

Rabinovich, Joel

Working Paper

The Evolving Contribution of R&D, Advertising and Capital Expenditures for US-Listed Firms' Growth in Sales, 1979-2018

CITYPERC Working Paper, No. 2022-01

Provided in Cooperation with:

City Political Economy Research Centre (CITYPERC), City, University of London

Suggested Citation: Rabinovich, Joel (2022) : The Evolving Contribution of R&D, Advertising and Capital Expenditures for US-Listed Firms' Growth in Sales, 1979-2018, CITYPERC Working Paper, No. 2022-01, City, University of London, City Political Economy Research Centre (CITYPERC), London

This Version is available at:

<https://hdl.handle.net/10419/251265>

Standard-Nutzungsbedingungen:

Die Dokumente auf EconStor dürfen zu eigenen wissenschaftlichen Zwecken und zum Privatgebrauch gespeichert und kopiert werden.

Sie dürfen die Dokumente nicht für öffentliche oder kommerzielle Zwecke vervielfältigen, öffentlich ausstellen, öffentlich zugänglich machen, vertreiben oder anderweitig nutzen.

Sofern die Verfasser die Dokumente unter Open-Content-Lizenzen (insbesondere CC-Lizenzen) zur Verfügung gestellt haben sollten, gelten abweichend von diesen Nutzungsbedingungen die in der dort genannten Lizenz gewährten Nutzungsrechte.

Terms of use:

Documents in EconStor may be saved and copied for your personal and scholarly purposes.

You are not to copy documents for public or commercial purposes, to exhibit the documents publicly, to make them publicly available on the internet, or to distribute or otherwise use the documents in public.

If the documents have been made available under an Open Content Licence (especially Creative Commons Licences), you may exercise further usage rights as specified in the indicated licence.

The evolving contribution of R&D, advertising and capital expenditures for US-listed firms' growth in sales, 1979-2018: A quantile regression analysis

Joel Rabinovich

CITYPERC Working Paper No. 2022-01

City, University of London
Northampton Square
London EC1V 0HB
United Kingdom

The evolving contribution of R&D, advertising and capital expenditures for US-listed firms' growth in sales, 1979-2018. A quantile regression analysis.¹

Joel Rabinovich

Lecturer in International Political Economy,
CityUniversity of London,
Email: joel.rabinovich@city.ac.uk

Abstract

This article presents new insights on the evolving contribution of different types of investments to the growth in sales of US nonfinancial listed firms during the 1979-2018 period. By means of quantile regressions it is observed an increasing contribution over time of intangible investment vis-à-vis a decline in capital expenditure both for high-growth and slow-growth firms. However, the impact of different types of intangible investment differs depending on the kind of firm. Whereas research and development (R&D) has a positive contribution for high-growth firms, only advertising has a positive effect for their slow-growth peers.

Keywords: Firm growth; Fast-growth firms; Quantile Regression; Intangibles.

1. Introduction

The capacity and means by which firms grow are defining features of modern economies. The centrality of this process was early indicated by Penrose (1959, pp. 2, 142), who highlighted that growth is not a medium to attain an objective (i.e., optimum size) but rather a goal in itself that consists of an internal process of cumulative development and change. A definition by Dosi et al. (2020, p. 311) picks up this evolutionary dimension and characterizes growth as ‘a process by which organizations pursue market opportunities and the acquisition and accumulation of the resources required to exploit those opportunities’.

The motivation of this article is to gain new insights into the changing ways by which firms are able to grow. Going back to the previous definition, how firms exploit those market opportunities is a context-specific question, which, in this paper, refers to both

¹ Earlier versions of this paper have been presented at the IFRIS internal seminar on INDUSTRY 4.0, ‘The Industry 4.0 and the international division of labour Industry 4.0’ (May, 2020) and the International Schumpeter Conference (July, 2021). The paper has benefited from discussions there and from comments made by Effie Kesidou, Sandra Lancheros Torres, Serdal Ozusaglam, Cecilia Rikap, Nicolas Aguila and Tristan Auvray. All errors and omissions remain the sole responsibility of the author.

the historical moment and the type of firm considered. Taking this into account, the objective of this article is precisely to measure the evolving role of three specific types of investments that facilitate growth. It is done by estimating the contribution to growth in sales of research and development (R&D), advertising and capital expenditures from 1979 to 2018 for US nonfinancial listed firms. Quantile regressions are implemented to study the impact of those categories of expenditures across firms' growth distribution.

This paper relates to the literature focusing on the poor performance of tangible investment in the USA and other developed economies, a widely acknowledged phenomenon (Döttling et al., 2017; Gutiérrez & Phillipon, 2017; IMF, 2006, 2015; D. W. Lee et al., 2016; OECD, 2007; Stockhammer, 2005). Capital expenditures have been, traditionally, one of the most important ways by which firms expand their sales capacity and outcompete rival peers. Therefore, the decline in capital expenditures raises the question about the mechanisms that allow those firms to remain competitive (Rabinovich, 2020). While the rise in intangible assets has been documented as part of the explanation for the decrease in capital expenditures (Alexander & Eberly, 2018; Haskel & Westlake, 2017; Orhangazi, 2018), the question on how these different types of investments actually contribute to firms' growth has been comparatively underexplored. Similarly, the question about how different types of intangibles play a different role depending on the firm's growth rate has also been overlooked.

By tackling these issues, this paper makes several contributions to the literature. Previous studies have shown that R&D positively contributes to fast-growth firms only (Coad & Rao, 2008; García-Manjón & Romero-Merino, 2012; Hölzl, 2009). This paper confirms this finding, extends it for a longer period of time and finds that advertising has a positive impact for slow-growth firms. Both results are robust to different checks.

The second contribution of this article is to show that both slow-growth and fast-growth firms have been increasingly relying on advertising and R&D, respectively, and less on capital expenditures over time. For the former, during the 1979-1988 period, an increase in one standard deviation of capital expenditures and advertising expenditures represented 7.71% and 4.70% respectively of growth standard error. Between 2009 and 2018, these figures changed to 3.63% and 8.31%. For fast-growth firms, between 1979 and 1988, an increase in one standard deviation of capital expenditures and R&D represented 4.60% and 18.76% respectively of growth standard error whereas, between the 2009 and 2018, these numbers went to 1.82% and 43.02%.

The paper is organized in the following way. Section 2 revises the literature on growth and the three types of investment considered (R&D, advertising and capital expenditures) along with their corresponding hypotheses. Section 3 discusses the data and stylized facts.

Sections 4, 5, and 6 present the methodology, results and their robustness respectively. Section 7 discusses and concludes.

2. Literature review and hypotheses

Empirical studies on firm's growth have been dominated by the Gibrat Law (1931). According to it, the growth rate in a specified period is a random phenomenon and therefore independent of the size of the firm at the beginning of the period. Santarelli et al. (2006) carry out an extensive survey of the literature in which they find heterogeneous behavioral patterns appearing across industries and size classes, arising partly due to the differences in samples and methodologies. Mixed evidence is also found in studies performed after this review. Small firms grow faster than large ones in, among others, French manufacturing (Bottazzi et al., 2011) and Portuguese firms (Barbosa & Eiriz, 2011) but not for Italian (Bottazzi et al., 2007) or Irish firms (Lawless, 2014). In a review of the topic, Coad (2009, p. 48) claims that '[i]f it were indeed possible to generalize ... It appears that smaller firms tend to grow faster than larger firms, although above a certain size threshold these differences fade out, such that expected growth rates are more or less independent of firm size.' Some studies have also intended to reconcile this mixed evidence by studying the ex-ante and ex-post reshaping of a population of firms as a result of market selection and learning (Lotti et al., 2009).

Moving away from purely stochastic shocks, heterogeneous, firm-specific decisions also play a role. In that sense, growth is essentially a multidimensional phenomenon (Bianchini et al., 2017; Moschella et al., 2019). This paper contributes to this stream by identifying and tracking the contribution of three specific types of expenditures: R&D, advertising and capital expenditures. All of them represent different but complementary means by which a firm is able to grow internally (Penrose, 1959).

Capital expenditures represent the flow of gross funds used for additions to property, plant, and equipment (Standard & Poor's, 2001).² These types of expenditures have been, traditionally, at the center of growth studies, both from national accounts perspectives or mainstream economics (Solow, 1957).

Empirical studies on tangible investment in developed economies have largely focused on its deceleration, providing different explanations that go from poor aggregate economic performance (Girardi & Pariboni, 2016; IMF, 2015; Stockhammer, 2008), financialization and changes in corporate governance (Döttling et al., 2017; Gutiérrez & Phillipon, 2017;

² As a gross measure, it may be performed just to replace old equipment and, in that case, may not necessarily be contributing to growth.

Orhangazi, 2008; Stockhammer, 2004), market concentration (Crouzet & Eberly, 2018; De Loecker et al., 2020) and offshoring (Alexander & Eberly, 2018; Auvray & Rabinovich, 2019; Milberg, 2008). While the rise in intangible assets has also been documented as part of the explanation (Crouzet & Eberly, 2018; Haskel & Westlake, 2017; Orhangazi, 2018), the question on how capital expenditures actually contribute to firms' growth has not received the same degree of attention.

Studies incorporating capital expenditures in growth equations have found relatively poor results. Coad and Broekel (2012) use total fixed assets as part of a multifactor productivity that alternates between positive and negative values depending on the specification. Power (1998) finds little evidence for a positive correlation between capital expenditures and productivity for a sample of US manufacturing firms. Likewise, Coad and Grassano (2016) do not find a significant effect of capital expenditures growth on sales growth for a panel of firms, which are the world's largest R&D investors. Coad and Broekel (2012, p. 1267) identify two potential reasons for the poor performance of capital expenditures. The first is the difficulty to distinguish between expansionary and replacement investment. Second, the lumpy character of investment in fixed assets (Cooper et al., 1999; Doms & Dunne, 1998) also hampers the task of identification. Both the recent deceleration of capital expenditures along with its poor performance in growth estimations will be tested in this paper with the following hypothesis:

H1: capital expenditures have decreased their growth contribution over time for all types of firms across growth distribution.

Complementary to the decreasing relevance of capital expenditure or tangible investments, another hypothesis explored in this paper is the increasing relevance of intangibles. They can be narrowly defined as 'knowledge capital' (Löf & Heshmati, 2002) or 'knowledge-based capital' (OECD, 2013). In their pioneering work on intangibles assets, Corrado, Hulten, and Sichel (2005) grouped them into three categories: computerized information, scientific and creative property, and economic competences. These assets can be grouped as well into technological (R&D, training and design, ICT) and non-technological (brand development).

Intangibles have been included in different types of performance estimations such as growth estimations (Calvo, 2006; Serrasqueiro et al., 2010; Yasuda, 2005), productivity (Añón Higón et al., 2017; Bontempi & Mairesse, 2015; Hall et al., 2010 -for a review on R&D and productivity-; Hall & Mairesse, 1995), innovation (Gómez & Vargas, 2012; Mairesse & Mohnen, 2004; Montresor & Vezzani, 2016) and market value of the firm (Lev & Gu, 2016, p. 89; Szewczyk et al., 1996; Woolridge & Snow, 1990). The question

addressed in this paper is whether or not these types of investments have increased their contribution to growth during the last decades.

Different theoretical insights seem to indicate that the answer should be positive. First, it is more likely that intangibles represent a distinctive or strategic feature vis-à-vis tangible assets (Haskel & Westlake, 2017, p. 186; Kay, 1993). With the vertical disintegration of production, firms have moved to their core or strategic competences (Prahalad & Hamel, 1990). Companies from developed economies have tended to focus mostly on some activities such as development and design, trans-divisional research, technology and business intelligence, while dropping the non-core activities, usually related to manufacturing (Gereffi et al., 2005; J. Lee & Gereffi, 2015; Schwörer, 2013). Those core competences basically imply intangible investing (World Intellectual Property Organization, 2017) whereas non-core imply mostly tangible. The former are also harder to imitate (Añón Higón et al., 2017). Ford Chairman, William Clay Ford Jr., eloquently illustrated this in 2006 when he claimed that ‘[i]t’s easy to build a car. It’s harder to build a brand’ (G. F. Davis, 2009, p. 200).

Intangible assets can also be scaled into a potentially endless number of goods and services (Andrews & Serres, 2012; De Ridder, 2019). Different from tangible investment, where the amount of production is physically determined by the stock of property, plant and equipment; in the case of intangibles that relation is weakened. This characteristic decreases marginal costs, potentially leading to winner-takes-all scenarios (Autor et al., 2020; Haskel & Westlake, 2017; McKinsey, 2018).

Further reasons that explain a higher relevance of intangible investments over time are related to its path-dependent or accumulative character: previous success tends to be a good predictor of future success in innovative activities (Arrighetti et al., 2014; Rikap, 2018). Firms with higher stock of intangible assets have a higher absorptive capacity (Cohen & Levinthal, 1990) that allow them to recognize and apply new internal and external flows of knowledge.

Rent-seeking behaviors and increased market power are also more frequent with these assets, allowing leading firms to break away from laggards (L. E. Davis & Orhangazi, 2020) and leading to what has been termed as “intellectual monopoly capitalism” (Pagano, 2014; Rikap, 2021).

It is important to highlight that the aforementioned arguments are rather generic, both in terms of firms they can be applied to, and in relation to the type of intangible. From the broad group of intangible investments, usual proxies of innovation such as patents, new products, and R&D have featured prominently in growth studies. Since the seminal work of Schumpeter (1942), innovation is recognized as playing a crucial role in economic

development and growth. However, the empirical relation between innovation and firm's growth has been elusive (Del Monte & Papagni, 2003, p. 1006) or paradoxical (Coad & Rao, 2008): the theoretical relevance has not been in hand with strong empirical results.

Different reasons have been provided for these empirical results. For the purpose of this article, it is relevant to highlight that conventional regression estimators focus on the average effect for the average or representative firm.³ The problem with these firms is that their growth is very low and could be due to anything (Coad, 2009). Growth, in fact, presents a tent distribution with heavy tails (Bottazzi & Secchi, 2003, 2006; Stanley et al., 1996).

Quantile regression techniques have been used to exploit this characteristic by focusing on above and below average firms. García-Manjón and Romero-Merino (2012) use a sample of top R&D spending firms and find a positive effect of R&D intensity on the sales growth of fast-growth firms. Coad and Rao (2008) find similar effects of innovation for US manufacturing firms although measuring innovation by a synthetic measure based on patent intensity and R&D intensity. Bianchini et al. (2016) apply fixed-effects quantile regressions in the case of Spanish manufacturing firms and find similar results. All these papers indicate that mostly high-growth firms obtain positive feedback in terms of market share from their innovative investments. Combining the growing relevance of intangibles in general with the specific characteristics of R&D, the second hypothesis to be tested is therefore that

H2: R&D a) has a positive effect on high-growth firms, and b) has increased in relevance for them over time.

The other type of intangible investments reviewed in this paper is advertising expenditures. Marketing contributes to building firm-level intangible assets such as brand equity, customer loyalty, bargaining power over distribution channel partners and market-sensing capability (McAlister et al., 2007; Srinivasan & Hanssens, 2009). Similarly to the case of innovation, the link between advertising and positive economic outcomes is rather inconsistent (Peterson & Jeong, 2010). Contradicting results have been found for different outcome variables such as sales (Abraham & Lodish, 1990; Sridhar et al., 2014; Yiannaka et al., 2002), market value of the firm (Connolly et al., 1986; Hirschey & Weygandt, 1985) and return on assets (Feng et al., 2015; Srinivasan & Hanssens, 2009), among others (for

³ Other motives are, first, that it takes time for a firm to convert innovation into economic performance so multiple periods should be taken into account (Davidsson & Wiklund, 2006; Weinzimmer et al., 1998; Yang & Huang, 2005). Second, innovation is a process in which there is uncertainty at different stages (Coad & Rao, 2008; Mansfield et al., 1977). Brown, Fazzari and Petersen (2009) show that R&D is done almost entirely with internal or external equity due to, apart from the lack of collateral, information problems and uncertain returns.

a review, Ali Shah & Akbar, 2008). The use of quantile regression in this paper is therefore a way to acknowledge those conflicting results.

Meta-analysis studies also show a decline in advertising elasticity over time: long-term elasticity is found to be 0.24 in Sethuraman et al. (2011) compared to previous studies in which it averaged 0.41 (Assmus et al., 1984).⁴ More recent studies, using data on different products from several categories, find even smaller elasticities of 0.025 and a negative return on investment in a given week of -79% for the median brand and negative for more than 2/3 of the sample (Shapiro et al., 2020).

To the best of my knowledge, there are no previous studies digging into the relation between advertising expenditures and different types of firms in terms of their growth profile. An approximate study has been carried out by Hirschey and Spencer (1992) who take into account size factors in explaining the link between advertising expenditures, R&D and market valuation. They find that while the strength of R&D is inversely related to firm size, advertising expenditures have a persistent effect on market value only in the case of large firms.

Smaller firms, typically growing faster and younger, are in a better condition to transform R&D into market value (Czarnitzki & Delanote, 2013). In their case, using those resources to advertise could be thought as a waste of money. On the other hand, continuing with Hirschey and Spencer's (1992) results, big firms, typically growing slower and older, are those which can turn advertising into more enduring effects in terms of market value. In their case, negative results for R&D are a standard finding in the literature, usually interpreted in the sense that they have exhausted the profitable opportunities to innovate (Bianchini et al., 2016; Coad & Rao, 2008; García-Manjón & Romero-Merino, 2012). Advertising their already profitable products can be hypothesized as a more reasonable way to use their resources. Combining the growing relevance of intangibles in general with the specific characteristics of advertising, the third hypothesis to be test is therefore that:

H3: advertising a) has a positive effect on slow-growth firms, and b) has increased in relevance for them over time.

⁴ Assmus et al. (1984) use 128 elasticity estimates from 22 studies published between 1962 and 1981. Sethuraman et al. (2011) use 751 short-term and 402 long-term direct-to-consumer brand advertising elasticities estimated in 56 studies published between 1960 and 2008.

3. Data and stylized facts

I use firm-level data from Compustat and take all active and inactive, publicly listed nonfinancial firms incorporated in the USA, excluding financial firms identified by the primary SIC codes from 6000 to 6799, firms without sectoral information and utilities. I remove firms with no information or nil values of total assets (Compustat item *AT*), net property plant and equipment (Compustat item *PPENT*), and sales (Compustat item *REVT*). I replace by 0 those missing values for capital expenditures (Compustat item *CAPX*), SG&A (Compustat item *XSGA*), and R&D (Compustat item *XRD*).

As part of the period under analysis is characterized by medium inflation, I deflate sales using publicly-available chain-type price indexes for gross output by industry from the Bureau of Economic Analysis. These indexes are provided for 3 to 4 NAICS digit code. For firms that disappeared before the appearance of NAICS codes, I impute one code following the correspondence tables between NAICS and SIC codes done by the United States Census Bureau. In some cases, SIC codes were compatible with multiple NAICS codes. When a clear majority of an arbitrary threshold of 70% belonged to one NAICS code, that code was imputed. If not, the observations were dropped. To check the robustness of the results, the estimations were also done with non-deflated sales.

In terms of further cleaning, I restrict the sample to firms that have, at least, three consecutive years of information, a common feature in the micro-econometric literature (Bond et al., 2003) and, in order to account for outliers, I winsorize observations at the upper and lower 0.5%.⁵

From a set of widely used variables such as value added, employment, total assets, sales or market capitalization (Delmar, 2006),⁶ there seems to be an overall consensus on using sales as an indicator of growth (Ardishvili et al., 1998; Barkham et al., 2002; García-Manjón & Romero-Merino, 2012). Additionally, for the purpose of this paper in which different types of productive investments are evaluated, using sales represents a better fit compared to employment or total assets due to possible substitution and endogeneity issues respectively. Market capitalization, on the contrary, has been inflated during the period under analysis by share buybacks and dividends (Lazonick, 2014). Therefore, growth is preferred and measured in the following way:

$$GROWTH_{i,t} = \ln(SALES_{i,t}) - \ln(SALES_{i,t-1})$$

Values on capital expenditures and R&D are taken directly from the income statement and flow of funds information, respectively. Advertising, on the other hand, presents a

⁵ Values of each variable are set either at the 0.5 or 99.5 percentile value when they are respectively lower or higher than these thresholds.

⁶ Penrose (1959, p. 26) herself measured growth in terms of fixed assets.

high number of missing values so I follow a standard methodology in the marketing literature that consists of calculating advertising expenditures as $XSGA-R\&D$ (for a review of different formulas see Currim et al., 2018, pp. 434–436). The robustness of the results will nevertheless be assessed with advertising expenses only (Compustat item XAD). Following Peters and Taylor (2017), I consider the exception that when XRD exceeds $XSGA$, but is less than $COGS$, $XSGA$ is kept with no further adjustment.

The starting year for the analysis, 1979, was chosen due to data availability. While capital expenditures data starts in the 1950s, reporting requirements for R&D changed in 1975 with the Financial Accounting Standards Board’s Statement n°2 which, among other things, provided more uniform accounting reporting (Nix & Nix, 1992). Previous studies using long-term R&D data from Compustat have started in 1977 in order to give firms two years to comply with those new requirements (Peters & Taylor, 2017, p. 257). I start in 1979 to compare four ten-year periods: 1979-1988, 1989-1998, 1999-2008, and 2009-2018.

Table 1 presents the basic descriptive statistics of the variables used in different periods, both for the whole sample and firms in the lower and upper decile of growth. Except for growth, size and age, the rest are presented as a ratio to total assets. Table 1 confirms that, for this sample, fast-growing firms are younger than slow or negative growing firms, but of relatively similar size.

This sample is no exception either, in terms of the fat-tailed distribution of growth highlighted by the literature. Figure 1 plots its distribution against an artificially created one with normal distribution and mean and variance taken from Table 1. As it is shown there, first, most of the observations are concentrated around the mean and second, the right-hand tail is fatter than in a normal distribution.

Table 1. Descriptive statistics for different periods

	Observations	Mean	Median	Min.	Max.	Std. Dev.
<i>Period 1979-1988</i>						
GROWTH	27165	0.0648102	0.0508544	-1.577575	2.391899	0.3576087
(CAPX/AT)	27165	0.0811607	0.0589624	0	0.501505	0.0790472
(R&D/AT)	27165	0.0268554	0	0	0.9081336	0.0601907
(ADV/AT)	27165	0.2926862	0.239121	0	1.786192	0.251878
SIZE	27165	4.354112	4.25963	-0.3105049	10.69531	2.027022
AGE	27165	9.179017	9	2	17	4.232426
GROWTH ₁₀	2773	-0.5215424	-0.3882923	-1.577575	-0.1337552	0.358879
(CAPX/AT) ₁₀	2773	0.0656466	0.0362587	0	0.501505	0.0865363
(R&D/AT) ₁₀	2773	0.0318568	0	0	0.9081336	0.0933073
(ADV/AT) ₁₀	2773	0.2707477	0.1883289	0	1.786192	0.2861064
SIZE ₁₀	2773	3.312478	3.136802	-0.3105049	10.43369	1.962892
AGE ₁₀	2773	8.38947	8	2	17	4.15871
GROWTH ₉₀	2143	0.804345	0.6434407	0.268075	2.391899	0.5020812
(CAPX/AT) ₉₀	2143	0.108813	0.0691151	0	0.501505	0.1171257
(R&D/AT) ₉₀	2143	0.0457237	0	0	0.9081336	0.0926389
(ADV/AT) ₉₀	2143	0.2564825	0.1981117	0	1.786192	0.2517259
SIZE ₉₀	2143	3.393898	3.255427	-0.3105049	10.69531	1.83701
AGE ₉₀	2143	5.953336	5	2	17	3.830399

Period 1989-1998

GROWTH	31190	0.117452	0.0821025	-1.577575	2.391899	0.3783799
(CAPX/AT)	31190	0.0683672	0.0475506	0	0.501505	0.0733293
(R&D/AT)	31190	0.0524562	0.0006991	0	0.9081336	0.1103171
(ADV/AT)	31190	0.296729	0.2335493	0	1.786192	0.2761585
SIZE	31190	4.722348	4.660349	-0.3105049	10.69531	2.072082
AGE	31190	11.98609	10	2	27	7.931683
GROWTH ₁₀	3251	-0.4775859	-0.3396628	-1.577575	-0.120213	0.3701396
(CAPX/AT) ₁₀	3251	0.0534239	0.0288866	0	0.501505	0.0766037
(R&D/AT) ₁₀	3251	0.0902975	0	0	0.9081336	0.1760214
(ADV/AT) ₁₀	3251	0.3557172	0.236551	0	1.786192	0.3924419
SIZE ₁₀	3251	3.470385	3.387589	-0.3105049	10.69531	2.133587
AGE ₁₀	3251	11.239	9	2	27	7.387293
GROWTH ₉₀	2541	0.9230001	0.7576137	0.3858089	2.391899	0.4878089
(CAPX/AT) ₉₀	2541	0.0860546	0.0492403	0	0.501505	0.1051572
(R&D/AT) ₉₀	2541	0.0984441	0.0124061	0	0.9081336	0.1716024
(ADV/AT) ₉₀	2541	0.2605809	0.1857926	0	1.786192	0.288838
SIZE ₉₀	2541	3.986181	4.044274	-0.3105049	10.60006	1.826867
AGE ₉₀	2541	6.628886	4	2	27	5.850602

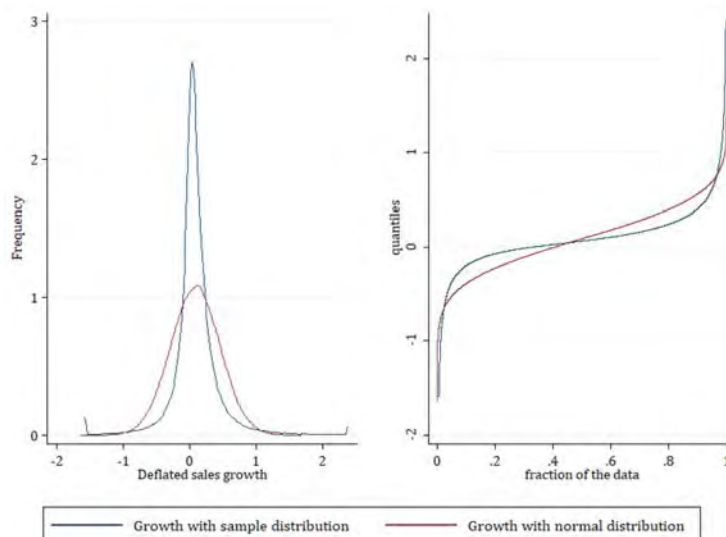
Period 1999-2008

GROWTH	29062	0.1050973	0.0756502	-1.577575	2.391899	0.377633
(CAPX/AT)	29062	0.0520499	0.0333019	0	0.501505	0.0602872
(R&D/AT)	29062	0.0659008	0.0105099	0	0.9081336	0.126217
(ADV/AT)	29062	0.2742015	0.2051171	0	1.786192	0.2690842
SIZE	29062	5.694356	5.64812	-0.3105049	10.69531	1.97767
AGE	29062	15.11238	12	2	37	10.48239
GROWTH ₁₀	2967	-0.4919996	-0.3550489	-1.577575	-0.0742803	0.3854976
(CAPX/AT) ₁₀	2967	0.041577	0.0219468	0	0.501505	0.0589871
(R&D/AT) ₁₀	2967	0.1288223	0.0339073	0	0.9081336	0.1968846
(ADV/AT) ₁₀	2967	0.2828079	0.1706452	0	1.786192	0.3492054
SIZE ₁₀	2967	4.782329	4.68299	-0.3105049	10.69531	2.011968
AGE ₁₀	2967	13.58106	10	2	37	9.645613
GROWTH ₉₀	2472	0.8709598	0.6967033	0.3519444	2.391899	0.4945883
(CAPX/AT) ₉₀	2472	0.0545146	0.0293302	0	0.501505	0.0773665
(R&D/AT) ₉₀	2472	0.1254216	0.059477	0	0.9081336	0.181472
(ADV/AT) ₉₀	2472	0.2427015	0.155956	0	1.786192	0.2962667
SIZE ₉₀	2472	5.029194	4.959432	-0.3105049	10.69531	1.732795
AGE ₉₀	2472	8.598301	6	2	37	7.673004

Period 2009-2018

GROWTH	23773	0.0621611	0.0457969	-1.577575	2.391899	0.3624513
(CAPX/AT)	23773	0.0438772	0.0268706	0	0.501505	0.056841
(R&D/AT)	23773	0.0675599	0.00922	0	0.9081336	0.1364966
(ADV/AT)	23773	0.2492793	0.1710175	0	1.786192	0.2652159
SIZE	23773	6.367	6.408911	-0.3105049	10.69531	2.041266
AGE	23773	20.22168	18	2	47	13.44789
GROWTH ₁₀	2395	-0.5187593	-0.3799279	-1.577575	-0.1273761	0.4012486
(CAPX/AT) ₁₀	2395	0.0342901	0.0164819	0	0.501505	0.0534065
(R&D/AT) ₁₀	2395	0.1487384	0.033058	0	0.9081336	0.2242332
(ADV/AT) ₁₀	2395	0.2252363	0.1172492	0	1.786192	0.323658
SIZE ₁₀	2395	5.250964	5.063305	-0.3105049	10.69531	2.065134
AGE ₁₀	2395	17.50313	15	2	47	12.52231
GROWTH ₉₀	2054	0.7835293	0.5788519	0.2756412	2.391899	0.5211954
(CAPX/AT) ₉₀	2054	0.0576884	0.020166	0	0.501505	0.0976665
(R&D/AT) ₉₀	2054	0.1457164	0.0651748	0	0.9081336	0.2060594
(ADV/AT) ₉₀	2054	0.239732	0.1188441	0	1.786192	0.3340588
SIZE ₉₀	2054	5.423251	5.369934	-0.3105049	10.69531	1.965305
AGE ₉₀	2054	11.44401	7	2	47	10.422

Figure 1. Annual deflated sales growth rate distribution of the sample compared to an artificially created normal distribution of same mean and variance



I further study the differences in growth among firms and how capital expenditures, R&D and advertising relate to them in Figure 2. I group firms belonging to the first, second, third, and fourth quintiles plus the ninth and tenth deciles of each year's growth rate (i.e. without tracking a specific group of firms).⁷ In all cases, I take the median value of each group.

The top-left part of the figure displays the evolution of growth in sales. Different features can be highlighted. First, the lowest quintile started with growth close to 0 but then digs into negative territory. The rest of the groups have rather stagnant rates of growth except for the highest decile. Second, a marked bifurcation seemed to be on its way until the end of the 1990s between the upper quintile and the rest with a 90 percentage points increase in the gap of the two extreme groups comparing the beginning of the sample with the peak. However, the general deceleration experienced in the 2000s reduced that difference to 15 percentage points. High-growth firms grow only slightly faster now than they did at the beginning of the period.

The top-right part of the figure tracks the evolution of capital expenditures and shows a decreasing trend for all types of firms since the 1980s. Also, it can be noticed that up to the mid-1980s approximately, the fast-growth firms were also those with the highest rates of property, plant and equipment as a percentage of total assets. This characteristic not only reverts then, but also the upper decile has some of the lowest capital expenditures to total asset ratios from all groups (sometimes even the lowest).

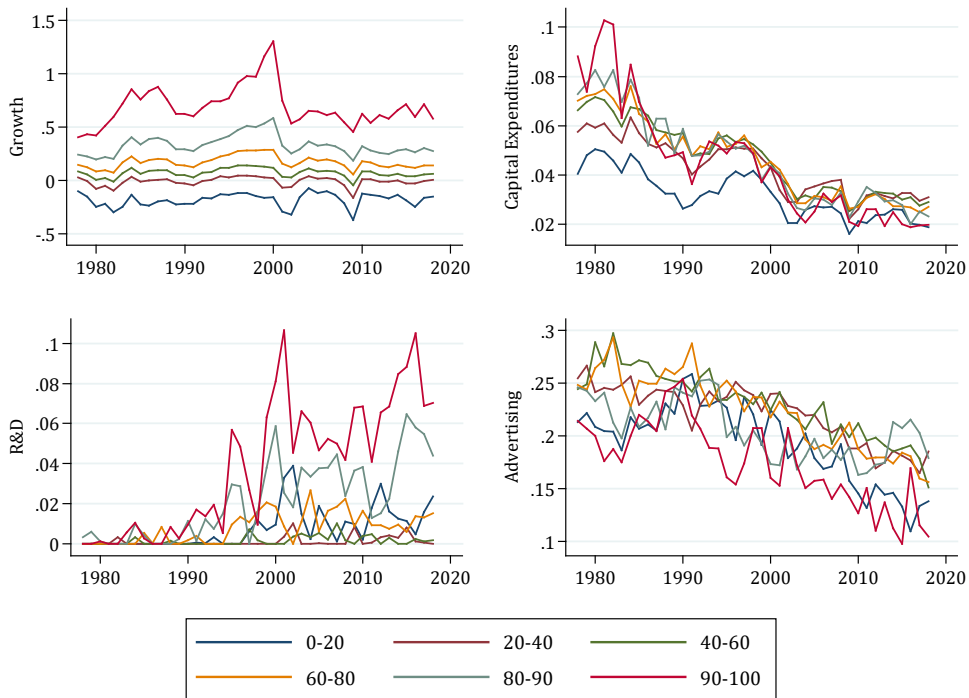
⁷ That means I create, for each year, the following groups:

$$[X_{[0]}, X_{[20]}], (X_{[20]}, X_{[40]}], (X_{[40]}, X_{[60]}], (X_{[60]}, X_{[80]}], (X_{[80]}, X_{[90]}], (X_{[90]}, X_{[100]})]$$

where $X_{[20]}$, $X_{[40]}$, $X_{[60]}$, $X_{[80]}$, $X_{[90]}$ are the respective 20th, 40th, 60th, 80th, 90th percentiles of growth.

The bottom-left part of the figure focuses on R&D. Contrary to the case of capital expenditures, here the tenth decile is the one spending the most throughout the whole period, followed by the ninth decile. It is important to highlight that, in many cases, median values are 0. Lastly, advertising expenses show a decreasing trend for all categories since the beginnings of the 1990s. High-growth firms systematically had the lowest values of advertising spending whereas the highest values tend to be concentrated in the intermediate categories of growth.

Figure 2. Average value of growth rate, capital expenditures, acquisitions and intangible investment for the first (0-20), second (20-40), third (40-60) and fourth (60-80) quintiles plus the ninth (80-90) and tenth (90-100) deciles of each year's growth rate. Median values reported in all cases. All firms, 1979-2018.



4. Methodology

Following most of the literature on firms' growth (Bianchini et al., 2016; Bottazzi et al., 2011; Coad & Grassano, 2016; Coad & Rao, 2008; García-Manjón & Romero-Merino, 2012), an augmented Gibrat's Law equation will be estimated:

$$\begin{aligned}
 GROWTH_{i,t} = & \alpha_0 + \alpha_1 GROWTH_{i,t-1} + \alpha_2 \left(\frac{CAPX}{AT} \right)_{i,t-1} + \alpha_3 \left(\frac{R\&D}{AT} \right)_{i,t-1} + \alpha_4 \left(\frac{ADV}{AT} \right)_{i,t-1} \\
 & + \alpha_5 SIZE_{i,t-1} + \alpha_6 AGE_{i,t} + \gamma_{jt} + \beta_t + \varepsilon_{it} \quad (1)
 \end{aligned}$$

where $\alpha_0 \dots \alpha_6$ are parameters, the i , j and t subscripts denote firm, industry and time period. $SIZE$ is the logarithm of total assets (Compustat item AT). γ_{jt} is a coefficient

that controls industry specific trends. AGE is calculated as current year t minus year of appearance in Compustat. β_t are coefficients of a set of time dummies, while ε_{it} represents non-observable shocks. Independent variables are taken in lags to avoid endogeneity and the lagged growth is included to control for dynamic effects in some specification.

As shown in the previous section, the sample is characterized by the majority of firms concentrated around the mean, something standard in the literature (Bottazzi & Secchi, 2003, 2006; Coad, 2009; Hözl, 2009). On this basis, I will carry out an empirical strategy that consists of calculating, first, fixed effects (without dynamic effect) and GMM (Arellano & Bover, 1995; Blundell & Bond, 1998) estimators. A fixed effects estimator, although wiping out the individual effects, is unable to eliminate the correlation between the lagged variable and the error term. GMM, on the other hand, are useful for situations with “small T, large N” panels, linear functional relationships, one left-hand variable that is dynamic, independent variables that are not strictly exogenous, fixed individual effects, and, finally, heteroscedasticity and autocorrelation within individuals but not across them (Roodman, 2009).

Then, I will also estimate quantile regressions (QR) for the 10th, 25th, 50th, 75th and 90th quantiles. Quantile regressions are a fairly standard procedure for growth estimations that allow to exploit differences in growth distribution (Bianchini et al., 2016; Coad & Rao, 2008; García-Manjón & Romero-Merino, 2012; Mazzucato & Parris, 2015).

If e_i is the prediction error, then OLS minimizes $\sum_i e_i^2$ and QR minimizes a sum that gives asymmetric penalties $(1 - q)|e_i|$ for overprediction and $q|e_i|$ for underprediction (Cameron & Trivedi, 2009). The q th QR estimator $\widehat{\beta}_q$ minimizes over β_q the objective function:

$$Q(\beta_q) = \sum_{i:y_i \geq x_i' \beta} q |y_i - x_i' \beta_q| + \sum_{i:y_i < x_i' \beta} (1 - q) |y_i - x_i' \beta_q|$$

The specific case in which $q = 0.5$ is the median regression, also called least absolute-deviations regression. By taking absolute rather than squared deviations, this method is more robust to outliers than mean regression.

Besides this, the main objective of this paper is to estimate how each input contributed throughout time. In order to do that, I will estimate the equation for the following periods: 1979-1988, 1989-1998, 1999-2008 and 2009-2018. Finally, in order to check for the stability of these results and whether they depend or not on a specific starting and ending year, I will perform recursive estimations for a window of ten years. The robustness of these results will also be checked by taking different groups of firms (all

industries without ‘healthcare, medical equipment and drugs’), adding more control variables, using fixed-effects quantile regressions (Canay, 2011) and taking averages of dependent and independent variables.

5. Results

Table 2 presents the results of the estimation of equation (1) for different periods. The effects of R&D, advertising and capital expenditures on growth are significant at the 1% level in almost all cases but do change over different periods. Moreover, it is clear how the contribution of different types of investments affects low/negative, medium and fast-growth firms differently.

Table 2 confirms that neither FE nor GMM seem to be suitable to capture those differences. Results for both of them are close to the median but biased to the right-hand tail which has, as it was shown, a heavier weight than the left one. These results reinforce the need to account for growth differentials. The remaining of this section will therefore focus on QR results solely.

Results for QR10 and QR25 are qualitatively similar. Capital expenditures always have a positive and statistically significant contribution at the 1% level. For advertising spending, positive and statistically significant results are obtained during the first period, mostly non-statistically different from 0 in the following two periods, reverting to positive during 2009-2018. In the case of R&D, negative and statistically significant values at the 1% level are verified in all periods except for the first one for QR25. These negative results have been previously found in similar research (Coad & Rao, 2008; García-Manjón & Romero-Merino, 2012; Hözl, 2009). Firms who fail to transform R&D into growth seem to be penalized and decrease their market share. According to the results presented in Table 2, the penalty for these firms has grown over time as values tend to be increasingly negative.

Results for QR50 are rather different. Capital expenditures are always positive and statistically significant from 0 at the 1% level, although with no stable pattern throughout time. This is not the case of advertising and R&D. The former is always negative and statistically different from 0 but increasingly turning to non-significant. The latter switches from positive and statistically significant values during the first period to non-different from 0 afterwards. This seems to indicate that returns from R&D in terms of growth have disappeared for the median firm.

Finally, the results for QR75 and QR90 are similar but differ in some important aspects. Advertising presents negative and statistically different from 0 results at the 1% level in

all periods. Capital expenditures, on the other hand, present positive and statistically different from 0 values during the first and second periods and for QR75 during 2009-2018. Finally, while R&D is always statistically significant and different from 0, QR75 presents a declining contribution while for QR90 is stable.

Tests for the equality of coefficient between the subsequent quantiles were performed for capital expenditures and R&D for QR50, QR75 and QR90, and capital expenditures and advertising for QR10, QR25 and QR50 (Table A1). Differences were found to be statistically significant from 0 in most cases, except for capital expenditures.

Interpretation of the coefficients of the quantile regression is similar to that of linear regression. While the latter is about the partial derivative of the mean value of y with respect to a specific regressor, the former relates to the partial derivative of the conditional quantile of y with respect to a specific regressor (Koenker, 2005). For the last period, the coefficient of R&D is 1.088 for QR90, which implies that a 1-standard deviation increase of the R&D to asset ratio for this quantile (see Table 1), that is to say a 20.6% increase, generates an increase of 22.4% in growth, which has a 52.12% standard error. This represents more than 43% of growth standard deviation compared to 2% in the case of capital expenditures. This picture contrasts with that of the first period when R&D and capital expenditures represented 18.76%, and 4.6% respectively. Turning to QR10, while in the first period an increase in one standard deviation of advertising and capital expenditures represent 4.7% and 7.7% of growth standard error, during the last period those values switched to 8.3% and 3.6%. The growing contribution of R&D and advertising is maintained for QR75 and QR25 respectively. Capital expenditures, on the other hand, have slightly declined. These results, therefore, confirm the hypotheses of an increasing contribution of advertising and R&D for slow-growth and fast-growth firms respectively along with a decreasing relevance of capital expenditures in general. In the next section, I evaluate the robustness of these results.

Table 2. Fixed-effects, GMM and quantile regression estimation of equation (1) for each period. All firms, 1979-2018.

	FE	GMM	QR (%)				
			10	25	50	75	90
<u>Period 1979-1988, obs=27,165</u>							
GROWTH _{t-1}		0.165*** (0.021)	0.134*** (0.016)	0.146*** (0.011)	0.185*** (0.010)	0.200*** (0.011)	0.165*** (0.015)
(CAPX/AT) _{t-1}	0.387*** (0.062)	0.590*** (0.090)	0.320*** (0.048)	0.230*** (0.025)	0.181*** (0.021)	0.160*** (0.029)	0.197*** (0.060)
(R&D/AT) _{t-1}	0.274 (0.173)	0.518 (0.379)	-0.558*** (0.144)	-0.030 (0.064)	0.186*** (0.051)	0.529*** (0.080)	1.017*** (0.138)
(ADV/AT) _{t-1}	-0.616*** (0.050)	-0.477*** (0.098)	0.059*** (0.013)	0.014** (0.007)	-0.030*** (0.005)	-0.090*** (0.006)	-0.188*** (0.010)
SIZE _{t-1}	-0.203*** (0.010)	0.052*** (0.011)	0.030*** (0.002)	0.011*** (0.001)	-0.001 (0.001)	-0.014*** (0.001)	-0.033*** (0.002)
AGE _t	-0.011 (0.010)	-0.020*** (0.003)	0.006*** (0.001)	-0.001 (0.001)	-0.005*** (0.000)	-0.011*** (0.001)	-0.022*** (0.001)
[Pseudo-]R ²	0.078		0.0698	0.053	0.0671	0.1152	0.1709
AR-1		0					
AR-2		0.662					
Hansen test		0.165					
<u>Period 1989-1998, obs=31,190</u>							
GROWTH _{t-1}		0.191*** (0.020)	0.142*** (0.013)	0.180*** (0.008)	0.245*** (0.010)	0.255*** (0.009)	0.215*** (0.013)
(CAPX/AT) _{t-1}	0.455*** (0.066)	0.608*** (0.100)	0.407*** (0.052)	0.293*** (0.022)	0.217*** (0.019)	0.190*** (0.028)	0.161*** (0.062)
(R&D/AT) _{t-1}	0.073 (0.080)	0.360* (0.217)	-0.737*** (0.063)	-0.319*** (0.031)	0.000 (0.030)	0.392*** (0.042)	0.941*** (0.090)
(ADV/AT) _{t-1}	-0.488*** (0.033)	-0.530*** (0.078)	0.018 (0.012)	-0.002 (0.007)	-0.029*** (0.004)	-0.102*** (0.005)	-0.197*** (0.012)
SIZE _{t-1}	-0.163*** (0.008)	0.070*** (0.011)	0.031*** (0.001)	0.013*** (0.001)	-0.001 (0.001)	-0.016*** (0.001)	-0.035*** (0.002)
AGE _t	-0.002 (0.009)	-0.012*** (0.001)	-0.001 (0.000)	-0.001*** (0.000)	-0.003*** (0.000)	-0.005*** (0.000)	-0.009*** (0.000)
[Pseudo-]R ²	0.058		0.0702	0.0526	0.087	0.1426	0.1782
AR-1		0					
AR-2		0.001					
Hansen test		0.002					
<u>Period 1999-2008, obs=29,062</u>							
GROWTH _{t-1}		0.251*** (0.022)	0.131*** (0.014)	0.170*** (0.009)	0.255*** (0.009)	0.301*** (0.010)	0.293*** (0.013)
(CAPX/AT) _{t-1}	0.223*** (0.083)	0.074 (0.122)	0.292*** (0.045)	0.170*** (0.030)	0.109*** (0.020)	0.020 (0.029)	-0.019 (0.052)
(R&D/AT) _{t-1}	-0.068 (0.076)	0.148 (0.157)	-0.883*** (0.086)	-0.329*** (0.031)	0.034 (0.024)	0.387*** (0.044)	0.982*** (0.089)
(ADV/AT) _{t-1}	-0.443*** (0.034)	-0.220*** (0.066)	0.042*** (0.011)	0.005 (0.006)	-0.029*** (0.005)	-0.097*** (0.008)	-0.208*** (0.011)
SIZE _{t-1}	-0.215*** (0.009)	0.060*** (0.016)	0.018*** (0.001)	0.006*** (0.001)	-0.004*** (0.001)	-0.017*** (0.001)	-0.036*** (0.002)
AGE _t	-0.046*** (0.009)	-0.006*** (0.001)	0.000 (0.000)	-0.000*** (0.000)	-0.001*** (0.000)	-0.002*** (0.000)	-0.004*** (0.000)
[Pseudo-]R ²	0.113		0.082	0.0506	0.0778	0.1393	0.2007
AR-1		0					
AR-2		0.453					
Hansen test		0.251					
<u>Period 2009-2018, obs=23,773</u>							
GROWTH _{t-1}		0.172*** (0.028)	0.105*** (0.018)	0.153*** (0.013)	0.199*** (0.012)	0.200*** (0.013)	0.164*** (0.021)
(CAPX/AT) _{t-1}	0.294*** (0.102)	0.445*** (0.153)	0.273*** (0.047)	0.210*** (0.033)	0.203*** (0.024)	0.150*** (0.034)	0.097 (0.086)
(R&D/AT) _{t-1}	0.045 (0.102)	0.081 (0.189)	-1.030*** (0.095)	-0.390*** (0.042)	0.014 (0.028)	0.397*** (0.037)	1.088*** (0.098)
(ADV/AT) _{t-1}	-0.297*** (0.049)	0.064 (0.097)	0.103*** (0.011)	0.043*** (0.007)	-0.001 (0.006)	-0.061*** (0.007)	-0.152*** (0.012)
SIZE _{t-1}	-0.128*** (0.012)	0.066*** (0.019)	0.026*** (0.002)	0.010*** (0.001)	-0.001** (0.001)	-0.011*** (0.001)	-0.027*** (0.002)
AGE _t	0.007 (0.011)	-0.004*** (0.001)	-0.000 (0.000)	-0.001*** (0.000)	-0.001*** (0.000)	-0.002*** (0.000)	-0.003*** (0.000)
[Pseudo-]R ²	0.037		0.1317	0.0646	0.0568	0.1043	0.1649
AR-1		0					
AR-2		0.929					
Hansen test		0.172					

The table presents the coefficient and standard errors (in parenthesis) of the estimations by using fixed effects, GMM and quantile regression. Estimations include year and industry dummies. Standard errors for the quantile regression coefficients are obtained using 150 bootstrap replications. I have included the R² (percent of variance in the dependent variable explained collectively by all of the independent variables) in the OLS and fixed effects estimation and [Pseudo-]R² (based on change in the deviance statistic) in the quantile regression. P-values are reported for all tests. * indicates significance at 10%, ** significance at 5% and *** significance at 1%.

Table 3. Tests for the equality of coefficient from selected cases from Table 3.

	Period 1	Period 2	Period 3	Period 4
CAPX ₇₅ =CAPX ₉₀	0.4655	0.5844	0.3628	0.1992
R&D ₇₅ =R&D ₉₀	0.0000	0.0000	0.0000	0.0000
CAPX ₇₅ =CAPX ₅₀	0.2941	0.2381	0.0005	0.4071
R&D ₇₅ =R&D ₅₀	0.0000	0.0000	0.0000	0.0000
CAPX ₂₅ =CAPX ₅₀	0.0079	0.0002	0.0074	0.8065
ADV ₂₅ =ADV ₅₀	0.0000	0.0000	0.0000	0.0000
CAPX ₂₅ =CAPX ₁₀	0.0063	0.0048	0.0003	0.1553
ADV ₂₅ =ADV ₁₀	0.0000	0.0899	0.0000	0.0000

6. Robustness and further analysis

The first measures to test the robustness of the results focus on whether they are driven by a specific selection of time frame and industry. In terms of the former, I regress equation (1) on a moving window of 10 years, from 1979 to 2009. For simplicity, results are presented graphically in Figure 3. It depicts the same evolution of the coefficients discussed in Table 2: a declining contribution of capital expenditures, and a growing role of advertising spending in all categories although only QR10 and QR25 are positive. R&D, on the contrary, declines in all cases except for QR90 remaining positive for it and QR75.

In terms of industry, Figure 4 plots the percentage of firms from each sector in the whole sample using the Fama-French Industrial Classification System (Fama & French, 1997). The only industry with a clear increasing participation is ‘healthcare, medical equipment and drugs’. Figure 5 shows the evolution of median capital expenditures, R&D and advertising differentiated by industry and it can be seen that ‘healthcare, medical equipment and drugs’ concentrates the more marked rise in R&D. Results for this variable may therefore be driven by that sector.

Figure 3. Quantile regression estimation of equation (1) for a moving 10-year window. Dotted lines indicate the 95% confidence interval. All firms, 1979-2018.

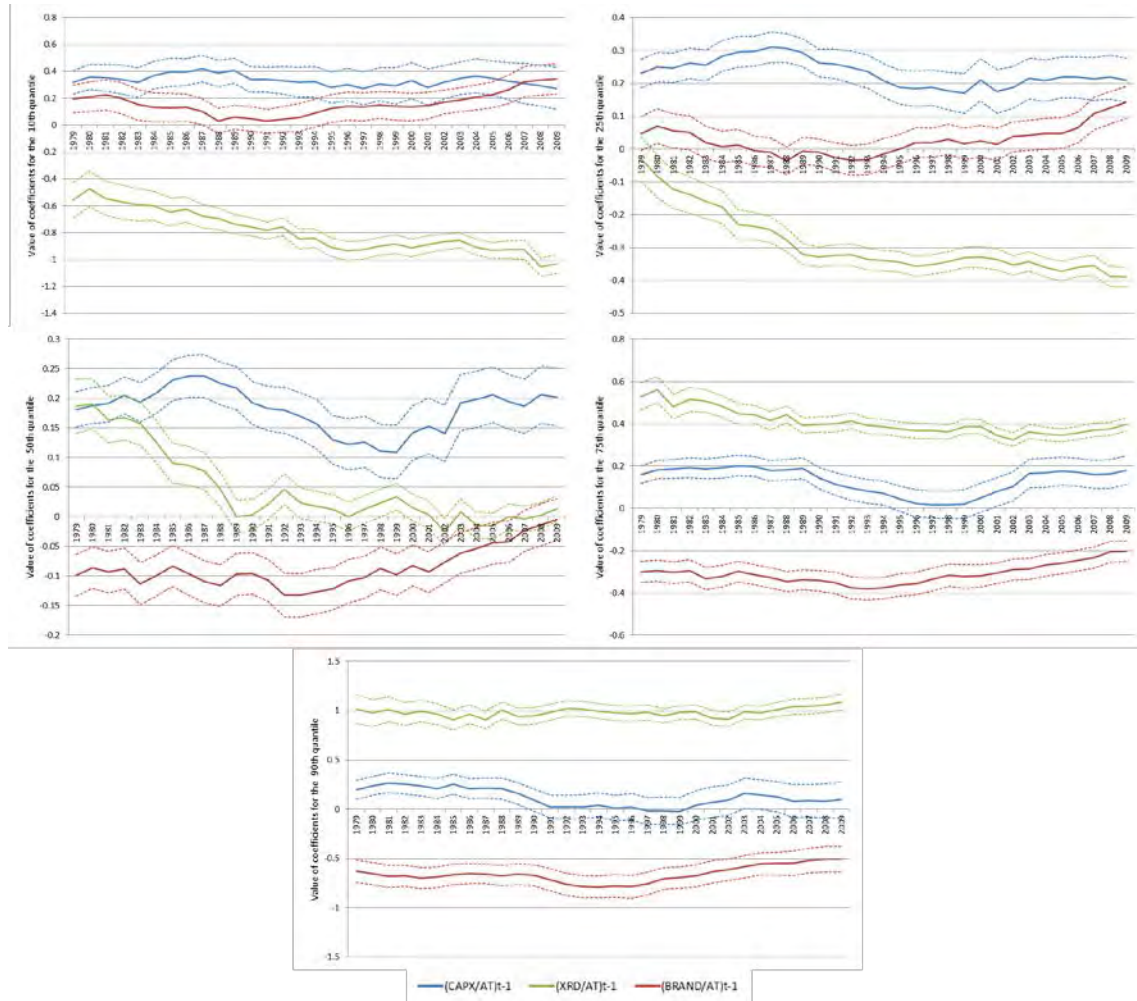


Figure 4. Percentage of firms from each sector in the sample

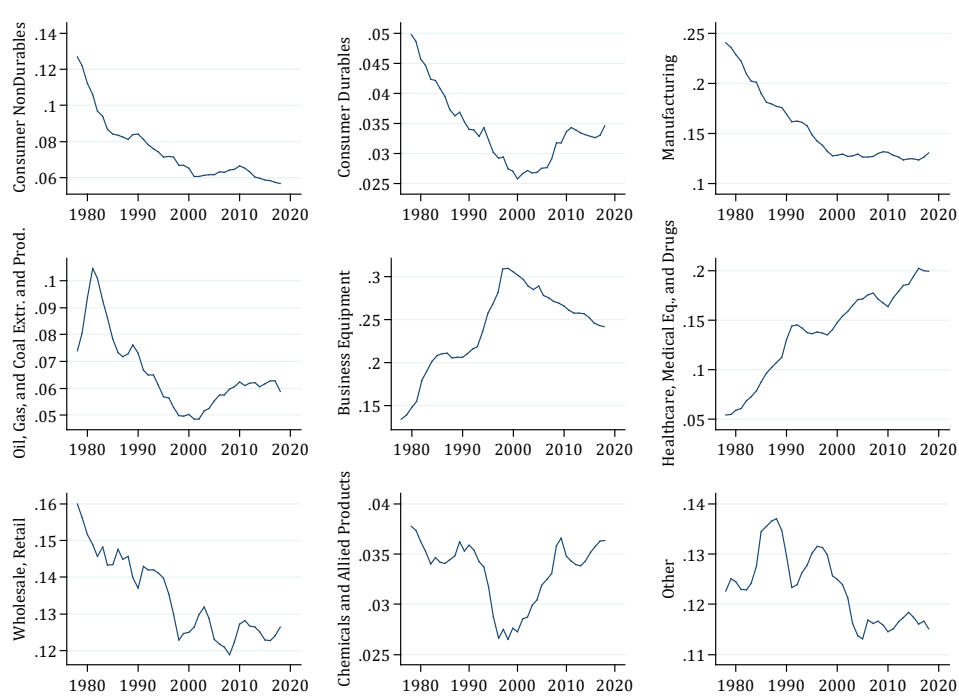


Figure 5. Median value of capital expenditures, R&D and advertising from each sector in the sample.



Due to space constraints, output tables are presented in the online appendix. In Table A1, equation (1) is reestimated for the whole sample excluding firms belonging to ‘healthcare, medical equipment and drugs’. Results are maintained qualitatively: advertising is still positive and statistically significant for slow-growth firms (QR10 and QR25), although only in periods 1 and 4. In the case of R&D, it is still positive for high-growth firms (QR75 and QR90). However, the relevance of these variables throughout time is more diffuse. While in the first period an increase in one standard deviation of capital expenditures and R&D represent 5.04% and 13.18% of growth standard error, during the last period those values are relatively similar: 4.8% and 10.07% respectively. In terms of advertising, the increasing relevance for slow-growth firms is maintained: during the first and the last period, an increase in one standard deviation of capital expenditures and advertising go from 7.55% and 13.93% of growth standard error to 4.50% and 20.94% respectively.

Some further considerations are taken into account in order to assess the robustness of the results. First, I take advertising values as presented in Compustat rather than calculated following the methodology presented in Section 4 (Table A2). Second, following Mazzucato and Parris (2015, p. 161) I add an additional variable, acquisitions - Compustat data item *AQC*-, that allows to control for external sources of growth (Table A3). Third, I apply the fixed-effects quantile regression estimator developed in Canay (2011) that allows to remove firms’ constant unobservable heterogeneity (Table A4). In this case, the autoregressive term is not included following that paper. Fourth, and finally, Moschella et al. (2019) highlight that taking a year-to-year growth is not enough to characterize firms as outperformers and therefore they compute an annualized average growth as well as averages of the focal variables over three years. I also follow this strategy, dropping growth’s lagged value to avoid serial correlation.

In all cases, the main results of positive and statistically significant values of advertising for QR10 and QR25 and R&D for QR75 and QR90 hold. The only exception is advertising in FE-QR. Intangible growing contribution is also verified as well. Capital expenditures in all cases portray a declining contribution to growth.

7. Discussion and concluding remarks

This paper has presented evidence of a shift in the way firms are growing, with a higher preponderance of intangible investment and a lower contribution of capital expenditures using firm-level data for a period that starts in 1979 and ends in 2018. It has identified and differentiated between two types of intangible investment: innovative spending, measured by R&D, and brand-building, measured by advertising. Whereas the former

has a positive, increasing over time effect for high-growth firms, the latter has similar effect for slow-growth firms. Capital expenditures' contribution, on the other hand, has decreased for both types of firms.

The literature on intangibles has indicated different reasons for the growing importance of this type of investment. In an increasingly globalized world, they build up distinctive or strategic features of the firm, harder to imitate by others (Haskel & Westlake, 2017, p. 186; Kay, 1993). Firms from developed economies have tended to redefine their core competences to focus on innovation, product strategy, marketing – in general, higher value-added activities that involve intangible investing -, while reducing direct ownership of non-core activities (Gereffi, Humphrey, & Sturgeon, 2005).

This paper has taken one step further in relation to this literature and linked different types of intangible investments with various growth profiles. More specifically and following previous findings on these topics, innovative investment has been linked to high-growth firms (Bianchini et al., 2016; Coad & Rao, 2008; García-Manjón & Romero-Merino, 2012). The novelty followed in this paper is to show that the relevance of R&D has grown over time: in the 2009-2018 period, an increase in one standard deviation represents more than 43% of growth's standard deviation. This picture contrasts with the 1979-1988 period when it represented 18.76%.

This growing relevance goes in line with those studies highlighting the path-dependent or accumulative character of innovation, where previous success tends to be a good predictor of future success in innovative activities (Arrighetti et al., 2014; Rikap, 2021). The results presented in this paper not only show this, but also a corollary. Firms who fail in their innovative efforts and do not increase their sales are not only more likely to perform poorly (Freel, 2000) but also the penalty on growth has increased over time.

For the slow-growth firms, on the contrary, other types of intangible investments seem to be more profitable in terms of keeping their market share: advertising. While in the 1979-1988 period, an increase in one standard deviation in advertising represented 4.7% of growth standard error, during the 2009-2018 period that value increased to 8.3%.

In an increasingly intangible economy, firms have therefore turned to this type of investment for their growth prospects, progressively abandoning more traditional tangible outlays. These results are verified for different types of firms: during the 1979-1988 period, an increase in one standard deviation of capital expenditures represented 4.6% and 7.7% of growth standard deviation for QR90 and QR10 respectively while in the last period they decreased to 2% and 4.6%. Hence, as a whole, the results obtained in this paper support the idea of substitution between tangible and intangible investment (Alexander & Eberly, 2018).

Moving forward, some limitations and avenues for future research can be identified. In terms of the former, the results obtained for the median firm do not support a turn to intangibles; neither to R&D nor to advertising. Other databases, with more disaggregated information on R&D, advertising, and other types of intangible investments (such as employee training) would be useful to better identify their specific contribution.

Also, when the ‘healthcare, medical equipment and drugs’ industry is excluded from the sample, R&D contribution still increases but less for high-growth firms. Results are not altered for advertising, though. This outcome seems logical as that sector both spends the most in R&D and verifies the highest increase in number of firms (Figure 5).

Finally, the results highlight the significant drop in growth experienced in the 2000s, which affected all types of firms. This decrease has come with an overall reduction or stagnation in intangible investment, along with further reductions in capital expenditures. Further studies should also focus on the specific drivers of this phenomenon.

References

- Abraham, M. M., & Lodish, L. M. (1990). Getting the most out of advertising and promotion. *Harvard Business Review*, 68(3), 50–51.
- Alexander, L., & Eberly, J. (2018). Investment hollowing out. *IMF Economic Review*, 66(1), 5–30. <https://doi.org/10.1057/s41308-017-0044-2>
- Ali Shah, S. Z., & Akbar, S. (2008). Value relevance of advertising expenditure: A review of the literature. *International Journal of Management Reviews*, 10(4), 301–325.
- Andrews, D., & Serres, A. de. (2012). Intangible Assets, Resource Allocation and Growth: A Framework for Analysis. *OECD Economics Department Working Papers*, 989. <https://doi.org/10.1787/18151973>
- Añón Higón, D., Gómez, J., & Vargas, P. (2017). Complementarities in innovation strategy: Do intangibles play a role in enhancing firm performance? *Industrial and Corporate Change*, 26(5), 865–886. <https://doi.org/10.1093/icc/dtw055>
- Ardishvili, A., Cardozo, S., Harmon, S., & Vadakath, S. (1998). Towards a theory of new venture growth. *Babson Entrepreneurship Research Conference, Ghent, Belgium*, 19–24.
- Arellano, M., & Bover, O. (1995). Another look at the instrumental variable estimation of error-components models. *Journal of Econometrics*, 68(1), 29–51. [https://doi.org/10.1016/0304-4076\(94\)01642-D](https://doi.org/10.1016/0304-4076(94)01642-D)
- Arrighetti, A., Landini, F., & Lasagni, A. (2014). Intangible assets and firm heterogeneity: Evidence from Italy. *Research Policy*, 43(1), 202–213. <https://doi.org/10.1016/j.respol.2013.07.015>
- Assmus, G., Farley, J. U., & Lehmann, D. R. (1984). How Advertising Affects Sales: Meta-Analysis of Econometric Results. *Journal of Marketing Research*, 21(1), 65–74. <https://doi.org/10.1177/002224378402100107>
- Autor, D., Dorn, D., Katz, L. F., Patterson, C., & Van Reenen, J. (2020). The Fall of the Labor Share and the Rise of Superstar Firms*. *The Quarterly Journal of Economics*, 135(2), 645–709. <https://doi.org/10.1093/qje/qjaa004>
- Auvray, T., & Rabinovich, J. (2019). The financialisation-offshoring nexus and the capital accumulation of US nonfinancial firms. *Cambridge Journal of Economics*, 43(5), 1183–1218. <https://doi.org/10.1093/cje/bey058>
- Barbosa, N., & Eiriz, V. (2011). Regional Variation of Firm Size and Growth: The Portuguese Case. *Growth and Change*, 42(2), 125–158. <https://doi.org/10.1111/j.1468-2257.2011.00547.x>
- Barkham, R., Gudgin, G., & Hart, M. (2002). *Determinants of small firm growth: An inter-regional study in the United Kingdom 1986-90*. Routledge.
- Bianchini, S., Bottazzi, G., & Tamagni, F. (2017). What does (not) characterize persistent corporate high-growth? *Small Business Economics*, 48(3), 633–656. <https://doi.org/10.1007/s11187-016-9790-1>

- Bianchini, S., Pellegrino, G., & Tamagni, F. (2016). Innovation strategies and firm growth. *IEB Working Paper, 2016/10*.
- Blundell, R., & Bond, S. (1998). Initial conditions and moment restrictions in dynamic panel data models. *Journal of Econometrics, 87*(1), 115–143.
- Bond, S., Elston, J. A., Mairesse, J., & Mulkay, B. (2003). Financial factors and investment in Belgium, France, Germany, and the United Kingdom: A comparison using company panel data. *Review of Economics and Statistics, 85*(1), 153–165. <https://doi.org/10.1162/003465303762687776>
- Bontempi, M. E., & Mairesse, J. (2015). Intangible capital and productivity at the firm level: A panel data assessment. *Economics of Innovation and New Technology, 24*(1–2), 22–51. <https://doi.org/10.1080/10438599.2014.897859>
- Bottazzi, G., Cefis, E., Dosi, G., & Secchi, A. (2007). Invariances and diversities in the evolution of Italian manufacturing industry. *Small Business Economics, 29*, 137–159.
- Bottazzi, G., Coad, A., Jacoby, N., & Secchi, A. (2011). Corporate growth and industrial dynamics: Evidence from French manufacturing. *Applied Economics, 43*(1), 103–116. <https://doi.org/10.1080/00036840802400454>
- Bottazzi, G., & Secchi, A. (2003). Common Properties and Sectoral Specificities in the Dynamics of U.S. Manufacturing Companies. *Review of Industrial Organization, 23*(3), 217–232. <https://doi.org/10.1023/B:REIO.0000031366.28559.c1>
- Bottazzi, G., & Secchi, A. (2006). Explaining the distribution of firm growth rates. *The RAND Journal of Economics, 37*(2), 235–256. <https://doi.org/10.1111/j.1756-2171.2006.tb00014.x>
- Brown, J. R., Fazzari, S. M., & Petersen, B. C. (2009). Financing innovation and growth: Cash flow, external equity, and the 1990s R&D boom. *The Journal of Finance, 64*(1), 151–185.
- Calvo, J. L. (2006). Testing Gibrat’s law for small, young and innovating firms. *Small Business Economics, 26*(2), 117–123. <https://doi.org/10.1007/s11187-004-2135-5>
- Cameron, A. C., & Trivedi, P. K. (2009). *Microeconometrics using stata*. Stata Press Publication.
- Canay, I. A. (2011). A simple approach to quantile regression for panel data. *The Econometrics Journal, 14*(3), 368–386. <https://doi.org/10.1111/j.1368-423X.2011.00349.x>
- Coad, A. (2009). *The growth of firms: A survey of theories and empirical evidence*. Edward Elgar Publishing.
- Coad, A., & Broekel, T. (2012). Firm growth and productivity growth: Evidence from a panel VAR. *Applied Economics, 44*(10), 1251–1269. <https://doi.org/10.1080/00036846.2010.539542>

- Coad, A., & Grassano, N. (2016). *Who's doing who? Growth of sales, employment, assets, profits and R&D entangled in a curious five-way love triangle* (No. 03/2016). IPTS Working Papers on Corporate R&D and Innovation.
- Coad, A., & Rao, R. (2008). Innovation and firm growth in high-tech sectors: A quantile regression approach. *Research Policy*, *37*(4), 633–648. <https://doi.org/10.1016/j.respol.2008.01.003>
- Cohen, W. M., & Levinthal, D. A. (1990). Absorptive capacity: A new perspective on learning and innovation. *Administrative Science Quarterly*, 128–152.
- Connolly, R. A., Hirsch, B. T., & Hirschey, M. (1986). Union rent seeking, intangible capital, and market value of the firm. *The Review of Economics and Statistics*, 567–577.
- Cooper, R., Haltiwanger, J., & Power, L. (1999). Machine Replacement and the Business Cycle: Lumps and Bumps. *American Economic Review*, *89*(4), 921–946. <https://doi.org/10.1257/aer.89.4.921>
- Corrado, C., Hulten, C., & Sichel, D. (2005). Measuring capital and technology: An expanded framework. In C. Corrado, J. Haltiwanger, & D. Sichel (Eds.), *Measuring capital in the new economy: Studies in Income and Wealth* (pp. 11–46). University of Chicago Press.
- Crouzet, N., & Eberly, J. (2018). Intangibles, investment, and efficiency. *AEA Papers and Proceedings*, *108*, 426–431.
- Currin, I. S., Lim, J., & Zhang, Y. (2018). Effect of analysts' earnings pressure on marketing spending and stock market performance. *Journal of the Academy of Marketing Science*, *46*(3), 431–452. <https://doi.org/10.1007/s11747-017-0540-y>
- Czarnitzki, D., & Delanote, J. (2013). Young Innovative Companies: The new high-growth firms? *Industrial and Corporate Change*, *22*(5), 1315–1340. <https://doi.org/10.1093/icc/dts039>
- Davidsson, P., & Wiklund, J. (2006). Conceptual and empirical challenges in the study of firm growth. In P. Davidsson, F. Delmar, & J. Wiklund, *Entrepreneurship and the Growth of Firms* (pp. 39–61). Edward Elgar Publishing.
- Davis, G. F. (2009). *Managed by the Market: How Finance Reshaped America*. Oxford University Press.
- Davis, L. E., & Orhangazi, Ö. (2020). Competition and monopoly in the U.S. economy: What do the industrial concentration data show? *Competition & Change*, 1024529420934011. <https://doi.org/10.1177/1024529420934011>
- De Loecker, J., Eeckhout, J., & Unger, G. (2020). The Rise of Market Power and the Macroeconomic Implications. *The Quarterly Journal of Economics*, *135*(2), 561–644. <https://doi.org/10.1093/qje/qjz041>
- De Ridder, M. (2019). *Market power and innovation in the intangible economy*.

- Del Monte, A., & Papagni, E. (2003). R&D and the growth of firms: Empirical analysis of a panel of Italian firms. *Research Policy*, *32*(6), 1003–1014. [https://doi.org/10.1016/S0048-7333\(02\)00107-5](https://doi.org/10.1016/S0048-7333(02)00107-5)
- Delmar, F. (2006). Measuring growth: Methodological considerations and empirical results. *Entrepreneurship and the Growth of Firms*, *1*(1), 62–84.
- Doms, M., & Dunne, T. (1998). Capital adjustment patterns in manufacturing plants. *Review of Economic Dynamics*, *1*(2), 409–429.
- Dosi, G., Grazzi, M., Moschella, D., Pisano, G., & Tamagni, F. (2020). Long-term firm growth: An empirical analysis of US manufacturers 1959–2015. *Industrial and Corporate Change*, *29*(2), 309–332. <https://doi.org/10.1093/icc/dtz044>
- Döttling, R., Gutierrez Gallardo, G., & Philippon, T. (2017). *Is there an investment gap in advanced economies? If so, why?* <https://ssrn.com/abstract=3002796>
- Fama, E. F., & French, K. R. (1997). Industry costs of equity. *Journal of Financial Economics*, *43*(2), 153–193. [https://doi.org/10.1016/S0304-405X\(96\)00896-3](https://doi.org/10.1016/S0304-405X(96)00896-3)
- Feng, H., Morgan, N. A., & Rego, L. L. (2015). Marketing Department Power and Firm Performance. *Journal of Marketing*, *79*(5), 1–20. <https://doi.org/10.1509/jm.13.0522>
- Freel, M. S. (2000). Do Small Innovating Firms Outperform Non-Innovators? *Small Business Economics*, *14*(3), 195–210. <https://doi.org/10.1023/A:1008100206266>
- García-Manjón, J. V., & Romero-Merino, M. E. (2012). Research, development, and firm growth. Empirical evidence from European top R&D spending firms. *Research Policy*, *41*(6), 1084–1092. <https://doi.org/10.1016/j.respol.2012.03.017>
- Gereffi, G., Humphrey, J., & Sturgeon, T. (2005). The governance of global value chains. *Review of International Political Economy*, *12*(1), 78–104. <https://doi.org/10.1080/09692290500049805>
- Gibrat, R. (1931). *Les inégalités économiques; applications: Aux inégalités des richesses, à la concentration des entreprises, aux populations des villes, aux statistiques des familles, etc., d'une loi nouvelle, la loi de l'effect proportionnel*. Recueil Sirey.
- Girardi, D., & Pariboni, R. (2016). Long-run Effective Demand in the US Economy: An Empirical Test of the Sraffian Supermultiplier Model. *Review of Political Economy*, *28*(4), 523–544. <https://doi.org/10.1080/09538259.2016.1209893>
- Gómez, J., & Vargas, P. (2012). Intangible resources and technology adoption in manufacturing firms. *Research Policy*, *41*(9), 1607–1619. <https://doi.org/10.1016/j.respol.2012.04.016>
- Gutiérrez, G., & Phillipon, T. (2017). Investmentless Growth: An Empirical Investigation. *Brookings Papers on Economic Activity*, 89–169.
- Hall, B. H., & Mairesse, J. (1995). Exploring the relationship between R&D and productivity in French manufacturing firms. *Journal of Econometrics*, *65*(1), 263–293. [https://doi.org/10.1016/0304-4076\(94\)01604-X](https://doi.org/10.1016/0304-4076(94)01604-X)

- Hall, B. H., Mairesse, J., & Mohnen, P. (2010). Measuring the Returns to R&D. In *Handbook of the Economics of Innovation* (Vol. 2, pp. 1033–1082). Elsevier.
- Haskel, J., & Westlake, S. (2017). *Capitalism without capital: The rise of the intangible economy*. Princeton University Press.
- Hirschey, M., & Spencer, R. S. (1992). Size Effects in the Market Valuation of Fundamental Factors. *Financial Analysts Journal*, 48(2), 91–95. <https://doi.org/10.2469/faj.v48.n2.91>
- Hirschey, M., & Weygandt, J. J. (1985). Amortization policy for advertising and research and development expenditures. *Journal of Accounting Research*, 326–335.
- Hözl, W. (2009). Is the R&D behaviour of fast-growing SMEs different? Evidence from CIS III data for 16 countries. *Small Business Economics*, 33(1), 59–75. <https://doi.org/10.1007/s11187-009-9182-x>
- IMF. (2006). Awash with Cash: Why are Corporate Savings So High?. In *World Economic Outlook*.
- IMF. (2015). Private Investment: What’s the Holdup? In *World Economic Outlook. Uneven growth: Short and long-term factors*. International Monetary Fund Washington, DC.
- Kay, J. (1993). *Foundations of Corporate Success: How Business Strategies Add Value*. Oxford University Press.
- Koenker, R. (2005). *Quantile Regression*. Cambridge University Press.
- Lawless, M. (2014). Age or size? Contributions to job creation. *Small Business Economics*, 42(4), 815–830.
- Lazonick, W. (2014). Profits without prosperity. *Harvard Business Review*, 92(9), 46–55.
- Lee, D. W., Shin, H.-H., & Stulz, R. M. (2016). *Why Does Capital No Longer Flow More to the Industries with the Best Growth Opportunities?* Fisher College of Business Working Paper No. 2016-03-15.
- Lee, J., & Gereffi, G. (2015). Global value chains, rising power firms and economic and social upgrading. *Critical Perspectives on International Business*, 11(3/4), 319–339. <https://doi.org/10.1108/cpoib-03-2014-0018>
- Lev, B., & Gu, F. (2016). *The end of accounting and the path forward for investors and managers*. John Wiley & Sons.
- Lööf, H., & Heshmati, A. (2002). Knowledge capital and performance heterogeneity: A firm-level innovation study. *International Journal of Production Economics*, 76(1), 61–85. [https://doi.org/10.1016/S0925-5273\(01\)00147-5](https://doi.org/10.1016/S0925-5273(01)00147-5)
- Lotti, F., Santarelli, E., & Vivarelli, M. (2009). Defending Gibrat’s Law as a long-run regularity. *Small Business Economics*, 32(1), 31–44. <https://doi.org/10.1007/s11187-007-9071-0>

- Mairesse, J., & Mohnen, P. (2004). The importance of R&D for innovation: A reassessment using French survey data. *The Journal of Technology Transfer*, 30(1–2), 183–197.
- Mansfield, E., Rapoport, J., Romeo, A., Villani, E., Wagner, S., & Husic, F. (1977). *The Production and Application of New Industrial Technology* (Vol. 63). Norton & Company.
- Mazzucato, M., & Parris, S. (2015). High-growth firms in changing competitive environments: The US pharmaceutical industry (1963 to 2002). *Small Business Economics*, 44(1), 145–170.
- McAlister, L., Srinivasan, R., & Kim, M. (2007). Advertising, Research and Development, and Systematic Risk of the Firm. *Journal of Marketing*, 71(1), 35–48. <https://doi.org/10.1509/jmkg.71.1.035>
- McKinsey. (2018). *Superstars': The dynamics of firms, sectors, and cities leading the global economy* [McKinsey Global Institute (MGI) Discussion Paper].
- Milberg, W. (2008). Shifting sources and uses of profits: Sustaining US financialization with global value chains. *Economy and Society*, 37(3), 420–451. <https://doi.org/10.1080/03085140802172706>
- Montesor, S., & Vezzani, A. (2016). Intangible investments and innovation propensity: Evidence from the Innobarometer 2013. *Industry and Innovation*, 23(4), 331–352.
- Moschella, D., Tamagni, F., & Yu, X. (2019). Persistent high-growth firms in China's manufacturing. *Small Business Economics*, 52(3), 573–594. <https://doi.org/10.1007/s11187-017-9973-4>
- Nix, P. E., & Nix, D. E. (1992). A historical review of the accounting treatment of research and development costs. *Accounting Historians Journal*, 19(1), 51–78.
- OECD. (2007). Corporate Savings and Investment: Recent Trends and Prospects. In *OECD Economic Outlook*.
- OECD. (2013). *New Sources of Growth: Knowledge Based Capital. Key Analyses and Policy Conclusions. Synthesis Report*. OECD.
- Orhangazi, Ö. (2008). Financialisation and capital accumulation in the non-financial corporate sector: A theoretical and empirical investigation on the US economy: 1973–2003. *Cambridge Journal of Economics*, 32(6), 863–886. <https://doi.org/10.1093/cje/ben009>
- Orhangazi, Ö. (2018). The role of intangible assets in explaining the investment–profit puzzle. *Cambridge Journal of Economics*, 43(5), 1251–1286. <https://doi.org/10.1093/cje/bey046>
- Pagano, U. (2014). The crisis of intellectual monopoly capitalism. *Cambridge Journal of Economics*, 38(6), 1409–1429. <https://doi.org/10.1093/cje/beu025>
- Penrose, E. T. (1959). *The Theory of the Growth of the Firm*. Basil Blackwell.

- Peters, R. H., & Taylor, L. A. (2017). Intangible capital and the investment-q relation. *Journal of Financial Economics*, *123*(2), 251–272. <https://doi.org/10.1016/j.jfineco.2016.03.011>
- Peterson, R. A., & Jeong, J. (2010). Exploring the impact of advertising and R&D expenditures on corporate brand value and firm-level financial performance. *Journal of the Academy of Marketing Science*, *38*(6), 677–690. <https://doi.org/10.1007/s11747-010-0188-3>
- Prahalad, C. K., & Hamel, G. (1990). The core competence of the corporation. *Harvard Business Review*, *68*(3), 79–91.
- Rabinovich, J. (2020). Financialisation and the ‘supply-side’ face of the investment-profit puzzle. *Journal of Post Keynesian Economics*, *En prensa*.
- Rikap, C. (2018). Innovation as economic power in Global Value Chains. *Revue d'Économie Industrielle*, *3*(163), 35–75.
- Rikap, C. (2021). *Capitalism, Power and Innovation: Intellectual Monopoly Capitalism Uncovered*. Routledge.
- Roodman, D. (2009). How to do xtabond2: An introduction to difference and system GMM in Stata. *Stata Journal*, *9*(1), 86–136. <https://doi.org/10.1177/1536867X0900900106>
- Santarelli, E., Klomp, L., & Thurik, A. R. (2006). Gibrat’s law: An overview of the empirical literature. In E. Santarelli (Ed.), *Entrepreneurship, growth, and innovation* (pp. 41–73). Springer.
- Schumpeter, J. A. (1942). *Socialism, capitalism and democracy*. Harper and Brothers.
- Schwörer, T. (2013). Offshoring, domestic outsourcing and productivity: Evidence for a number of European countries. *Review of World Economics*, *149*(1), 131–149. <https://doi.org/10.1007/s10290-012-0139-9>
- Serrasqueiro, Z., Nunes, P. M., Leitão, J., & Armada, M. (2010). Are there non-linearities between SME growth and its determinants? A quantile approach. *Industrial and Corporate Change*, *19*(4), 1071–1108. <https://doi.org/10.1093/icc/dtp053>
- Sethuraman, R., Tellis, G. J., & Briesch, R. A. (2011). How Well Does Advertising Work? Generalizations from Meta-Analysis of Brand Advertising Elasticities. *Journal of Marketing Research*, *48*(3), 457–471. <https://doi.org/10.1509/jmkr.48.3.457>
- Shapiro, B., Hitsch, G. J., & Tuchman, A. (2020). Generalizable and robust TV advertising effects. *NBER Working Paper*, *w27684*.
- Solow, R. M. (1957). Technical change and the aggregate production function. *The Review of Economics and Statistics*, *39*(3), 312–320.
- Sridhar, S., Narayanan, S., & Srinivasan, R. (2014). Dynamic relationships among R&D, advertising, inventory and firm performance. *Journal of the Academy of Marketing Science*, *42*(3), 277–290. <https://doi.org/10.1007/s11747-013-0359-0>

- Srinivasan, S., & Hanssens, D. M. (2009). Marketing and Firm Value: Metrics, Methods, Findings, and Future Directions. *Journal of Marketing Research*, 46(3), 293–312. <https://doi.org/10.1509/jmkr.46.3.293>
- Standard & Poor's. (2001). *Compustat (North America) User's Guide*. McGraw Hill.
- Stanley, M. H. R., Amaral, L. A. N., Buldyrev, S. V., Havlin, S., Leschhorn, H., Maass, P., Salinger, M. A., & Stanley, H. E. (1996). Scaling behaviour in the growth of companies. *Nature*, 379(6568), 804–806.
- Stockhammer, E. (2004). Financialisation and the slowdown of accumulation. *Cambridge Journal of Economics*, 28(5), 719–741. <https://doi.org/10.1093/cje/beh032>
- Stockhammer, E. (2005). Shareholder value orientation and the investment-profit puzzle. *Journal of Post Keynesian Economics*, 28(2), 193–215. <https://doi.org/10.2753/PKE0160-3477280203>
- Stockhammer, E. (2008). Some stylized facts on the finance-dominated accumulation regime. *Competition & Change*, 12(2), 184–202. <https://doi.org/10.1179/102452908X289820>
- Szewczyk, S. H., Tsetsekos, G. P., & Zantout, Z. (1996). The valuation of corporate R&D expenditures: Evidence from investment opportunities and free cash flow. *Financial Management*, 105–110.
- Weinzimmer, L. G., Nystrom, P. C., & Freeman, S. J. (1998). Measuring organizational growth: Issues, consequences and guidelines. *Journal of Management*, 24(2), 235–262. <https://doi.org/10.1177/014920639802400205>
- Woolridge, J. R., & Snow, C. C. (1990). Stock market reaction to strategic investment decisions. *Strategic Management Journal*, 11(5), 353–363. <https://doi.org/10.1002/smj.4250110503>
- World Intellectual Property Organization. (2017). *Intangible Capital in Global Value Chains* [World Intellectual Property Report 2017].
- Yang, C.-H., & Huang, C.-H. (2005). R&D, Size and Firm Growth in Taiwan's Electronics Industry. *Small Business Economics*, 25(5), 477–487. <https://doi.org/10.1007/s11187-004-6487-7>
- Yasuda, T. (2005). Firm growth, size, age and behavior in Japanese manufacturing. *Small Business Economics*, 24(1), 1–15. <https://doi.org/10.1007/s11187-005-7568-y>
- Yiannaka, A., Giannakas, K., & Tran, K. C. (2002). Medium, message and advertising effectiveness in the Greek processed meats industry. *Applied Economics*, 34(14), 1757–1763. <https://doi.org/10.1080/00036840110118755>

Appendix

Table A1. OLS, fixed-effects and quantile regression estimation of equation (1) for each period. All firms without ‘healthcare, medical equipment and drugs’, 1979-2018

	FE	GMM	QR (%)				
			10	25	50	75	90
<u>Period 1979-1988, obs=25,232</u>							
GROWTH _{t-1}		0.170*** (0.022)	0.135*** (0.016)	0.146*** (0.010)	0.184*** (0.008)	0.199*** (0.011)	0.164*** (0.014)
(CAPX/AT) _{t-1}	0.411*** (0.063)	0.573*** (0.092)	0.310*** (0.047)	0.222*** (0.024)	0.174*** (0.020)	0.154*** (0.030)	0.208*** (0.061)
(R&D/AT) _{t-1}	0.485*** (0.186)	0.868** (0.430)	-0.519*** (0.165)	-0.096 (0.081)	0.114** (0.054)	0.428*** (0.087)	0.834*** (0.172)
(ADV/AT) _{t-1}	-0.662*** (0.054)	-0.483*** (0.102)	0.173*** (0.045)	0.056** (0.025)	-0.079*** (0.013)	-0.282*** (0.018)	-0.604*** (0.036)
SIZE _{t-1}	-0.210*** (0.011)	0.054*** (0.011)	0.030*** (0.002)	0.012*** (0.001)	0.000 (0.001)	-0.013*** (0.001)	-0.031*** (0.002)
AGE _t	-0.007 (0.010)	-0.019*** (0.003)	0.006*** (0.001)	-0.001 (0.001)	-0.004*** (0.000)	-0.010*** (0.001)	-0.021*** (0.001)
[Pseudo-]R ²	0.087	0	0.0723	0.0552	0.0645	0.1061	0.1575
AR-1		0					
AR-2		0.941					
Hansen test		0.141					
<u>Period 1989-1998, obs=27,113</u>							
GROWTH _{t-1}		0.205*** (0.022)	0.166*** (0.012)	0.195*** (0.008)	0.263*** (0.008)	0.284*** (0.010)	0.241*** (0.016)
(CAPX/AT) _{t-1}	0.519*** (0.069)	0.707*** (0.106)	0.424*** (0.050)	0.283*** (0.023)	0.207*** (0.018)	0.181*** (0.031)	0.208*** (0.065)
(R&D/AT) _{t-1}	0.166 (0.101)	0.022 (0.279)	-0.501*** (0.063)	-0.264*** (0.032)	-0.019 (0.026)	0.242*** (0.044)	0.552*** (0.101)
(ADV/AT) _{t-1}	-0.540*** (0.036)	-0.540*** (0.084)	-0.062 (0.044)	-0.038 (0.025)	-0.093*** (0.017)	-0.313*** (0.023)	-0.574*** (0.046)
SIZE _{t-1}	-0.167*** (0.009)	0.072*** (0.011)	0.030*** (0.002)	0.012*** (0.001)	-0.001 (0.001)	-0.015*** (0.001)	-0.034*** (0.002)
AGE _t	0.004 (0.009)	-0.012*** (0.001)	-0.000 (0.000)	-0.001*** (0.000)	-0.003*** (0.000)	-0.005*** (0.000)	-0.008*** (0.001)
[Pseudo-]R ²	0.071	0	0.0709	0.0601	0.0971	0.1521	0.1786
AR-1		0					
AR-2		0.041					
Hansen test		0.026					
<u>Period 1999-2008, obs=24,520</u>							
GROWTH _{t-1}		0.292*** (0.019)	0.150*** (0.015)	0.189*** (0.010)	0.283*** (0.011)	0.337*** (0.010)	0.334*** (0.014)
(CAPX/AT) _{t-1}	0.195** (0.085)	-0.048 (0.123)	0.258*** (0.052)	0.164*** (0.029)	0.105*** (0.025)	0.041 (0.032)	0.002 (0.056)
(R&D/AT) _{t-1}	0.019 (0.101)	0.099 (0.204)	-0.480*** (0.084)	-0.152*** (0.040)	0.078** (0.037)	0.301*** (0.039)	0.510*** (0.080)
(ADV/AT) _{t-1}	-0.472*** (0.041)	-0.209*** (0.072)	0.019 (0.043)	-0.041** (0.021)	-0.125*** (0.021)	-0.303*** (0.030)	-0.614*** (0.045)
SIZE _{t-1}	-0.225*** (0.010)	0.032** (0.014)	0.015*** (0.002)	0.005*** (0.001)	-0.004*** (0.001)	-0.016*** (0.001)	-0.035*** (0.001)
AGE _t	-0.044*** (0.007)	-0.004*** (0.001)	0.000* (0.000)	-0.000** (0.000)	-0.001*** (0.000)	-0.002*** (0.000)	-0.004*** (0.000)
[Pseudo-]R ²	0.161	0	0.075	0.0608	0.0949	0.1588	0.2168
AR-1		0					
AR-2		0.133					
Hansen test		0.114					
<u>Period 2009-2018, obs=19,649</u>							
GROWTH _{t-1}		0.252*** (0.027)	0.146*** (0.017)	0.199*** (0.013)	0.250*** (0.012)	0.252*** (0.013)	0.236*** (0.017)
(CAPX/AT) _{t-1}	0.408*** (0.102)	0.370** (0.145)	0.234*** (0.043)	0.174*** (0.034)	0.203*** (0.026)	0.219*** (0.034)	0.164** (0.072)
(R&D/AT) _{t-1}	-0.222 (0.171)	0.002 (0.316)	-0.352*** (0.059)	-0.093*** (0.033)	0.032 (0.026)	0.172*** (0.036)	0.342*** (0.067)
(ADV/AT) _{t-1}	-0.350*** (0.062)	-0.132 (0.132)	0.212*** (0.034)	0.051** (0.021)	-0.018 (0.019)	-0.136*** (0.024)	-0.316*** (0.037)
SIZE _{t-1}	-0.143*** (0.011)	0.047*** (0.017)	0.024*** (0.001)	0.009*** (0.001)	-0.001** (0.001)	-0.011*** (0.001)	-0.026*** (0.002)
AGE _t	0.000 (0.008)	-0.003*** (0.001)	-0.000 (0.000)	-0.001*** (0.000)	-0.001*** (0.000)	-0.002*** (0.000)	-0.003*** (0.000)
[Pseudo-]R ²	0.083	0	0.1134	0.0884	0.088	0.1245	0.1516
AR-1		0					
AR-2		0.416					
Hansen test		0.143					

The table presents the coefficient and standard errors (in parenthesis) of the estimations by using fixed effects, GMM and quantile regression. Estimations include year and industry dummies. Standard errors for the quantile regression coefficients are obtained using 150 bootstrap replications. I have included the R² (percent of variance in the dependent variable explained collectively by all of the independent variables) in the OLS and fixed effects estimation and [Pseudo-]R² (based on change in the deviance statistic) in the quantile regression. P-values are reported for all tests. * indicates significance at 10%, ** significance at 5% and *** significance at 1%.

Table A2. Fixed-effects, GMM and quantile regression estimation of equation (1) for each period. All firms with original advertising values, 1979-2018.

	FE	GMM	QR (%)				
			10	25	50	75	90
<u>Period 1979-1988, obs=27,165</u>							
GROWTH _{t-1}		0.186*** (0.021)	0.132*** (0.014)	0.146*** (0.010)	0.187*** (0.010)	0.198*** (0.012)	0.164*** (0.015)
(CAPX/AT) _{t-1}	0.390*** (0.063)	0.684*** (0.091)	0.314*** (0.048)	0.226*** (0.022)	0.187*** (0.019)	0.181*** (0.029)	0.205*** (0.053)
(R&D/AT) _{t-1}	0.050 (0.170)	-0.067 (0.409)	-0.562*** (0.136)	-0.031 (0.065)	0.169*** (0.047)	0.490*** (0.080)	0.912*** (0.136)
(ADV/AT) _{t-1}	-1.009*** (0.217)	-0.080 (0.384)	0.187*** (0.053)	0.026 (0.030)	-0.058* (0.030)	-0.142*** (0.028)	-0.352*** (0.050)
SIZE _{t-1}	-0.153*** (0.009)	0.076*** (0.011)	0.028*** (0.001)	0.011*** (0.001)	0.000 (0.001)	-0.011*** (0.001)	-0.027*** (0.002)
AGE _t	-0.017* (0.011)	-0.024*** (0.003)	0.006*** (0.001)	-0.001 (0.001)	-0.005*** (0.000)	-0.011*** (0.001)	-0.025*** (0.001)
[Pseudo-]R ²	0.049		0.0693	0.053	0.0665	0.1112	0.162
AR-1		0.000					
AR-2		0.984					
Hansen test		0.146					
<u>Period 1989-1998, obs=31,190</u>							
GROWTH _{t-1}		0.204*** (0.021)	0.143*** (0.012)	0.181*** (0.007)	0.244*** (0.010)	0.260*** (0.010)	0.209*** (0.014)
(CAPX/AT) _{t-1}	0.401*** (0.066)	0.647*** (0.101)	0.414*** (0.049)	0.293*** (0.023)	0.222*** (0.020)	0.193*** (0.034)	0.158*** (0.056)
(R&D/AT) _{t-1}	-0.030 (0.078)	-0.052 (0.203)	-0.728*** (0.055)	-0.321*** (0.025)	0.000 (0.027)	0.355*** (0.041)	0.888*** (0.094)
(ADV/AT) _{t-1}	-0.679*** (0.136)	-0.672** (0.286)	0.120** (0.059)	0.035 (0.031)	-0.022 (0.021)	-0.109*** (0.032)	-0.222*** (0.055)
SIZE _{t-1}	-0.113*** (0.007)	0.106*** (0.010)	0.030*** (0.002)	0.013*** (0.001)	0.000 (0.001)	-0.012*** (0.001)	-0.025*** (0.001)
AGE _t	-0.009 (0.009)	-0.015*** (0.001)	-0.001 (0.000)	-0.001*** (0.000)	-0.003*** (0.000)	-0.005*** (0.000)	-0.010*** (0.000)
[Pseudo-]R ²	0.033		0.0702	0.0526	0.0865	0.1382	0.1689
AR-1		0.000					
AR-2		0.000					
Hansen test		0.036					
<u>Period 1999-2008, obs=29,062</u>							
GROWTH _{t-1}		0.255*** (0.022)	0.130*** (0.012)	0.170*** (0.009)	0.257*** (0.008)	0.300*** (0.010)	0.288*** (0.012)
(CAPX/AT) _{t-1}	0.144* (0.084)	0.151 (0.125)	0.292*** (0.051)	0.168*** (0.029)	0.112*** (0.019)	0.017 (0.033)	-0.081 (0.062)
(R&D/AT) _{t-1}	-0.182** (0.073)	0.003 (0.152)	-0.901*** (0.088)	-0.329*** (0.032)	0.028 (0.022)	0.366*** (0.036)	0.951*** (0.083)
(ADV/AT) _{t-1}	-0.791*** (0.173)	0.179 (0.355)	-0.049 (0.051)	-0.032 (0.034)	-0.032 (0.030)	-0.125*** (0.032)	-0.312*** (0.064)
SIZE _{t-1}	-0.162*** (0.008)	0.080*** (0.015)	0.016*** (0.001)	0.005*** (0.001)	-0.003*** (0.001)	-0.013*** (0.001)	-0.026*** (0.002)
AGE _t	-0.051*** (0.009)	-0.007*** (0.001)	0.000 (0.000)	-0.000*** (0.000)	-0.001*** (0.000)	-0.002*** (0.000)	-0.004*** (0.000)
[Pseudo-]R ²	0.093		0.0814	0.0506	0.0772	0.1355	0.1908
AR-1		0.000					
AR-2		0.477					
Hansen test		0.180					
<u>Period 2009-2018, obs=23,773</u>							
GROWTH _{t-1}		0.161*** (0.028)	0.102*** (0.017)	0.153*** (0.012)	0.199*** (0.011)	0.192*** (0.013)	0.157*** (0.019)
(CAPX/AT) _{t-1}	0.246** (0.104)	0.511*** (0.155)	0.305*** (0.054)	0.222*** (0.033)	0.204*** (0.025)	0.185*** (0.033)	0.090 (0.069)
(R&D/AT) _{t-1}	0.005 (0.102)	0.021 (0.176)	-1.072*** (0.096)	-0.389*** (0.043)	0.014 (0.029)	0.400*** (0.041)	1.082*** (0.131)
(ADV/AT) _{t-1}	-0.288 (0.219)	0.023 (0.432)	0.264*** (0.043)	0.081*** (0.030)	0.015 (0.031)	-0.066** (0.033)	-0.307*** (0.048)
SIZE _{t-1}	-0.097*** (0.011)	0.069*** (0.018)	0.020*** (0.001)	0.008*** (0.001)	-0.001* (0.001)	-0.008*** (0.001)	-0.020*** (0.002)
AGE _t	0.006 (0.011)	-0.005*** (0.001)	0.000 (0.000)	-0.000*** (0.000)	-0.001*** (0.000)	-0.002*** (0.000)	-0.004*** (0.000)
[Pseudo-]R ²	0.030		0.128	0.0636	0.0568	0.1026	0.1592
AR-1		0.000					
AR-2		0.936					
Hansen test		0.127					

The table presents the coefficient and standard errors (in parenthesis) of the estimations by using fixed effects, GMM and quantile regression. Estimations include year and industry dummies. Standard errors for the quantile regression coefficients are obtained using 150 bootstrap replications. I have included the R² (percent of variance in the dependent variable explained collectively by all of the independent variables) in the OLS and fixed effects estimation and [Pseudo-]R² (based on change in the deviance statistic) in the quantile regression. P-values are reported for all tests. * indicates significance at 10%, ** significance at 5% and *** significance at 1%.

Table A3. Fixed-effects, GMM and quantile regression estimation of equation (1) for each period. All firms with further controls, 1979-2018.

	FE	GMM	QR (%)				
			10	25	50	75	90
<u>Period 1979-1988, obs=27,165</u>							
GROWTH _{t-1}		0.158*** (0.021)	0.124*** (0.015)	0.135*** (0.010)	0.169*** (0.010)	0.172*** (0.011)	0.134*** (0.014)
(CAPX/AT) _{t-1}	0.437*** (0.062)	0.714*** (0.089)	0.317*** (0.041)	0.241*** (0.022)	0.204*** (0.020)	0.187*** (0.028)	0.270*** (0.053)
(R&D/AT) _{t-1}	0.048 (0.170)	0.096 (0.391)	-0.536*** (0.150)	-0.021 (0.072)	0.215*** (0.051)	0.611*** (0.076)	1.115*** (0.116)
(ADV/AT) _{t-1}	-0.905*** (0.212)	0.093 (0.367)	0.061*** (0.014)	0.016** (0.006)	-0.026*** (0.004)	-0.084*** (0.007)	-0.171*** (0.010)
SIZE _{t-1}	-0.171*** (0.009)	0.060*** (0.010)	0.029*** (0.002)	0.010*** (0.001)	-0.002*** (0.001)	-0.015*** (0.001)	-0.035*** (0.001)
(ACQ/AT) _{t-1}	1.095*** (0.074)	1.057*** (0.105)	0.338*** (0.057)	0.375*** (0.045)	0.497*** (0.038)	0.837*** (0.078)	1.383*** (0.124)
AGE _t	-0.011 (0.011)	-0.021*** (0.003)	0.006*** (0.001)	-0.000 (0.001)	-0.004*** (0.000)	-0.011*** (0.001)	-0.022*** (0.001)
[Pseudo-]R ²	0.067		0.071	0.0551	0.0712	0.1238	0.1869
AR-1		0.000					
AR-2		0.924					
Hansen test		0.147					
<u>Period 1989-1998, obs=31,190</u>							
GROWTH _{t-1}		0.171*** (0.020)	0.131*** (0.013)	0.170*** (0.009)	0.221*** (0.010)	0.236*** (0.011)	0.201*** (0.015)
(CAPX/AT) _{t-1}	0.449*** (0.065)	0.711*** (0.098)	0.449*** (0.048)	0.317*** (0.024)	0.252*** (0.022)	0.250*** (0.028)	0.272*** (0.053)
(R&D/AT) _{t-1}	-0.079 (0.078)	-0.181 (0.203)	-0.723*** (0.051)	-0.311*** (0.030)	0.021 (0.030)	0.419*** (0.042)	0.987*** (0.096)
(ADV/AT) _{t-1}	-0.658*** (0.135)	-0.629** (0.276)	0.021 (0.013)	0.001 (0.007)	-0.025*** (0.005)	-0.088*** (0.007)	-0.183*** (0.010)
SIZE _{t-1}	-0.126*** (0.007)	0.095*** (0.010)	0.030*** (0.002)	0.012*** (0.001)	-0.002*** (0.001)	-0.017*** (0.001)	-0.036*** (0.002)
(ACQ/AT) _{t-1}	0.777*** (0.050)	0.797*** (0.066)	0.368*** (0.045)	0.372*** (0.038)	0.484*** (0.036)	0.684*** (0.047)	0.855*** (0.091)
AGE _t	-0.009 (0.009)	-0.014*** (0.001)	-0.000 (0.000)	-0.001*** (0.000)	-0.003*** (0.000)	-0.005*** (0.000)	-0.008*** (0.000)
[Pseudo-]R ²	0.045		0.0726	0.056	0.0928	0.1515	0.1873
AR-1		0.000					
AR-2		0.000					
Hansen test		0.000					
<u>Period 1999-2008, obs=29,062</u>							
GROWTH _{t-1}		0.217*** (0.021)	0.115*** (0.013)	0.153*** (0.009)	0.240*** (0.011)	0.291*** (0.010)	0.282*** (0.013)
(CAPX/AT) _{t-1}	0.205** (0.083)	0.253** (0.122)	0.328*** (0.048)	0.215*** (0.029)	0.155*** (0.023)	0.067* (0.034)	0.059 (0.060)
(R&D/AT) _{t-1}	-0.223*** (0.073)	-0.053 (0.148)	-0.885*** (0.080)	-0.319*** (0.036)	0.055** (0.023)	0.407*** (0.039)	1.044*** (0.074)
(ADV/AT) _{t-1}	-0.746*** (0.174)	0.224 (0.342)	0.046*** (0.010)	0.007 (0.005)	-0.028*** (0.004)	-0.090*** (0.007)	-0.199*** (0.011)
SIZE _{t-1}	-0.177*** (0.009)	0.069*** (0.015)	0.017*** (0.001)	0.005*** (0.001)	-0.005*** (0.001)	-0.018*** (0.001)	-0.036*** (0.002)
(ACQ/AT) _{t-1}	0.657*** (0.037)	0.571*** (0.048)	0.419*** (0.042)	0.321*** (0.020)	0.297*** (0.019)	0.309*** (0.030)	0.389*** (0.055)
AGE _t	-0.048*** (0.009)	-0.006*** (0.001)	0.001* (0.000)	-0.000** (0.000)	-0.001*** (0.000)	-0.002*** (0.000)	-0.004*** (0.000)
[Pseudo-]R ²	0.104		0.0859	0.0547	0.0817	0.1426	0.204
AR-1		0.000					
AR-2		0.707					
Hansen test		0.158					
<u>Period 2009-2018, obs=23,773</u>							
GROWTH _{t-1}		0.145*** (0.025)	0.086*** (0.019)	0.135*** (0.010)	0.179*** (0.012)	0.172*** (0.012)	0.149*** (0.018)
(CAPX/AT) _{t-1}	0.301*** (0.104)	0.572*** (0.144)	0.310*** (0.053)	0.271*** (0.034)	0.259*** (0.026)	0.255*** (0.040)	0.219*** (0.080)
(R&D/AT) _{t-1}	-0.014 (0.102)	0.105 (0.172)	-1.000*** (0.091)	-0.390*** (0.040)	0.043* (0.025)	0.441*** (0.036)	1.148*** (0.096)
(ADV/AT) _{t-1}	-0.225 (0.219)	0.264 (0.407)	0.108*** (0.011)	0.046*** (0.006)	0.006 (0.005)	-0.047*** (0.007)	-0.130*** (0.014)
SIZE _{t-1}	-0.109*** (0.011)	0.055*** (0.017)	0.025*** (0.002)	0.009*** (0.001)	-0.001** (0.001)	-0.011*** (0.001)	-0.027*** (0.002)
(ACQ/AT) _{t-1}	0.598*** (0.038)	0.643*** (0.045)	0.451*** (0.035)	0.393*** (0.022)	0.365*** (0.021)	0.417*** (0.023)	0.501*** (0.052)

AGE _t	0.008	-0.004***	-0.000	-0.000***	-0.001***	-0.002***	-0.003***
	(0.011)	(0.001)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
[Pseudo-]R ²	0.039		0.1373	0.0711	0.0639	0.1123	0.1708
AR-1		0.000					
AR-2		0.932					
Hansen test		0.172					

The table presents the coefficient and standard errors (in parenthesis) of the estimations by using fixed effects, GMM and quantile regression. Estimations include year and industry dummies. Standard errors for the quantile regression coefficients are obtained using 150 bootstrap replications. I have included the R² (percent of variance in the dependent variable explained collectively by all of the independent variables) in the OLS and fixed effects estimation and [Pseudo-]R² (based on change in the deviance statistic) in the quantile regression. P-values are reported for all tests. * indicates significance at 10%, ** significance at 5% and *** significance at 1%.

Table A4. Fixed-effects, GMM and fixed-effect quantile regression estimation of equation (1) for each period. All firms, 1979-2018.

	FE QR (%)				
	10	25	50	75	90
<u>Period 1979-1988, obs=29,414</u>					
(CAPX/AT) _{t-1}	0.374*** (0.041)	0.335*** (0.022)	0.340*** (0.015)	0.337*** (0.023)	0.419*** (0.050)
(R&D/AT) _{t-1}	-0.436*** (0.109)	0.003 (0.057)	0.263*** (0.032)	0.506*** (0.063)	0.914*** (0.103)
(ADV/AT) _{t-1}	-0.473*** (0.013)	-0.545*** (0.006)	-0.603*** (0.004)	-0.657*** (0.006)	-0.731*** (0.011)
SIZE _{t-1}	-0.168*** (0.001)	-0.188*** (0.001)	-0.202*** (0.001)	-0.215*** (0.001)	-0.233*** (0.002)
AGE _t	0.021*** (0.001)	0.015*** (0.000)	0.013*** (0.000)	0.011*** (0.000)	0.003** (0.001)
[Pseudo-]R ²	0.3713	0.464	0.5086	0.4921	0.4503
<u>Period 1989-1998, obs=34,208</u>					
(CAPX/AT) _{t-1}	0.487*** (0.044)	0.415*** (0.024)	0.407*** (0.015)	0.349*** (0.024)	0.322*** (0.056)
(R&D/AT) _{t-1}	-0.670*** (0.045)	-0.296*** (0.036)	0.055*** (0.016)	0.395*** (0.034)	0.809*** (0.068)
(ADV/AT) _{t-1}	-0.352*** (0.009)	-0.425*** (0.006)	-0.479*** (0.003)	-0.538*** (0.006)	-0.621*** (0.011)
SIZE _{t-1}	-0.128*** (0.001)	-0.147*** (0.001)	-0.162*** (0.000)	-0.175*** (0.001)	-0.194*** (0.001)
AGE _t	0.013*** (0.000)	0.012*** (0.000)	0.011*** (0.000)	0.011*** (0.000)	0.009*** (0.000)
[Pseudo-]R ²	0.2803	0.3821	0.4357	0.4204	0.3805
<u>Period 1999-2008, obs=30,464</u>					
(CAPX/AT) _{t-1}	0.245*** (0.064)	0.255*** (0.033)	0.214*** (0.016)	0.142*** (0.029)	0.096* (0.055)
(R&D/AT) _{t-1}	-0.944*** (0.062)	-0.432*** (0.033)	-0.077*** (0.015)	0.245*** (0.030)	0.727*** (0.061)
(ADV/AT) _{t-1}	-0.340*** (0.013)	-0.390*** (0.007)	-0.437*** (0.004)	-0.493*** (0.007)	-0.561*** (0.014)
SIZE _{t-1}	-0.192*** (0.002)	-0.204*** (0.001)	-0.214*** (0.000)	-0.223*** (0.001)	-0.238*** (0.002)
AGE _t	-0.001*** (0.000)	-0.003*** (0.000)	-0.003*** (0.000)	-0.004*** (0.000)	-0.006*** (0.000)
[Pseudo-]R ²	0.4474	0.534	0.5827	0.5804	0.5509
<u>Period 2009-2018, obs=24,861</u>					
(CAPX/AT) _{t-1}	0.350*** (0.054)	0.307*** (0.030)	0.245*** (0.019)	0.198*** (0.028)	0.153*** (0.057)
(R&D/AT) _{t-1}	-0.837*** (0.054)	-0.339*** (0.035)	-0.000 (0.022)	0.339*** (0.036)	0.879*** (0.063)
(ADV/AT) _{t-1}	-0.166*** (0.011)	-0.236*** (0.006)	-0.294*** (0.005)	-0.356*** (0.006)	-0.442*** (0.011)
SIZE _{t-1}	-0.101*** (0.002)	-0.117*** (0.001)	-0.128*** (0.000)	-0.138*** (0.001)	-0.153*** (0.002)
AGE _t	0.012*** (0.000)	0.011*** (0.000)	0.011*** (0.000)	0.010*** (0.000)	0.009*** (0.000)
[Pseudo-]R ²	0.4001	0.4333	0.4583	0.4271	0.3758

The table presents the coefficient and standard errors (in parenthesis) of the estimations by using fixed effects, GMM and quantile regression. Estimations include year and industry dummies. Standard errors for the quantile regression coefficients are obtained using 150 bootstrap replications. I have included the R² (percent of variance in the dependent variable explained collectively by all of the independent variables) in the OLS and fixed effects estimation and [Pseudo-]R² (based on change in the deviance statistic) in the quantile regression. P-values are reported for all tests. * indicates significance at 10%, ** significance at 5% and *** significance at 1%.

Table A5. Fixed-effects and quantile regression estimation of equation (1) for each period. All firms with annualized average growth over three years as dependent variable and three-year average for independent variables, 1979-2018.

	FE	QR (%)				
		10	25	50	75	90
<u>Period 1979-1988, obs=22,104</u>						
(CAPX/AT) _{t-1}	0.272*** (0.061)	0.472*** (0.032)	0.384*** (0.022)	0.327*** (0.018)	0.271*** (0.024)	0.276*** (0.043)
(R&D/AT) _{t-1}	-0.021 (0.136)	-0.031 (0.063)	0.049* (0.028)	0.142*** (0.021)	0.191*** (0.032)	0.218*** (0.049)
(ADV/AT) _{t-1}	-0.072** (0.032)	0.029*** (0.006)	0.013*** (0.003)	-0.002 (0.003)	-0.022*** (0.004)	-0.061*** (0.006)
SIZE _{t-1}	0.063*** (0.007)	0.020*** (0.001)	0.009*** (0.001)	0.003*** (0.001)	-0.001 (0.001)	-0.008*** (0.001)
AGE _t	-0.003 (0.004)	0.002* (0.001)	-0.001* (0.001)	-0.005*** (0.001)	-0.011*** (0.001)	-0.020*** (0.001)
[Pseudo-]R ²	0.076	0.0949	0.0722	0.0654	0.0857	0.1176
<u>Period 1989-1998, obs=23,246</u>						
(CAPX/AT) _{t-1}	0.335*** (0.078)	0.529*** (0.044)	0.437*** (0.019)	0.363*** (0.020)	0.278*** (0.027)	0.202*** (0.040)
(R&D/AT) _{t-1}	-0.021 (0.084)	-0.226*** (0.039)	-0.076*** (0.020)	0.033* (0.019)	0.161*** (0.026)	0.281*** (0.046)
(ADV/AT) _{t-1}	-0.095*** (0.027)	0.032*** (0.006)	0.010** (0.004)	-0.007** (0.003)	-0.035*** (0.004)	-0.077*** (0.006)
SIZE _{t-1}	0.048*** (0.007)	0.026*** (0.001)	0.013*** (0.001)	0.006*** (0.000)	0.002** (0.001)	-0.005*** (0.001)
AGE _t	-0.002 (0.005)	-0.003*** (0.000)	-0.003*** (0.000)	-0.005*** (0.000)	-0.007*** (0.000)	-0.011*** (0.000)
[Pseudo-]R ²	0.043	0.0717	0.0504	0.0708	0.1173	0.1523
<u>Period 1999-2008, obs=24,273</u>						
(CAPX/AT) _{t-1}	0.178** (0.071)	0.442*** (0.047)	0.335*** (0.025)	0.232*** (0.022)	0.118*** (0.029)	0.003 (0.046)
(R&D/AT) _{t-1}	0.229*** (0.072)	-0.448*** (0.035)	-0.241*** (0.021)	-0.058*** (0.020)	0.117*** (0.025)	0.348*** (0.051)
(ADV/AT) _{t-1}	-0.132*** (0.024)	0.022*** (0.007)	-0.016*** (0.005)	-0.037*** (0.005)	-0.073*** (0.006)	-0.116*** (0.009)
SIZE _{t-1}	0.051*** (0.006)	0.017*** (0.001)	0.008*** (0.001)	0.004*** (0.001)	-0.000 (0.001)	-0.006*** (0.001)
AGE _t	-0.039*** (0.004)	-0.001*** (0.000)	-0.001*** (0.000)	-0.002*** (0.000)	-0.004*** (0.000)	-0.005*** (0.000)
[Pseudo-]R ²	0.077	0.0777	0.0427	0.056	0.0927	0.1295
<u>Period 2009-2018, obs=20,538</u>						
(CAPX/AT) _{t-1}	0.207* (0.111)	0.374*** (0.054)	0.302*** (0.031)	0.259*** (0.027)	0.209*** (0.038)	0.206*** (0.064)
(R&D/AT) _{t-1}	0.033 (0.097)	-0.635*** (0.050)	-0.229*** (0.024)	-0.021 (0.021)	0.243*** (0.029)	0.465*** (0.045)
(ADV/AT) _{t-1}	-0.016 (0.054)	0.041*** (0.007)	0.012** (0.005)	-0.007 (0.005)	-0.032*** (0.006)	-0.071*** (0.008)
SIZE _{t-1}	0.053*** (0.008)	0.017*** (0.001)	0.010*** (0.001)	0.004*** (0.001)	-0.000 (0.001)	-0.005*** (0.001)
AGE _t	0.005 (0.005)	-0.000*** (0.000)	-0.001*** (0.000)	-0.001*** (0.000)	-0.002*** (0.000)	-0.004*** (0.000)
[Pseudo-]R ²	0.032	0.0925	0.0453	0.0448	0.0872	0.1424

The table presents the coefficient and standard errors (in parenthesis) of the estimations by using fixed effects, GMM and quantile regression. Estimations include year and industry dummies. Standard errors for the quantile regression coefficients are obtained using 150 bootstrap replications. I have included the R² (percent of variance in the dependent variable explained collectively by all of the independent variables) in the OLS and fixed effects estimation and [Pseudo-]R² (based on change in the deviance statistic) in the quantile regression. P-values are reported for all tests. * indicates significance at 10%, ** significance at 5% and *** significance at 1%.