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The Anatomy of Anomalies in the Sweden Stock Market

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The Anatomy of Anomalies in the Sweden Stock Market

Xiang Gao [α] & Shouhao Li [σ]

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I. Introduction

a) Stock Price

Swedish stock prices we use in this study are from Rydqvist (2015), which are collected from a hard copy of the official quotation list of the Stockholm Stock Exchange kept by the National Library of Sweden. Prices are recorded from 1912 (the beginning of our sample). Stocks are traded in a call auction[1] followed by floor trading[2]. Initially, there are two auctions per day. The aftermarket operates between the first and the second auction, as well as after the second auction. From 1932, there is only one auction per day.

The quotation lists contain various transaction prices. Table 1 summarizes the evolution of data reporting. Throughout this period the registrar collects the high and low transaction prices from the auction, and from 1927-1978, the registrar further records the last transaction price. From 1920-1978, the high and low transaction prices from the aftermarket are also recorded. The maximum number of recorded transaction prices increases from initially two prices (high and low) to as many as ten prices in 1927-1931. In 1932, the registrar settles at a set of maximum five transaction prices

b) Stock returns

Our original sample covers stock transaction prices and best uncleared buy and sell limit order prices[3] from each day in 1912-1978. In total, there are 2,194,226 firm-day observations of 297 firms. Based on our research purpose, we only select one class share to our final sample if a firm has multiple classes of shares outstanding. This criterion reduces our observations to 1,877,602. Among them, there are 667,268 firm-days with at least one trading price, which only accounts for 36 percent. To augment valid observations reasonably, we compute the mean of the best buy and sell price in limit order book, if both exist, as a pretended transaction price, and we name this price "midpoint price". Then, each day the stock price is calculated as the equally weighted average of all transaction prices and the midpoint price. This procedure helps us increase the number of observations to 1,156,077, accounting for 62 percent of the sample. Stock returns are the main variables in our analysis. The realized return from period t - 1 to t is calculated as:

$$R_t = \frac{P_t \times S_t + D_t - P_{t-1}}{P_{t-1}} \qquad (1)$$

where P_t (P_{t-1}) is the price per share at time t (t-1), D_t is the cash dividend, and S_t is the split factor. The split factor equals 1 if there are no new shares distributions.

In this paper, we use stock returns at three levels: annually, monthly, and daily. For annually (monthly) returns, we use stock prices at the end of the year (month) as P_t, and we use stock prices at the beginning of the year (month) as P_{t-1}. If P_{t-1} is missing, we adopt a 10-day rule to calculate annually (monthly) returns, which is the same method as used by CRSP to handle missing data. Specifically, when P_{t-1} is missing, we search back for 10 business days to find the latest available stock price as a proxy for P_{t-1}.

We also adopt 10-day rule[4] to compute daily returns. After implementing 10-day rule, we get 3,447 annually returns, 45,087 monthly returns and 1,416,745 daily returns in our sample. We report the distribution of the number of business days that we have searched back in Panel A of Table 2. There are 1,289,769 daily returns calculated based on two consecutive business days' prices, which accounts for 91% of total available daily returns. 10-day rule helps us increase the number of observations by 10%.

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[1] A call auction market is different with a continuous market as follows: In a call auction market, an auction takes place at specified times; in a continuous market, orders are executed whenever a buy and sell order match up.

[2] Floor trading is continuous trading.

[3] The "best buy" is the highest uncleaned buy price, and the "best sell price" is the lowest uncleaned sell price.

[4] We have experimented with 1-day rule and 5-day rule as robust tests, which do not influence the findings in this study.

Since we adopt 10-day to calculate daily returns, according to random walk hypothesis, there is obviously heteroskedastic problem due to time-series gap when we use daily return as the dependent variable for regression analysis. To alleviate this concern, following Green and Rydqvist (1999), we adopt weighted least squares (WLS)[5] for all regression analyses that use daily return as the dependent variable. The weights in the WLS regressions are simply the reciprocal of square root of the calendar days that have elapsed between trades.

To value Sweden stock market performance, we calculate equally weighted average market returns from 1912 to 1978. Sweden nominal annual return is 10%, which is slightly lower than US 12% during 1926-1978 (Jones, 2002). The real annual return, calculated as the difference between nominal return and inflation rate[6], is 6.18%, while the real annual return in U.S. is 11%. More details about Sweden market performance are available in Table 3.

c) *Literature Review*

The seasonality of stock return is a long-standing object of interest along the chronicle of finance research not only in the U.S. but also across the world. Jennergren and Korsvold (1975) are the very first to investigate this topic for Scandinavian markets. They report positive and significant autocorrelation among Swedish stocks. Rozeff and Kinney (1976) present evidence of monthly seasonality for New York Stock Exchange from 1904-1974. Gultekin and Gultekin (1983) examine seasonality across major industrialized economies. They find evident January effect in most countries and April returns in U.K. Jones, Pearce, and Wilson (1987) extend the findings about January effect and confirm its existence long before income tax reform in 1918. Keim and Stambaugh (1984) use a fairly long sample of 55 years (1928-1983) to examine weekend effect. Negative Monday returns are detected for SP500 constituents stocks, exchange-traded stocks, and active OTC stocks. Condoyanni, O'Hanlon, and Ward (1987), comparing U.S. with other six economies, suggest that negative mean weekend returns are universal across these countries, rather than U.S. specific. Thaler (1987a) and Thaler (1987b) do a thorough investigation on literatures about seasonality anomalies, concluding the cause and behavior of those patterns need more research. Ariel (1987) then focus on monthly return of stock returns based on CRSP value weighted index and equally weighted index. His findings suggest that stock indices earn positive returns only within the beginning and first half of each month but zero average returns in latter halves. Jaffe and Westerfield (1989), following Ariel (1987), test monthly return patterns for countries other than U.S. They report only weak effect for those countries but there does exist significant "last day of the month" effect. Lakonishok and Smidt (1988) further use a sample of 90 years of Dow Jones Industrial Average (DJIA) and find evidence of persistently abnormal returns around the turn of the week, the turn of the month, the turn of the year, and holidays. Kim (1994) researches on holiday effects in three major stock markets of U.S.: NYSE, AMEX, and NASDAQ and find abnormally high returns before holidays. Also, holiday effects exist in U.K. and Japan, and they are independent of the holiday effect in the U.S. market. Ostermark (1989), focusing on Finland and Sweden, demonstrate that most of the stock prices in both markets are predictable with seasonal and even non-seasonal models. Cadsby and Ratner (1992) also provide evidences of senilities of stock returns for international economies but certain countries with their own specific institutional practices do not have such effects. Aggarwal and Rivoli (1989) complement the seasonality literature by researching the markets of four emerging economies: Hong Kong, Singapore, Malaysia, and Philippines. They find significant January effects and day-of-week effects across all the four markets. Agrawal and Tandon (1994) study eighteen countries for five seasonal patterns: the weekend, turn-of-the month, end-of-December, monthly, and Friday the 13th. They observe vivid effects of the first four but do not find the Friday the 13th to be supported internationally. Solnik and Bousquet (1990) find not only positive Monday effect but also negative Tuesday effect. Kohers, Kohers, Pandey, and Kohers (2004) claim that day-of-week effects have vanished in large developed economies. However, Doyle and Chen (2009) do not agree with that and confirm wandering day-of-week effects in that the effects are seen in form of interaction between year and weekday. Lasfer (1995) claim that the ex-day abnormal returns are no longer significant since the introduction of ICTA 1988, a tax reform which treats dividend and capital gain the same, in U.K. Later Green and Rydqvist (1999) study the ex-day effect of U.S. stock market by comparing it with Swedish lottery bonds, supporting the tax-based explanation. Corhay, Hawawini, and Michel (1987) test the risk premium from Fama-MacBeth estimate for seasonality for four exchanges: the NYSE, London, Paris, and Brussels. They report that in Belgium and France, risk premia are positive in January and negative the rest of the year. There is no January seasonal in the U.K. risk premium but a positive April seasonal and a negative average risk premium over the rest of the year. In the U.S., the pattern of risk-premium seasonality coincides with the pattern of stock-return seasonality. Both are positive and significant only in January.

[5] To control for cross-section correlation of stocks returns, we also have clustered standard errors at day-level, which does not influence the significance of our results.

[6] To control for cross-section correlation of stocks returns, we also have clustered standard errors at day-level, which does not influence the significance of our results.

II. The January Effect [7]

Rozeff and Kinney (1976) find that, during 1904-1974, NYSE equally weighted average monthly return in January is 3.5 percent, while other months average about 0.5 percent. So more than one-third of the annual return occurs in January alone. In this section, we will investigate this seasonal pattern in Sweden market.

We start from comparing the pooled average return of each month. Monthly average return is calculated from dummy variables regression:

$$R_{it} = \sum_{t=1}^{12} \beta_t \times D_t + \epsilon_{it}\,, \qquad (2)$$

where R_{it} is the monthly return, and D_t is the dummy variable indicating corresponding month. Since we force the intercept of the regression to be zero, the estimated t is actually month t's average return in statistical sense. To take care of cross sectional correlations among stocks returns, we cluster standard errors at month-level. The regression results are shown in Table 4. The average January return is higher than all other remaining months, and the return differences between January and other months, except July, are significant at the 1% level. The average July return is slightly lower than January, but the difference is not significant at any conventional level. The mean February-December return is 0.53%, 86% less than January return (3.77%). In Table 4, we also tabulate the average monthly return for U.S. market from 1945 to 1979, reported by Givoly and Ovadia (1983). The Swedish average January return is 3.77%, comparable to 4.36% of U.S. Table 4 clearly shows that Sweden has similar January effect to U.S.

The abnormal January return might be caused by window dressing strategy used by institutional investors near quarter end to improve the appearance of performance. To investigate this explanation, we have checked institutional investors' market weights in Sweden. The aggregate market cap to the whole market of pension fund, mutual fund, and insurance company is tiny at the beginning of the sample period. It increases form 1.50% in 1950 to 15.10% in 1979, still a very small portion of the whole market. Therefore, window dressing could not provide a satisfactory explanation for January abnormal return.

Since our whole sample period is subjected to capital gains taxation of stocks[8], the tax-loss selling theory might be one possible explanation for the January Effect. The argument is that the prices of stocks which have previously price drop will decline further in the latter months as owners sell off the shares to realize capital losses for tax purpose. Then, after the new year, loser stocks' prices bounce up in the absence of selling pressure, which causes the January Effect.

To value the tax-loss selling theory, we follow Reinganum (1982) to define a measure of potential tax-loss selling (PTS) as dividing the stock price of the last trading day of the year by the maximum stock price of the concurrent year. By construction, the tax-loss selling measure could not jump beyond the interval of [0, 1]. For example, if the price of a stock on December 31 equals 20 and the maximum price during this year is 25, the value of PTS would be 0.80 (= 20/25). The average PTS of the whole sample is 0.9. In each year t, stocks are ranked in ascending order according to PTS. Based on these rankings, firms are equally divided into three groups: the winner group (top 33%), the middle group, and the loser group (33%)[9]. The winner group's average PTS is 0.97, and the loser group's average PTS is 0.80.

Before we formally start our analysis based on PTS, it is important to stress the evolution of the number of firms in each portfolio, since Swedish market is less liquid during our sample period. Reporting the number of firms in each winner/loser portfolio could help us evaluate the reliability of our coming analysis. The related plot is provided in Figure 1. As the trading frequency on the market increases, the number of firms in each winner/loser portfolio also increases: from 5 in 1912 to around 30 in 1978. After 1917, each portfolio contains 15 or more firms, alleviating our concerns that there are too few firms in each group. Predicted by the tax-loss selling theory, loser stocks surfer significant selling pressure in December, which will cause sustained losses. However, such selling pressure will not occur to winner stocks. Figure 5 plots the pooled average daily return of both winner and loser portfolios around turn-of-year. It is clearly that the loser portfolio suffers constant loss from day -17 to day -5, but the return re-bounces dramatically in the beginning of the new year. However, for the winner portfolio, we do not observe such constant losses at the end of the prior year. This finding is compatible with the tax loss selling theory. In addition, from the whole sample, we find the sum of daily return from Day +1 to Day +4 is 1.77% (not tabulated), which accounts for 55% of the whole January

[7] In 1914, the outset of World War I, trading was suspended from August through October.

[8] Capital gains taxation of stocks begins in 1910. From 1910 to 1951, short-term capital gains as defined by a holding period of less than five years are taxed as ordinary income, while long-term capital gains are exempt. From 1952 to 1976, a portion π of short-term capital gains is taxed as ordinary income, and the portion depends on the holding period. From 1967---1976, 10% of the sales price of a security held more than five years is taxed as ordinary income. More details could be found in the Supplement of Rydqvist, Spizman, and Strebulaev (2012).

[9] One concern for this classification method is that, in some year, the PTS difference between winner group and loser group could be very small, which cannot efficiently differentiate those two groups. To address this concern, we also have used fixed cutoffs to form winner and loser portfolio. The winner portfolios are organized by stocks with PTS greater than 0.95, and the loser portfolios is formed by stocks with PTS smaller than 0.7. This experiment doesn't influence our finding in this section.

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return. This finding is similar to US that January peculiar return is mainly caused by excess returns at beginning several days.

One natural question related to our finding is whether investors could arbitrage against such January seasonal pattern: buy loser stocks at the end of December, hold to the new year, and then sell in January. As we mention before, the lower bound estimation of Swedish average transaction cost is 0.9% of trading price (the sum of brokerage commission and transfer tax), which is greater than any daily return at the beginning of the new year. If we further consider other transaction cost, such as financing cost and opportunity cost, it will substantially stop investors from arbitraging against such seasonal pattern.

III. The Weekend Effect

The Weekend Effect is another seasonal pattern that has been found in U.S. French (1980) studies the period of 1953-1977 and finds that the mean Monday return is negative for the full period (mean= -0.168%, t= -6.8) and the same for every sub-period of 5 years. The mean return is positive for all other days of the week, with Wednesday and Friday having the highest returns. Keim and Stambaugh (1984) have shown that the Weekend Effect holds for S&P Composite Index for period 1928-1982, and Lakonishhok and Smidt (1987) have found consistent negative Monday return by studying Dow Jones Industrial Average (DJIA) for the period 1897-1986. In this section, we will study the Swedish Weekend Effect.

We adopt WLS[10] regression method to calculate the pooled average return for each weekday. To exclude the influence of other weekdays, we abandon 10-day rule in this section. Only daily returns that are calculated from prices of two consecutive business days are included in this sub-sample. The number of total observations is 1,044,953. Following the calendar time hypothesis by French (1980), we expect Monday returns to be 2 or 3 times as large as other trading days, since the time between the close of trading on Friday and the close of trading on Monday is 2 or 3 calendar days[11] rather than the normal one day between other trading days. To control this difference between Monday's return and other weekday's return, we use the following regression function:

$$R_{it} = \sum_{t=1}^{12} \beta_t \times D_t K_{it} + \epsilon_{it}, \tag{3}$$

where R_{it} stock i's return on weekday t, D_t is the weekday dummy variable, and K_{it} is the number of calendar days that elapse between trade prices. For Monday, K equals to 2 or 3, depending on whether there is trading on Saturday[12]. For remaining weekdays, K equals one. Since we force the intercept of the regression to be zero, the estimated t is the average weekday return. Table 6 reports the pooled regression results for the whole sample period. The pooled regression results show that Monday's average return is significantly positive, which is different from the finding in U.S. Saturday's return is the highest among all weekdays. Following French (1980), we also have decomposed the whole sample period to decades (not tabulated). Comparing weekday returns during different sub-periods, we do not find any evidently constant weekday pattern. Table 6 also has compared weekday's return with the pooled average daily return (0.04%). Monday, Wednesday, Friday, and Saturday's returns are significantly greater than the average daily return, but Tuesday and Wednesday's returns are significantly lower than the pooled average. Due to the high volatility of daily return, we interpret such finding as occasional case, because, after controlling the calendar days intervals, there is no economic reason to consider any of these weekdays different from others.

IV. Momentum and Reversals

In previous literature, momentum and reversals are deemed as the evidence for the predictability of returns and against random walk hypothesis, the basis of efficient market hypothesis. Jegadeesh and Titman (1993) show that stock returns exhibit momentum behavior within 1-year horizon. DeBondt and Thaler (1985), Lee and Swaminathan (2000), and Jegadeesh and Titman (2001) document mid-term reversals for stock returns. Stocks that performed poorly in the past would perform better over the next 3 to 5 years than stocks that performed well in the past. In Barberis, Shleifer, and Vishny (1998), and Hong and Stein (1999), momentum occurs because traders are slow to revise their priors when new information arrives. Reversals occur when traders finally do adjust. In Daniel, Hirshleifer, and Subrahmanyam (1998), momentum occurs because traders overreact to prior information when new information confirms it. Reversals occur as the overreaction is corrected in the long run. In this section, we will investigate momentum and reversals in Sweden.

Following Jegadeesh and Titman (1993), at the beginning of each month t, we rank stocks in ascending order according to their past performance. Based on these rankings, three portfolios are formed[13]. Stocks

[10] We also experiment with clustering standard errors at day-level to mitigate the concern of cross-section correlation among stocks returns, which doesn't influence the significance of our results.

[11] Before 1960, it is 2 calendar days. After 1960, it is 3 calendar days.

[12] Saturday trading ends in 1960.

[13] Different with Jagadeesh and Titman (1993) in which they form decile portfolios, we form tercile portfolios since Swedish market is less liquid during our sample period, and decile portfolios will only contain too few stocks.

ranked in the top 33% constitute the winner portfolio, stocks in bottom 33% constitute the loser portfolio, and the remaining stocks constitute the middle portfolio. These portfolios are equally weighted. The (6, 6) momentum strategies is to form a portfolio based on past 6-month returns and hold the portfolio for 6 months. Following Jegadeesh and Titman (1993), one stock will be selected into the portfolio only if the monthly stock return is not missing in continuous 12 months (6 months before the forming day, and 6 months after forming day). However, only few stocks (usually less than 3) could satisfy this criterion during 1912-1917, so we start our sample from 1918 in this subsection.

To validify our analysis, we need to pay attention to the number of stocks in each winner/loser portfolio, since Swedish market is much less liquid than US during our sample period. If there are only few stocks in each portfolio, it might challenge our previous analysis. Figure 5 plots the evolution of the number of firms in each winner/loser portfolio in 1918-1978. In a sufficient long period (1918-1953), the number of firms in winner/loser portfolio fluctuates around 5, and it starts to increase to around 30 firms in 1970s. However, during our sample period, there are about 103 firms listed on the exchange each year. Thus, the number of firms in each of our portfolio only accounts for a small portion of the whole market, which might influence the confidence of our previous analysis.

Table 7 Panel A reports average monthly raw returns for winner- and loser-portfolio under four different strategies: (6,3), (6, 6), (6,9), and (6,12). Since investors are not allowed to short stocks on the exchange during our sample period, self-financing portfolios (long winner, short loser) are not applicable for our analysis. Instead, we report the average return difference between winner-portfolio and loser-portfolio. Comparing long portfolio returns in Sweden with US, we could find that Swedish long portfolio returns are only half of the U.S. ones. A possible explanation is that our sample includes periods of recession: The Great Depression of 1932-1934 and the World War II (1939-1945). Among these four strategies, winner-portfolio's return is greater than the loser portfolio's return only except (6,12) strategy. Thus, there is some evidence of momentum in Sweden. However, Swedish momentum is not as strong as U.S. Next, we analyze the extent to which the momentum of stocks with extreme rankings disappears or reverses. The analysis is similar to momentum strategy, except the time gap between when the past performance is measured and when the stocks are held is larger.

The (6, 12) momentum strategy is designed to measure returns in the 12-month period immediately after portfolio formation, while the (6, ~24, 12) strategy[14] is designed to measure returns in the 12-month period that begins 24 months after portfolio formation. This allows us to test whether momentum persists, reverses, or disappears in 24 months after a stock's past performance ranks in the top or bottom 33%. Table 7 Panel B presents the long portfolio return of reversal strategies. For reversal strategies, the return difference between winner-portfolio and loser-portfolio is not statistically different from zero under either strategy, which means that the momentum disappears, rather than reverses, in mid-term. However, we can see that the return of self-financing portfolio (long winner, short loser) is negative and significant different from zero under any one of four reversal strategies in U.S.: (6, ~12, 12), (6, ~24, 12), (6, ~36, 12), and (6, ~48, 12), which implies the reversal of momentum in intermediate horizon. All in all, stocks momentum questions the efficiency of Swedish market. In addition, different with US, the momentum disappears, rather than reverses, in intermediate horizon.

V. The Ex-day Effect

In this study, we also focus on the anomalies on the ex-day of rights offers, stock dividends, and stock splits. In this subsection, we review these three different methods used to distribute new shares. Stock dividends and stock splits are two similar methods, while the main difference is in accounting setting: stock dividends would increase share capital[15], but stock splits would not. There is no cash transaction involved in these two types of share distributions. However, different with stock splits and stock dividends, if shareholders want to execute the rights offer, they have to pay the firm offering price, in which cash transactions are involved. Along with cash transactions, financing costs (the cost to arrange a loan) might be an important market friction that influences investors decision. The previous literature also has studied the ex-day effects in U.S.: Eades, Hess, and Kim (1984) report positive anomalies on the ex-day of stock splits[16] and cash dividends; Smith (1977) shows positive but insignificant abnormal returns on the ex-right day of rights offers. In this subsection, we will focus on Swedish ex-day effect.

To estimate the average abnormal return on ex-right day, we use the sample of daily stock returns to run

[14] For simplicity, we will call such kind of strategy as "reversal strategy" in the remaining of this article.

[15] Share capital is defined as the product of par-value the number of shares.

[16] In this project, "stock splits" represent both stock dividends and stock splits.

the following WLS[17] regression for rights offers, stock splits, and cash dividends:

$$AR_{it} = b_1 I_N + b_2 I_s + b_3 I_D + \epsilon_{it}, \qquad (4)$$

where AR_{it} is the ex-day abnormal return estimated as the difference between the event day (day 0) return and the average daily return from day -60 to day -1, and independent variables (IN, IS, and ID) are three dummy variables indicating ex-right for rights offers, ex-right for stock splits, and ex-right for stock dividends. There are 343 rights offers and 389 stock splits with corresponding daily returns in our sample. The regression results are presented in Table 8 Panel A. Our regression results suggest that, in 1912-1978, there is a positive and highly significant abnormal return (1.298%) on the ex-right day for rights offers. It is much larger than 0.141%, the number reported by Smith (1977) for U.S. For the other event, stock splits, the abnormal return is also positive (1.311%) and strongly significant at 1% level, which is higher than 0.387% from Eades, Hess, and Kim (1984) for U.S. The abnormal return of the ex-dividend day is 0.722%, which is comparable with 0.568% (annualized from 0.142% by multiplying by four quarters in the year) reported by Eades, Hess, and Kim (1984).

Table 8 also has reported the lower bound estimation of the average transaction costs (0.9%) as the sum of brokerage commission and transfer tax. The transaction costs exclude investors from arbitraging against ex-dividend anomalies. The abnormal returns around rights offers and splits are significantly higher than the lower bound of transaction cost, which might imply arbitrage opportunities. However, as we mention before, the lower bound of transaction cost only considers brokerage commission and transfer tax, so it should be an optimistically biased estimation. The model proposed by Rydqvist[18] considers the fixed financial cost as an important cost that keeps investors from arbitraging against the anomalies around rights offers. However, there is no economic theory to explain the anomalies on the ex-right day of stock splits. For such anomalies in U.S., Eades, Hess, and Kim (1984) say "the results are quite surprising" and leave it as an open question.

Rydqvist model attributes the positive abnormal return on ex-right day of rights offers to a positive financing fee that represents a fixed cost to arrange a bank loan to purchase the new shares. When a firm offers shareholders right to purchase n new shares at price P_0, the condition to make long-term investors indifferent between selling the stock including the right at cum-price (P_{t-1}) and exercising the right and then selling the stock at expected ex-price $\hat{P}_t$ is that:

$$P_{t-1} = \hat{P}_t + n\hat{P}_t - nP_0 - c, \qquad (5)$$

where c represents fixed financing cost. Then we can write the split factor $S(c)$ that considers the fixed financing fee as:

$$S_t(c) = \frac{P_{t-1}}{\hat{P}_t} = \frac{P_{t-1}(1+n)}{P_{t-1}+nP_0+c}, \qquad (6)$$

Since the financing cost is a positive quantity, we must have $S_t(c) < S_t = \frac{P_{t-1}(1+n)}{P_{t-1}+nP_0}$, where S_t is the split factor without considering the fixed financing cost. For simplicity, we ignore the rare events that stock goes ex dividend on the same day as the distribution of rights. Then, the stock return over the distribution of rights using the standard split factors S_t is:

$$r_t = \frac{P_t S_t - P_{t-1}}{P_{t-1}}, \qquad (7)$$

However, suppose that the market uses the fee-adjusted split factor such that $P_t = P_{t-1}/S_t(c)$. Substitute this expression into the return equation:

$$AR_t = \frac{P_{t-1}(S_t/S_t(c))}{P_{t-1}} = \frac{S_t}{S_t(c)} - 1, \qquad (8)$$

A positive financing fee implies a positive abnormal return, and the abnormal return increases as the financing fee increase. We expect that, as the market efficiency improves, the fixed financing fee will decrease gradually, which is accompanied by the decrease of the abnormal returns on the ex-right day of rights offers. To study the time trend of the abnormal return on the ex-right day of rights offers and splits, we do the following regression:

$$AR_{it} = \alpha + \beta \times (year_{it} - 1912) + \epsilon_{it}, \qquad (9)$$

We normalize year by subtracting 1912 (the first year of our sample) as one independent variable. This design makes the estimated equal the predicted event's abnormal return in 1912, and the estimated equals yearly change of abnormal return in the linear model. Table 8 Panel $\hat{\beta}$ reports the estimation results for both rights offers and splits.

For rights offers, the estimated is negative, indicating that the abnormal return on ex-right day of rights offers decreases as time goes by. The predicted abnormal return decreases from 2.08% in 1912 to 0.628% in 1978. Combining the negative estimated with Rydqvist model, we can interpret the decreasing

[17] To control the cross-section correlation among stocks, we also experiment with clustering standard errors at day-level, which does not influence the significance of our estimates.

[18] We refer this model as Rydqvist model in the remaining of this article.

abnormal returns as the manifestation of the decrease of the fixed financing fee, implying the improvement of market efficiency. Although the linear regression model gives us a negative predicted, consistent with the prediction of Rydqvist model, it has an uncomfortable feature that it would predict that, after many years, the abnormal return around rights offers turns negative, meaning the fixed financing fee becomes negative. A more realistic model would predict the anomaly on rights offers keeps decreasing but never crosses zero. To address this limitation of the linear model, we adopt the non-linear power function: $AR_{it} = a \times (year_{it} - 1912)^b + \epsilon_{it}$. If the abnormal return on ex-right day of rights offers keeps decreasing but never crosses zero, we would expect the estimated magnitude controlling variable a to be positive, and the estimated power variable b negative. Our estimation results show that $\hat{a}$= 0.0398 ($p < 0.001$), and $\hat{b}$ = -0.327 ($p < 0.001$), consistent with our prediction. The estimated power function predicts that the abnormal return on the ex-right day of rights offers decreases from 3.98% (2.08% in the linear model) in 1912 to 1.01% (0.63% in the linear model) in 1978.

What surprises us is that the estimated $\hat{\beta}$ for stock splits is positive and strongly significant, implying that the predicted abnormal return keeps increasing. Although $\hat{\beta}$ is statistically significant, there is no economic theory supporting this finding.

To visualize the evolution of the abnormal return on the ex-right day of rights offers and splits, we plot the estimated regression lines in Figure 3 respectively, where the observations of abnormal return scatter around the estimated line. It is obvious to see the decreasing time trend of rights offers and the increasing time trend of splits in Figure 3. Another point we can learn from this figure is that rights offers cluster at both the beginning and end of our sample period. During the middle of sample period (1922-1952) only few rights offers are observed. However, for splits, most observations cluster at the second half of our sample period (1946-1977).

VI. Conclusion

In this study, we have studied the efficiency of the Swedish market for the January Effect, Weekend Effect, Ex-right Day Effect, and momentum and reversals. Similar to previous findings in U.S., we have found striking January effect and peculiar abnormal return on ex-right day for rights offers and splits. In addition, stock's return also exhibits momentum, but such momentum disappears, rather than reverses, in mid-term horizon. We also have observed that the anomaly on ex-right day for rights offers keeps decreasing. Combining such evolution of the anomaly with the Rydqvist model, it implies the decrease of fixed financing cost, which accompanies the improvement of market efficiency.

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A. Commission Fees and Transfer Tax

In this section, we will review the evolution of commission fees and transfer tax in Sweden. Based on the data provided by Kristian Rydqvist, we have plotted commission fees and transfer tax as percent of the transaction price in Figure 4. The brokerage commission fee roughly keeps increasing from 0.25% in 1910 to 0.90% in 1980. In addition, the transfer tax is stable at 0.30% in a long period from 1930-1979, and then it drops to zero in 1980. In this report, we take the sum of commission fees and transfer tax as the lower bound estimation of the transaction cost. The average of the estimation is 1%.

B. Split Factors

This this section, we will review how to calculate the split factors for stock dividends, stock splits, the combination of stock dividends and stock splits, and rights offers, which are the four events that we have focused in Section 4. Split factors are calculated as:

$$S = \frac{P^{cum}}{\hat{P}^{ex}}, \tag{10}$$

where Pcum is the stock price right before a new share distribution, and Pex is the expected stock price on the ex-day. The Pcum could be observed directly. However, to calculate split factors, we must estimate Pex.

B.1 Stock Splits

For an,1 stock split, the split factor is estimated as:

$$S = \frac{P^{cum}}{\hat{P}^{ex}} = \frac{P^{cum}}{P^{cum}/n} = n. \tag{11}$$

B.2 Stock Dividends

For an,1 stock dividends, the split factor is estimated as:

$$S = \frac{P^{cum}}{\hat{P}^{ex}} = \frac{P^{cum}}{P^{cum}/(1+n)} = 1 + n. \tag{12}$$

B.3 The Combination of Stock Splits and Stock Dividends

For a combination of n, 1stock splits and m, 1 stock dividends, the split factor is estimated as:

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$$S = \frac{P^{cum}}{\hat{P}^{ex}}$$

$$= \frac{P^{cum}}{P^{cum}/n(1+m)} \quad (13)$$

$$= n(1+m).$$

B.4 Rights offer

In rights offer, whether new shares are excluded from the following cash dividends will influence the calculation of split factors. For a n, 1 rights offer that is followed by 20 Krona cash dividends, the offer price is P0. If all shares (both new shares and older shares) can claim the following cash dividends, the splits factor is estimated as:

$$S = \frac{P^{cum}}{\hat{P}^{ex}}$$

$$= \frac{P^{cum}}{[P^{cum} + nP_0 - (n+1)D]/(1+n) + D} \quad (14)$$

$$= \frac{P^{cum}(1+n)}{P^{cum} + nP_0}.$$

If only old shares can claim on the following cash dividends, the split factor is estimated as:

$$S = \frac{P^{cum}}{\hat{P}^{ex}}$$

$$= \frac{P^{cum}}{[P + nP_0 - D]/(1+n) + D} \quad (15)$$

$$= \frac{P^{cum}(1+n)}{P^{cum} + nP_0 + nD}.$$

This table is provided by The Swedish Stock Market 1912-1978 (Rydqvist 2015). The table displays the transaction prices, which are recorded on the official quotation list, high, low, and last transaction prices from each auction, and high and low transaction prices from the aftermarket. In addition to transaction prices, the official quotation list contains the best uncleared buy and sell limit order price from each auction. The rightmost column states the maximum number of transaction prices that is recorded on a given day.

Table 1: Recorded Transaction Price

	First Auction			Between		Second Auction			After		Max
	High	Low	Last	High	Low	High	Low	Last	High	Low	
1912-1916	H	L	-	-	-	-	-	-	-	-	2
1917-1979	H	L	-	-	-	H	L	-	-	-	4
1920-1926	H	L	-	H	L	H	L	-	-	-	6
1927-1931	H	L	F	H	L	H	L	F	H	L	10
1932-1978	H	L	F	-	-	-	-	-	H	L	5

We adopt 10-day rule to calculate stock yearly, monthly, and daily return. Specifically, when P_{t-1} is missing, we search back for 10 business days to find the latest available stock price as a proxy for P_{t-1}. Panel A provides the distribution of the number of business days that we have searched back when we calculate stock return.

Table 2: The Number of Search Back Business Days in 10-day Rule

Panel A, Distribution of Searching Back Business Days for Daily Return		
Business Day	Frequency	Cumulative Percentage (%)
1	1,044,953	56
2	54,797	59
3	27,477	60
…	…	…
…	…	…
10	789	61
Total missing data	730,621	100
Total Sample	1877602	100
Panel B, Distribution of Searching Back Business Days for Monthly Return		
1	47,088	57
2	2,315	60
3	799	61
…	…	…
…	…	…
10	74	62.66
Total missing data	30,864	100
Total Sample		
Panel C, Distribution of Searching Back Business Days for Yearly Return		
1	3,855	56
2	0	56
3	133	58
…	…	…
…	…	…
10	21	62
Total missing data	2,659	100
Total Sample	6927	100

This table provides Sweden equal-weighted average daily, monthly, and yearly return in 1912-1978. It also reports the average daily and monthly return for all NYSE stocks in 1926-1978, which is calculated from CRSP data. The average annual return in US is 12%, which is provided by Jones (2002).

Table 3: Stock Returns

Equal-weighted Average Market Return in 1912-1978			
	Daily Return (%)	Monthly Return (%)	Yearly Return (%)
Mean	0.0431	0.774	10.99
Standard Error	0.0014	0.136	2.22
Number of Observations	1,146,981	51,784	4,268
NYSE (1926-1978)	0.073	1.197	14.01

This table reports Sweden average monthly return in 1912-1978, and the differences between January return and all other months returns. To control for cross-section correlation among stocks returns, we have clustered standard errors at month-level. The duster method increases the standard errors from 0.14% to the values that have been reported in the table. The last column in the table shows US average monthly return in 1945-1979, which is provided by Givoly and Ovadia (1983). *, **, *** represents significantly different from 0 at the 0.10, 0.05 and 0.01 levels using two-tailed Student's t test.

Table 4: Average Monthly Return

Month	Observations	Mean Return (%)	Difference from January Return (%)	Standard Error for the Difference	U.S. Mean Monthly Return from 1945-1979
January	4,279	3.77			
February	4,336	0.27	-3.51***	0.69	0.53
March	4,361	0.34	-3.44***	0.68	1.84
April	4,317	1.01	-2.77***	0.77	0.94
May	4,319	0.69	-3.09***	0.68	0
June	4,278	0.32	-3.46***	0.64	-0.34
July	4,189	2.67	-1.11	0.68	1.49
August	4,299	0.21	-3.57***	0.69	0.79
September	4,292	-0.78	-4.56***	0.63	-0.11
October	4,264	-0.36	-4.14***	0.74	0.14
November	4,306	0.10	-3.68***	0.71	2.24
December	4,508	1.06	-2.72***	0.62	2.17

Following Reinganum (1982), we have defined the potential tax-loss selling (PTS) as the quotient of the stock price on the last trading day of the year and the concurrent year maximum price. In each year *t,* stocks are ranked in ascending order according to PTS. Based on these rankings, three portfolios are formed. Stocks ranked in the top 33% constitute the winner portfolio, stocks in bottom 33% constitute the loser portfolio, and the remaining stocks constitute the middle portfolio. In this figure, we plot the turn-of-year daily returns for both the winner portfolio and loser portfolio.

Table 5: Daily Return around End-of-Year

	Day 1	Day 2	Day 3	Day 4	Day 5	Sum of daily returns from day 1 to day 5	Total month return	Sum of first 5 days' returns to total monthly return	Expected percentage
	Panel A, January								
Winner	0.621	0.593	0.407	0.174	0.119	1.914	3.948	48%	25%
Middle	0.584	0.494	0.309	0.201	0.255	1.843	4.283	43%	25%
Loser	0.614	0.318	0.381	0.408	0.269	1.99	4.654	43%	25%
	Panel B, Placebo Test for July								
Winner	0.188	0.147	0.124	0.18	0.263	0.902	3.117	29%	25%
Middle	0.237	0.155	0.192	0.244	0.209	1.037	3.911	27%	25%
Loser	0.211	0.222	0.248	0.3244	0.298	1.304	4.356	30%	25%

This table reports Swedish average weekday returns, standard errors, and number of observations for each weekday. Saturday trading ends in 1960. It also provides US average weekday returns in 1953-1977, which is reported by French (1980). We also have compared each weekday's return with the pooled average daily return. *, **, ***represents significantly different from 0 at the 0.10, 0.05 and 0.01 levels using two-tailed Student's t-test.

Table 6: Weekday Return

	Mean Weekday Return in 1912-1978 (%)					
	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
Sweden 1912-1978	0.0543	-0.013	0.0081	0.069	0.0541	0.0901
Standard Errors	0.0037	0.008	0.0089	0.0087	0.0084	0.0103
Difference with average daily return 0.04%	0.0143***	-0.0531***	-0.03199***	0.029***	0.0141*	0.0501***
Obs.	198,296	185,111	194,666	191 ,546	185,265	89,403
U.S. 1953-1977	-0.168	0.016	0.097	0.049	0.087	N/A

Following Jegadeesh and Titman (1993), at the beginning of each month *t,* stocks arc ranked in ascending order according to their past performance. Based on these rankings, three portfolios are formed. Stocks ranked in the top 33% constitute the winner portfolio, stocks in bottom 33% constitute the loser portfolio, and the remaining stocks constitute the middle portfolio. These portfolios are equally weighted. For example, (6, 6) strategies is that each month investors form a portfolio based on past 6-month returns, and hold the position for 6 months. The return of momentum strategy is reported in Panel A. To check whether the momentum reverses in mid-term, we also construct reversal strategies in Panel B. For example, the strategy (6, ~24, 12) selects stocks based on performance over the 6-month period that begins 31 months earlier and ends 25 months earlier. This table also presents US market momentum strategy returns, which is reported by Jegadeesh and Titman (1993 & 2001). *, **, ***represents significantly different from 0 at the 0.10, 0.05 and 0.01 levels using two-tailed Student's t-test.

Table 7: Momentum and Reversals

	Sweden in 1912-1978			U.S. in 1965-1989		
	Winner	Loser	Mean Return of Winner - Loser	Winner	Loser	Mean Return of Winner - Loser
Panel A, Momentum Strategy (in%)						
(6, 3) strategy	0.74***	0.47**	0.27**	1 .71***	0.87	0.84***
s.e.	0.15	0.2				
Average # of stocks in each portfolio	12	12				
(6, 3) strategy	0.71***	0.47**	0.24**	l.74***	0.79	0.95***
s.e.	0.15	0.2				
Average # of stocks in each portfolio	11	11				
(6, 3) strategy	0.71***	0.48***	0.23*	1.74***	0.72	1.02***
s.e.	0.16	0.2				
Average # of stocks in each portfolio	10	10				
(6, 3) strategy	0.71***	0.56***	0.15	1.66***	0.8	0.86***
s.e.	0.16	0.19				
Average # of stocks in each portfolio	9	9				
Panel B, Reversal Strategy (in %)						
						U.S. in 1965-1998
(6, ~12, 12) strategy	0.54***	068**	-0.13			-0.24***
s.e.	0.17	0.19				
Average # of stocks in each	9	9				

portfolio				
(6, ~24, 12) strategy	0.65***	0.64***	0.01	-0.26***
s.e.	0.184	0.18		
Average # of stocks in each portfolio	8	8		
(6, ~36, 12) strategy	0.76***	0.72***	0.04	-0.23***
s.e.	0.1 7	0.2		
Average # of stocks in each portfolio	7	7		
(6, ~48, 12) strategy	0.77	O.66	0.11	-0.31***
s.e.	0.18	0.19		
Average # of stocks in each portfolio	6	6		

This table reports abnormal returns on ex-right day for rights offers and ex-right day for stock splits in 1912-1978. It also reports the abnormal returns in US as comparisons. The US abnormal return on splits is reported by Eades, Hess, and Kim (1984), which are significant at 1% level. The abnormal return on rights offers is provided by Smith (1977), and the average is not statistically different from zero. *, **, *** represents significantly different from 0 at the 0.10, 0.05 and 0.01 levels using two-tailed Student's t-test.

Table 8: Ex-day Effect

Panel A, Whole sample estimation			
	Rights Offers (%)	Splits (%)	Dividend (%)
Sweden	1.298***	1.311***	0.722***
Standard Errors	0.17	0.191	0.0287
Obs.	270	389	4931
Sample	343	479	7627
The lower bound of average transaction cost	0.9	0.9	0.9
U.S.	0.141	0.387***	0.568***
Panel B, Year trend estimation			
Intercept	1.91***	-0.71	0.39***
Standard Errors	0.331	0.57	0.069
Slope of (*year* -1912)	-0.019**	0.039***	0.0085***
Standard Errors	0.0074	0.011	0.0016
Panel C, Year trend estimation, Power function of Rights Offers			
$AR_{it} = a \times (year_{it} - 1911)^{b} + \varepsilon_{it}$			
	Estimation	Standard Errors	
a	0.0398		
b	-0.327		

This figure plots the evolution of the number of firms in each PTS winner /loser portfolio during 1912-1978.

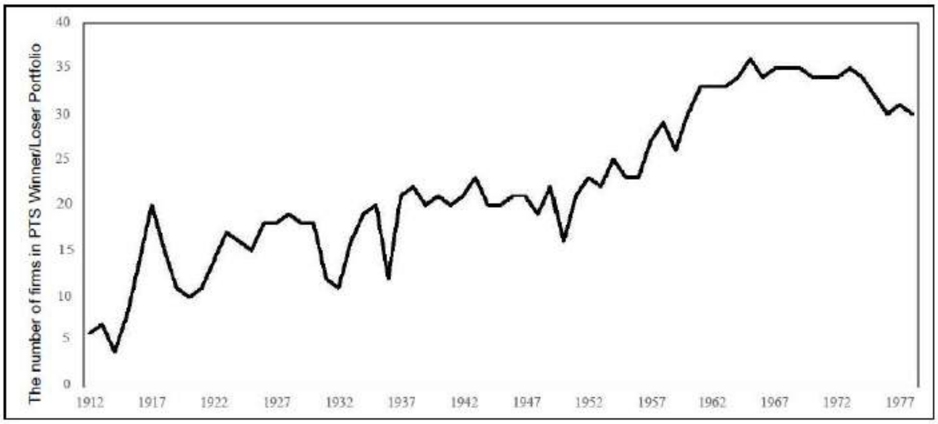


Figure 1: The Number of Firms in PTS Winner /Loser Portfolio

This figure plots the evolution of the number of firms in each winner/loser portfolio under (6,6) momentum strategy during 1918-1978.

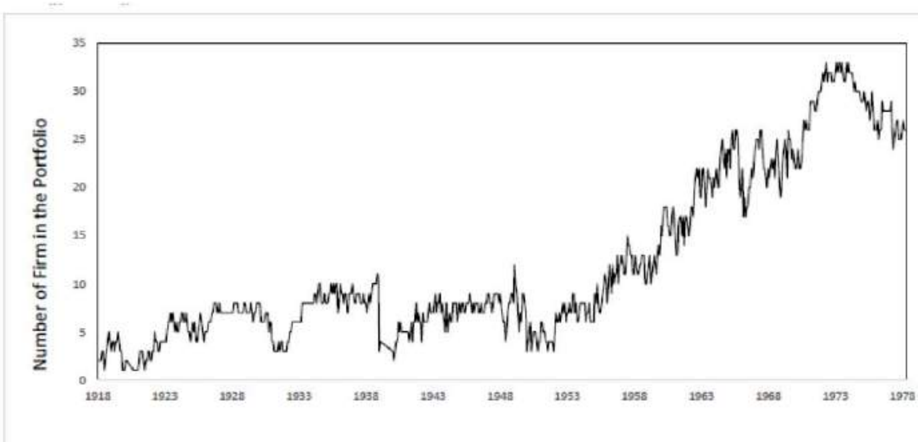
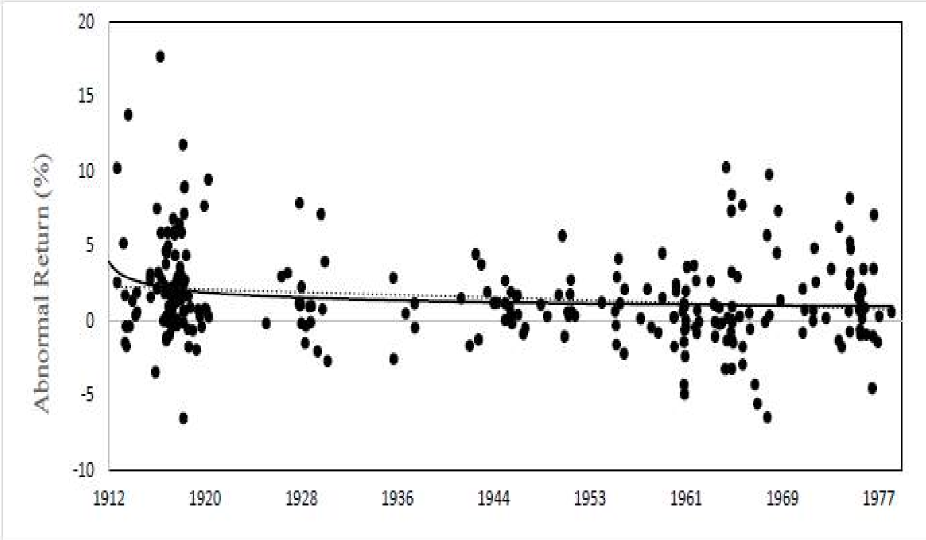
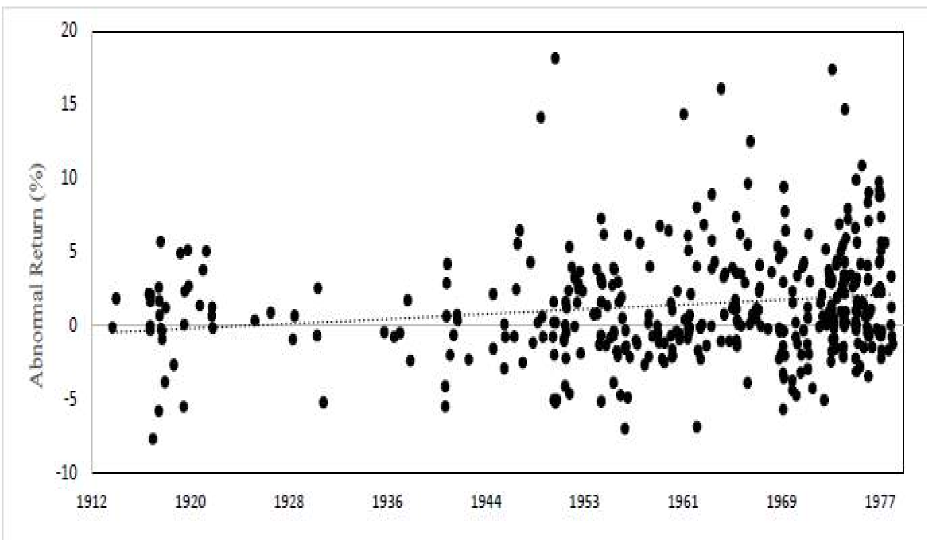


Figure 2: The Number of Firms in Winner /Loser Portfolio under (6, 6) Strategy

This figure plots the estimated regression line of Equation 9 for both rights offers and stock splits. The observed abnormal returns scatter around the regression linear. More details about the regression results could be found in Table 8.



(a) Rights



(b) Splits

The figure plots brokerage commission and transfer tax in percent of the transaction price, which is provided by Kristian Rydqvist. Brokerage commission is determined by the Stockholm Stock Exchange for all its members. In this report, we take the sum of commission fees and transfer tax as the lower bound estimation of the transaction costs.

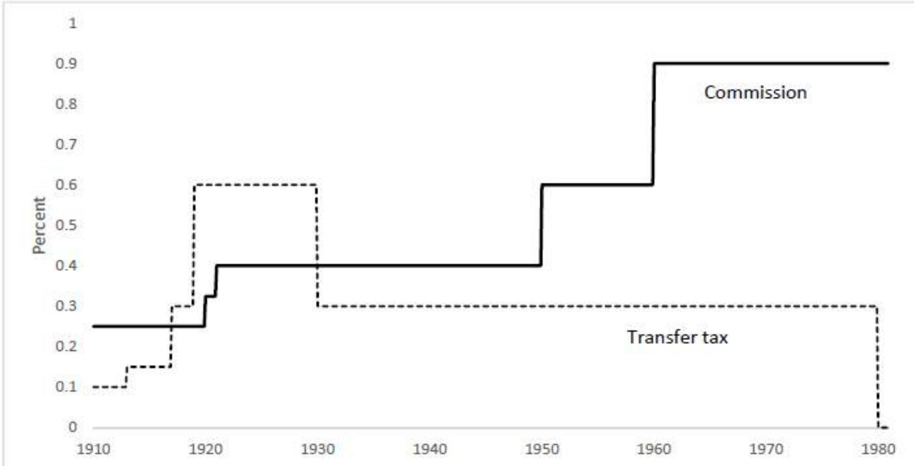


Figure 4: Brokerage Commission and Transfer Tax