What Determines Firm Growth? Empirical Evidence for Switzerland

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Abstract
The study analyses determinants of firm growth for a sample of public companies in Switzerland. The sample includes observations from 349 public companies listed in Switzerland over the time period from 1999 to 2021. We consider the impact of firm- and macro-specific factors on firm growth, as measured by three different growth proxies, namely the growth rate of the number of employees, the growth rate of fixed assets and revenue growth. In particular, we consider the impacts of the most recent crises on firm growth, so the financial crisis from 2008 and the COVID-2019 crisis on firm growth and how these events impacted the firms in the different industries. In addition, we analyze whether family firms behave differently from corporations without significant ownership stake of a family. Our results provide empirical evidence for firm growth not following a random walk, i.e., we find a positive related size-growth relationship Also, firm age has a negative effect on growth, while more leveraged firms grow faster. However, this latest result only holds for the pre-crisis period. Also, more profitable firms grow faster. Furthermore, family-owned companies exhibit a slower growth rate compared to non-family firms. From the inclusion of macroeconomic variables we finally observe GDP growth, inflation and the stock market performance all having a positive impact on firm growth.

Key words: Firm growth, performance during crisis, financial crisis, Covid-19, resilience

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1 Introduction

"No firm ever yields returns indefinitely, if only run according to unchanged plan" (Schumpeter, 1928, p. 381). Schumpeter already noticed in the first part of the 20th century that firm growth, here in terms of innovation, is necessary for progress. Firm growth is one of the focal points in business economics. Gibrat (1931) was probably one of the first academics stressing the relationship between firm growth and its size. According to Gibrat's Law, there exits no relationship between firm growth and initial firm size. The recent empirical evidence, however, reveals a different story.

Given that every company is unique and in any way different from its peers and competitors, firm leaders and especially a company's top management should be aware of their individual determinants of growth to adopt an adequate management style in order to reach long term objectives. Turning a blind eye to this fact can lead to vast decision making mistakes. From a macroeconomic point of view, corporate growth plays an indispensable role for economic development. According to the Keynesian theory, growing firms tend to require further workforce and, therefore, have a positive impact on employment rates. Since the demand for labour increases, wages will increase as well, leading to higher consumer spendings (Pasinetti, 1974, p. 29). This, as a matter of fact has a positive impact on government's tax revenue, resulting in a better debt service and superior domestic investments. Following this reasoning, a country's government as well as its population are interested in maintaining appropriate sustainable growth rates of corporations.

There exists a substantial number of academic studies investigating the relationships between firm size, age and firm growth. However, very few studies include Switzerland in their analyses. This is more surprising because Switzerland provides an interesting environment to study firm growth. Switzerland enjoys an almost unique position in Europe by being independent from European political decisions. Furthermore, the firm size distribution is characterized by the dominance of small- and medium-sized firms (i.e. with up to 50 and 250 employees, respectively, Fueglistaller, Fust, Brunner & Althaus, 2013, p. 11), while the presence of large firms is mainly dominated by a few players of the pharmaceutical industry like Novartis AG and Roche Holding AG, as well as by commodity trading firms like Glencore PLC and Trafigura AG[1]. In the banking industry UBS AG, Credit Suisse AG, ZKB and Raiffeisen[2] are the dominant players. Therefore, the firm size disproportion makes Switzerland very special and different from other countries in Europe, where the economies tend to be more dominated by large firms. Finally, Switzerland is a very open economy, with export activities amounting up to 60% of the total GDP. Accordingly, exports play an important role in Switzerland as well (Swiss Confederation (a), online).

The purpose of our paper is to investigate the impacts of firm-specific characteristics and macroeconomic variables on firm growth of listed companies at the Swiss stock exchange over the last 15 years. More precisely, we examine the impact of size, age, financial leverage, profitability, location, industry, ownership structure, R&D, export activity, inflation, GDP growth and domestic stock market performance on firm growth. We also investigate potential effects of the recent financial crisis by splitting up the sample in a pre-crisis and crisis and post-crisis period, respectively.

Our results provide evidence against Gibrat's Law, i.e. firm growth is not following a random walk and therefore, firm growth is not independent of firm size. As a matter of fat, we find a positive size-growth relationship. Also, firm age has a negative effect on growth, while more leveraged firms grow faster. However, this latest result only holds for the pre-crisis period. Also, more profitable firms grow faster. Furthermore, family-owned companies exhibit a slower growth rate compared to non-family firms. There

[1] Ranked by revenue.

[2] Ranked by total assets.

exist also some significant differences between the industrial sectors, with, e.g., an above average growth rate of the firms in the consumer (non-cyclical) sector over the time period considered. From the inclusion of macroeconomic variables we finally observe GDP growth, inflation and the stock market performance all having a positive impact on firm growth.

The new aspects of the paper are as follows: It is the first paper that investigates the determinants of Swiss public companies over the latest 15 years. Furthermore, our growth determinants include variables which make sense from an economic point of view, but have not all been considered yet for this sample. Finally, we also consider potential impacts of the latest financial crisis, which provides a particularly interesting experiment to study firm growth.

The paper is structured as follows: section two reviews the theory of firm growth dynamics and the existing literature. Section three outlines the definition of the dependent and independent variables as well as the development of the model. The data and the applied methodology are part of section four. Our findings and robustness tests are presented in section five. In section six we introduce some practical implications based on our results, and section seven concludes.

2 Theoretical background

2.1 Theory of firm growth

Gibrat (1931) examined the relationship between growth and size of a company. The so called Gibrat's Law is the idea that "the probability of a given proportionate change in size during a specified period is the same for all firms in a given industry - regardless of their size at the beginning of the period" (Mansfield, 1962, p. 1031). In other words, the growth rate of a firm in a given period is independent of its absolute size, at the beginning of the examined period. This stochastic approach is the first attempt to deliver an answer for the right skewed distribution of firm's size. The question about this relationship is still important in recent studies. Santarelli, Klomp and Thurik (2006) found in their meta-analysis with various samples and methodologies no prevalence of a law in general. The main reason is that there exist heterogeneous patterns of behaviour across industry and size of a company (p. 43).

Furthermore, Schumpeter (1942) focused on the entrepreneur as a person who creates something new and defined the process of creative destruction. Through shifting the curves of costs and revenue, a market disequilibrium is created. This attracts other competitors to catch up with this and leads to economic development and growth (Brännback, Carsrud & Kiviluoto, 2014, p. 56). Moreover, he introduced new combination of different markets, manufacturing methods or commodities, so called innovations, as necessity for firm growth. The Schumpeterian model delivers answers for empirically observed stylized facts on firm size distribution and firm dynamics using firm-level data. For example, there is a highly right-skewed firm size distribution, because firms need to succeed many attempts to overtake their competitors by new products or business lines to become larger (Aghion, Akcigit & Howitt, 2015, p. 3).

A few years later, Penrose (1959) outlined firm growth, in particular the expansion of assets and employment rates, in the industrial sector. She assumed that firms grow in general and focused on principles that govern this process and the time frame, rather than particular determinants (p. 7). In her mind-set growth and profitability are the same, because the only motivation for firms to grow is always driven by a desire to increase long-term-profits. Other determinants, like social aspects, were ignored (p. 29).

Moreover, Jovanovic (1982) provides a theory of selection with incomplete information. He figured out that within an industry, smaller firms grow faster and are more likely to fail than large firms. According to this inverse growth-size relationship, the efficiency of a firm is the key determinant for differences in terms of size. In other words, efficient firms grow and survive and inefficient ones decline and fail (Jovanovic, 1982, pp. 649-650).

The historical overview reveals that size, age, profitability and the innovation process were examined as the basic indicators for firm growth. In contrast, the following section shed light into the findings of recent studies.

2.2 Overview of the literature

Academic literature on firm growth is mostly dominated by empirical studies focusing on the potential impact of size, age and industry. Becchetti and Trovato (2002), for example, analysed 4,000 small and medium sized Italian firms using data from 1989 to 1997 finding that size, age and industry do have a significant impact on firm growth. Bothner (2005) reveals a significant firm size and growth relationship in the global computer industry. Further studies like Niskanen and Niskanen (2007), Birley and Westhead (1989) and Cooney and Malinen (2004) also focused on the three mentioned explanatory variables finding evidence for their significance. The results of Evans (1987b) reveal that growth rates decline with increasing age and size. According to Alessi, Barigozzi and Capasso (2012) there is significant variation in the growth rates looking at different industries.

Beside the classical determinants, a wider range of firm growth determinants have been considered. For instance, Hermelo and Vassolo (2007) provide evidence for the importance of innovation in terms of investments in new technologies, but not for diversification by products. In contrast, product diversification plays an important role in the pharmaceutical industry as shown by Bottazzi, Dosi, Lippi, Pammolli and Riccaboni (2001). Amirkhalkhali and Mukhopadhyay (1993) analysed the size-growth relationship for R&D- and non-R&D intensive industries and found that there is no a priori expectation that larger firms will have a significantly higher or lower growth rate (p. 225).

Moreover, access to external financing is as a key factor in the literature of corporate finance. The potential relationship to growth rates was analysed and confirmed by Lang, Ofek and Stulz (1996), as well as Fotopoulos and Louri (2004), stating that profitable companies increase their growth rates when using external financing.

Furthermore, Iturriaga and Crisostomo (2010) examined the relevance of ownership structure for 182 Brazilian firms. They reveal that ownership has an asymmetric impact on growth opportunities. A higher ownership concentration increases firm value, due to better monitoring of the management, and this holds irrespective of firm growth. On the other hand, there is still the risk that large shareholders will expropriate wealth of small shareholders (p. 5). Additionally, Martin-Reyna and Duran-Encalada (2012) did a similar analysis for the Mexican market in the period from 2005 to 2011. In line with prior researchers, they found that ownership structure plays an important role when looking at growth rates, arguing that the management of companies with low amount of free floating shares may be directly influenced by a few owners.

Effects of profitability on firm growth is also discussed in the most recent literature. Retained earnings may be used to explore further markets or undertake investments, which will stimulate growth rates. Lee (2014) analysed 600 Korean firms in the period from 1999 to 2008 and finds that highly profitable firms tend to grow faster. Table 10 delivers an overview of significant firm growth determinants and reveals extensions to the indicators we already mentioned in this section. The majority of these studies cover the U.S. industry with focus on SMEs.

To our best knowledge, there exist only two studies that analyze growth determinants of Swiss companies. Demirgüc-Kunt and Maksimovic (1998) investigated how legal and financial constraints affect the firms' use of external financing to fund growth, and their sample includes for a sub-panel of 127 Swiss companies (p. 2118). They found that an active stock market and a well-developed legal system are key determinants to develop firm growth (p. 2134). Furthermore, Havnes and Senneseth (2001) indicate the meaning of networks, in particular through a network index, to enhance performance and growth opportunities of small firms (p. 293). Observing north European countries and data from Switzerland as well, they found no significant relationship. Additionally, Burghardt and Helm (2015) examined the effect of mergers and acquisitions

(M&A) on employee growth, restricting the analysis on newly acquired firm establishments. Based on a sample of Swiss firms they figured out that the relative deal size is an important determinant of growth (p. 889).[3]

Again, the lack of research in the area of growth opportunities motivates us to illuminate the determinants, especially for listed firms. Moreover, we use a larger time period than previous studies to increase the number of observations and reveal more robust results.

3 Determinants of firm growth and variable selection

In this section we introduce the dependent and independent variables and develop the expected relationships. A summary of the relationships can be seen in Table 8 and a detailed explanation of the variable components in Table 9.

3.1 Dependent variables

GROWTH: There are different approaches for measuring firm growth. Usually growth rates are used, however, in recent studies an increasing demand for more appropriate measures like growth mode are claimed. Growth mode distinguishes between internal and external growth dynamics. The latter is more appropriate to explain jumps in the amount of employees or sales through M&A activities (McKelvie & Wiklund, 2010, p. 261). The review of previous studies reveals that this approach is not commonly used in research. However, firm growth can be measured on individual- (entrepreneur) and firm-level. Both are heterogeneous, but in recent studies the firm-level analysis is primarily considered. There are also differences of measurement, using relative vs. absolute growth, whereas the latter was used with highest frequency (Brännback et al., 2014, p. 43).

The most common indicators to capture firm growth are the year-on-year changes in the number of employees, the amount of fixed assets and revenue (Brännback et al., 2014, p. 28). All these indicators have some limitations. Measuring growth by the number of employees is biased against capital-intensive firms. In contrast, measuring by the amount of fixed assets is biased against labour-intensive firms or companies with a significant share of outsourcing (Hermelo & Vassolo, 2007, p. 11). Nevertheless, there are studies which apply these variables despite the mentioned limitations. For example, Evans (1987a) used the logarithmic average growth rate over the last of five business years to examine growth in terms of employees (p. 572). Becchetti and Trovato (2002) considered the average growth rates of the last three years. In this study we apply the natural logarithm of the year-to-year growth rate instead, to avoid a loss of information in the first years of observation when building the two- or three-year average.

Focusing on revenue, Hermelo and Vassolo (2007) referred to the average growth rate of firm revenue in a three-year period (p. 11). Amaral et al. (1997) defined the logarithmic revenue growth to the previous year. Considering the high volatility of firm sales we decide to additionally use the natural logarithm of the annual growth rate of fixed assets and the natural logarithm of the year-on-year growth of employees.

$$Employees\_G\_Log_{it} = ln(\frac{Employees_{it}}{Employees_{it-1}}) \quad (1)$$

[3] The studies of Demirgüc-Kunt and Maksimovic (1998), Havnes and Senneseth (2001) and Burghardt and Helm (2015) are not included in Table 10 as they only capture firm growth dynamics indirectly through other indicators, like M&A activities.

$$FixedAssets\_G\_Log_{it} = ln(\frac{FixedAssets_{it}}{FixedAssets_{it-1}}) \quad (2)$$

$$Revenue\_G\_Log_{it} = ln(\frac{Revenue_{it}}{Revenue_{it-1}}) \quad (3)$$

3.2 Independent variables

The following paragraph describes the implemented independent variables for firm growth. We distinguish between firm-specific variables and macroeconomic characteristics. Moreover, we provide an accurate definition, outline the relevance of these characteristics and document the applied proxies.

3.3 Firm-specific determinants

SIZE_DUMMY: Beginning with the firm-specific variables we apply size as done by several recent studies to test whether Gibrat's Law holds or not. Hermelo and Vassolo (2007), as well as Alessi et al. (2012) use gross sales as a proxy for firm size. Chen and Lu (2003), in contrast, use fixed assets to measure the size of a company. Since gross sales tend to be volatile, dependent of the economic cycles, and susceptible for exogenous impacts, we use an alternative approach mapping firms according to their listing in the Swiss Performance Index (SPI) Small, Mid and Large to dummy variables. The classification of the subindices is based on the market capitalization of the underlying stocks. According to Figure 1 the SPI Large comprises the 20 largest firms, the SPI Mid the consecutive 80 firms, whereas the SPI Small contains the remaining ones (SIX Swiss Exchange, 2014, p. 10). The advantage is that we consider changes over time within these subindices. The remaining stocks which are not captured by the size indices are mapped manually using market capitalization data from Bloomberg. Bottom and top thresholds are displayed in Table 1. However, in line with various researchers we expect that small firms grow faster than bigger ones. We therefore expect Gibrat's Law to be rejected (Becchetti & Trovato, 2001; Dunne & Hughes, 1994; Hermelo & Vassolo, 2007).

Table 1: Firm size classification.

Firm Size	Thresholds market capitalization
Small	x < CHF 0.5 bn
Mid	CHF 0.5 bn < x < CHF 5 bn
Large	x > CHF 5 bn

AGE: The relationship between firm-age and -size is well observed, but also controversial discussed. For example, Birley and Westhead (1989) examined a positive relationship, whereas Evans (1987b) observed a negative. According to the life-cycle effect, young (and smaller) firms tend to grow faster than mature (and larger) firms (Kueng, Yang & Hong, 2014, p. 5). We therefore expect a negative relationship, as well. In recent studies firm age is measured by years since the foundation of the company in absolute terms (Niskanen & Niskanen, 2007, p. 19). In order to capture the age-growth relationship we apply age as an absolute number defined as the number of years since foundation. Again, in accordance to Evans (1987b) and the life-cycle effect, we expect a lower growth rate with increasing firm age.

LEVERAGE: Firms normally raise debt to finance further investments. We apply this variable in order to measure whether there is an impact of different debt levels on the growth rates of firms. According to Jensen and Meckling (1976) a firm's leverage increases with a lack of growth opportunities, since managers with valuable growth opportunities should prefer a lower leverage to be able to realize their investment purpose (Harris & Raviv, 1991, pp. 204, 327). Following this causal interdependence, Niskanen and Niskanen (2007) found a positive relationship between financial leverage and growth of firms operating under unlimited liability (p. 11). This finding matches our expectations. In general, financial leverage is defined as the amount of total debt relative to shareholders equity. A large ratio indicates high financial leverage and therefore high debt levels. We therefore apply the ratio as follows:

$$Leverage_{it} = \frac{(Long\ Term\ Debt_{it} + Short\ Term\ Debt_{it})}{Shareholders\ Equity_{it}} \tag{4}$$

PROFIT: Recent studies suggest that profitability is the prerequisite for enhancing growth (Brännback et al., 2014, p. 68). Firms with a solid capital surplus can easily foster their growth by undertaking growth stimulating investments. For those firms with limited access to external financing a sustainable grade of profitability becomes more important. Internal financing can be realized by retaining earnings instead of paying out dividends. Profitable firms therefore are more likely to grow by internal financing since their earnings can play a substantial role in case that they are reinvested in their business. To include profitability in our model we again make use of the following ratios:

$$Profit\_Margin_{it} = \frac{Net\ Income_{it}}{Revenue_{it}} \tag{5}$$

$$Profit\_ROA_{it} = \frac{Net\ Income_{it}}{Total\ Assets_{it}} \tag{6}$$

Since the term profit margin does include revenue as well as net income, we replace profit margin by Return on Assets (ROA) for the revenue growth regression model to avoid multicollinearity. Lee (2014) indicates a positive relationship between profitability and growth rates, whereas the relationship was stronger for small firms. This finding is in line with our expectation since small firms are more likely to have a limited access to external financial sources and therefore rely on internal financing like retaining earnings.

FAMILY_DUMMY/FREE_FLOAT: A firm's ownership structure can substantially vary. Fotopoulos and Louri (2004) examine the relevance of foreign ownership and indicate a significant relationship to firm growth. Jensen (1986) reveals that a high ownership concentration can discipline managers to use the free cash flow efficiently in line to develop the company. Taking a gander at family owned companies, the majority of shares are usually held by the founders. In contrast, quoted companies have a significant amount of free floating shares which can be traded on a stock exchange. In case that large investors are engaged, the amount of free floating shares can decrease substantially. As a matter of fact, investors with a large proportion of shares can directly influence the management (Berle & Means, 1932; Iturriaga & Crisostomo, 2010). We observe two proxies for ownership structure. First, we apply the amount of free floating shares as a percentage number of the total number of shares allowing us to distinguish between firms with high free floating amount and those with a few large shareholders. Second, we observe a dummy variable which indicates whether a firm is family owned or not. Family owned firms are defined as those with a family stake of at least 20%. Although a threshold of 20% may seem low, there is a widely accepted view that this is sufficient to influence managerial decisions substantially (Isakov & Weisskopf, 2015, p. 336). Overall, we expect firms with managerial influence by shareholders or high ownership concentration to grow faster since shareholders do benefit from high growth rates and therefore will increase their influence over the management. However, family owned firms could tell a different story since the management will likely apply a more restrictive and

less risky managerial approach providing more sustainable, but lower growth rates (Sharma, Chrisman & Chua, 2009, p. 5).

SECTOR: Competition, market potential and changes in the business environment can differ substantially from sector to sector. We therefore expect different results in growth dynamics along the industries. As a matter of fact we are interested in the relevance of the sector a company belongs to. We define our dummy variables along the Bloomberg classification as follows: financial, industrial, consumer (non-cyclical), consumer (cyclical), basic materials, utilities, communication, technology, diversified and energy.[4] Niskanen and Niskanen (2007), for example, used dummy variables as well to distinguish between various sectors in Finland. As a result, they found that non-manufacturing firms grow faster than manufacturing firms. First, we are interested to examine interdependencies between different sectors and the firm growth dynamics in general. Second, we expect higher growth rates for the sectors financials and technology in contrast to the other sectors. Financials due to a high financial leverage, which is the nature of banking (DeAngelo & Stulz, 2013, p. 21), technology due to the rapidly enhancing innovation in this sector.

R&D Spending: Introducing innovations in terms of products or business lines can facilitate firms in conquering new market share from competitors. Moreover, in a later stage production costs can be reduced through innovation. The ability to introduce new technologies can be determined through R&D activities in a company. Amirkhalkhali and Mukhopadhyay (1993) differentiate between R&D intensive and non-intensive industries. Since our sample consists of firms from heterogeneous sectors the number of launched products cannot be used as an indicator like Bottazzi et al. (2001) applied. According to the positive correlation between innovation and R&D intensity, we use a R&D ratio as indicator and assume a positive relationship to firm growth (Mairesse & Mohnen, 2005, p. 95; Coad & Hölzl, 2010, p. 6).

$$R\&D_{it-1} = \frac{R\&D\ Expenses_{it-1}}{Total\ Operating\ Expenses_{it-1}} \tag{7}$$

EXPORT_DUMMY: In 2014, Switzerland's total export amounted up to two-thirds of the total GDP, which was CHF 642 bn. In contrast, Germany had a 50% export to GDP ratio in the same year (Swiss Confederation (a), online). Firms with a significant share of exportation make their products available for a broader range of potential clients and therefore tend to be more profitable. Buckley, Dunning and Pearce (1984) test export intensity along multinational production processes without significant results. Hermelo and Vassolo (2007) applied a dummy variable to distinguish between firms with national and those with international sales and indicate a significant relationship to firm growth. We therefore expect firms that act internationally to grow faster than firms acting solely on a domestic level. Again, we apply a dummy variable to differ between domestic- and international acting firms. The latter are defined as firms which operate in more than one country.

3.4 Macroeconomic characteristics

LOCATION: From a macroeconomic perspective the location of a firm's headquarter can play an important role when looking at growth rates. Tax rates in Switzerland can differ substantially from region to region. Firms with a low tax rate tend to grow faster since the amount saved due to tax efficiency can be reinvested in the company. Moreover, the regional choice is an important strategic issue. Regional peculiarities like supply and demand, age and wealth of potential customers, infrastructure and the availability of qualified workforce have to be taken into consideration (Niskanen & Niskanen, 2007, p. 7). We therefore want to include the location of a firm's headquarters into our model using a dummy variable for each of the seven major areas in Switzerland and Liechtenstein. Niskanen and Niskanen (2007) and Hardwick and Adams (2002) differ between rural and urban, respectively between smaller communities and capital areas.

[4] For further sample information see section 4.1.

According to their findings we expect firms in economically strong, for example Zurich, or rather urban regions to grow faster. We define the location according to the definition of major areas in Switzerland as follows: Lake Geneva region, Espace Mittelland, Northwestern Switzerland, Zurich, Eastern Switzerland, Central Switzerland and Ticino (Swiss Confederation (b), online).

INFLATION: Inflation is measured based on the Swiss Consumer Price Index (CPI), which allows measuring the annual price change of a representative basket of specific goods. According to economic theory inflation increases either for the reason of excess in aggregate demand for goods or supply side factors, like increasing raw material prices, rising import prices or declining productivity. It therefore gives information about consumer sentiment and serves as a lagging indicator for economic health. Since the prices of goods increase due to inflation, firms are able to increase their revenue over time, even when the number of goods sold remains constant. This should have an impact on all three dependent variables. We therefore expect to find a positive relationship. The literature on the relationship between inflation and firm growth is very thin. Beck, Demirgüc-Kunt and Maksimovic (2005) found a positive relationship between firm growth, operationalized by average change of sales over the last three years, and inflation rate. Moreover, Goddard and Wilson (2002) measured inflation differently. They captured inflation in the intercept and time dummies and did not observe it individually (p. 247).

$$Inflation_t = \frac{CPI_t}{CPI_{t-1}} - 1 \tag{8}$$

GDP_G: Real GDP growth rates reflect the increase in the total amount of all goods and services sold in an economy relative to the past year or quarter. This, as a matter of fact, is an indicator to gauge for a country's economic health, since an increasing GDP automatically leads to improving debt service, higher wealth, growing employee rates and rising consumer spendings. A country's gross domestic product is partly driven by inflation, which is kept positive but close to zero by the central banks. Therefore, as a logical consequence of rising price levels, higher valuations of the total amount of goods sold result. However, we are interested in observing the impact of a 1% change in GDP on firm growth and therefore apply the year-on-year growth rate as follows:

$$GDP_{G_t} = \frac{GDP_t}{GDP_{t-1}} - 1 \tag{9}$$

For example, Demirgüc-Kunt and Maksimovic (1998) observed a positive relationship between GDP growth and firm growth (p. 2134). This is in accordance with our expectations.

SMI_TR_G_LOG: In order to capture the relation between the domestic stock market and effective firm growth we apply the Swiss Market Index (SMI) as a total return index. The stock market capitalizes the present value of growth opportunities (Rajan & Zingales, 1996, p. 2). We therefore apply the SMI as a proxy for the market opinion whether firms will grow or not. Moreover, we apply a time lag of one year since the SMI performance represents the expectations about future growth. We expect a positive relationship between stock market returns and firm growth and calculate the variable as follows:

$$SMI_t = ln(\frac{SMI_t}{SMI_{t-1}}) \tag{10}$$

FINANCIAL_CRISIS_DUMMY: The recent financial crisis had a far-reaching impact on the global economy. We want to observe how firm growth was affected during the financial crisis. Therefore, we use a dummy variable which is equal to one for the period of 2007 until 2009 and zero otherwise according to Dietrich and Wanzenried (2014, p. 340). We expect that firm growth decreases substantially over all three dependent variables.

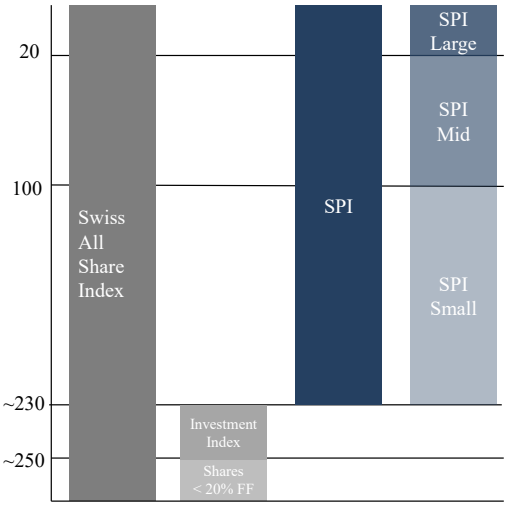
4 Data and methodology

In the following section we introduce the source and the data itself. Moreover, we describe our regression model which captures the firm specifications as well as macroeconomic determinants on firm growth.

4.1 Data

For the empirical analysis we use firm-level panel data from Bloomberg and S&P Capital IQ database. Historical index compositions are requested from SIX Swiss Exchange and macroeconomic statistics from the Federal Statistical Office, Neuchâtel. According to the Swiss Code of Obligations[5] publicly traded companies are defined as those who "have shares listed on a stock exchange, have bonds outstanding, [respectively] contribute at least 20 per cent of the assets or of the turnover to the consolidated accounts of a company in [the previous] terms …". To capture the majority of all listed firms in Switzerland we focus on the Swiss All Share Index provided by the SIX Swiss Exchange. This index was introduced in July 1998 after all investment companies and stocks with a free float (FF) minor to 20% were excluded from the SPI (Figure 1). It contains all listed companies domiciled in Switzerland and Liechtenstein. Upon request, foreign domiciled companies may be included in case that they fulfil mandatory conditions. Nevertheless, we only consider quoted companies domiciled in Switzerland and Liechtenstein. However, the Swiss All Share Index does not represent the entire Swiss equity market. For the sake of completeness a second stock exchange in Bern has to be mentioned. This stock exchange focuses only on SMEs and comprises 22 stocks as of October 10th, 2015. In contrast, the SIX comprises 264 firms and delivers various subindices according to ownership structure, sectors and size (SIX Swiss Exchange, 2014, p. 1; BX Berne Exchange, online).

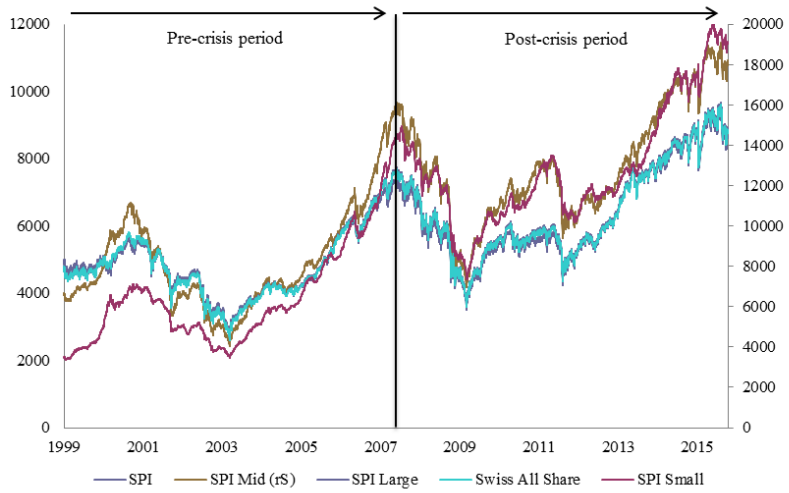
Figure 1: Swiss Stock Exchange indices (SIX Swiss Exchange, 2015, p. 1).



According to the availability of historical index composition we observe data from 1999 to 2014. To account for the effects of the financial crisis on the determinants of firm growth we define two subsamples. As already mentioned in the literature review, we find no studies which analyse the impact of the financial crisis on firm growth. Animated by the paper of Dietrich and Wanzenried (2011) who examined the relationship between bank profitability before and during the financial crisis, we define two subsamples as well (p. 307). In particular, the pre-crisis comprises the period from 1999 to 2006 and the post-crisis period contains data from 2007 to 2014 as can be seen in Figure 2.

Figure 2: Determining two subsamples.

[5] Article 727 as of July, 1st 2015, SR 220.



As a common approach in longitudinal studies we accept missing data at some point to enlarge the number of observations (Alessi et al., 2012, p. 74; Niskanen & Niskanen, 2012, p. 4; Dunne & Hughes, 1994, p. 118). In order to avoid a fragmentary data sample we use end of financial year data instead of quarterly interim results. However, the composition of the Swiss All Share Index, respectively the SPI, can change from time to time. Companies in liquidation or firms which change their exchange listing were automatically removed. We therefore consider those firms which survived for at least three consecutive years in the Swiss All Share Index. As a result, we observe some companies only for particular years and not for the whole sample period. These restrictions yield a sample of 349 unique firms, whereas the numbers of observations are documented in descriptive statistics (Table 3).

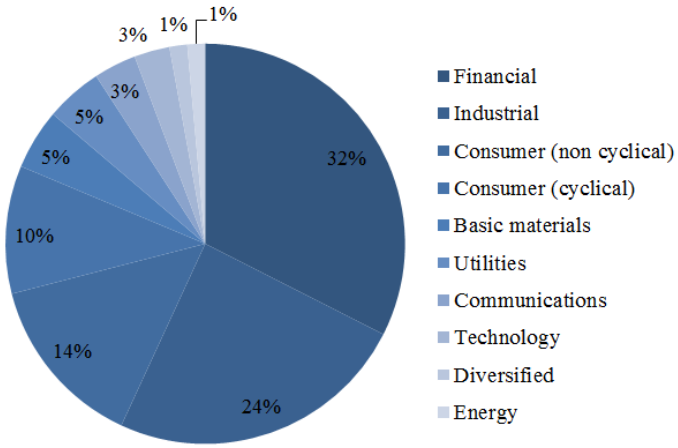
Table 2 reveals the distribution of the observed companies according to their location and in relation to the population (Swiss Confederation (b), online). Roughly 28% of the listed companies are located in Zurich and 18% in the area of Lake Geneva, whereas the number of population is quite similar. Furthermore, the table indicates that East and South-East Switzerland has the lowest share of listed companies in the observed period.

Table 2: Sample distribution by location.

Firm location	Sample distribution in %	Share of population in %
Zurich	28.08	17.42
Lake Geneva region	18.32	18.81
Central Switzerland	16.91	9.48
Northwestern Switzerland	13.47	13.51
Espace Mittelland	11.46	22.15
Eastern Switzerland	9.76	13.94
Ticino	1.15	4.22
Liechtenstein	0.86	0.46

Due to Figure 3 the majority of the firms operate in the financial sector, for example various cantonal banks, Credit Suisse AG or Liechtensteinische Landesbank AG. On the side of industrial companies we observe for instance ABB Ltd., Sulzer AG or Georg Fischer AG, whereas Autoneum Holding AG, Galenica AG and Chocoladenfabrik Lindt & Spruengli AG are examples for the consumer sector.

Figure 3: Sample distribution by sector.



However, Table 3 describes the variables we use in the following regression analysis. Due to an unbalanced data panel the numbers of observations which are included in our analysis depend from the period and the used independent variables, since only cross sections are considered which contain data for the observed variables. As a result, the descriptive statistics shows an individual sample which contains all available observations from the data sources.

For each variable we report mean, median, standard deviation, minimum, maximum and number of observations for the whole period. In the following paragraph we highlight some interesting results. The landscape of listed firms is dominated by small companies and only 10% are large companies. The companies are on average 67 years old, whereas the oldest company in our sample with 495 years is Orell Füssli Holding AG, a printing and bookselling company. Furthermore, the average free float is 68% and almost one fifth of the companies are family owned.

Around 72% of the observed companies act or sell products beyond Switzerland. This is usual for a country with a limited growth within the domestic market. A view on the financials reveals quite interesting results. Table 3 shows that Swiss listed firms were on average not profitable. With every Swiss Franc they earned they made a loss of CHF -1.46. Similar results indicate the ROA ratio. In contrast, the median of ROA and profitability is slightly positive which indicate a highly skewed distribution. Reasons for this performance could be new entrants into the market and distressed firms. For example, Basilea Pharmaceutica AG, a Basel located biopharmaceutical company that was formed as a spin-off entity from Roche Holding AG was founded in 2000 and did its IPO in 2004. From the beginning it was highly exposed to R&D expenses and made no profit until 2009 (Basilea Pharmaceutica AG, online).

Moreover, the average leverage multiple is 1.26x, whereas the median is 0.538x. This indicates that listed firms are leveraged to finance their growth. Due to a high share of firms from the financial sector we have banks and investment companies with a high share of debt relative to their equity. Finally, we describe the macroeconomic variables which are the same for every firm since we only observe in Switzerland based companies. The real GDP growth rate was 2.0%, which is 0.2% less than Germany's GDP growth rate for the same period (The World Bank, online). The inflation rate is relatively low comparable to the European average. Nevertheless, the SMI total return is 3.8%, whereas the DAX yielded around 8% in the same period.

As can be seen in Table 3 R&D comprises a comparably low number of observations. Looking at the common sample descriptive statistics, which are not shown separately, the inclusion of the variable free float leads to a substantial loss in the total number of observations as well. For this sake we decide to exclude free float and R&D from the analysis.

Table 3: Descriptive statistics.

Dependent variables: firm growth	Mean	Median	Maximum	Minimum	Std. Dev.	Observations
EMPLOYEES	9,601.476	1,259.500	361,796.000	1.000	33,365.290	3,688
EMPLOYEES_G_LOG	0.033	0.018	2.796	-4.154	0.263	3,166
FIXED_ASSETS	11,306.360	134.015	2,688,977.000	0.000	158,536.900	3,965
FIXED_ASSETS_G_LOG	0.016	0.002	4.341	-5.432	0.402	3,599
REVENUE	41,898.580	419.972	11,226,735.000	-17,767.500	591,680.700	4,089
REVENUE_G_LOG	0.044	0.029	6.526	-6.729	0.463	3,699

Independent variables	Mean	Median	Maximum	Minimum	Std. Dev.	Observations
Firm characteristics						
SMALL DUMMY	0.557	1.000	1.000	0.000	0.497	5,933
MID_DUMMY	0.338	0.000	1.000	0.000	0.473	5,933
LARGE_DUMMY	0.104	0.000	1.000	0.000	0.305	5,933
AGE	66.979	50.000	495.000	1.000	61.358	5,636
LEVERAGE	1.260	0.538	37.098	0.000	2.372	3,753
FREE_FLOAT	0.681	0.730	1.000	0.002	0.293	3,528
R&D	0.184	0.111	0.979	0.000	0.204	1,544
PROFIT_MARGIN	-1.460	0.047	75.506	-930.333	25.627	3,216
PROFIT_ROA	-0.826	0.024	18.018	-937.574	21.977	3,719
FAMILY_DUMMY	0.194	0.000	1.000	0.000	0.396	5,886
EXPORT_DUMMY	0.719	1.000	1.000	0.000	0.449	5,933
Macroeconomic characteristics						
GDP_G	0.020	0.019	0.041	-0.021	0.016	5,933
INFLATION	0.006	0.006	0.020	-0.007	0.007	5,931
SMI_TR_G_LOG	0.038	0.080	0.312	-0.410	0.196	5,584

able 8.

Notes: The table reports the descriptive statistics of the individual sample, whereas the number of observations in the regression analysis depends on the included variables, the sample period and the regression model. For the notation of the variables see T

4.2 Methodology

We empirically examine the impact of firm specific and macroeconomic determinants on firm growth. We therefore use a linear regression framework. To account for the individual characteristics of firms within a panel data framework we test whether a fixed effects or random effects model is appropriate. The Hausman test delivers evidence that the fixed effects method fits best. In this case the intercept varies across the companies but not over time. One drawback of this method is that the effect of independent time invariant variables cannot be investigated since they are perfectly collinear to the dependent variable. Therefore, we run a pooled regression to analyse time invariant variables, e.g. dummy variables for location, sector, family and export and deny the individuality that may exist among the companies (Kohler & Kreuter, 2012, p. 245). For some variables we could not estimate the coefficient since the number of observations is low and due to a high level of invariance. Nevertheless, we estimate the model for the whole, pre- and post-crisis period for employee, fixed assets and revenue growth. We apply a stepwise regression to test for empirical evidence of each group. First, we include the firm specific variables followed by the macroeconomic variables and second, we add the location and sector dummies.

(a) Pooled regression:

$$FirmGrowth_{it} = \alpha_i + \sum_{j=1}^{J-1} \gamma_i Size_{ijt} + \beta_1 Age_{it} + \beta_2 Debt_{it} + \beta_3 FreeFloat_{it} + \beta_4 ProfitMargin_{it-1} + \beta_5 FamilyDummy_i + \beta_6 (FamilyDummy_i \; x \; ProfitMargin_{it-1}) + \beta_7 R\&D_{it} + \beta_8 Export_i + \beta_9 (R\&D_{it} \; x \; Export_i) + \beta_{10} GdpG_t + \beta_{11} Inlfation_t + \beta_{12} SmiTrLogG_{it-1} + \beta_{13} FinancialCrisisDummy_t + \sum_{k=1}^{K-1} \delta_i Location_{ik} + \sum_{l=1}^{L-1} \vartheta_i Sector_{il} + \varepsilon_{it.} \quad (11)$$

(b) Fixed effects regression:

$$FirmGrowth_{it} = \alpha_i + \sum_{j=1}^{J-1} \gamma_i Size_{ijt} + \beta_1 Age_{it} + \beta_2 Debt_{it} + \beta_3 FreeFloat_{it} + \beta_4 ProfitMargin_{it-1} + \beta_5 R\&D_{it} + \beta_6 GdpG_t + \beta_7 Inlfation_t + \beta_8 SmiTrLogG_{t-1} + \beta_9 FinancialCrisisDummy_t + \sigma_i + \varepsilon_{it.} \quad (12)$$

Equation 11 and 12 reveal the firm growth, measured by employees, fixed assets and revenues of a company i at time t, with $i = 1, \dots, N$, $t = 1, \dots, T$. α_i is a constant term and ε_{it} indicates the error term. Moreover, we include σ_i to the fixed effects model, denoting a separate indicator variable for each firm. We use dummy variables, whereas the number of SIZE dummies is $j - 1$, the number of LOCATION dummies is $k - 1$ and $l - 1$ for SECTOR dummies, according to the Bloomberg classification. To isolate the effect of interaction between family owned companies and their profitability and between export oriented firms and their R&D activities we include two interaction terms. Depending on the left side variables we applied lags for some right side variables. The result of the actual business year of a company has an impact on the following expenses and operational management. Therefore we lagged PROFIT_MARGIN and PROFIT_ROA by one year. Similar effect has the SMI_TR_G_LOG since equities are traded according to future expectations of investors. For the revenue growth model we apply an additional lag for LEVERAGE, because there is a delay between borrowing and investing money and as a result generate an increase in revenues.

To achieve a better understanding of our variables we examine correlation coefficients between those across all sample sub-periods. We define the critical threshold for an existing correlation when the coefficient is

larger than 0.3 and substantial when the coefficient is larger than 0.6. For the interpretation of the correlation coefficients we only consider values on a minimum significance level of at least 5%. In the first instance our correlation analysis helps to avoid multicollinearity in our model. We therefore test pairwise relationships which do not imply causality in direct line or which are redundant. Furthermore, we regress all the independent variables pairwise in a pooled OLS model and observe whether one variable determines another. To cut a long story short, we observe highly significant positive correlation across all three dependent variables. This observation serves evidence for plausibility and outlines the quality of our data since REVENUE, FIXED_ASSETS and EMPLOYEES logically should be correlated in any way. We also find significant positive correlation between REVENUE and PROFIT_MARGIN. To avoid multicollinearity and therefore spurious or biased outcomes we replace PROFIT_MARGIN by PROFIT_ROA in the revenue model. Moreover, we observe a highly significant positive relationship between GDP_G and INFLATION. This as a matter of fact is a logical economical artefact since an increase of the inflation rate mostly comes along with an increase in demand and productivity. But we do not drop one of these variables since GDP_G is a lagging indicator for environmental health of the economy. An observation which is also worth to mention is the relation between SMI_TR_G_LOG and GDP_G. We find a strong, highly significant positive correlation in the pre-crisis period, whereas the relationship in the post-crisis period is negative. Here we can argue that markets were mainly fundamentally driven in the pre-crisis period, while the post-crisis period was strongly influenced by low interest rates and strong monetary easing. While stock markets crashed, economic growth kept stable in Switzerland during the post-crisis period. We further observe highly negative correlation between the size dummies which is a matter of fact since there are complementary in sum. Table 4 also reports a negative relationship between R&D and AGE in the pre-crisis period which allow to suggest, that young firms are more R&D intensive. Finally, family owned companies do have a negative relationship to the amount of free floating shares. This is in line with our expectations since a substantial amount of shares is logically held by the family members.

Table 4: Correlation matrix.

Correlation	EMPLOYEES_G_LOG			FIXED_ASSETS_G_LOG			REVENUE_G_LOG			SMALL_DUMMY			MID_DUMMY		
	(1)	(2)	(3)	(1)	(2)	(3)	(1)	(2)	(3)	(1)	(2)	(3)	(1)	(2)	(3)
EMPLOYEES_G_LOG	1	1	1												
FIXED_ASSETS_G_LOG	0.447***	0.480***	0.409***	1	1	1									
REVENUE_G_LOG	0.178***	0.315***	0.092	0.212***	0.122**	0.292***	1	1	1						
SMALL_DUMMY	-0.095**	-0.105*	-0.101*	-0.155***	-0.215***	-0.082	-0.035	-0.056	-0.028	1	1	1			
MID_DUMMY	0.087**	0.096	0.090	0.119***	0.175***	0.053	0.021	0.030	0.020	-0.845***	-0.860***	-0.828***	1	1	1
LARGE_DUMMY	0.020	0.024	0.022	0.072*	0.091	0.051	0.027	0.053	0.015	-0.328***	-0.339***	-0.316***	-0.226***	-0.185***	-0.269***
AGE	-0.061	-0.094	-0.006	0.008	-0.028	0.050	-0.025	-0.026	-0.024	-0.132***	-0.049	-0.217***	0.123***	0.054	0.193***
LEVERAGE	-0.031	-0.008	-0.051	0.010	0.014	0.006	-0.035	-0.030	-0.037	0.050	0.119**	0.017	-0.024	-0.061	-0.009
FREE_FLOAT	0.066	0.032	0.095	0.101**	0.102*	0.123**	0.031	0.017	0.036	0.043	0.123**	-0.070	-0.009	-0.081	0.088
PROFIT_MARGIN	-0.103**	-0.159***	-0.109*	-0.072*	-0.266***	-0.009	0.486***	0.195***	0.561***	-0.020	0.094	-0.064	0.009	-0.113*	0.053
PROFIT_ROA	0.049	0.141**	0.039	0.066	0.226***	0.052	0.036	0.084	0.031	0.052	-0.103*	0.086	-0.072*	0.045	-0.103*
FAMILY_DUMMY	-0.052	-0.068	-0.036	-0.128***	-0.177***	-0.070	-0.040	-0.038	-0.044	0.143***	0.231***	0.053	-0.140***	-0.234***	-0.049
R&D	0.021	0.074	-0.041	0.010	0.145**	-0.138**	-0.048	-0.118**	-0.008	-0.027	-0.090	0.036	-0.029	0.052	-0.108*
EXPORT_DUMMY	0.065	0.073	0.074	0.046	0.062	-0.005	0.043	0.099*	0.001	-0.128***	-0.121**	-0.114*	0.091**	0.080	0.086
GDP_G	0.198***	0.155***	0.248***	0.013	0.070	-0.033	0.078*	0.106*	0.063	-0.015	-0.007	-0.040	0.021	0.004	0.051
INFLATION	0.146***	0.119**	0.175***	0.072*	0.034	0.155***	0.105**	0.113*	0.107*	0.057	0.022	0.005	-0.034	-0.021	0.018
SMI_TR_G_LOG	-0.011	0.056	-0.107*	-0.036	-0.036	-0.033	0.083**	0.129**	0.057	0.020	-0.000	0.034	-0.023	-0.005	-0.036

Correlation	LARGE_DUMMY			AGE			LEVERAGE			FREE_FLOAT			PROFIT_MARGIN		
	(1)	(2)	(3)	(1)	(2)	(3)	(1)	(2)	(3)	(1)	(2)	(3)	(1)	(2)	(3)
LARGE_DUMMY	1	1	1												
AGE	0.022	-0.005	0.046	1	1	1									
LEVERAGE	-0.048	-0.117*	-0.014	0.069*	0.131**	0.030	1	1	1						
FREE_FLOAT	-0.062	-0.087	-0.029	0.093**	0.010	0.208***	0.095**	0.095	0.108*	1	1	1			
PROFIT_MARGIN	0.019	0.026	0.020	0.071*	0.092	0.079	0.032	0.066	0.027	0.055	0.066	0.055	1	1	1
PROFIT_ROA	0.032	0.115*	0.026	0.085**	0.055	0.124**	0.002	0.051	-0.002	-0.063	0.025	-0.112*	0.025	0.023	0.024
FAMILY_DUMMY	-0.013	-0.014	-0.009	0.063	0.165***	-0.051	-0.005	-0.062	0.030	-0.368***	-0.346***	-0.413***	0.043	0.064	0.042
R&D	0.102**	0.077	0.119**	-0.269***	-0.303***	-0.237***	0.137***	0.060	0.187***	0.119***	0.156***	0.097*	-0.184***	-0.326***	-0.160***
EXPORT_DUMMY	0.072*	0.085	0.050	0.028	0.045	-0.024	-0.025	-0.038	-0.029	-0.003	0.052	-0.034	-0.005	-0.020	0.006
GDP_G	-0.011	0.006	-0.017	0.025	0.035	0.024	-0.056	-0.027	-0.071	0.051	-0.005	0.076	0.010	0.091	-0.016
INFLATION	-0.043	-0.004	-0.039	-0.010	-0.017	0.024	-0.011	0.001	-0.003	0.160***	-0.008	0.167***	-0.006	0.027	-0.024
SMI_TR_G_LOG	0.004	0.010	0.001	0.014	0.033	-0.004	0.003	-0.004	0.010	-0.014	0.011	-0.049	0.101**	0.067	0.129**

Correlation	PROFIT_ROA			FAMILY_DUMMY			R&D			EXPORT_DUMMY			GDP_G			INFLATION		
	(1)	(2)	(3)	(1)	(2)	(3)	(1)	(2)	(3)	(1)	(2)	(3)	(1)	(2)	(3)	(1)	(2)	(3)
PROFIT_ROA	1	1	1															
FAMILY_DUMMY	0.086**	0.069	0.108*	1	1	1												
R&D	-0.016	-0.073	-0.006	-0.257***	-0.311***	-0.204***	1	1	1									
EXPORT_DUMMY	0.033	0.167***	0.023	0.104**	0.120**	0.105*	-0.035	-0.039	-0.045	1	1	1						
GDP_G	0.027	0.077	0.015	0.041	0.030	0.046	-0.017	-0.050	0.014	0.014	0.057	-0.016	1	1	1			
INFLATION	0.055	0.020	0.039	0.010	-0.008	0.000	-0.052	-0.050	-0.042	-0.101**	-0.053	-0.062	0.413***	0.294***	0.490***	1	1	1
SMI_TR_G_LOG	0.013	0.069	0.001	0.015	0.039	-0.011	-0.000	-0.028	0.029	0.038	0.102*	-0.068	0.013	0.498***	-0.438***	-0.076*	0.226***	-0.281***

Notes: Coefficients that are significantly different from zero at 1%, 5% and 10% level are marked with ***, ** and * respectively. Furthermore, (1) indicates the whole period, (2) the pre-crisis period and (3) the post-crisis period.

5 Empirical results

Table 5, 6 and 7 summarises the results of 15 different models for each dependent variable as described in the previous section. The first five columns reveal the results from the whole sample period, whereas the first three show the pooled model and the following two the fixed effects models. We need to apply a pooled regression since time invariant variables cannot be observed in a fixed effects model. The dummies for location, sector, export and family owned companies, however, are time invariant. The number of observations depends on which variables are included in the model. Overall, the fixed effects models are significant according to the F-statistic on a 10% level. In contrast, some pooled regression models are not significant and will not be considered for further interpretations. Additionally, the adjusted R-squared is quite low for pooled regression, because we deny the individuality of the observed companies, whereas the fixed effects model gets a moderate share of determination comparable to further studies (Becchetti & Trovato, 2001, p. 300; Cooney & Malinen, 2004, p. 74; Niskanen & Niskanen, 2007, p. 20).

Since time series are exposed to autocorrelation it is important to take Durbin Watson statistic into consideration to avoid a biased standard error. To indicate the level of autocorrelation we consider critical values according to the method of Imhoff (1961), using the code adapted from algorithm AS 256, by Farebrother (1990). According to a high number of observations, the range for Durbin Watson becomes significantly smaller. Our Durbin Watson test therefore is susceptible to the indication of positive and negative autocorrelation.

5.1 Findings

First, we state the results from firm specific determinants. The coefficient of *SMALL_DUMMY* is negative related to firm growth, except for few observations in the pre-crisis. The results are highly significant for the whole and pre-crisis period for fixed assets growth. Given that we control for time invariant firm characteristics it is not surprising that SIZE is only significant within pooled regression framework. For example, a coefficient of -0.066 means that small firms grow 6.6 log points, respectively 6.8%, slower than the reference category large firms in terms of fixed assets. In contrast, the variable MID_DUMMY reveals no explicit results. The coefficient is positive and negative as well but not significant at all. As assumed Gibrat's Law can be rejected, meaning that firm size matters. Nevertheless, the negative size-growth relationship differs from our expectation that small firms grow faster. Economies of scale could be a reason for this finding.

When observing the negative relationship between *AGE* and firm growth we find evidence across the whole period and both sub-periods of three models. Even though our pooled models do not consider the individuality of each firm, they indicate the same results in the employee model for the whole period and the pre-crisis period. We further accept our findings in the fixed assets and revenue model despite a comparably low coefficient of determination, since they are confirmed in the employee model, which is of better quality. Here we mainly rely on our fixed effects regressions since pooled regressions do not indicate significance. According to our expectations we observe a negative coefficient stating that mature firms grow slower than younger firms. This seems to be logical given that mature firms already exploited their growth potential and therefore need to enter new markets if they are willing to expand further. We find a coefficient which is close to zero. This also matches our expectations since an increase in firm age of one year has only a marginal impact on firm growth.

Furthermore, we find evidence that the level of *LEVERAGE* has an impact on revenue growth (Table 7). This is the case when looking at the pre-crisis fixed effects regression of our revenue model, whereas leverage is lagged by one year. The observed coefficient is positive stating that an increase of one percent in leverage leads to an increase in revenues of 3.5 log points, which corresponds to 3.6%. The observed coefficient is not significant in the post-crisis. The mentioned relationship therefore exists only in the pre-crisis period. We suppose that the debt level of a company could have become irrelevant for two reasons. First, interest rates have dropped substantially in the post-crisis period which could have led to distortion in the relationship

since firms were incentivised to raise debt disproportional to revenue growth. Second, due to a lack of growth stimulating investment cases, which could have been a result of high uncertainty during the financial crisis.

Next, we find different results for the relationship between profitability and growth. Table 5 reveals a significant positive relation over all periods, whereas the coefficient is quite low. In contrast, the financial crisis might have influenced the pattern for the fixed assets model (Table 6) since the positive profit growth relationship turns negative in the post-crisis. It might be possible that even profitable firms reduced their new investments and therefore growth rates slowed downed or turned negative due to depreciations and higher uncertainty after financial crisis. Moreover, the lagged PROFIT_ROA within the revenue model shows comparable higher and negatively related coefficients over the whole period. Overall, our hypothesised relation holds only for growth in terms of employees.

However, we expect that family owned firms grow slower than those with a substantial amount of free floating shares or those with substantial managerial influence through observing *FAMILY_DUMMY.* We rely on our assumptions since the latter are only interested in maximising profitability, while family owned firms prefer a more sustainable and less risky managerial approach (Sharma, Chrisman & Chua, 2009, p. 5). Since this variable is time invariant we are not able to estimate a fixed effects regression. However, we find evidence for its relevance in the post-crisis pooled regressions of our employee and fixed assets model. Even though the models show a poor coefficient of determination, the F-statistic is significant. We therefore aim to interpret the direction and relevance of the relationship. Our employee model indicates a negative coefficient on a 10% significance level while our fixed effects model reveals a negative coefficient on a 5% significance level, meaning that family owned firms grow slower than others. This confirms our expectation.

We further apply an interaction term to provide information about the relevance of *FAMILY_DUMMY* and *PROFIT* as one entity. We only find a significant relationship on a 5% level in the pre-crisis period of our fixed assets model. Due to a low coefficient of determination and vast positive autocorrelation, which was not further eliminable by changing the lag structure, we forego to interpret this finding.

Next, we examine whether *EXPORT_DUMMY* has an influence. The variable is time invariant and therefore only observable for pooled regression model. We only come up with negatively related significant results on a 10% significance level over the whole period. For the fixed assets models we observe a high standard error, while the revenue models deny a significant relationship. In consideration of the low adjusted R-squared and a significant positive autocorrelation we cannot evaluate our hypothesised relationship.

One could assume that the *LOCATION* of a company matters. Economic areas are exposed to different market growth rates, competition and tax regimes. Interestingly, we find no evidence that companies which are located in the area of Zurich have higher growth rates than others. The tax system in Switzerland reflects the federalistic oriented political system (Swiss Confederation (c), online). For example, the canton Zug, which is a part of Central Switzerland, is very attractive for national and international company headquarters due to low tax rates. Almost 10.6% of our observed companies are located in this area. However, the tax level overall Switzerland is relatively low in comparison to other European countries, like Germany or France. Another fact for the independence between firm growth and location could be that, Switzerland has an excellent infrastructure and well developed public transport system which improves the local labour availability.

Moreover, we observe *SECTOR* specific growth pattern through a dummy variable, whereas the FINANCIAL sector is the largest one and therefore used as reference category. Table 5, 6 and 7 reveal significant and consistent results over the whole and sub-periods. BASIC_MATERIALS, DIVERSIFIED and CONSUMER_CYCLICAL have on average lower growth rates than firms in the financial sector. In contrast, CONSUMER_NON_CYCLICAL and ENERGY have higher growth rates. We assume that the highly significant ENERGY dummy is biased through restructuring activities of the Swiss energy sector. In 2009, Swissgrid AG, which is owned by various Swiss energy companies, took over the operation of the high voltage grid and became owner of the Swiss transmission grid in 2013 (Swissgrid, 2013, p. 1). The non-

cyclical consumer sector contains mainly firms from the pharmaceutical industry like Roche Holding AG, Novartis AG, Acino Holding AG or Santhera Pharmaceuticals AG. Therefore, it is not surprising that this sector is significant since the pharmaceutical industry has an annual average growth rate of 10% over the last 20 years (Interpharma, 2011, p. 14).

In the following section we want to outline the results from macroeconomic determinants. *GDP_G* is an important ex post indicator for economic health as recently mentioned. We find significant evidence for a positive relationship in the pre-crisis of the employee and revenue model. Especially the fixed effects regressions, which are of better quality than the pooled regressions show up significance on a 1% level in the employee model, and on 5% level in the revenue model. The post crisis period again could be biased by a high degree of uncertainty inducing firms not to hire new employees. We abstain from interpreting our significant coefficients in the fixed assets model due to poor coefficient of determination, significance at 10% level and absence of confirmation by the fixed effects model.

Furthermore, *INFLATION* is positively significant related to all three firm growth rates on a 1% significance level. The high coefficient has to be handled with particular caution since the standard error is very high and the autocorrelation occur as well. Nevertheless, we observe a distinct pattern for this macroeconomic determinant. An increase in the general national price level leads to increasing growth rates, including the employee model. This is in line with our expectation.

We expected a positive relationship between the *SMI_TR_G_LOG* and firm growth. We lagged the variable by one year since it represents the expectations for the upcoming year. Our revenue model indicates a highly significant positive relationship on a 1% level during the pre-crisis period. The stock market therefore correctly predicted the growth potential of revenue in the pre-crisis. We can argue that stocks were mainly driven by monetary easing and uncertainty which came up with the banking crisis and then spilled over to a global financial and debt crisis. Our employee and fixed asset model does not show evidence for a significant relationship. We do not interpret the significant coefficient in the employee model fixed effects regression due to a significance level of 10% and a relatively high standard error.

Finally, we apply a *FINANCIAL_CRISIS_DUMMY* to distinguish between firm growth during the financial crisis period and the time around the financial crisis. Our models do not show evidence for the significance of this term. We do not interpret the fixed assets model due to positive autocorrelation, a relatively high standard error and significance on a 10% level.

Table 5: Regression results for the employee model.

Dependent variable:	Whole period: 1999 - 2014					Pre-crisis: 1999 - 2006					Post-crisis: 2007 - 2014				
EMPLOYEES_G_LOG	Pooled model			Fixed effects model		Pooled model			Fixed effects model		Pooled model			Fixed effects model	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
CONSTANT	0.054**	0.016	0.003	0.678***	0.629***	0.077***	-0.004	-0.024	1.033***	1.484***	0.012	-0.001	-0.007	0.986***	0.078
	(0.022)	(0.023)	(0.028)	(0.113)	(0.200)	(0.028)	(0.033)	(0.039)	(0.258)	(0.369)	(0.036)	(0.037)	(0.044)	(0.285)	(0.696)
Firm specific															
SMALL_DUMMY	-0.022	-0.024	-0.005	-0.062	-0.062	-0.015	-0.017	0.007	-0.100	-0.128	-0.028	-0.028	-0.020	-0.057	-0.056
	(0.017)	(0.017)	(0.019)	(0.054)	(0.054)	(0.024)	(0.023)	(0.025)	(0.115)	(0.113)	(0.026)	(0.026)	(0.028)	(0.070)	(0.070)
MID_DUMMY	0.019	0.018	0.036*	0.013	0.013	0.015	0.013	0.039	-0.007	-0.023	0.025	0.026	0.034	0.033	0.031
	(0.018)	(0.018)	(0.019)	(0.050)	(0.049)	(0.025)	(0.025)	(0.026)	(0.102)	(0.100)	(0.027)	(0.027)	(0.029)	(0.063)	(0.063)
AGE	-0.000***	-0.000***	-0.000**	-0.007***	-0.007***	-0.000***	-0.000***	-0.000**	-0.012***	-0.018***	-0.000	-0.000	-0.000	-0.011***	-0.000
	(0.000)	(0.000)	(0.000)	(0.001)	(0.002)	(0.000)	(0.000)	(0.000)	(0.003)	(0.004)	(0.000)	(0.000)	(0.000)	(0.003)	(0.008)
LEVERAGE	-0.001	-0.001	-0.001	-0.001	0.000	-0.002	-0.001	-0.001	-0.001	-0.000	-0.000	0.000	-0.000	0.004	0.007
	(0.002)	(0.002)	(0.002)	(0.003)	(0.003)	(0.002)	(0.002)	(0.002)	(0.004)	(0.004)	(0.004)	(0.004)	(0.005)	(0.011)	(0.011)
PROFIT_MARGIN(-1)	0.000**	0.000**	0.000**	0.000**	0.000*	0.000	0.000	0.000	0.001*	0.001*	0.000**	0.000**	0.000**	0.000*	0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
FAMILY_DUMMY	-0.017	-0.017	-0.009			-0.005	-0.004	0.005			-0.030*	-0.030*	-0.020		
	(0.011)	(0.011)	(0.012)			(0.015)	(0.015)	(0.016)			(0.018)	(0.018)	(0.019)		
FAMILY x PROFIT(-1)	-0.049	-0.045	-0.054			-0.040	-0.057	-0.067			-0.050	-0.046	-0.050		
	(0.033)	(0.033)	(0.033)			(0.066)	(0.065)	(0.066)			(0.040)	(0.040)	(0.040)		
EXPORT_DUMMY	0.007	0.010	0.008			-0.011	-0.009	-0.011			0.039	0.039	0.043		
	(0.014)	(0.014)	(0.015)			(0.018)	(0.017)	(0.019)			(0.024)	(0.024)	(0.027)		
Macro specific															
GDP_G		0.708*	0.651*		1.326***		1.204**	1.214**		1.989***		0.323	0.248		0.460
		(0.374)	(0.374)		(0.437)		(0.565)	(0.561)		(0.571)		(0.575)	(0.573)		(0.699)
INFLATION		3.098***	3.391***		0.520		5.689***	5.740***		0.108		2.337**	2.719**		3.349
		(0.833)	(0.836)		(1.579)		(1.560)	(1.555)		(2.044)		(1.147)	(1.148)		(2.235)
SMI_TR_G_LOG(-1)		0.025	0.022		0.056*		0.001	-0.004		0.071		-0.006	-0.011		-0.012
		(0.027)	(0.027)		(0.030)		(0.041)	(0.041)		(0.046)		(0.045)	(0.045)		(0.060)
FINANCIAL_CRISIS_DUMMY		-0.000	-0.002		0.025										
		(0.014)	(0.014)		(0.020)										
Location dummy															
ESPACE_MITTELLAND			0.001					-0.002					0.001		
			(0.017)					(0.023)					(0.027)		
LAKE_GENEVA_REGION			-0.031*					-0.036					-0.031		
			(0.017)					(0.022)					(0.027)		
LIECHTENSTEIN			-0.030					-0.045					0.009		
			(0.056)					(0.067)					(0.095)		
NW_SWITZERLAND			-0.011					-0.025					0.011		
			(0.017)					(0.023)					(0.027)		
EASTERN_SWITZERLAND			0.022					0.006					0.034		
			(0.023)					(0.033)					(0.035)		
TICINO			-0.006					-0.049					0.027		
			(0.058)					(0.074)					(0.093)		
CENTRAL_SWITZERLAND			-0.009					-0.018					-0.000		
			(0.017)					(0.022)					(0.026)		
Sector dummy															
BASICMATERIALS			-0.054**					-0.050					-0.061		
			(0.025)					(0.034)					(0.037)		
COMMUNICATIONS			-0.019					-0.030					-0.012		
			(0.039)					(0.053)					(0.059)		
CONSUMER_CYCLICAL			-0.046**					-0.013					-0.121***		
			(0.023)					(0.029)					(0.039)		
CONSUMER_NONCCYCLICAL			0.031*					0.046*					0.012		
			(0.019)					(0.026)					(0.028)		
DIVERSIFIED			0.068					0.042					0.109		
			(0.049)					(0.065)					(0.076)		
ENERGY			0.109**					0.161**					0.056		
			(0.048)					(0.067)					(0.070)		
INDUSTRIAL			-0.012					-0.023					-0.002		
			(0.017)					(0.024)					(0.027)		
TECHNOLOGY			-0.005					0.059					-0.102*		
			(0.032)					(0.040)					(0.054)		
UTILITIES			0.048*					0.095**					0.001		
			(0.028)					(0.039)					(0.043)		
Number of observations	2,114	2,114	2,114	2,143	2,143	1,103	1,103	1,103	1,132	1,132	1,011	1,011	1,011	1,011	1,011
Number of companies	248	248	248	259	259	227	227	227	238	238	171	171	171	171	171
Adjusted R-squared	0.012	0.024	0.034	0.109	0.118	0.006	0.027	0.043	0.113	0.137	0.015	0.020	0.032	0.254	0.260
F-statistic	4.217	5.415	3.688	1.992	2.077	1.852	3.769	2.844	1.597	1.734	2.970	2.873	2.244	2.970	2.992
Prob. (F-statistic)	0.000	0.000	0.000	0.000	0.000	0.064	0.000	0.000	0.000	0.000	0.003	0.001	0.000	0.000	0.000
Durbin-Watson statistic	1,528(2)	1,531(2)	1,559(2)	1,934(1)	1,938(1)	1,578(2)	1,588(2)	1,639(2)	2,223(3)	2,222(3)	1,335(2)	1,334(2)	1,373(2)	2,101(1)	2,111(1)

Notes: The table reports results from pooled and fixed effects estimations of firm specific- and macro specific characteristics on firm growth. The dependent variable is the natural logarithm of annual employee growth. The reference categories are defined as follows: LOCATION – ZURICH, SECTOR – FINANCIAL and SIZE – LARGE_DUMMY. Furthermore, interaction term considers the influence of profit on family owned companies within the pooled regression framework. Coefficients that are significantly different from zero at 1%, 5% and 10% level are marked with ***, ** and * respectively. Robust standard errors are in brackets. Critical values for Durbin Watson test are set by the Imhoff 1961) method, using the code adapted from algorithm AS 256, by Farebrother (1990). We approximately use n=2000 for the whole period, n=1100 for the pre-crisis period and n=1000 for the post-crisis period. The number of variables is K=8 for the firm specific model and K=12 for the model including macro specific variables and K=21 for the model including location and sector dummies. For simplicity reasons we cap the number of variables at K=21 for the last model in each pooled regression even though we observe 28 independent variables. The Durbin Watson test for the fixed effects models is estimated with K=5 for the firm specific model and K=9 for the model including macro specific variables. (1) indicates that DW values are in range, (2) indicates positive autocorrelation and (3) indicates negative autocorrelation. Numbers are untouched in case of inconclusiveness. Critical values can be found in Table 11.

Table 6: Regression results for the fixed assets model.

Dependent variable:	Whole period: 1999 - 2014					Pre-crisis: 1999 - 2006					Post-crisis: 2007 - 2014				
FIXEDASSETS_G_LOG	Pooled model			Fixed effects model		Pooled model			Fixed effects model		Pooled model			Fixed effects model	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
CONSTANT	0.099***	0.088***	0.130***	0.584***	0.448	0.101**	0.046	0.114*	1.973***	2.062***	0.095**	0.099**	0.105**	1.127***	1.329
	(0.030)	(0.032)	(0.038)	(0.154)	(0.276)	(0.045)	(0.053)	(0.063)	(0.426)	(0.619)	(0.039)	(0.041)	(0.048)	(0.332)	(0.821)
Firm specific															
SMALL_DUMMY	-0.066***	-0.067***	-0.059**	-0.021	-0.011	-0.082**	-0.084**	-0.081**	-0.013	-0.021	-0.046	-0.046	-0.029	-0.011	-0.011
	(0.024)	(0.024)	(0.025)	(0.076)	(0.076)	(0.038)	(0.037)	(0.040)	(0.202)	(0.203)	(0.030)	(0.029)	(0.032)	(0.082)	(0.082)
MID_DUMMY	-0.013	-0.013	-0.000	0.055	0.063	-0.009	-0.011	-0.019	0.230	0.223	-0.016	-0.015	0.015	-0.012	-0.012
	(0.025)	(0.025)	(0.027)	(0.069)	(0.069)	(0.040)	(0.040)	(0.042)	(0.182)	(0.182)	(0.031)	(0.031)	(0.033)	(0.074)	(0.074)
AGE	-0.000	-0.000	-0.000	-0.007***	-0.005*	-0.000	-0.000	-0.000	-0.026***	-0.028***	-0.000	-0.000	-0.000	-0.012***	-0.015
	(0.000)	(0.000)	(0.000)	(0.001)	(0.003)	(0.000)	(0.000)	(0.000)	(0.005)	(0.007)	(0.000)	(0.000)	(0.000)	(0.003)	(0.009)
LEVERAGE	-0.000	-0.000	-0.004	-0.002	-0.002	0.000	-0.000	-0.004	0.001	0.001	-0.000	-0.000	-0.003	-0.011	-0.011
	(0.003)	(0.003)	(0.003)	(0.005)	(0.005)	(0.004)	(0.004)	(0.004)	(0.007)	(0.007)	(0.005)	(0.005)	(0.005)	(0.011)	(0.011)
PROFIT_MARGIN(-1)	-0.000	-0.000	-0.000	-0.000***	-0.000**	0.000	0.000	0.000	0.002	0.002	-0.000	-0.000	-0.000	-0.000***	-0.000***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
FAMILY_DUMMY	-0.030*	-0.030*	-0.011			-0.014	-0.014	0.010			-0.048**	-0.048**	-0.037		
	(0.016)	(0.016)	(0.017)			(0.025)	(0.025)	(0.027)			(0.020)	(0.020)	(0.022)		
FAMILY x PROFIT(-1)	0.058	0.058	0.054			0.256**	0.251**	0.227**			-0.003	-0.001	-0.009		
	(0.047)	(0.047)	(0.048)			(0.106)	(0.106)	(0.108)			(0.047)	(0.048)	(0.048)		
EXPORT_DUMMY	-0.036*	-0.034*	-0.035*			-0.037	-0.032	-0.038			-0.032	-0.031	-0.022		
	(0.019)	(0.019)	(0.021)			(0.028)	(0.028)	(0.030)			(0.026)	(0.026)	(0.028)		
Macro specific															
GDP_G		-0.821	-0.907*		-0.605		-0.769	-0.770		0.277		-1.093*	-1.169*		-0.273
		(0.512)	(0.513)		(0.610)		(0.907)	(0.901)		(0.957)		(0.646)	(0.646)		(0.837)
INFLATION		2.802**	3.204***		2.085		7.358***	7.736***		1.370		4.038***	4.331***		0.896
		(1.142)	(1.149)		(2.216)		(2.520)	(2.508)		(3.480)		(1.289)	(1.292)		(2.676)
SMI_TR_G_LOG(-1)		0.000	-0.003		0.021		-0.067	-0.075		0.058		0.015	0.009		0.095
		(0.038)	(0.038)		(0.043)		(0.067)	(0.066)		(0.077)		(0.051)	(0.051)		(0.073)
FINANCIAL_CRISIS_DUMMY		0.034*	0.030		0.037										
		(0.020)	(0.020)		(0.028)										
Location dummy															
ESPACE_MITTELLAND			0.028					0.024					0.023		
			(0.024)					(0.037)					(0.031)		
LAKE_GENEVA_REGION			-0.016					-0.036					0.016		
			(0.023)					(0.035)					(0.029)		
LIECHTENSTEIN			-0.071					-0.031					-0.127		
			(0.082)					(0.116)					(0.114)		
NW_SWITZERLAND			-0.022					-0.026					-0.023		
			(0.024)					(0.038)					(0.030)		
EASTERN_SWITZERLAND			0.040					0.052					0.016		
			(0.034)					(0.054)					(0.042)		
TICINO			0.027					0.007					0.021		
			(0.086)					(0.128)					(0.113)		
CENTRAL_SWITZERLAND			-0.005					0.012					-0.037		
			(0.024)					(0.037)					(0.030)		
Sector dummy															
BASICMATERIALS			-0.059*					-0.071					-0.035		
			(0.035)					(0.055)					(0.043)		
COMMUNICATIONS			-0.072					-0.127					-0.023		
			(0.055)					(0.087)					(0.068)		
CONSUMER_CYCLICAL			-0.090***					-0.107**					-0.037		
			(0.031)					(0.047)					(0.044)		
CONSUMER_NONCCYCLICAL			-0.024					-0.015					-0.027		
			(0.025)					(0.041)					(0.031)		
DIVERSIFIED			-0.247***					-0.466***					-0.037		
			(0.067)					(0.110)					(0.080)		
ENERGY			-0.013					-0.149					0.127		
			(0.064)					(0.104)					(0.077)		
INDUSTRIAL			-0.069***					-0.101***					-0.029		
			(0.023)					(0.037)					(0.029)		
TECHNOLOGY			-0.068					0.018					-0.216***		
			(0.044)					(0.064)					(0.063)		
UTILITIES			-0.024					0.020					-0.057		
			(0.038)					(0.063)					(0.047)		
Number of observations	2,438	2,438	2,438	2,469	2,469	1,264	1,264	1,264	1,295	1,295	1,174	1,174	1,174	1,174	1,174
Number of companies	264	264	264	275	275	246	246	246	257	257	179	179	179	179	179
Adjusted R-squared	0.008	0.012	0.017	0.072	0.074	0.011	0.016	0.031	0.047	0.046	0.005	0.011	0.015	0.127	0.129
F-statistic	3.426	3.473	2.484	1.684	1.700	2.732	2.874	2.493	1.246	1.239	1.674	2.142	1.682	1.931	1.930
Prob. (F-statistic)	0.001	0.000	0.000	0.000	0.000	0.005	0.001	0.000	0.010	0.012	0.100	0.015	0.016	0.000	0.000
Durbin-Watson statistic	1,639(2)	1,634(2)	1,654(2)	1,967(1)	1,959(1)	1,271(2)	1,288(2)	1,328(2)	1,626(2)	1,629(2)	1,778(2)	1,781(2)	1,815(2)	2,375(3)	2,367(3)

Notes: The table reports results from pooled and fixed effects estimations of firm specific- and macro specific characteristics on firm growth. The dependent variable is the natural logarithm of annual fixed assets growth. The reference categories are defined as follows: LOCATION – ZURICH, SECTOR – FINANCIAL and SIZE – LARGE_DUMMY. Furthermore, interaction term considers the influence of profit on family owned companies within the pooled regression framework. Coefficients that are significantly different from zero at 1%, 5% and 10% level are marked with ***, ** and * respectively. Robust standard errors are in brackets. Critical values for Durbin Watson test are set by the Imhoff 1961) method, using the code adapted from algorithm AS 256, by Farebrother (1990). We approximately use n=2000 for the whole period, n=1100 for the pre-crisis period and n=1000 for the post-crisis period. The number of variables is K=8 for the firm specific model and K=12 for the model including macro specific variables and K=21 for the model including location and sector dummies. For simplicity reasons we cap the number of variables at K=21 for the last model in each pooled regression even though we observe 28 independent variables. The Durbin Watson test for the fixed effects models is estimated with K=5 for the firm specific model and K=9 for the model including macro specific variables. (1) indicates that DW values are in range, (2) indicates positive autocorrelation and (3) indicates negative autocorrelation. Numbers are untouched in case of inconclusiveness. Critical values can be found in Table 11.

Table 7: Regression results for the revenue model.

Dependent variable:	Whole period: 1999 - 2014					Pre-crisis: 1999 - 2006					Post-crisis: 2007 - 2014				
REVENUE_G_LOG	Pooled model			Fixed effects model		Pooled model			Fixed effects model		Pooled model			Fixed effects model	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
CONSTANT	0.079*	0.014	-0.020	0.813***	0.474	0.095*	0.012	-0.029	0.522	1.115**	0.071	0.028	0.003	1.255**	0.409
	(0.038)	(0.040)	(0.048)	(0.178)	(0.312)	(0.049)	(0.057)	(0.069)	(0.372)	(0.526)	(0.060)	(0.062)	(0.074)	(0.486)	(1.163)
Firm specific															
SMALL_DUMMY	-0.044	-0.049	-0.011	-0.076	-0.083	-0.060	-0.066	-0.020	0.068	0.061	-0.036	-0.037	-0.006	-0.104	-0.106
	(0.030)	(0.029)	(0.031)	(0.075)	(0.074)	(0.040)	(0.040)	(0.043)	(0.163)	(0.161)	(0.044)	(0.044)	(0.048)	(0.105)	(0.104)
MID_DUMMY	-0.021	-0.023	0.005	-0.047	-0.051	-0.048	-0.052	-0.022	0.001	-0.006	-0.000	-0.000	0.026	-0.054	-0.057
	(0.032)	(0.032)	(0.034)	(0.066)	(0.066)	(0.044)	(0.043)	(0.046)	(0.139)	(0.137)	(0.048)	(0.047)	(0.051)	(0.091)	(0.091)
AGE	-0.000	-0.000*	-0.000*	-0.008***	-0.005	-0.000	-0.000	0.000	-0.007	-0.015**	-0.000	-0.000	-0.000	-0.013**	-0.004
	(0.000)	(0.000)	(0.000)	(0.001)	(0.003)	(0.000)	(0.000)	(0.000)	(0.004)	(0.006)	(0.000)	(0.000)	(0.000)	(0.005)	(0.013)
LEVERAGE(-1)	-0.005	-0.005	-0.003	0.008	0.010	-0.005	-0.005	-0.002	0.032***	0.035***	-0.007	-0.007	-0.006	-0.015	-0.015
	(0.004)	(0.004)	(0.004)	(0.006)	(0.006)	(0.004)	(0.004)	(0.005)	(0.008)	(0.008)	(0.008)	(0.008)	(0.009)	(0.013)	(0.013)
PROFIT_ROA(-1)	-0.012	-0.014	-0.011	-0.017	-0.019	-0.030	-0.033	-0.041	-0.053	-0.056*	-0.007	-0.009	-0.004	-0.012	-0.015
	(0.016)	(0.016)	(0.016)	(0.020)	(0.020)	(0.031)	(0.031)	(0.032)	(0.034)	(0.034)	(0.019)	(0.019)	(0.020)	(0.027)	(0.027)
FAMILY_DUMMY	-0.020***	-0.023	-0.010			-0.031	-0.030	-0.012			-0.016	-0.017	0.000		
	(0.021)	(0.021)	(0.023)			(0.028)	(0.028)	(0.030)			(0.032)	(0.032)	(0.035)		
FAMILY x PROFIT(-1)	-0.056**	-0.055	-0.072			0.111	0.109	0.083			-0.103	-0.101	-0.134**		
	(0.056)	(0.056)	(0.056)			(0.116)	(0.115)	(0.118)			(0.066)	(0.066)	(0.068)		
EXPORT_DUMMY	0.016	0.019	0.006			0.029	0.029	0.005			0.004	0.005	0.004		
	(0.025)	(0.025)	(0.027)			(0.031)	(0.031)	(0.034)			(0.041)	(0.041)	(0.044)		
Macro specific															
GDP_G		1.103*	1.082		1.467**		-0.032	-0.016		1.798**		1.281	1.271		1.822
		(0.662)	(0.661)		(0.662)		(1.018)	(1.009)		(0.798)		(1.001)	(1.004)		(1.128)
INFLATION		5.469***	5.788***		3.790		7.842***	7.773**		2.548		5.333***	5.651***		4.769
		(1.429)	(1.437)		(2.384)		(2.740)	(2.725)		(2.839)		(1.983)	(1.992)		(3.612)
SMI_TR_G_LOG(-1)		0.157***	0.150***		0.129***		0.221***	0.216***		0.200***		0.117	0.104		0.122
		(0.049)	(0.049)		(0.046)		(0.075)	(0.075)		(0.064)		(0.078)	(0.078)		(0.100)
FINANCIAL_CRISIS_DUMMY		0.012	0.011		-0.004										
		(0.026)	(0.026)		(0.030)										
Location dummy															
ESPACE_MITTELLAND			-0.030					-0.026					-0.035		
			(0.031)					(0.042)					(0.049)		
LAKE_GENEVA_REGION			-0.015					-0.010					-0.017		
			(0.029)					(0.040)					(0.045)		
LIECHTENSTEIN			-0.067					-0.027					-0.115		
			(0.099)					(0.120)					(0.168)		
NW_SWITZERLAND			0.029					0.024					0.030		
			(0.031)					(0.043)					(0.046)		
EASTERN_SWITZERLAND			0.026					0.004					0.028		
			(0.042)					(0.061)					(0.060)		
TICINO			-0.013					-0.033					-0.006		
			(0.104)					(0.132)					(0.166)		
CENTRAL_SWITZERLAND			0.000					0.005					-0.024		
			(0.031)					(0.042)					(0.048)		
Sector dummy															
BASICMATERIALS			-0.025					-0.004					-0.048		
			(0.043)					(0.059)					(0.065)		
COMMUNICATIONS			0.004					-0.002					-0.003		
			(0.068)					(0.093)					(0.101)		
CONSUMER_CYCLICAL			-0.033					-0.043					0.003		
			(0.040)					(0.051)					(0.067)		
CONSUMER_NONCCYCLICAL			0.066**					0.079*					0.053		
			(0.032)					(0.045)					(0.048)		
DIVERSIFIED			-0.287***					-0.473***					-0.066		
			(0.094)					(0.122)					(0.149)		
ENERGY			0.174**					0.232**					0.139		
			(0.082)					(0.109)					(0.126)		
INDUSTRIAL			0.004					0.014					-0.007		
			(0.030)					(0.041)					(0.046)		
TECHNOLOGY			0.008					0.129*					-0.216*		
			(0.063)					(0.076)					(0.114)		
UTILITIES			0.081					0.163**					0.001		
			(0.051)					(0.073)					(0.075)		
Number of observations	2,125	2,125	2,125	2,824	2,824	1,086	1,086	1,086	1,477	1,477	1,039	1,039	1,039	1,347	1,347
Number of companies	267	267	267	291	291	239	239	239	263	263	170	170	170	218	218
Adjusted R-squared	0.002	0.018	0.025	0.013	0.026	0.000	0.020	0.041	0.087	0.113	0.000	0.010	0.007	0.089	0.101
F-statistic	1.431	4.178	2.950	1.130	0.130	1.040	3.062	2.698	1.527	1.698	0.970	1.972	1.258	1.590	1.669
Prob. (F-statistic)	0.178	0.000	0.000	0.073	0.003	0.403	0.000	0.000	0.000	0.000	0.458	0.028	0.172	0.000	0.000
Durbin-Watson statistic	2,320(3)	2,339(3)	2,373(3)	2,399(3)	2,401(3)	1,512(2)	1,512(2)	1,564(2)	1,945(1)	1,955(1)	2,624(3)	2,633(3)	2,664(3)	2,825(3)	2,836(3)

Notes: The table reports results from pooled and fixed effects estimations of firm specific- and macro specific characteristics on firm growth. The dependent variable is the natural logarithm of annual revenue growth. The reference categories are defined as follows: LOCATION – ZURICH, SECTOR – FINANCIAL and SIZE – LARGE_DUMMY. Furthermore, interaction term considers the influence of profit on family owned companies within the pooled regression framework. Coefficients that are significantly different from zero at 1%, 5% and 10% level are marked with ***, ** and * respectively. Robust standard errors are in brackets. Critical values for Durbin Watson test are set by the Imhoff 1961) method, using the code adapted from algorithm AS 256, by Farebrother (1990). We approximately use n=2000 for the whole period, n=1100 for the pre-crisis period and n=1000 for the post-crisis period. The number of variables is K=8 for the firm specific model and K=12 for the model including macro specific variables and K=21 for the model including location and sector dummies. For simplicity reasons we cap the number of variables at K=21 for the last model in each pooled regression even though we observe 28 independent variables. The Durbin Watson test for the fixed effects models is estimated with K=5 for the firm specific model and K=9 for the model including macrospecific variables. (1) indicates that DW values are in range, (2) indicates positive autocorrelation and (3) indicates negative autocorrelation. Numbers are untouched in case of inconclusiveness. Critical values can be found in Table 11.

5.2 Robustness tests

In the following part we outline information about robustness tests we did before and during the regression analysis. First, we analysed sample data regarding causality, variability and extreme values. For the independent variables we only consider data if there is variation between the reported business years. More precisely, if there is no variation in the data of recent years comparable to previous years we only look at data from the previous year and recent year were labelled with n/a. In the case that data quality for specific variables was not satisfactory we use S&P Capital IQ database, for example for AGE or EXPORT_DUMMY to improve data quality. We further did random tests if the amount of the variable fits to the related company. Consistent with M&A activities at the market, we consider jumps for example in the amount of employees or fixed assets, if the amount remain consistent on a higher or lower level in the following years, otherwise we adjust the data to previous years.

Second, the sample includes all companies that are at least three consecutive years in the Swiss All Share Index. Hence, we consider firms which were liquidated during the observation period and have therefore no survivorship bias in our sample. Furthermore, we do not have a selection bias, given that the sample includes all Swiss listed companies.

Third, before we run the lag structure we lagged all independent variables by one year in order to reduce autocorrelation and to improve the coefficient of determination. This method did not lead to remarkable improvements comparing to the described model. Therefore, we decide to follow our theoretical assumptions and apply time lags only for those variables which seems to be economically meaningful.

Finally, we apply a stepwise regression. Even if the coefficient of determination is quite low for the majority of the estimated models, we could see that significant relationships remain stable. The decomposition of the sample in pre- and post-crisis period increase transparency as well.

6 Practical implications

Overall, our findings provide some interesting insights into the dynamics that determine the growth of Swiss listed firms. For managers and also for investors it is important to be aware about the determinants. We therefore touch the managerial and the investors perspective to point out some practical implication in accordance to our findings.

The universe of strategic decisions is quite manifold. One strategic decision, which has to be taken by the management, is the determination of the achievable size of a company. We find evidence that large firms tend to grow faster than small firms. This seems logical in any way since large firms have better access to external financing, manage easier to hire qualified workforce for reputational reasons and - in case that a firm is internationally established - have access to foreign markets. This, as a matter of fact, should incentivise managers to achieve a certain size enabling the company to benefit from the mentioned reasons.

A merger or acquisition of a company probably is a one in a lifetime experience for the most managers. According to our findings it should be more attractive from a growth perspective to acquire a young firm than mature ones. Managers therefore should consider start-ups as well, when thinking about mergers or acquisitions. Since young firms show up a larger growth potential, investors should perform a broad analysis to judge the risk-return relation.

Again, we reveal that the choice of a firm's headquarters does not matter in Switzerland. Managers therefore should choose a location that is beneficiary from a strategic point of view.

Additionally, there is a positive relationship between financial leverage and revenue growth in the pre-crisis period. This, as a matter of fact, should incentivise managers to leverage their firm. However, we expect this relationship only to be existent when growth-stimulating investments can be undertaken. This was probably not the case in the post crisis period where we do not observe a significant relationship.

The relationship between profitability and firm growth was positive, meaning that the more profitable a firm is, the faster it grows. This finding is interesting from an investor's perspective. These could invest only in the most profitable firms speculating for increasing growth rates in the future. Even though the expected future cash flows will be priced in the investment vehicle, this strategy could be successful when business grows faster than expected. Looking at the ownership structure we find evidence that family owned firms grow slower than others. We expect this result since family owned companies more likely apply a sustainable approach, which is not as risky as those if the shareholder’s only aim is to maximise profitability. Investors therefore can invest in family owned businesses if they pursue a sustainable low risk strategy rather than a profit maximising one.

We also observe GDP growth and inflation and indicate a positive relationship for both variables. Neither managers, nor investors are able to influence these determinants.

However, they should be able to judge in which economic cycle they are to prepare themselves adequately. We therefore advise both to undertake ongoing market analysis and research.

7 Concluding remarks

This study is one of the former examining the determinants of firm growth for Swiss listed firms. We answer the question by observing firm specific and macroeconomic determinants in accordance to previous literature. In contrast to previous studies we enlarged our analysis and investigate the impact of the financial crisis, domestic location, export activity, (family-) ownership structure and the Swiss market index. The sample period is split into two sub-periods consisting of the pre-crisis period from 1999 until 2006 and the post-crisis period from 2007 until 2014. More precisely, we obtain panel data from 349 listed firms and apply a pooled and fixed effects model to examine the determinants.

Our main result is that firm growth does not follow a random walk and has specific determinants. For example, we find evidence for a positive related size-growth relationship and therefore reject Gibrat's Law. According to our expectations we reveal that family owned companies tend to grow slower than others. Moreover, listed companies are highly exposed to the macroeconomic development, irrespective of their own life cycle. Our results suggest that the more profitable firm is the higher are its growth rates. Furthermore, the significant coefficient indicates that leverage does positively impact firm growth. However, this finding is only observable in the pre-crisis period. Interestingly, the choice of a company's location has no significant influence on their growth opportunities. In contrast, we indicate different growth rates along the sectors, whereas the consumer (non-cyclical) sector is the fastest growing.

Although, we fill the lack of variables in the existing literature on the determinants of firm growth, we want to outline the limitations of our study in the following paragraph. First, according to the literature we assume causality in one direction. For example, the relationship between firm growth and profitability can be bidirectional. Second, there are no other studies observing Swiss listed companies which could allow us to compare our results more precisely. Therefore, we are limited to international studies, which may have different sample characteristics. Third, our regression analysis would presumably deliver better results if we could replace the time invariant dummy variables by numerical ones. As a result, we would be able to include these variables into the fixed effects model to control for firm specific individualities.

Finally, we want to deliver some suggestions for further research. Our model is highly exposed to missing data for some variables, e.g. for R&D and free float. In general, researchers which use an unbalanced data panel are faced with a trade-off between increasing the number of observations and the attempt to examine data for various variables. We therefore suggest shrinking the potential sample size to be able to obtain omitted data manually from the original annual reports or more extensive firm data sources like Thomson Reuters Worldscope. As a result, a regression analysis of a balanced panel could appreciate the model quality. Moreover, since the majority of the Swiss companies included in the sample are exposed to a high share of export activity, foreign macroeconomic variables could be included as well.

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