Long Run Stock Returns: Evidence from Belgium 1838-2008

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Abstract

We investigate monthly returns of Belgian stocks listed on the Brussels Stock Exchange in the period 1838-2008. Our sample covers all stocks in the market over the entire period. While the equity premium is positive, the reward for equity risk is very volatile over time. Even in the long run equity investors frequently earned a negative return. Stock returns strongly depend on dividend income: real capital appreciation tends to be negative. There are no consistent differences between returns on small stocks and large stocks. We find some evidence that the equity premium is positively related to realized inflation.

Keywords: long run stock returns, equity premium, size effect, inflation, 19th and 20th centuries, Brussels stock exchange

1. Introduction

Economists and economic historians are becoming increasingly interested in historical stock return data, which can be used to investigate a variety of concepts such as market efficiency, asset pricing anomalies, the predictability of stock returns, the economic effects of technological and political changes, or the evolution of economic activity over time. In this study, we use a unique dataset to investigate monthly stock returns for the Brussels Stock Exchange (BSE) for the period 1838-2008. Our dataset is unique for several reasons. It is based on official quotation lists of the stock exchange and it takes into account *all* common stocks that were ever listed on the stock exchange during the period considered. This allows us to investigate the performance of the market as a whole in a consistent way over the 19th and 20th centuries. For all stocks we have complete information on end-of-the-month stock prices, dividends, ex-dividend day, number of stocks, (reverse) stock splits, bonus stocks, subscription rights and attribution rights. We can therefore calculate corrected monthly stock returns that include dividends, distinguish between capital appreciation returns and dividend income returns, and adjust stocks portfolios and their market cap weights month by month. We are not aware of any other study which is able to determine stock returns in a consistent way over such a long period, which considers the full market, and which consistently distinguishes between capital appreciation return and dividend income return.

From a historical perspective, the BSE is particularly interesting since it was one of the most important stock exchanges in the world during the late 19th and early 20th century. It developed early since Belgium was the first country to take part in the

industrial revolution on the European continent. At its peak in the late 1920s there were more than 1,000 companies and more than 1,500 stocks quoted at the BSE. The BSE had listed firms from a diverse range of industries including railroads, tramways, coal mining, steel, glass, banking, telecommunications and electricity. It was also a very international market, with listed companies from all over the world. Before World War I (WW I) Belgium belonged to the top of foreign direct investors (per capita), and a lot of foreign capital flowed to the BSE and was subsequently reinvested abroad (Chlepner, 1930).

We address four research questions. First, we investigate the evolution of risk-free and stock market returns in the past two centuries, distinguishing between capital income and dividend income. We find that in the long run capital appreciation returns were insufficient to compensate for inflation, while dividend income returns were substantial in all the decades of the period 1838-2008. They were also remarkably stable over time. Second, we analyze the premium of equity returns over risk-free returns. Other studies on the long-term performance of stocks have found evidence of a substantial equity premium relative to treasury bills and bonds, in the U.S. as well as in many other countries (e.g., Dimson et al., 2002; Jorion and Goetzmann, 1999; Le Bris and Hautcoeur, 2010; Siegel, 1994), which cannot be explained by standard asset pricing theories (Mehra and Prescott, 1985). We find that while the equity premium relative to bills is positive over the full period, the reward for equity risk was very volatile over time. As a result, even in the very long run equity investors sometimes earned a negative return. Third, we investigate whether small-capitalization stocks earned a higher return than large-capitalization stocks. While this 'size effect' has been observed in many modern markets (e.g., Banz, 1981; Dimson et al., 2002), there is also some evidence that it has largely disappeared in

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recent times (e.g., Dimson et al., 2004; Schwert, 2003). Our results suggest that there was no consistent size effect on the Brussels stock exchange, and there was a strong variation in the small stocks premium over time. Fourth, we find a negative relation between real stock returns and inflation. However, when the years during both world wars and their aftermath are excluded, the relation disappears. In addition, we find stocks outperforming nominally risk-free investments also in periods of high inflation.

2. Historical context

In the nineteenth century, Belgium was the first country in continental Europe to industrialize and to become a major player in the world market (Chlepner, 1943; Cameron, 1967). Funding of heavy industries was mainly provided by universal banks, which were actively involved in industrial finance and assisted in the creation of a large number of limited liability firms (e.g. Cameron, 1967; Kurgan-van Hentenryk, 1991). Before 1873 the banking sector was dominated by two banks: the Société Générale and the Banque de Belgique, and Belgian company law was based on the French Civil Code (1804) and the French Commercial Code (1807). Governmental authorization was required to establish a limited liability firm. Gaining such permission usually involved a cumbersome process, and the government could grant authorizations at its discretion. Additionally, the government could ban firms from trading on the stock exchange, restricting their access to capital markets and the composition of their equity and bond funding (Van Nieuwerburgh et al., 2006).

The Company Reform Act of 1873 abolished the requirement of governmental authorization to set up a limited liability firm. As might be expected, free incorporation triggered intensified market competition, which led to a strong increase in the number of

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firms (Chlepner, 1943). Deregulation and increased competition in the market also led to the creation of a large number of universal banks, but while the *Banque de Belgique* went bankrupt in the late 19th century, the *Société Générale* preserved its dominant position (Durviaux, 1947). By the turn of the twentieth century, Belgium combined an active stock market with a strongly developed banking sector (e.g., Van Overfelt et al., 2009). Brussels ranked as one of the four major international financial centers (Cassis, 2006). The abundance of capital enabled large investments abroad. Reversely, Belgium attracted a lot of capital from abroad, which was stimulated by the favorable tax treatment of investors.

The period between the world wars in Belgium was characterized by the devastating economic consequences of WW I, the long lasting crisis of the 1930s, and regulatory reforms of the financial system in 1934-1935. An important factor was the massive concentration in the banking sector. Because of the War and the German occupation, the capital basis of most firms, including banks, had weakened. Banks recapitalized through a process of concentration, and a system of multiple voting rights per share allowed the universal banks to control firms with minor equity stakes. This freed up much capital that the banks invested domestically and in the Belgian colony of Congo. The Belgian economy flourished in the years before the great depression. The financial reforms in 1934–1935 tightened government control over the stock exchange. Shares with multiple voting rights were forbidden and universal banks were obliged to separate their industrial activities from their banking activities.

After World War II (WW II) the Belgian economy went through a rather difficult period until 1958. After the independence of Congo in 1960 and especially after the

nationalization wave in 1967, an important part of the colonial firms were transformed into holding companies. Many of these firms disappeared from the stock exchange. This was the beginning of a steady trend of delisting by Belgian firms. During the oil crises in 1974 and 1979, traditional industries, such as coal mining, steel, shipbuilding, textiles, and glass, increasingly met with severe difficulties, and many firms disappeared from the stock market. The Cooreman-De Clercq law of 1982 introduced some measures to make equity investments more attractive. As in most other developed economies, the Brussels stock exchange witnessed an increase in stock market participation and a fast rate of growth of market capitalization in the 1980s and 1990s. However, this would not reverse the continual decline in Belgian listed firms. In 2001 the Brussels stock exchange merged with the Amsterdam and Paris stock exchanges to form the new Euronext exchange, which on its turn merged with the New York Stock Exchange in 2007.

*** Figure 1 about here ***

Figure 1 shows the number of Belgian common stocks listed on the Brussels stock exchange at the end of each year between 1835 and 2008[1]. There was a strong increase in listings at the end of the 19th century and in the 1920s. The number of listings peaked in 1929 at 892, and almost continuously declined afterwards, except for a temporary increase after WW II. This pattern reflects the 'great reversal' in financial market development over the 20th century which has been observed in a number of continental European countries including Belgium (Rajan and Zingales, 2003).

3. Data

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[1] The figure includes all common stocks issued by Belgian firms with main activity in Belgium or abroad and Belgian colonial firms as defined by SCOB. It does not include stocks issued by foreign firms.

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We consider the returns of Belgian common stocks traded on the spot market of the Brussels Stock Exchange, including all common stocks issued by Belgian firms irrespective of whether they have their main activities in Belgium or abroad. From 1871 there was also a forward market on the Brussels Stock Exchange, but before 1996 we only consider common stocks trade on the spot market, for several reasons. The spot market had a wider coverage because stocks listed on the forward market had to be listed on the spot market, but not vice versa. Furthermore, before 1871 there was no forward market reported at all, between 1871 and 1914 the forward market consisted nearly exclusively of foreign stocks, and from 1940 until 1950 the forward market was closed due to the Second World War. Since 1996 stocks were listed *either* on the spot market or the forward market, and we therefore consider both markets. We only consider *common stocks*, and ignore bonds and other instruments with mixed characteristics.

The data on stock returns were taken from the SCOB-database which includes end-of-the-month stock prices, dividends, interests, ex-dividend day and the number of stocks for all stocks ever quoted on the Brussels Stock Exchange. If a stock was not traded on the last day of a month, the previous price was used. Based on these data we calculated monthly market cap weighted total return which include net dividends. All dividends are reinvested in the ex-dividend month, and all returns were adjusted for (reverse) stock splits, bonus stocks, subscription rights and attribution rights. The stock portfolio and the weights based on market capitalization were adjusted each month. Market capitalization is based on the number of shares 'admitted at the official quotation list'. This number may be smaller than the total number of shares issued, but for most of

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the period considered in this study there are no data available on the total number of shares.

The risk-free return (RF) is based on the open market discount rate for commercial paper (1838-1940) and the interest rate on Belgian Treasury Bills (1940-2008). These rates were collected from various sources. For 1832-1918, the commercial paper rate was taken from the official quotation lists of the Antwerp Stock Exchange (where it was published on a daily basis until 1883) and from the newspapers 'Journal du Commerce d'Anvers, 'L'Avenir', 'Moniteur des Intérêts Matériels' and 'Het Handelsblad'. For 1919-1940, our source is the National Bank of Belgium. The Treasury Bill rates were compiled from Vanheurck (1954) for 1940-45, Baudhuin (1958) and Homer and Sylla (1991) for 1945-57, the National Bank of Belgium for 1957-1991, and the financial newspaper 'De Financieel-Economische Tijd/De Tijd' for 1991-2008.

Since we focus on real returns, all nominal returns are deflated in each month using the relative change in the consumer price index (*CPI*). The formula is 1 + *nominal return* divided by 1 + *CPI* minus 1. Until 1919 consumer price levels were taken from Michotte (1937) as extended by Van De Velde (1943). From 1920 onwards, we use consumer price data from the Ministry of Economic Affairs.[2]

*** Figure 2 about here ***

4. Results

4.1. Stock returns

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[2] Since the official price index was unreliable during World War II, for this period we use a weighted average of the official price index (75%) and a black market index (25%) (source: National Bank of Belgium).

Figure 2 shows the cumulative real risk-free return and equity return (logarithmic scale) from January 1838 until December 2008. The indices are set at one in December 1837 and are calculated in each month t as $RI_t = RI_{t-1} \times (1+R_t)$ where R_t are monthly returns, either of the equity portfolio or the risk-free investment over the period considered. Not surprisingly equity investments performed much better than risk-free investments. An equity investment of 1 Belgian franc (BEF) at the start of 1838 would have earned 133 BEF by the end of 2008, while risk-free investments would have earned only 3 BEF. Risk-free investments beat inflation before WW I, but they strongly declined in value during the world wars (see the shaded periods in Figure 2): an investment at the risk-free rate that started in 1838 would have earned a negative real return for a long time after WW II.

*** Table 1 about here ***

Table 1 reports the mean and standard deviation of annual stock returns for each decade of the 1838-2008 period, and distinguishes between capital appreciation returns and dividend income returns. We use end-of-December return indices to compute annual returns. The arithmetic mean return for M returns is given by:

$$\overline{R}_A = \frac{1}{M}\sum_{t=1}^{M} R_t \ .$$

The geometric mean return for M returns is given by:

$$\overline{R}_G = \left[\prod_{t=1}^{M}(1+R_t)\right]^{\frac{1}{M}} - 1.$$

The standard deviation σ_R of M returns is calculated as:

$$\sigma_R = \sqrt{\frac{1}{M-1} \sum_{t=1}^{M} \left(R_t - \overline{R}_A \right)^2} \, .$$

Consistent with evidence for other countries (e.g. Acheson et al., 2009; Dimson et al., 2002; Grossman, 2002; Le Bris and Hautcœur, 2010; Siegel, 1992, 1994) we find that stocks generally earned positive real returns for investors. The overall arithmetic mean return is 5.00% while the geometric mean is 2.90%. The only decades with a negative (geometric mean) return were the 1840s (with a financial crisis in the wake of the 1848 revolution in France), the 1910s (WW I), the 1930s (the Great Depression), the 1970s (the oil crises) and the years 2000 (the high-tech bubble and the subprime crisis). Interestingly, the standard deviation of stock returns was quite low before WW I. Especially the 1860s (5.28%) and the 1890s (6.90%) were characterized by relatively stable stock returns. In the UK, the standard deviation of stock returns was also lower in the 19th century than in the 20th century (Acheson et al., 2009; Grossman, 2002).

Studies on historical stock returns often need to rely on capital appreciation returns when there are no reliable data on dividend income available. However, as Acheson et al. (2009) demonstrate, this may seriously bias results. Since we have complete information on the dividends paid and the ex-dividend date for all the stocks in our sample, we can take into account both capital appreciation return and dividend income return. Table 1 shows that over the whole period 1838-2008 real capital appreciation returns were insufficient to compensate for inflation. This result holds for the pre-WW I period, the interwar period, the post-WW II period, as well as the two decades of the world wars. Real dividend income return on the other hand was positive in *all* decades of the period 1838-2008. It was also remarkably stable over time, ranging

between 2.09% in the 1940s and 5.48% in the 1970s. While dividends were fairly low in the last two decades of the 20th century, over the full period there has been no clear trend towards lower (or higher) dividends. These findings show that it is essential to take into account dividend income when considering long run stock returns.

*** Table 2 about here ***

4.2. The equity premium

Since Mehra and Prescott (1985) found the observed difference between equity returns and the risk-free return in the US to be much higher than predicted by general equilibrium models, an extensive literature has investigated the so-called 'equity premium puzzle'. A number of studies based on historical data for the 20th century have found evidence of a substantial equity premium relative to treasury bills and bonds, in the U.S. as well as in other countries (e.g., Dimson et al., 2002; Jorion and Goetzmann, 1999; Siegel, 1992). For example, Dimson et al. (2002) find an equity premium compared to bills which ranges between 1.8% and 7.4% for 17 countries over the entire 20th century. Results for the 19th century are mixed. Siegel (1992) finds for the US a premium compared to bonds of only 0.6% in the period 1802-1870, and of 3.5% in the period 1871-1921. For France, Le Bris and Hautcœur (2010) find in the period 1854-1913 a premium of 2.25% compared to bills, while Ye and Turner (2010) find for the UK in the period 1825-1913 a premium of 3.24%.[3]

Table 2 report the historical equity premium in Belgium for each decade of the period 1838-2008. The premium is calculated as the (annualized) geometric mean difference between the all stocks return and the risk-free return. The formula is 1 + *equity*

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[3] All reported figures are geometric mean, annualized (historical) equity premiums.

return divided by 1 + *risk-free return*, minus 1. The equity premium for the full period is

2.26%. For the periods before and after the world wars we find a lower equity premium.

The average equity premium was 1.04% before WW I, 1.98% after WW II and 1.50%

between the wars. However, the interwar premium of 1.50% masks a huge different

between the 1920s, when the premium was 11.5%, and the 1930s, when it was strongly

negative at minus 9.21%. Other decades with a negative equity premium were the 1840s

(a period of deflation), the 1970s, and the 2000s, when the Belgian stock market was hit

hard by the high-tech bubble and the subprime crisis. Table 2 also includes the Sharpe

ratio as a measure of the risk reward for equity investors. The ratio, which is computed by

dividing the arithmetic mean excess stock return by its standard deviation, varies strongly

over time.

Findings that stocks on average earned a substantial premium over bills and bonds

have often been interpreted as evidence that stocks are always good investments in the

long run. However, the results in Table 2 show that the equity premium was often

negative, and the reward for equity risk was very volatile over time. It is therefore

possible that in some periods even (very) long run equity investors earned negative

returns relative to bills and bonds. Table 3 reports statistics on rolling period cumulative

returns of risk-free investments and investments in the all stocks portfolio for 1-, 10-, 20-,

30- and 40-year investment horizons. The excess return is the difference between the all

stocks return and the risk-free return. Monthly data are used to compute holding period

returns. The return of an investment starting in month *t* for a *M* months period equals:

$$R_t^M = \prod_{j=0}^{M-1} R_{t+j}$$

*** Table 3 about here ***

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The mean return for a one year investment in stocks is 5.02%, which is 3.85% higher than the risk-free return. However, almost half of the time one year equity investments generated a lower return than risk-free investments. Not surprisingly, the percentage of months with a positive excess return increases as the holding period increases. With a 10 year investment horizon, stocks beat risk-free investments in 77.70% of the months. When investors held their stocks for 40 years, they beat risk-free investments in 99.87% of the months. A positive equity premium does not necessarily imply a positive equity return, since risk-free returns could be more negative than equity returns. As reported in Table 3, even over a 40-year horizon equity investments sometimes yielded a negative real return: investors who held their stocks for 40 years earned a negative real return in 13.03% of the months.

*** Figure 3 about here ***

Figure 3 shows the evolution of rolling-period annualized returns for 10- and 20-year investment horizons over the period 1838-2008. Investors who held their stocks for 10 years earned a negative return if they invested in 1838-40, 1906-1916, most of the years between 1924 and 1942, 1956-1958, the second half of the 1960s, the early 1970s, and 1999. 10-year equity investments were beaten by risk-free investments starting in the periods 1838-1842, 1873-1878, 1881-1882, 1907, 1924-1930, 1956-1960 and 1968-1974. For a 20-year investment horizon, stock returns were negative for investments starting between 1897 and 1903, most of the time between 1905 and 1916 and between 1923 and 1931, and between 1955 and 1963. The equity premium of 20-year equity investments was negative when started in 1928-1929, 1955-1965 and in 1989. Combined these results

suggest that while stocks almost always beat risk-free investments in the very long run, they still may earn negative returns over very long periods of time.

4.3. Does size matter?

Since Banz (1981) found that small-capitalization stocks earned a higher risk-adjusted return than large-capitalization stocks on the New York Stock Exchange between 1936 and 1975, the size effect has been observed in many other markets (e.g., Dimson et al., 2002). However, there is some evidence that the size effect has largely disappeared in recent times (e.g., Dimson et al., 2004; Schwert, 2003). This raises the question whether the size effect was perhaps a phenomenon that appeared by chance, and only existed for a certain period of time. An alternative explanation for the disappearing size effect would be that there always has been a size anomaly in the past, but this anomaly has been arbitraged away since it was discovered (e.g., Schwert, 2003). An obvious way to address this issue is to investigate whether there was already a size effect in periods before the effect was discovered. If the size effect existed in earlier periods, it is unlikely that it would have appeared in modern samples by chance or due to "data snooping". Ye and Turner (2009) and Grossman and Shore (2006) investigate the size effect in stock returns in the UK before WW I. Grossman and Shore also consider CRSP data covering the period 1926-1999. While Grossman and Shore find a smooth and relatively monotonic relationship between size and returns for their US data, they find no clear relationship between size and returns in the UK during the period 1870-1913, except for extremely small stocks which have much higher returns than other stocks. Ye and Turner (2009) on the other hand find a significant size effect for stocks listed on the London Stock Exchange between 1825 and 1870. As Ye and Turner point out, one

explanation for the difference between their results and the results of Grossman and Shore could be that the performance of small stocks follows a cyclical pattern and hence the size effect varies over time. Consistent with this argument, they find that the size effect in their data is much stronger after 1848 than before.

As a first look we measure the small stocks premium by the arithmetic mean return difference between large stocks and small stocks. The return for large stocks is based on the market cap weighted portfolio of the 20 stocks with the largest market cap. The small stocks return is based the market cap weighted portfolio of the 20% smallest stocks based on market cap. Again, the portfolios were adjusted each month.

*** Figure 4 about here ***

Over the full period 1838-2008 the overall small stocks premium is only 0.64%, which suggests that there was no consistent size effect on the Brussels stock exchange. Figure 4 shows the evolution of the relative performance of small stocks over large stocks in the period 1838-2008, which is measured by the cumulative return index of small stocks over the cumulative return over large stocks. Whenever small stocks outperform large stocks, the relative performance line will increase. Moreover, the reader can easily gauge the relative performance over any desired period: whenever the line is higher at the end point than at the starting point of the period small stocks outperform. The figure shows a strong variation in the small stocks premium over time. Furthermore, periods in which the small stocks premium increases (e.g., WW I, the 1930s) are typically followed by periods in which it decreases again. This raises strong doubts about the existence of any persistent size effect over time.

4.4. Stock returns and inflation

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We have shown that on average equity investments outperform cash investments. At the same time, the statistics clearly illustrate the risks involved even over long periods of time (see Table 2). Of course, the analysis in these tables is unconditional in the sense that we lump together all the potential months regardless of their economic environment. It may be the case that there are periods in which the economic constellation is particularly harmful or beneficial for the excess return on equity investments. Although many state variables could be considered to study this issue, we focus on inflation in this section for several reasons. First, there is a general belief that equity investments are good inflation hedges. This follows from extending Fisher's hypothesis that the expected return on an asset can be decomposed into its expected real return and expected inflation. The two components are assumed to be mutually independent (Fisher, 1930; Fama and Schwert, 1977). Moreover, in contrast to bonds or bills, stocks are claims on real cash flows and should therefore protect the investor against money erosion. It is therefore expected that during periods of high inflation stocks would strongly outperform a nominally risk-free investment. On the other hand, during deflationary periods stocks would perform relatively bad. As such, it is interesting to look at the relative performance of stock returns in periods with different inflationary experience.

Second, the empirically literature has surprisingly found stock returns to be negatively related both to expected and unexpected inflation (e.g. Jaffe and Mandelker, 1976; Nelson, 1976; Fama and Schwert, 1977). The debate in the literature to explain this counter intuitive result has juxtaposed the proxy hypothesis to the inflation or money illusion hypothesis. The proxy hypothesis (Fama, 1981) states that high expected inflation is related to future economic hardships. Likewise, stock prices also anticipate

lower future cash flows, implying negative returns. Both relations translate in a negative correlation (but no causation) between inflation and stock returns. Alternatively, it may be that aggregate risk aversion varies with news about expected inflation. Brandt and Wang (2003) find some evidence that increasing inflation makes investors more risk averse. In periods with increasing inflationary expectations the increased risk premia would drive stock prices down. While both explanations are consistent with rational asset pricing, the inflation illusion hypothesis on the other hand assumes that investors incorrectly discount future real cash flows using nominal discount rates (Modigliani and Cohn, 1979). When expected inflation is high, the higher discount rates are not compensated by higher (nominal) cash flows, which also results in lower stock prices. The negative relation between inflation and stock returns is therefore the result of mispricing.

Although the debate is relatively old, it still goes on in recent research. For instance, using post WW II data, Bekaert and Engstrom (2010) show that although there is some evidence for the proxy hypothesis, it is not able to explain a significant amount of the covariation between inflation and stock returns. The inflation illusion hypothesis fares even worse. Instead, the largest part of the covariation is due to variation in the expected risk premia for equity investments. These premia would increase in periods of high expected inflation and low expected economic growth (stagflation). In contrast, Campbell and Vuolteenaho (2004) using a similar VAR setup but including data going back to 1926 dismiss the rational explanations in favor of the inflation illusion hypothesis. Because periods of high inflation and deflation occur very infrequently, and all variables involved in the analysis are quite persistent, it seems that the data period studied is crucial for the

results obtained. We therefore arrive at the final reason we focus on inflation: its data availability over a long period of time.

Figure 5 about here

As can be seen in the Figure 5 we have very different inflationary periods in our dataset. This also follows from the average inflation rates by decade are reported in Table 2. On average, annual inflation is 4% (arithmetic mean) with a standard deviation of 14%. However, these statistics differ strongly across subperiods. In the pre WW I period, inflation is hardly present on average (0.3% per year, arithmetically). However, the standard deviation of 5.4% points to relatively high volatility. It is therefore not surprising that in this period we observe both years with high inflation, alternating with years of negative deflation. In contrast, in the post WW II period there are only four years with negative inflation, the last of which is 1960. With a standard deviation of 3.8%, inflation is also less volatile in this period. However, average inflation is higher (3.3%). Inflation is also somewhat more persistent in the post WW II period than in the pre WW I period: the first order serial correlation coefficients are 0.28 versus 0.17 respectively. During the first half of the 20th century, both world wars stand out as periods with very high inflation. Monetary overhang is (partly) eliminated after each war. Inflation in the 1920s-1930s is also particularly volatile with the depreciation, the subsequent devaluation and then stabilization of the Belgian franc in 1926-1927 (Chlepner, 1930; Van der Wee and Tavernier, 1975) which was followed by the financial crisis of 1929 and the depression of the early 1930s.

Figure 6 about here

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As a first step to analyze the relationship between asset returns and inflation, we plot annual real returns versus annual CPI inflation in Figure 5. We add the OLS fitted line to these scatter plots. When an asset provides protection against inflation, its real return should be unrelated to inflation and a flat line is expected. Unsurprisingly, from panel A it is clear that a cash investment is a bad hedge against inflation. However, the OLS regression also has a negative slope for equities (panel B), which is consistent with the US literature reported above. To a large extent this is due to some world war years when high inflation coincided with very negative real stock returns. The observation of 1919 with an inflation of -38% and a real stock return of 106% also contributes to the negative relation. Arguably, world war events and their aftermaths have dramatically affected both economic uncertainty regarding future real cash flows and inflationary developments. As conjectured by the proxy hypothesis, it would not be reasonable to attribute the negative effect on stock returns only to inflation.[4] Omitting the world war years and 1919 indeed reduces the absolute value of the negative slope and eliminates its statistical significance (see panel A of Table 4). Of course, a richer analysis taking into account measures of economic activity and/or economic uncertainty besides inflation is needed to enable more conclusive results.

Table 4 about here

Inflation clearly has a negative effect on cash returns and to some extent also on equity returns. To answer whether stock returns outperform cash investments regardless the inflationary environment, we also regress stock returns in excess of the risk-free

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[4] Alternatively, it is also plausible that during these war periods with high inflation risk aversion would have increased, implying negative stock prices reactions.

return onto CPI inflation. Results are shown in Table 4 (panel B). We find some evidence that the equity premium is positively related to realized inflation, although the slope coefficient is only statistically significant when the world war years and 1919 are omitted.

Figure 7 about here

An additional way to illustrate the relation between return and inflation is provided in Figure 7. We sort all years from 1838 to 2007 based on their realized inflation rate and group years into quartiles. We then compute the performance of both the stock market and the risk-free asset over horizons ranging from one to five years. The bars in Figure 6 indicate for each investment horizon (indicated on the horizontal axis) average annualized return for each quartile. The top panel presents results for the real equity return, the middle panel for the real risk-free return, and the bottom panel for the equity premium. The latter is simply computed as the difference between the annualized equity return and the annualized risk-free return. The top and middle panels clearly indicate the negative relation between returns and realized inflation, although the inflation impact drops off over longer horizons. The bottom panel shows a weak positive relation between the excess return on stocks and inflation. The relation is clearly not monotonous across quartiles, but the excess returns following extremely low inflation (quartile 1) are always lower than excess returns after extremely high inflation (quartile 4).

5. Conclusions

In this study we have used a unique dataset of monthly stock returns on common stocks that were listed on the Brussels stock exchange to investigate long run stock

returns in the period 1838-2008. Our dataset allows us to determine stock returns in a consistent way over 171 year, to consider the full market, and to consistently distinguish between capital appreciation return and dividend income return. We find that in the very long run capital appreciation returns were insufficient to compensate for inflation, but real dividend income returns were consistently high and remarkably stable over time. Our findings suggest that equity investments were not always good investments in the long run. The equity premium is on average positive, but it was also frequently negative. While equities almost always beat risk-free investments in the very long run, the real long-term return on equity was frequently negative. Our results also raise doubts about the existence of a durable size-effect over time. Consistent with most of the literature, we also find a negative relation between real stock returns and inflation. However, this relation is to a large extent driven by the years during and immediately after the world wars. This seems to give more credence to the proxy hypothesis or to time varying risk aversion linked to inflation expectations, but more formal analysis is needed to arrive at firm conclusions. In any case, the equity risk premium is unrelated to inflation. However when war times are excluded, there seems to be a significantly positive relation. This implies that stocks will outperform nominally risk-free investments in periods of high inflation.

It should be noted that this paper is still a work in progress. In a next version we will elaborate the analyses in several ways:

- In the current version of the paper risk-free returns are based on bills. As an alternative measure we will consider the return on government bonds.

- We will correct for survivorship bias: stock returns may be overestimated if a firm went bankrupt. Uniquely, for most stocks in our sample we have information which allows us to determine whether a stock was delisted because of bankruptcy, merger or any other reason, which allows us to incorporate the appropriate return at the time of delisting. We are not aware of any other study based on historical data which has this information available to the same extent as we have.

- The analyses for the size effect and the relation between returns and inflation are preliminary and will be developed in a next version of the paper.

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Table 1: Stock returns

Period	All stocks return (arithmetic mean)	All stocks return (geometric mean)	All stocks standard deviation	Capital appreciation return (geometric mean)	Dividend income return (geometric mean)
1840-1849	0.30%	-1.38%	18.08%	-4.15%	2.89%
1850-1859	10.70%	9.79%	14.97%	4.95%	4.61%
1860-1869	2.54%	2.42%	5.28%	-2.62%	5.17%
1870-1879	7.58%	6.81%	13.71%	2.16%	4.55%
1880-1889	5.93%	5.48%	10.55%	1.39%	4.03%
1890-1899	7.18%	6.98%	6.90%	2.30%	4.57%
1900-1909	3.88%	2.85%	15.39%	-1.47%	4.38%
1910-1919	-1.90%	-7.86%	41.58%	-10.40%	2.83%
1920-1929	10.26%	6.96%	27.22%	3.16%	3.69%
1930-1939	-4.13%	-6.38%	23.32%	-9.79%	3.78%
1940-1949	4.07%	0.13%	30.64%	-1.92%	2.09%
1950-1959	10.69%	9.32%	18.20%	4.87%	4.24%
1960-1969	1.61%	0.73%	13.97%	-3.17%	4.02%
1970-1979	0.04%	-1.21%	15.60%	-6.12%	5.23%
1980-1989	17.78%	15.76%	22.34%	9.75%	5.48%
1990-1999	11.05%	9.19%	21.04%	6.30%	2.72%
2000-2008	-0.19%	-5.25%	29.53%	-7.60%	2.54%
1838-1913	4.80%	4.03%	12.53%	-0.20%	4.24%
1919-1939	7.99%	3.58%	33.74%	-0.11%	3.69%
1946-2008	6.26%	3.90%	21.13%	-0.11%	4.01%
1838-2008	5.00%	2.90%	20.88%	-0.98%	3.91%

Table 2: The equity premium

Period	Equity premium (geometric mean)	Risk-free return (arithmetic mean)	Inflation (arithmetic mean)	Sharpe ratio
1840-1849	-5.47%	4.53%	-0.22%	-0.21
1850-1859	7.65%	2.22%	0.85%	0.65
1860-1869	0.11%	2.41%	0.88%	0.31
1870-1879	3.37%	3.41%	0.08%	0.30
1880-1889	0.32%	5.22%	-1.72%	0.06
1890-1899	3.59%	3.30%	-0.89%	0.62
1900-1909	1.30%	1.73%	1.60%	0.19
1910-1919	2.99%	-6.40%	20.83%	0.32
1920-1929	11.15%	-2.99%	9.69%	0.46
1930-1939	-9.21%	3.33%	-0.60%	-0.28
1940-1949	11.04%	-7.04%	16.54%	0.33
1950-1959	9.92%	-0.50%	2.07%	0.59
1960-1969	-0.44%	1.18%	2.78%	0.03
1970-1979	-1.27%	0.12%	7.20%	-0.005
1980-1989	9.30%	5.92%	4.79%	0.52
1990-1999	4.93%	4.09%	2.09%	0.32
2000-2008	-6.11%	0.91%	2.26%	-0.37
1838-1913	1.04%	3.10%	0.29%	0.14.
1919-1939	1.50%	3.27%	2.52%	0.16
1946-2008	1.98%	1.96%	3.35%	0.21
1838-2008	2.26%	1.27%	4.01%	0.19

Table 3: Returns for different holding periods

	Mean	St. Dev.	Minimum	Maximum	% Positive
1-year rolling period returns					
Risk-free	1.17%	9.67%	-47.24%	65.21%	69.33%
All Stocks	5.02%	19.28%	-59.63%	127.18%	62.42%
Excess	3.85%	19.00%	-60.64%	109.42%	54.83%
10-year rolling period returns					
Risk-free	0.67%	4.78%	-14.66%	6.31%	75.63%
All Stocks	3.68%	5.76%	-13.31%	21.04%	76.05%
Excess	3.01%	4.85%	-12.34%	20.67%	77.70%
20-year rolling period returns					
Risk-free	0.49%	3.78%	-7.33%	5.24%	70.05%
All Stocks	3.48%	3.81%	-6.76%	14.14%	78.65%
Excess	3.00%	2.68%	-2.80%	10.58%	88.69%
30-year rolling period returns					
Risk-free	0.25%	3.37%	-8.46%	4.34%	59.24%
All Stocks	3.14%	2.67%	-3.50%	10.61%	86.41%
Excess	2.89%	1.74%	-0.39%	7.41%	97.81%
40-year rolling period returns					
Risk-free	0.02%	3.08%	-6.17%	4.03%	50.99%
All Stocks	2.93%	2.35%	-2.21%	7.91%	86.97%
Excess	2.91%	1.55%	-0.01%	6.50%	99.87%

Table 4 Regressions on annual CPI inflation

	All years	No WW	No WW or 1919
	A. Equity return		
Slope	-0.475**	-0.753*	-0.313
	(-2.384)	(-1.709)	(-1.172)
Adj. R2	0.098	0.067	0.006
	B. Equity risk premium		
Slope	0.232	0.227	0.520**
	(1.259)	(0.6904)	(2.068)
Adj. R2	0.022	0.001	0.026
Nobs	171	160	159

t-statistics in parentheses
* indicates significance at the 10 percent level
** indicates significance at the 5 percent level

Figure 1: Belgian common stocks listed on the Brussels stock exchange 1835-2008
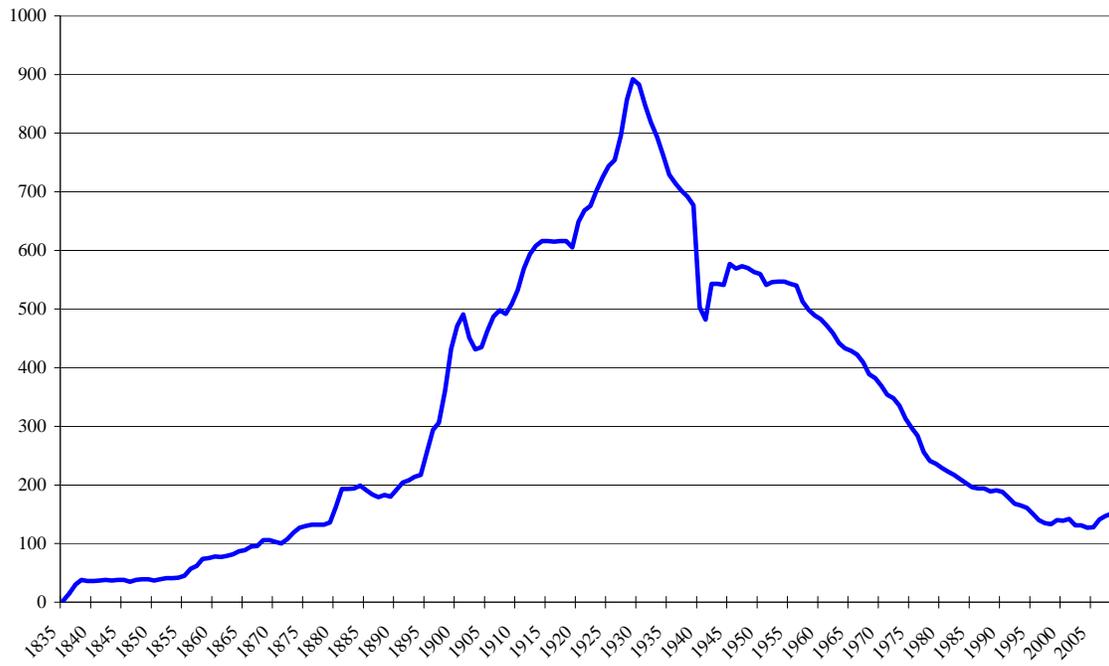
Figure 2: Equity return and risk-free return 1838-2008
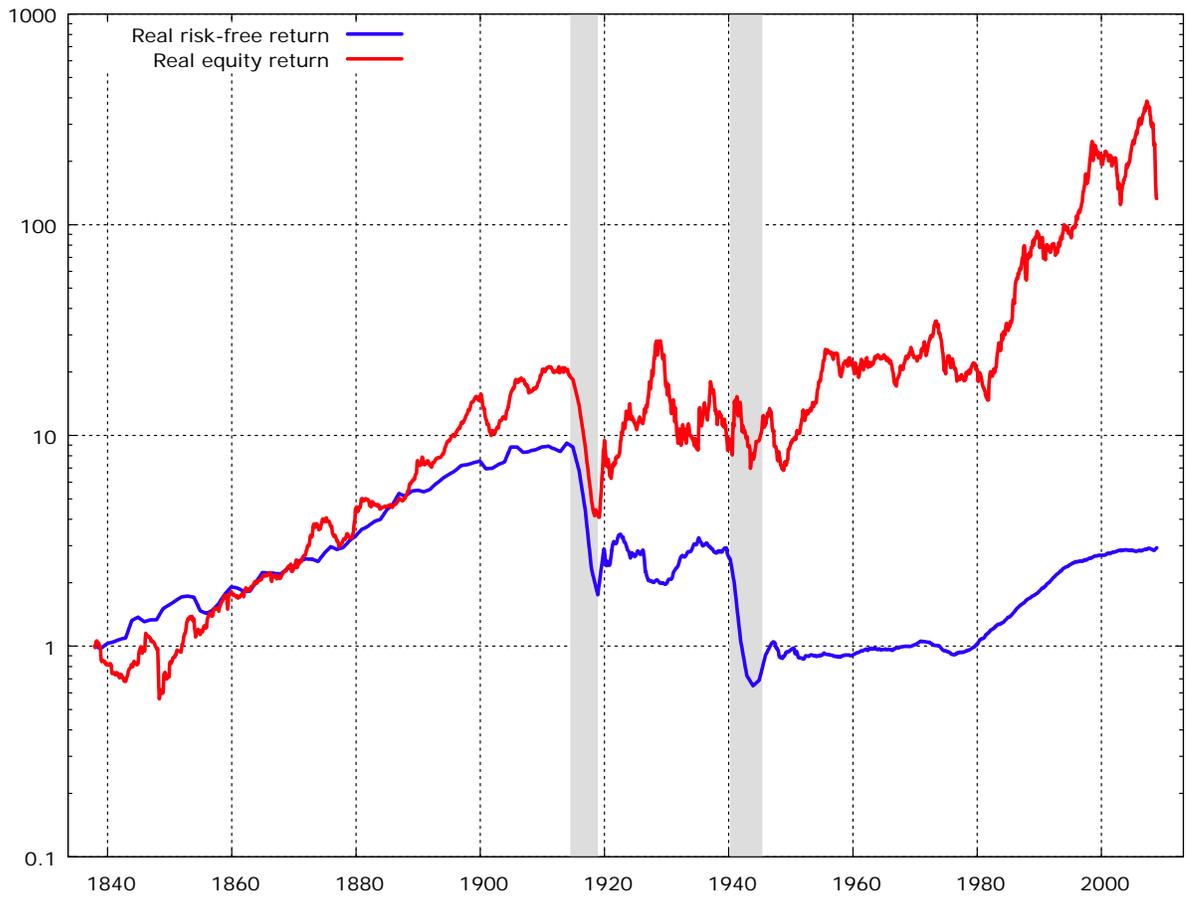
Figure 3: Rolling period returns
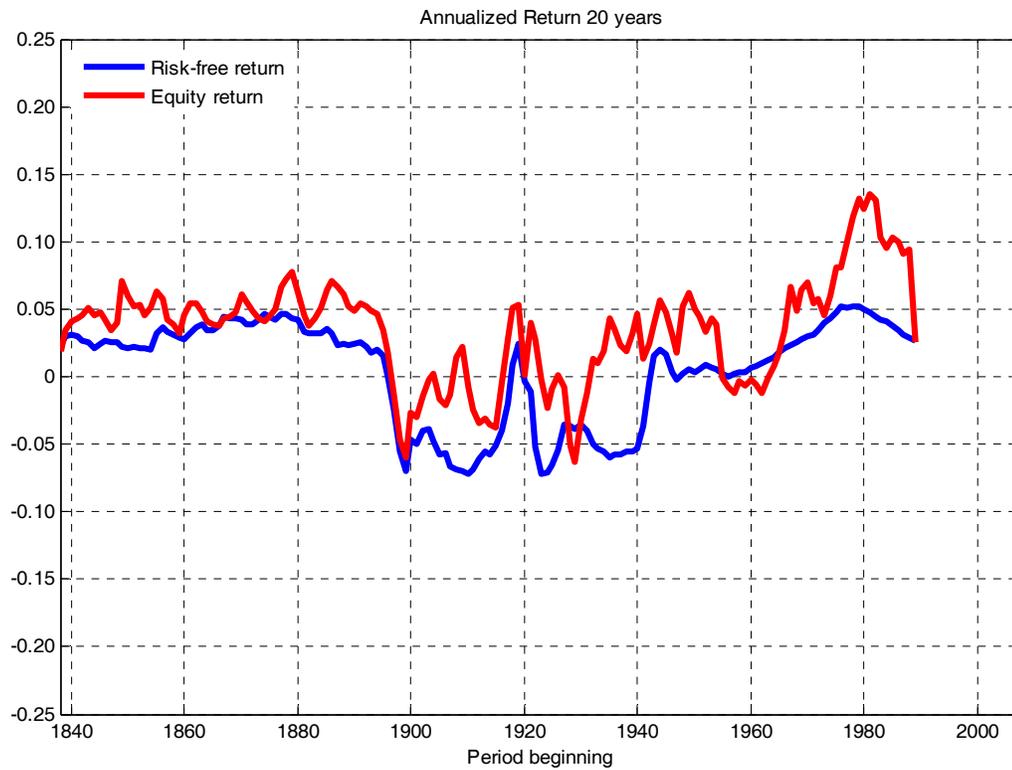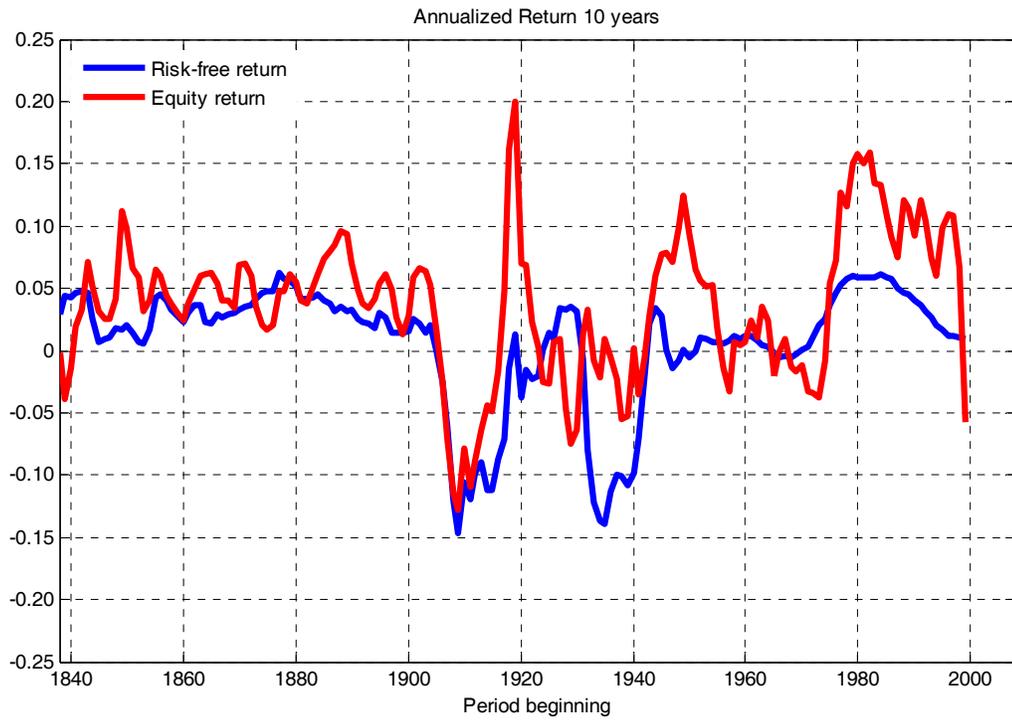
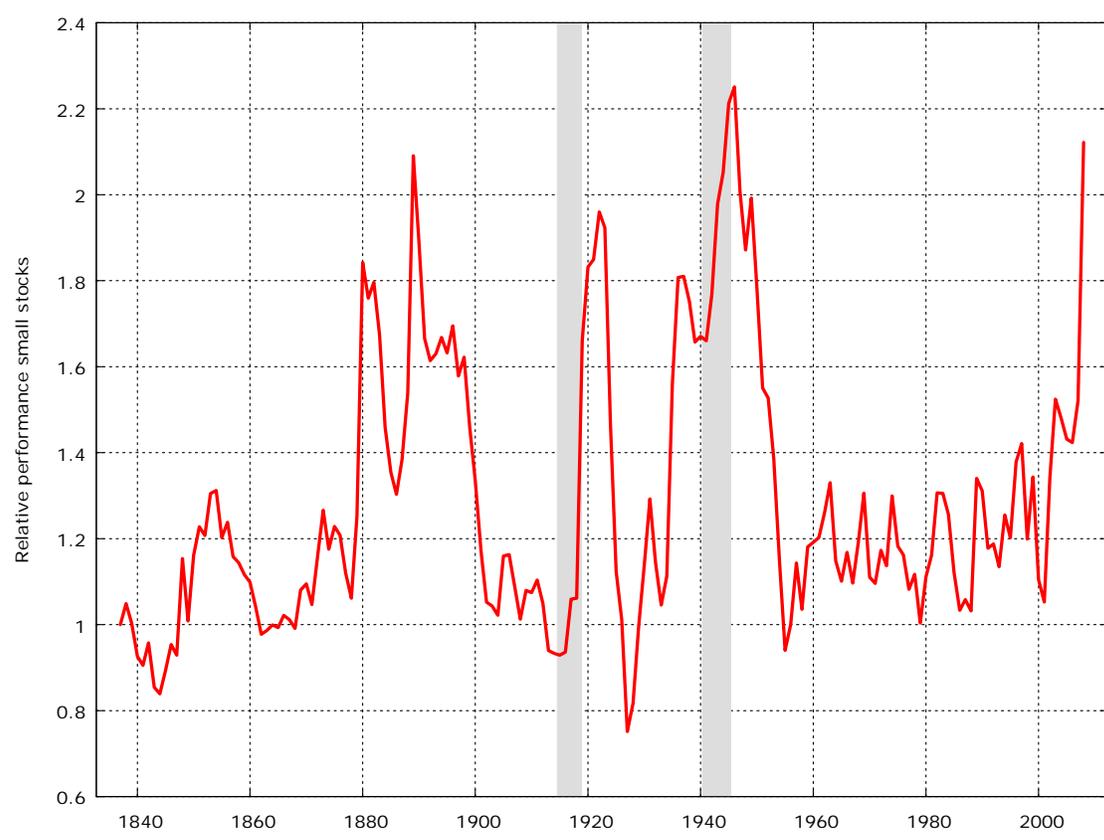Figure 4: The relative performance of small stocks versus large stocks

Figure 5: Annual CPI inflation
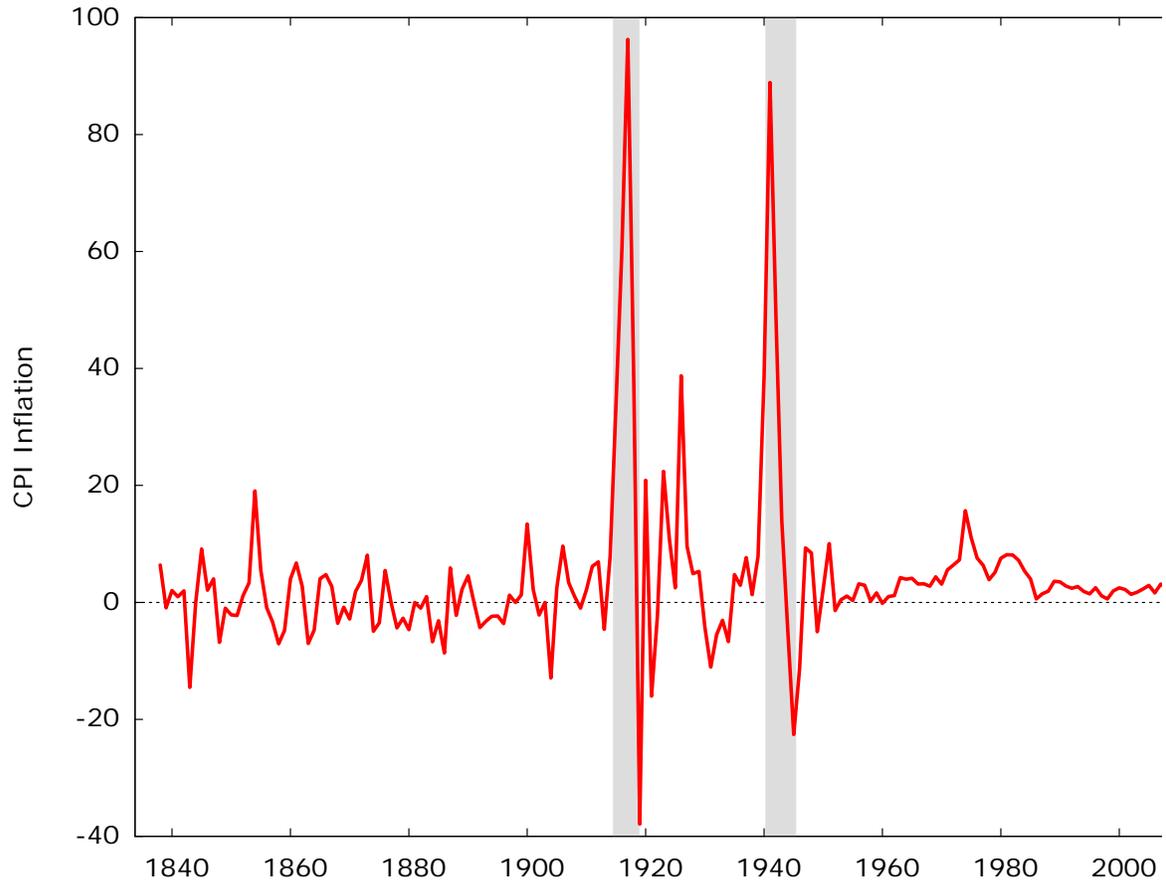
Figure 6: Annual returns versus annual inflation
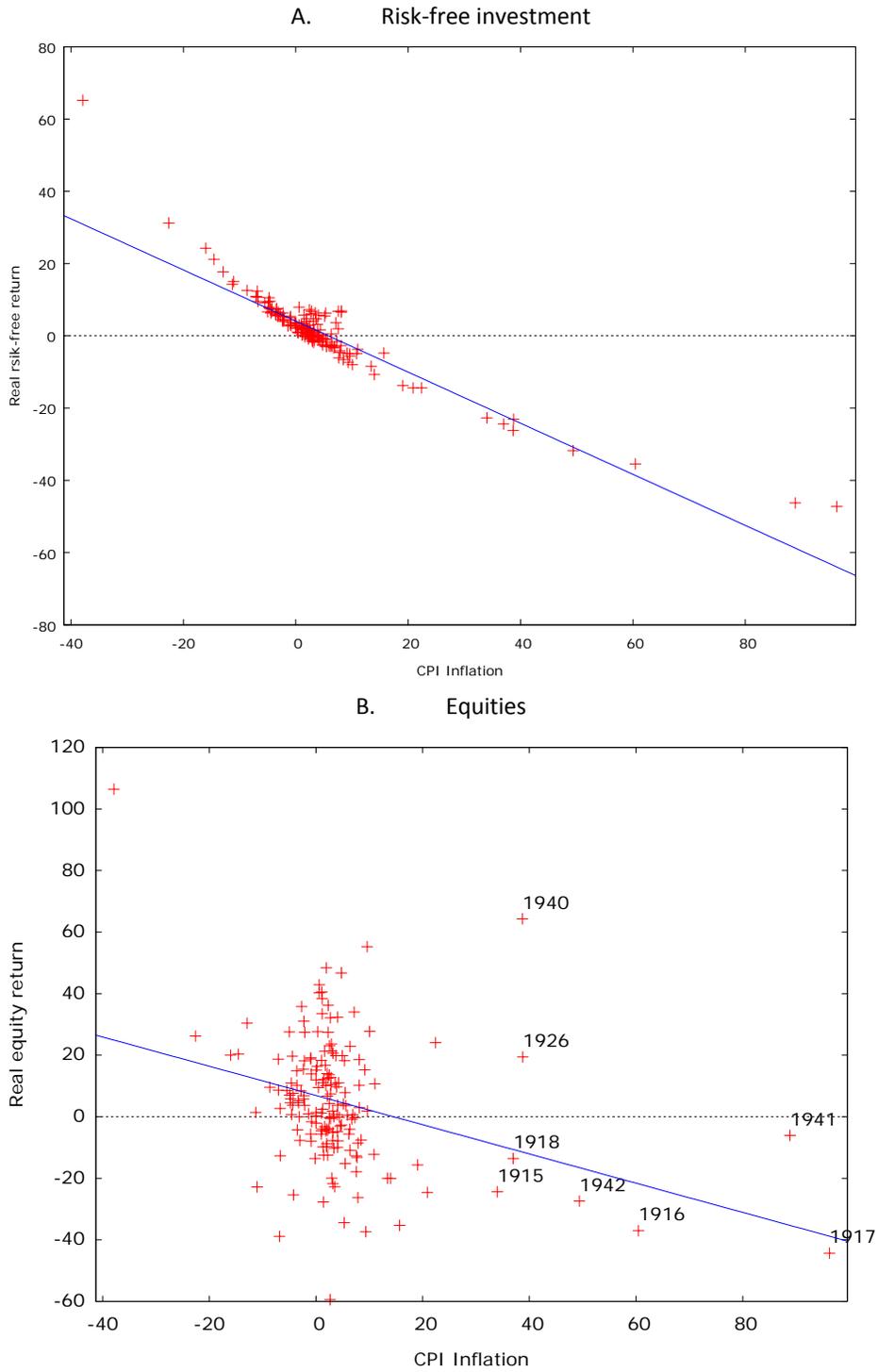

A.   Risk-free investment
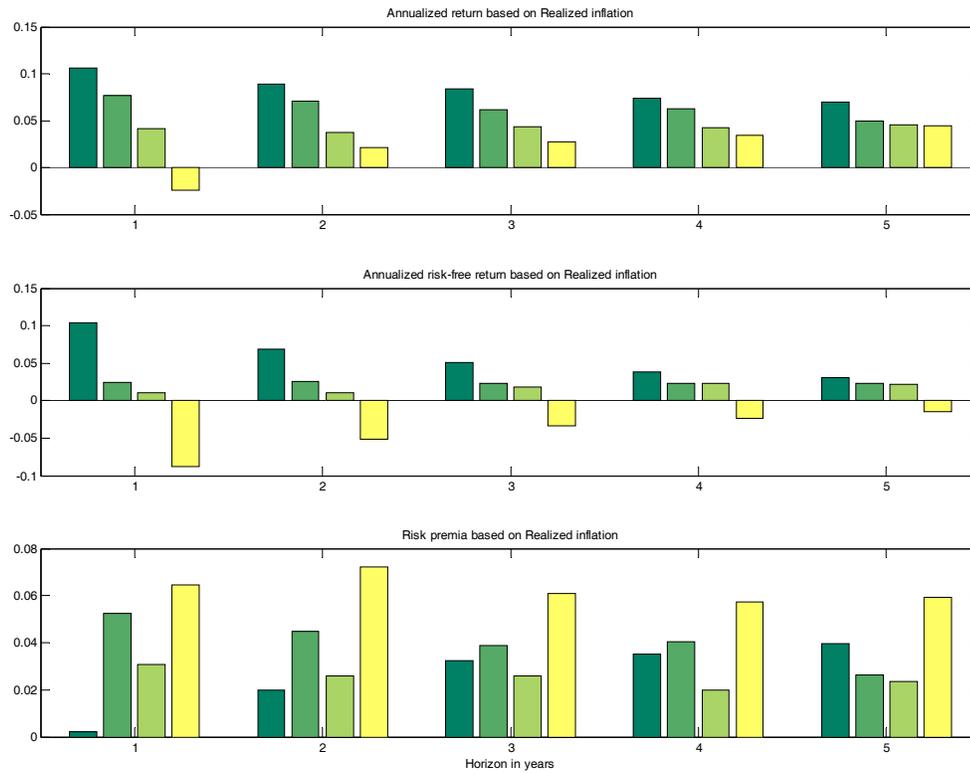

B.   Equities

Figure 7: Average annualized returns and risk premia per inflation quartile

The bars in the top two panels indicate the average annualized return of an investment started in years grouped by realized inflation. The bars in the bottom panel denote the average risk premium on equity investments (i.e. the difference between the top two panels). The investment horizon is indicated on the horizontal axis. Quartiles/bars are ranked from low inflation (left) to high inflation (right). The scales of the vertical axes are not identical.