.0080 (5.67)	0.0079 (5.58)		0.0075 (4.90)	0.0075 (5.19)	0.0081 (5.66)	0.0078 (5.48)
	Sell	0.0037 (2.69)	0.0037 (2.65)	0.0028 (2.10)	0.0027 (2.06)		0.0031 (2.19)	0.0033 (2.29)	0.0026 (1.87)	0.0027 (2.00)
	Buy-Sell	0.0028 (2.31)	0.0036 (3.17)	0.0051 (5.15)	0.0052 (5.58)		0.0040 (3.25)	0.0039 (3.56)	0.0051 (5.37)	0.0048 (5.44)
9	Buy	0.0071 (4.79)	0.0083 (5.72)	0.0082 (5.72)	0.0079 (5.51)		0.0076 (5.08)	0.0082 (5.63)	0.0081 (5.59)	0.0077 (5.30)
	Sell	0.0034 (2.38)	0.0024 (1.72)	0.0025 (1.83)	0.0027 (2.01)		0.0026 (1.86)	0.0020 (1.46)	0.0024 (1.75)	0.0028 (2.14)
	Buy-Sell	0.0035 (2.83)	0.0058 (5.16)	0.0056 (5.30)	0.0052 (5.09)		0.0047 (3.90)	0.0063 (5.55)	0.0057 (5.39)	0.0047 (4.75)
12	Buy	0.0083 (5.67)	0.0082 (5.56)	0.0078 (5.39)	0.0075 (5.17)		0.0086 (5.61)	0.0083 (5.51)	0.0080 (5.35)	0.0075 (5.02)
	Sell	0.0016 (1.13)	0.0019 (1.39)	0.0023 (1.68)	0.0027 (2.02)		0.0008 (0.55)	0.0017 (1.25)	0.0022 (1.65)	0.0029 (2.20)
	Buy-Sell	0.0068 (5.66)	0.0062 (5.10)	0.0056 (4.69)	0.0048 (4.26)		0.0077 (6.25)	0.0067 (5.61)	0.0059 (5.21)	0.0047 (4.37)

Table 3: Betas of Momentum Portfolios

The momentum portfolios are formed based on J -month lagged returns and held for K months. The stocks are ranked in ascending order on the basis of the lagged returns and an equally weighted portfolio of stocks in the lowest past return tercile is the sell portfolio and an equally weighted portfolio of the stocks in the highest return tercile is the buy portfolio. The most recent month in the portfolio formation period is skipped. This table presents the betas of the zero-cost, buy minus sell, portfolios with respect to the market portfolio represented by the price-weighted SPSE index. The values of J and K for the different strategies are indicated in the first column and row, respectively. The sample period is January 1865 to July 1914.

J	$K=$	3	6	9	12
3		0.04	0.07	0.06	0.06
6		0.15	0.09	0.09	0.11
9		0.12	0.11	0.12	0.13
12		0.17	0.16	0.16	0.16

Table 4: The Effects of *PSZ 3-9741* on Illiquidity

In the spirit of Bekaert, Harvey, and Lundblad (2007), the illiquidity measure is the price-weighted proportion of zero monthly stock returns. This table presents tests of the difference in illiquidity before and after *PSZ 3-9741*, a Russian law dated June 8, 1893 that removed all restrictions prohibiting futures dealings in stocks. These dealings are defined as any purchase of stock in the absence of cash and with delivery at a certain time in the future. *t*-statistics are in parentheses.

	All Stocks	Low Price	High Price
Full sample	0.1353 (22.56)	0.1679 (22.75)	0.1260 (20.27)
Pre-1893: February 1865-May 1893	0.1694 (19.91)	0.2180 (20.38)	0.1555 (17.35)
Post-1893: June 1893-July 1914	0.0896 (12.33)	0.1008 (12.80)	0.0865 (11.46)
Post-1893 Minus Pre-1893	-0.0797 (-6.83)	-0.1173 (-8.30)	-0.0690 (-5.64)

Table 5: The Effects of *PSZ* 3-9741 on Momentum Returns

The momentum portfolios are formed based on 6-month lagged returns and held for 6 months. The stocks are ranked in ascending order on the basis of the lagged returns and an equally weighted portfolio of stocks in the lowest past return tercile is the losers portfolio and an equally weighted portfolio of the stocks in the highest return tercile is the winners portfolio. This table presents tests of the difference in average momentum returns before and after *PSZ* 3-9741, a Russian law dated June 8, 1893 that removed all restrictions prohibiting futures dealings in stocks. These dealings are defined as any purchase of stock in the absence of cash and with delivery at a certain time in the future. The momentum portfolios in Panel A are formed using stocks listed on the St. Petersburg Stock Exchange from February 1865 to July 1914. The momentum portfolios in Panel B are formed using stocks listed on the London Stock Exchange from August 1866 to December 1907. *t*-statistics are in parentheses.

	Winners (W)	Losers (L)	W-L
Panel A: Momentum in Russia (February 1865-July 1914)			
Pre-1893: February 1865-May 1893	0.0063 (3.83)	0.0053 (3.15)	0.0005 (0.33)
Post-1893: June 1893-July 1914	0.0089 (3.56)	0.0007 (0.29)	0.0082 (5.33)
Post-1893 Minus Pre-1893	0.0026 (0.89)	-0.0046 (-1.58)	0.0077 (3.53)
Panel B: Momentum in Britain (August 1866-December 1907)			
Pre-1893: February 1865-May 1893			0.0036 (2.54)
Post-1893: June 1893-July 1914			0.0034 (1.73)
Post-1893 Minus Pre-1893			-0.0002 (-0.07)

Table 6: Higher-Order Statistics of Momentum Portfolios

The momentum portfolios are formed based on J -month lagged returns and held for K months. The stocks are ranked in ascending order on the basis of the lagged returns and an equally weighted portfolio of stocks in the lowest past return tercile is the sell portfolio and an equally weighted portfolio of the stocks in the highest return tercile is the buy portfolio. This table presents the higher-order statistics of the zero-cost, buy minus sell, portfolios. The values of J and K for the different strategies are indicated in the first column and row, respectively. Panel A and Panel B present the third and fourth moments, respectively. Panel C presents the smallest observed monthly returns. Panel D presents the largest observed monthly returns. The sample period is January 1865 to July 1914.

J	$K=$	3	6	9	12
Panel A: Skewness					
3		-0.25	-0.31	-0.39	-0.25
6		-0.24	-0.83	-0.25	-0.27
9		-0.55	-0.42	-0.44	-0.37
12		-0.25	-0.47	-0.52	-0.45
Panel B: Kurtosis					
3		4.54	5.14	4.94	4.50
6		4.06	6.41	4.20	4.55
9		2.61	2.59	2.70	2.53
12		2.93	2.61	2.68	2.59
Panel C: Minimum					
3		-0.12	-0.10	-0.09	-0.08
6		-0.14	-0.16	-0.11	-0.10
9		-0.12	-0.12	-0.11	-0.10
12		-0.12	-0.12	-0.12	-0.11
Panel D: Maximum					
3		0.13	0.10	0.09	0.08
6		0.15	0.11	0.11	0.11
9		0.12	0.10	0.10	0.09
12		0.15	0.11	0.10	0.10

Table 7: Momentum Returns in Event Time

The momentum portfolios are formed based on 6-month lagged returns. The stocks are ranked in ascending order on the basis of the lagged returns and an equally weighted portfolio of stocks in the lowest past return tercile is the sell portfolio and an equally weighted portfolio of the stocks in the highest return tercile is the buy portfolio. This table presents the average returns of the zero-cost, buy minus sell, portfolio in each month following the formation period. h is the month after portfolio formation. The sample period is January 1865 to July 1914.

h	Avg. Monthly Return	t -stat	h	Avg. Monthly Return	t -stat
1	0.0023	1.56	19	-0.0011	-0.65
2	0.0040	2.80	20	0.0014	0.90
3	0.0030	2.02	21	-0.0014	-0.95
4	0.0043	2.91	22	-0.0009	-0.56
5	0.0037	2.70	23	0.0021	1.48
6	0.0045	3.21	24	-0.0013	-0.86
7	0.0071	4.92	25	-0.0026	-1.71
8	0.0073	5.55	26	-0.0016	-1.03
9	0.0069	4.71	27	-0.0026	-1.78
10	0.0054	3.63	28	-0.0035	-2.45
11	0.0057	3.99	29	-0.0037	-2.35
12	0.0038	2.80	30	-0.0031	-2.05
13	-0.0009	-0.70	31	-0.0011	-0.67
14	-0.0040	-3.09	32	0.0018	1.11
15	-0.0016	-1.14	33	0.0022	1.28
16	-0.0016	-1.14	34	0.0008	0.45
17	-0.0020	-1.22	35	0.0013	0.85
18	-0.0026	-1.66	36	-0.0006	-0.41

Table 8: Returns of Price-Based Momentum Portfolios

The momentum portfolios are formed based on J -month lagged returns and held for K months. The stocks are ranked in ascending order on the basis of the lagged returns and an equally weighted portfolio of stocks in the lowest past return tercile is the sell portfolio and an equally weighted portfolio of the stocks in the highest return tercile is the buy portfolio. The average monthly returns of these portfolios, formed using price-based subsamples of stocks, are presented here. The values of J and K for the different strategies are indicated in the first column and row, respectively. Panel A and Panel B present, respectively, the momentum portfolios formed using the low price subsample and the high price subsample. t -statistics are in parentheses. The sample period is January 1865 to July 1914.

		Panel A: Low Price				Panel B: High Price				
J	$K=$	3	6	9	12	$K=$	3	6	9	12
3	Buy	0.0077 (4.58)	0.0082 (4.87)	0.0084 (5.20)	0.0083 (5.14)		0.0047 (3.05)	0.0052 (3.50)	0.0055 (4.01)	0.0056 (4.19)
	Sell	0.0036 (1.94)	0.0044 (2.43)	0.0045 (2.57)	0.0041 (2.48)		0.0032 (2.23)	0.0035 (2.74)	0.0038 (3.02)	0.0033 (2.63)
	Buy-Sell	0.0041 (2.57)	0.0037 (2.95)	0.0038 (3.46)	0.0042 (4.44)		0.0016 (1.26)	0.0015 (1.53)	0.0018 (2.14)	0.0023 (3.02)
6	Buy	0.0073 (4.12)	0.0080 (4.74)	0.0091 (5.41)	0.0088 (5.23)		0.0055 (3.29)	0.0061 (3.89)	0.0064 (4.39)	0.0062 (4.39)
	Sell	0.0026 (1.42)	0.0033 (1.79)	0.0025 (1.45)	0.0022 (1.36)		0.0030 (2.29)	0.0029 (2.20)	0.0028 (2.12)	0.0028 (2.15)
	Buy-Sell	0.0044 (2.60)	0.0042 (2.68)	0.0060 (4.32)	0.0060 (4.79)		0.0025 (1.73)	0.0028 (2.35)	0.0034 (3.40)	0.0030 (3.18)
9	Buy	0.0076 (4.48)	0.0093 (5.31)	0.0098 (5.65)	0.0094 (5.44)		0.0059 (3.74)	0.0067 (4.50)	0.0063 (4.36)	0.0061 (4.27)
	Sell	0.0015 (0.75)	0.0013 (0.72)	0.0015 (0.90)	0.0020 (1.25)		0.0032 (2.38)	0.0026 (1.94)	0.0029 (2.18)	0.0032 (2.47)
	Buy-Sell	0.0059 (3.06)	0.0071 (4.45)	0.0078 (5.11)	0.0068 (4.92)		0.0025 (1.92)	0.0037 (2.95)	0.0035 (3.05)	0.0029 (2.57)
12	Buy	0.0095 (5.29)	0.0095 (5.46)	0.0102 (5.82)	0.0095 (5.44)		0.0065 (3.99)	0.0066 (4.29)	0.0063 (4.25)	0.0058 (4.02)
	Sell	-0.0011 (-0.58)	0.0008 (0.47)	0.0015 (0.85)	0.0024 (1.39)		0.0024 (1.76)	0.0025 (1.85)	0.0029 (2.14)	0.0038 (2.80)
	Buy-Sell	0.0100 (5.51)	0.0078 (4.82)	0.0081 (5.02)	0.0066 (4.40)		0.0041 (2.86)	0.0037 (2.73)	0.0033 (2.60)	0.0019 (1.56)

Table 9: Momentum Returns by Calendar Months

The momentum portfolios are formed based on 6-month lagged returns and held for 6 months. The stocks are ranked in ascending order on the basis of the lagged returns and an equally weighted portfolio of stocks in the lowest past return tercile is the losers portfolio and an equally weighted portfolio of the stocks in the highest return tercile is the winners portfolio. This table presents the average returns of the zero-cost, winners-minus-losers, portfolio by calendar months. t -statistics are in parentheses. p -values for the F -test that the returns are jointly equal in all calendar months are in brackets. The sample period is January 1865 to July 1914.

	All Stocks	Low Price	High Price
Jan.	-0.0044 (-1.06)	-0.0103 (-1.31)	0.0011 (0.22)
Feb.	-0.0001 (-0.02)	0.0048 (0.64)	-0.0046 (-1.13)
Mar.	0.0001 (0.02)	-0.0043 (-0.91)	0.0012 (0.31)
Apr.	0.0035 (1.07)	0.0063 (1.43)	0.0002 (0.03)
May	0.0003 (0.06)	0.0038 (0.77)	-0.0012 (-0.26)
Jun.	0.0045 (1.24)	0.0027 (0.56)	-0.0004 (-0.13)
Jul.	0.0144 (3.57)	0.0136 (2.88)	0.0153 (3.49)
Aug.	0.0060 (2.31)	0.0042 (1.24)	0.0060 (1.97)
Sep.	0.0054 (1.20)	0.0049 (0.86)	0.0056 (1.99)
Oct.	0.0057 (1.76)	0.0087 (1.76)	0.0042 (1.26)
Nov.	0.0054 (1.25)	0.0078 (1.46)	0.0033 (0.56)
Dec.	0.0065 (2.12)	0.0086 (1.65)	0.0038 (0.91)
F -statistic	1.55 [0.11]	1.33 [0.20]	1.45 [0.15]

Table 10: Sensitivity to Treatment of Exit Firms

The momentum portfolios are formed based on J -month lagged returns and held for K months. The stocks are ranked in ascending order on the basis of the lagged returns and an equally weighted portfolio of stocks in the lowest past return tercile is the sell portfolio and an equally weighted portfolio of the stocks in the highest return tercile is the buy portfolio. The average monthly returns of these portfolios are presented in this table. The values of J and K for the different strategies are indicated in the first column and row, respectively. The results in Panel A are presented earlier and do not assume exit firms have -100% return. The results presented in Panel B assume exit firms have -100% return. t -statistics are in parentheses. The sample period is January 1865 to July 1914.

		Panel A				Panel B				
J	$K=$	3	6	9	12	$K=$	3	6	9	12
3	Buy	0.0063 (4.23)	0.0072 (4.98)	0.0072 (5.21)	0.0072 (5.27)		0.0008 (0.45)	0.0023 (1.39)	0.0022 (1.37)	0.0024 (1.44)
	Sell	0.0038 (2.65)	0.0041 (2.94)	0.0042 (3.11)	0.0039 (2.94)		-0.0031 (-1.70)	-0.0026 (-1.47)	-0.0018 (-1.05)	-0.0015 (-0.93)
	Buy-Sell	0.0021 (1.91)	0.0030 (3.24)	0.0030 (3.83)	0.0035 (4.94)		0.0035 (2.33)	0.0048 (3.65)	0.0040 (3.64)	0.0041 (3.80)
6	Buy	0.0075 (4.90)	0.0075 (5.19)	0.0081 (5.66)	0.0078 (5.48)		0.0025 (1.32)	0.0024 (1.34)	0.0028 (1.54)	0.0028 (1.58)
	Sell	0.0031 (2.19)	0.0033 (2.29)	0.0026 (1.87)	0.0027 (2.00)		-0.0034 (-1.95)	-0.0027 (-1.49)	-0.0030 (-1.66)	-0.0027 (-1.54)
	Buy-Sell	0.0040 (3.25)	0.0039 (3.56)	0.0051 (5.37)	0.0048 (5.44)		0.0055 (3.05)	0.0049 (2.98)	0.0054 (3.41)	0.0051 (3.49)
9	Buy	0.0076 (5.08)	0.0082 (5.63)	0.0081 (5.59)	0.0077 (5.30)		0.0029 (1.54)	0.0030 (1.57)	0.0032 (1.71)	0.0031 (1.75)
	Sell	0.0026 (1.86)	0.0020 (1.46)	0.0024 (1.75)	0.0028 (2.14)		-0.0029 (-1.65)	-0.0035 (-1.85)	-0.0029 (-1.55)	-0.0024 (-1.28)
	Buy-Sell	0.0047 (3.90)	0.0063 (5.55)	0.0057 (5.39)	0.0047 (4.75)		0.0056 (3.18)	0.0066 (3.40)	0.0059 (3.31)	0.0054 (3.06)
12	Buy	0.0086 (5.61)	0.0083 (5.51)	0.0080 (5.35)	0.0075 (5.02)		0.0035 (1.70)	0.0033 (1.67)	0.0031 (1.60)	0.0029 (1.54)
	Sell	0.0008 (0.55)	0.0017 (1.25)	0.0022 (1.65)	0.0029 (2.20)		-0.0045 (-2.57)	-0.0036 (-1.87)	-0.0029 (-1.54)	-0.0019 (-1.03)
	Buy-Sell	0.0077 (6.25)	0.0067 (5.61)	0.0059 (5.21)	0.0047 (4.37)		0.0079 (3.99)	0.0071 (3.46)	0.0062 (3.12)	0.0050 (2.72)