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Tangible and intangible investments and sales growth of US firms

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ABSTRACT

This article presents new insights into the evolving relation among different types of investments and the growth in sales of US nonfinancial listed firms during the 1979–2018 period. By means of quantile regressions, it is observed an increasing relevance over time of intangible investments vis-à-vis a stable or declining contribution of capital expenditure for all types of firms. However, the impact of different types of intangible investment differs depending on the kind of firm. Whereas advertising has a growing relevance on all types of firms except the top decile in growth distribution, the positive effects of research and development become increasingly concentrated in high-growth firms.

1. Introduction

The transition into a knowledge economy has not only been marked by a sectorial transformation of the output produced in advanced economies, typically the rise of services vis-à-vis manufacturing, but also within economic sectors themselves. The fact that the icon of the manufacturing economy, the automobile, 'is less and less the product of metal fabrication and more a smart machine' (Powell and Snellman, 2004, p. 201) can be verified not only because cars nowadays have more lines of code than the Large Hadron Collider (Fitzgerald, 2013), or because Tesla Cars have garnered reputation as 'iPhones on wheels' (Siddiqui, 2021) but also when Ford Chairman claimed in 2006 that '[*i*]t's easy to build a car. It's harder to build a brand' (Davis 2009, p. 200).

The example of the automobile illustrates how the rise in the knowledge economy has been hand in hand with a transformation of the privileged type of investment, with intangible investment growing in preponderance over tangible. This shift has been extensively documented at the macroeconomic level, with renewed efforts from national agencies to update their statistics and better capture intangible investments (Corrado et al., 2022) given their positive impact on economic growth (Autor et al., 2003; Brynjolfsson and McAfee, 2014). In microeconomic studies, intangible assets are nowadays a key input for firms' production function (Antonelli et al., 2023), with positive effects on productivity (Añón Higón et al., 2017; Bontempi and Mairesse, 2015; Hall et al., 2010 -for a review on R&D and productivity-) and firms' market value (Conchar et al. 2005; Dosso and Vezzani 2020; Lev and Gu 2016, p. 89).

However, this transition into the knowledge economy manifested in the growing importance of intangible vis-à-vis tangible assets has been far less documented with respect to their actual contribution to firms' growth capacity. Scholars have mostly focused on research and development (R&D) and found a positive contribution for fast-growth firms only (Coad and Rao, 2008; Colombelli et al., 2013; García-Manjón and Romero-Merino, 2012; Hölzl, 2009; Mazzucato and Parris, 2015). Moreover, these studies have considered only one period of time, typically a recent one, foreclosing the possibility to analyze the evolving relevance of R&D over time. Another blind spot is the lack of studies looking at the role of the other major intangible investment that can be derived from financial statements: advertising. Lastly, the contribution of capital expenditures to firms' growth has featured less prominently than R&D, typically with poor results and also focusing on only one period of time (Coad and Broekel, 2012; Coad and Grassano, 2016).

Against this background, the motivation of this article is to gain new insights into how firms grow in the knowledge economy. Understanding growth as "a process by which organizations pursue market opportunities and the acquisition and accumulation of the resources required to exploit those opportunities" (Dosi et al. 2020, p. 311), the way firms exploit those market opportunities is a context-specific question which, in this paper, refers to both the historical moment and the type of firm considered. Therefore, the objective of this article is to measure the evolving role of three specific types of investments that facilitate growth. It is done by estimating the relation between growth in sales and R&D, advertising and capital expenditures intensity 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.

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By tackling these issues, this paper makes four contributions to the literature. First, it shows a growing contribution of R&D for fast-growth firms over time. Second, in relation to R&D too, the results show a concentration of positive effects across high-growth firms while the median and slow-growth firms become increasingly penalized. Third, all types of firms except the top decile have been increasingly relying on a different type of intangible investment, advertising. Fourth and lastly, the article shows that the contribution of capital expenditures has remained relatively stable.

The paper is organized in the following way. Section 2 reviews the relevance of intangibles in the knowledge economy along with the literature on firms' growth and the three types of investment considered (R&D, advertising and capital expenditures). Section 3 discusses the data and stylized facts. Sections 4–6 present the methodology, results and their robustness, respectively. Section 7 discusses and concludes.

2. Firms' growth in the knowledge economy

One of the defining features of the knowledge economy is the greater reliance on intellectual capabilities than on physical inputs or natural resources for the production of goods and services (Powell and Snellman, 2004). Those intellectual capabilities have been sometimes referred to as 'knowledge capital' (Lööf and Heshmati, 2002), 'knowledge-based capital' (OECD, 2013) or, more generally, intangible assets (Corrado et al., 2005).

Different reasons explain why this type of assets have become a source of sustained competitive advantage (Barney, 1991). Among them, with the globalization and vertical disintegration of production, firms have moved to their core or strategic competences (Prahalad and Hamel, 1990). Companies from developed economies have tended to focus mostly on intangible-intensive 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; Lee and Gereffi, 2015). Those core competences are not only the result of intangible investing but also tend to be distinctive and require harder-to-imitate skills vis-à-vis those related to tangible assets (Haskel and Westlake 2017, p. 186; Kay 1993).

Another reason why intangibles became a source of competitive advantage is that they can be scaled into a potentially endless number of goods and services (Andrews and Serres, 2012; Haskel and Westlake, 2017). Unlike 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; De Ridder, 2022; McKinsey, 2018). It is important to highlight that the possibility to transform the scaling property into economic benefits along with the difficulty to imitate intangible assets are inseparable of the process of knowledge enclosures that, with the support of US, European and Japanese transnational corporations, expanded globally via the WTO and bilateral or regional trade agreement (Abbott, 2006; Dreyfuss and Frankel, 2014; Shadlen, 2008).

Lastly, firms with a larger stock of intangible assets have a higher absorptive capacity (Cohen and Levinthal, 1990) that allows them to identify and apply new internal and external flows of knowledge while the introduction of information and communication technologies has further reduced knowledge absorption costs and improved knowledge interactions (Antonelli, 2017).

From a broad set of potential performance measures, this paper focuses on the growing relevance of intangible vis-à-vis tangible assets for sales growth.[1] Empirical studies on this subject 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. For instance, small firms grow faster than large ones in, among others, French manufacturing (Bottazzi et al., 2011) and among Portuguese firms (Barbosa and Eiriz, 2011) but not among Italian (Bottazzi et al., 2007) or Irish firms (Lawless, 2014). Some studies have also intended to reconcile this mixed evidence by considering 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, the literature agrees that firm-specific decisions also play a role. Hence, growth is essentially a multidimensional phenomenon (Bianchini et al., 2017; Moschella et al., 2019; Romano, 2019). This paper contributes to this stream by identifying and tracking the contribution of three specific types of expenditures' intensity: 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).

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 firms' growth through the generation of new goods and services that expand or create new markets and the development of new techniques that improve existing processes.

However, the theoretical relevance of innovation has not been accompanied by strong empirical results (Coad and Rao, 2008). Different reasons have been provided for these poor empirical results. For the purpose of this article, it is relevant to highlight that conventional regression estimators such as OLS or fixed-effects focus on the average effect of a focal variable (in this case, innovation) for the average or representative firm.[2] The problem with the average firm is that its growth is very low and could be due to anything (Coad, 2009). Growth, in fact, presents a tent distribution with heavy tails -i.e., with many firms growing above and below average (Bottazzi and Secchi, 2003, 2006; Stanley et al., 1996).

Quantile regression techniques have been used to overcome the limitation of traditional methods and focus on above and below average firms.[3] 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, measuring innovation by a synthetic measure based on patent intensity and R&D intensity. These results are also verified for French (Colombelli et al., 2013) and Spanish (Bianchini et al., 2016) manufacturing firms.

A consistent and robust finding of these papers is that mostly high-growth firms obtain a positive effect from their innovative

[1] Certainly, there are alternative ways to frame and measure the dynamics discussed in this paper besides performance variables. For instance, Antonelli et al. (2023) use firm-level data to estimate a production function that includes tangible and intangible assets and find that the direction of technological change has become increasingly knowledge intensive and tangible saving.

[2] Oher 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 and Wiklund, 2006; Weinzimmer et al., 1998; Yang and Huang, 2005). Second, innovation is a process in which there is uncertainty at different stages (Coad & Rao, 2008; Mansfield et al., 1977). Brown et al. (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.

[3] This methodology will be explained in more detail in Section 4.

investments in their market share. The theoretical justification for this finding is that those firms are in a position to deliver new and improved goods and services, to better manage innovation processes, and to more effectively deal with the challenges related to external sourcing and technical change (Bianchini et al., 2016). On top of this, it can also lead to increased market power (Rikap, 2021). On the other hand, negative effects of innovative investments for slow-growth firms are also 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 and Rao, 2008; García-Manjón and Romero-Merino, 2012).

The other type of intangible investment reviewed in this paper is advertising expenditures. Marketing spending creates brand equity, customer loyalty, bargaining power over distribution channel partners and market-sensing capabilities (McAlister et al., 2007; Srinivasan and Hanssens, 2009). Firms with stablished brands are able to accrue growth by creating a high awareness and consideration of their products and a reputation for their superior quality, thereby helping to reduce transaction costs and search frictions for customers (Bronnenberg et al., 2019). Brand loyalty can also extend those benefits over long periods of time (Conchar et al., 2005). Hence, advertising contributes to firms' sales growth by raising output prices and expanding markets (Bronnenberg et al., 2022).

Results on the relation between advertising and firm performance are mixed. In the case of market value, for instance, some studies have found positive (Chauvin and Hirschey, 1993; O'Brien, 2003) while others negative (Han and Manry, 2004) or non-statistically significant (Chan et al., 2001; Connolly et al., 1986) effects. Peterson and Jeong (2010, p. 687) acknowledge these diverse results by recognizing that the effect of advertising on firm-level performance is not linear but rather depends on the "purpose of the research and the corresponding research methodology—decisions regarding the nature (form and type) of the data analyzed, the firm-level financial metric employed, the brands or firms investigated, the analytical models specified, the output metrics computed, and so forth."

With the exception of Wang et al. (2012) for the financial services industry, quantile regression analysis has not been previously used to deal with the diversity of results regarding advertising and firm performance. There are no previous studies applying quantile regressions to analyze the impact of advertising on sales growth either. This should not come as a surprise since advertising has been traditionally neglected in economic theory (Bronnenberg et al., 2022, p. 54).

However, previous research indicate the potential relevance of quantile regression techniques for identifying the link between advertising and firms' growth along with the result that could be expected from that Sridhar et al. (2014, p. 279) find that the long-term impact of R&D spending on firm value is greater than that of advertising spending in the high technology industry. More generally, and based on a review of the literature, Shah and Akbar (2008, p. 317) indicate that firms belonging to industries characterized with low unit price and high turnover rate benefit more from advertising than those firms in industries producing high unit price industrial goods. They also find that larger firms are more effective in handling advertising. The reason for this, according to Hirschey and Spencer's (1992) is that big firms, typically growing slower and older, are those which can turn advertising into more enduring effects in terms of market value.

The final type of investment is tangible or capital expenditures, defined as the flow of gross funds used for additions to property, plant, and equipment (Standard and Poor's, 2001).[4] This type of investment has traditionally been one of the most important ways by which firms expand their sales capacity and outcompete rival peers (Rabinovich, 2020).

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 and Pariboni, 2016; IMF, 2015; Stockhammer, 2008), financialization and changes in corporate governance (Döttling et al., 2017; Gutiérrez and Phillipon, 2017; Orhangazi, 2008; Stockhammer, 2004), market concentration (Crouzet and Eberly, 2018; De Loecker et al., 2020) and offshoring (Alexander and Eberly, 2018; Auvray and Rabinovich, 2019; Milberg, 2008).

However, the question of how capital expenditures 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 the world's largest R&D private investors.

Consequently, and based on the literature reviewed in this section pointing towards a growing importance of intangible vis-à-vis tangible assets along with a differentiated effect of R&D and advertising for high-growth and slow-growth firms, the following hypothesis will be tested:

H1: R&D has a positive effect on high-growth firms and has increased its relevance for them over time.
H2: advertising has a larger effect on slow-growth firms and has increased its relevance over time.
H3: capital expenditures have maintained or decreased their growth contribution over time for all types of firms across growth distribution.

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*), selling, general and administrative expenses (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

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

[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.

is an overall consensus on using sales as an indicator of growth (Ardishvili et al., 1998; Barkham et al., 2002; Coad et al., 2011; Colombelli et al., 2013; García-Manjón and 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 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).[7] 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 cost of goods sold (Compustat item *COGS*), *XSGA* is kept with no further adjustment.[8]

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 and 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 and 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. Table 2 shows the correlation matrix. Except for growth, size and age, the rest are presented as a ratio to sales. Table 1 confirms that, for this sample, fast-growing firms are younger than slow or negative growing firms and smaller most of the times.

This sample is no exception either, in terms of the fat-tailed distribution of growth highlighted by the literature. Fig. 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.

I further study the differences in growth among firms and how capital expenditures, R&D and advertising relate to them in Fig. 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).[9] In all cases, I take the median value of each group.

[7] By focusing on those intangibles that can be measured with flow information such as R&D and advertising, I'm leaving aside other relevant intangibles such as computerized information.

[8] Capturing intangibles in such a way deals with one specific difficulty with these assets involving the way in which they have been traditionally treated under accounting rules. While internally generated intangibles through R&D, marketing or human resources' training are treated like regular expenses (i.e., not accumulated), the same intangibles, if acquired are considered assets and capitalized (Lev and Gu, 2016, p. 83). Arguments for and against such treatment, from an accounting perspective, can be found in CPA (2021).

[9] 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 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.[10] Second, a marked bifurcation seemed to be on its way until the end of the 1990s between the upper decile 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. A pattern verified here and for all types of expenditures is that investment intensities are monotonically ordered according to sales growth, i.e., with high-growth firms investing more and vice versa. The bottom-left part of the figure focuses on R&D. The figure indicates both an impressive increase for the ninth and especially the tenth decile, with various nil values. Lastly, advertising intensities follow a more stable pattern except for an increasing trend for the ninth decile.

4. Methodology

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

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

where $\alpha_0 \ldots \alpha_6$ are parameters, the *i, j* and *t* subscripts denote firm, industry and time period. *SIZE* is total revenue (Compustat item *REVT*). γ_{jt} is a coefficient that controls industry specific fixed-effects. *AGE* is calculated as current year *t* minus year of appearance in Compustat. β_t are coefficients to control for time fixed-effects, 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. All focal variables represent investment intensities as they are normalized by the lagged value of total sales to correct for heteroscedasticity and avoid regression fallacy given the size differences across firms.

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 and Secchi, 2003, 2006; Coad, 2009; Hölzl, 2009). On this basis, I will carry out an empirical strategy that consists of calculating, first, fixed effects (without dynamic effect) and GMM (Arellano and Bover, 1995; Blundell and 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).

System GMM can generate quite a great number of instruments, something that, although does not compromise consistency, can move it away from the asymptotic ideal and overfits endogenous variables failing to expunge their endogenous components (Roodman, 2009, p. 98). To reduce the number of instruments, I use one instrument for each

[10] These trends were already picked in Higson et al (2002), Fig. 6.

Table 1
Descriptive statistics for different periods.

	Observations	Mean	Median	Min.	Max.	Std. Dev.
Period 1979–1988						
GROWTH	27,165	0.065	0.051	−1.578	2.392	0.358
(CAPX/SALES)	27,165	0.168	0.048	0	7.826	0.614
(R&D/SALES)	27,165	0.072	0.000	0	27.934	0.797
(ADV/SALES)	27,165	0.306	0.209	0	10.908	0.667
SIZE	27,165	1310.328	112.305	0.105	63,368.730	5230.465
AGE	27,165	9.179	9	2	17	4.232
GROWTH$_{10}$	2773	−0.522	−0.388	−1.578	−0.134	0.359
(CAPX/SALES)$_{10}$	2773	0.162	0.026	0	7.826	0.660
(R&D/SALES)$_{10}$	2773	0.079	0.000	0	18.016	0.708
(ADV/SALES)$_{10}$	2773	0.268	0.153	0	10.908	0.609
SIZE$_{10}$	2773	392.493	24.664	0.105	63,368.730	2261.451
AGE$_{10}$	2773	8.389	8	2	17	4.159
GROWTH$_{90}$	2143	0.804	0.643	0.268	2.392	0.502
(CAPX/SALES)$_{90}$	2143	0.719	0.145	0	7.826	1.605
(R&D/SALES)$_{90}$	2143	0.446	0.000	0	27.934	2.514
(ADV/SALES)$_{90}$	2143	0.995	0.405	0	10.908	1.950
SIZE$_{90}$	2143	414.868	22.522	0.105	63,368.730	3007.778
AGE$_{90}$	2143	5.953	5	2	17	3.830
Period 1989–1998						
GROWTH	31,190	0.117	0.082	1.578	2.392	0.378
(CAPX/SALES)	31,190	0.161	0.045	0	7.826	0.604
(R&D/SALES)	31,190	0.240	0.001	0	27.934	1.781
(ADV/SALES)	31,190	0.332	0.221	0	10.908	0.713
SIZE	31,190	1484.964	131.214	0.105	63,368.730	5624.661
AGE	31,190	11.986	10	2	27	7.932
GROWTH$_{10}$	3251	−0.478	−0.340	−1.578	−0.120	0.370
(CAPX/SALES)$_{10}$	3251	0.125	0.021	0	7.826	0.542
(R&D/SALES)$_{10}$	3251	0.431	0.000	0	27.934	2.463
(ADV/SALES)$_{10}$	3251	0.287	0.172	0	10.908	0.625
SIZE$_{10}$	3251	562.462	23.876	0.105	63,368.730	3025.291
AGE$_{10}$	3251	11.239	9	2	27	7.387
GROWTH$_{90}$	2541	0.923	0.758	0.386	2.392	0.488
(CAPX/SALES)$_{90}$	2541	0.713	0.141	0	7.826	1.613
(R&D/SALES)$_{90}$	2541	1.418	0.028	0	27.934	4.833
(ADV/SALES)$_{90}$	2541	1.057	0.466	0	10.908	1.998
SIZE$_{90}$	2541	362.210	40.213	0.105	62,773.270	2021.718
AGE$_{90}$	2541	6.629	4	2	27	5.851
Period 1999–2008						
GROWTH	29,062	0.105	0.076	−1.578	2.392	0.378
(CAPX/SALES)	29,062	0.156	0.038	0	7.826	0.619
(R&D/SALES)	29,062	0.449	0.011	0	27.934	2.487
(ADV/SALES)	29,062	0.388	0.230	0	10.908	0.883
SIZE	29,062	2303.397	268.241	0.105	63,368.730	7251.083
AGE	29,062	15.112	12	2	37	10.482
GROWTH$_{10}$	2967	−0.492	−0.355	−1.578	−0.074	0.385
(CAPX/SALES)$_{10}$	2967	0.164	0.024	0	7.826	0.701
(R&D/SALES)$_{10}$	2967	0.962	0.027	0	27.934	3.663
(ADV/SALES)$_{10}$	2967	0.319	0.163	0	10.908	0.857
SIZE$_{10}$	2967	866.835	59.625	0.105	63,368.730	3914.614
AGE$_{10}$	2967	13.581	10	2	37	9.646
GROWTH$_{90}$	2472	0.871	0.697	0.352	2.392	0.495
(CAPX/SALES)$_{90}$	2472	0.665	0.116	0	7.826	1.559
(R&D/SALES)$_{90}$	2472	2.391	0.214	0	27.934	6.105
(ADV/SALES)$_{90}$	2472	1.317	0.494	0	10.908	2.327
SIZE$_{90}$	2472	733.642	69.435	0.105	63,368.730	4088.007
AGE$_{90}$	2472	8.598	6	2	37	7.673
Period 2009–2018						
GROWTH	23,773	0.062	0.046	−1.578	2.392	0.362
(CAPX/SALES)	23,773	0.150	0.032	0	7.826	0.666
(R&D/SALES)	23,773	0.603	0.010	0	27.934	3.202
(ADV/SALES)	23,773	0.389	0.208	0	10.908	1.029
SIZE	23,773	3283.308	551.652	0.105	63,368.730	8935.156
AGE	23,773	20.222	18	2	47	13.448
GROWTH$_{10}$	2395	−0.519	−0.380	−1.578	−0.127	0.401
(CAPX/SALES)$_{10}$	2395	0.180	0.021	0	7.826	0.794
(R&D/SALES)$_{10}$	2395	1.690	0.034	0	27.934	5.296
(ADV/SALES)$_{10}$	2395	0.410	0.124	0	10.908	1.352
SIZE$_{10}$	2395	1165.701	73.079	0.105	63,368.730	4180.515
AGE$_{10}$	2395	17.503	15	2	47	12.522
GROWTH$_{90}$	2054	0.784	0.579	0.276	2.392	0.521
(CAPX/SALES)$_{90}$	2054	0.664	0.078	0	7.826	1.663
(R&D/SALES)$_{90}$	2054	2.852	0.186	0	27.934	6.989
(ADV/SALES)$_{90}$	2054	1.185	0.349	0	10.908	2.387
SIZE$_{90}$	2054	1017.821	116.940	0.105	63,368.730	4260.954
AGE$_{90}$	2054	11.444	7	2	47	10.422

Table 2
Correlation matrix.

	GROWTH	(CAPX/ SALES)	(R&D/ SALES)	(ADV/ SALES)	SIZE	AGE
GROWTH	1					
(CAPX/ SALES)	0.349	1				
(R&D/ SALES)	0.233	0.430	1			
(ADV/ SALES)	0.401	0.399	0.246	1		
SIZE	-0.038	-0.080	-0.096	-0.192	1	
AGE	-0.172	-0.130	-0.101	-0.146	0.435	1

variable and lag distance instead of one for each time period, variable and lag distance (I collapse the instrument set). I also evaluate the correct specification of the GMM model by means of 3 tests. The first addresses serial correlation in the disturbance term. Since the model takes first differences, it could have first order but not second order serial correlation in the residuals. The m_1 and m_2 statistics test that first and second order correlation (ar1 and ar2 in the tables are the p-values associated with those tests). The final test addresses endogeneity. The Hansen J statistic of overidentifying restrictions evaluates the validity of instruments by testing the correlation between instruments and the error term.

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 and Rao, 2008; García-Manjón and Romero-Merino, 2012; Mazzucato and 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 and Trivedi, 2009). 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. More specifically, the qth QR estimator $\widehat{\beta_q}$ minimizes over β_q the objective function:

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

Therefore, the main objective of this paper is to estimate how each input is associated with firms' growth throughout time. To do that, I will estimate Eq. (1) 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, adding more control variables, using fixed-effects quantile regressions (Canay, 2011) and taking averages of dependent and independent variables.

5. Results

Table 3 presents the results of the estimation of Eq. (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 capital expenditures, R&D and advertising correlate differently with slow (QR10 and QR25), medium (QR50) and fast-growth (QR75 and QR90) firms.

Table 3 confirms that neither FE nor GMM seem to be suitable to capture those differences. Results for both types of methods 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.

Coefficients for QR10 and QR25 are qualitatively similar. Capital expenditures most of the times have a positive and statistically significant effect at the 1% level. For advertising spending, negative and statistically significant results are obtained during the first and second periods that later turn into positive. In the case of R&D, non-statistically different form 0 quickly turn into negative and statistically significant values at the 1% level. These negative results have been previously found in similar research (Coad and Rao, 2008; García-Manjón and Romero-Merino, 2012; Hölzl, 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 3, the penalty for these firms has in fact grown over time.

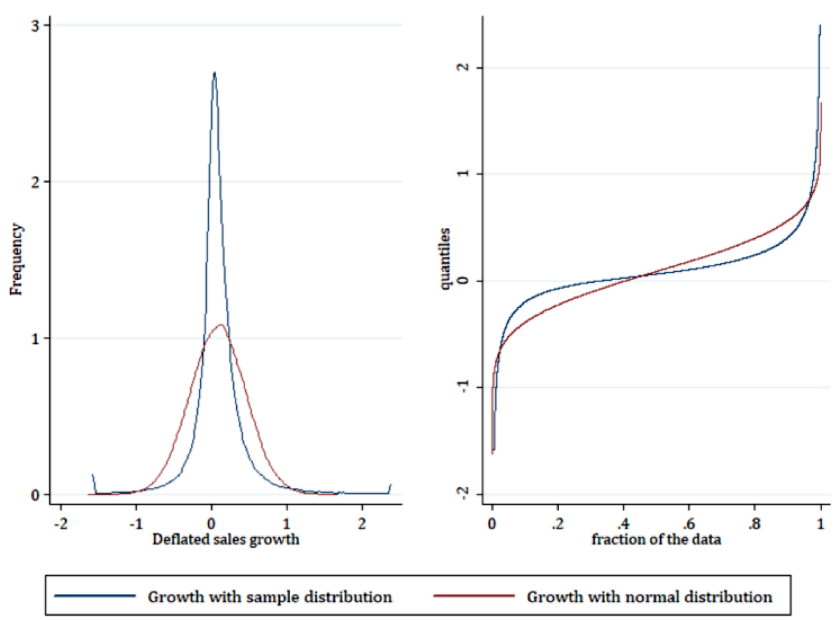

Fig. 1. Annual deflated sales growth rate distribution of the sample compared to an artificially created normal distribution of same mean and variance.

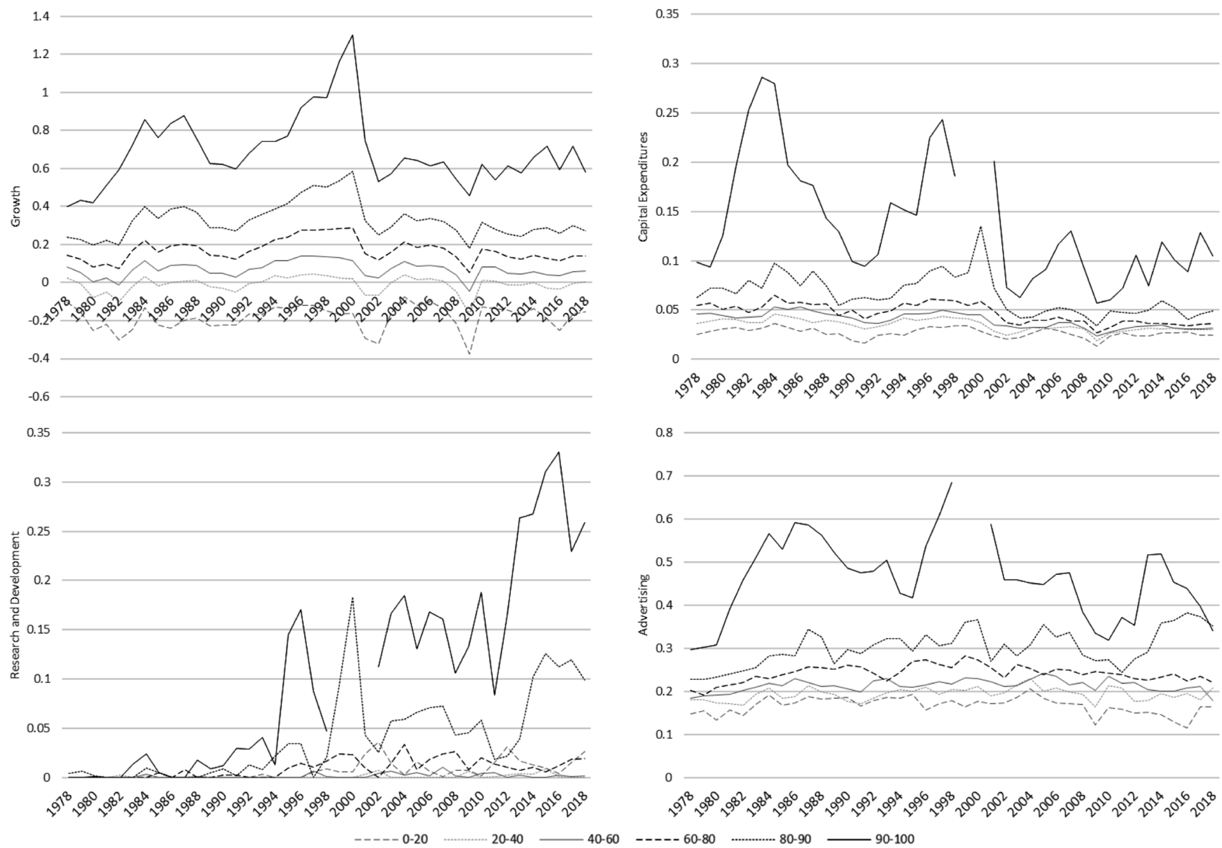

Fig. 2. Growth rate, capital expenditures, acquisitions and intangible investment for the first (0–20), second (20–40), third (40–60) and fourth (60–80) quintiles plus the ninth (80–90) and tenth (90–100) deciles of each year's growth rate. Median values reported in all cases. Outliers for tenth decile in 1999 and 2000 not reported. All firms, 1979–2018.

Results for QR50 are qualitatively similar. Capital expenditures are always positive and statistically different from 0 at the 1% level. This is not the case for R&D and advertising. The former switches from positive and statistically significant values during the first period, to non-different from 0 or negative afterwards. This seems to indicate that returns from R&D in terms of growth have disappeared for the median firm too. Advertising spending follows a similar pattern to QR10 and QR25, moving from values non-statistically different from zero to positive.

Finally, the results for QR75 and QR90 depart from the previous types of firms. For high-growth firms, all types of investments have a positive contribution to sales growth. Coefficients in Table 3 are non-standardized so should be interpreted as the partial derivative of the conditional quantile of y with respect to a specific regressor (Koenker, 2005). Therefore, positive values for all types of investments for QR75 and QR90 have translated into different magnitudes. For the last period, the coefficient of R&D is 0.061 for QR90, which implies that a 1-standard deviation increase of the R&D to sales ratio for this quantile (see Table 1), that is to say 6.99, generates an increase of 42.63% in growth, which has a 52.12% standard error. This represents more than 89% of growth standard deviation compared to 29% and 40% in the case of capital expenditures and advertising. This picture contrasts with that of the first period when R&D, capital expenditures and advertising represented 33.54%, 42.83% and 39.22%, respectively.[11]

Fig. 3 illustrates the evolving standardized results for all types of firms. It does so by regressing Eq. (1) on a moving window of 10 years, from 1979 to 2009. It depicts the same evolution of the coefficients discussed in Table 3 in a very neat way while also showing that results are not driven by a specific selection of a time frame.

On the one hand, Fig. 3 depicts an increasing penalty of R&D, positive effects of advertising and stagnant contribution of capital expenditures (although with fluctuations for the latter) for the 10th, 25th and 50th quantile. On the other hand, differences between the 75th and 90th quantile become more evident. While both advertising and R&D increased their growth contribution for the former, growth increasingly relies on R&D for the top decile. This contrasts with the beginning of the sample where all types of investment had a similar contribution to growth for those types of firms.

6. Robustness and further analysis

While Fig. 3 already indicates that results are not driven by a specific time frame, I now turn to the possibility of a different sample composition. Fig. 4 plots the percentage of firms from each sector in the whole sample using the Fama-French Industrial Classification System (Fama and French, 1997). The only industry with a clear increasing participation is 'healthcare, medical equipment and drugs'. Moreover, this sector concentrates the more marked rise in R&D (Fig. 5). Results for this variable may therefore be driven by that sector.

Due to space constraints, output tables are presented in the online appendix. In Table A2, Eq. (1) is re-estimated for the whole sample excluding firms belonging to 'healthcare, medical equipment and drugs'. Results are maintained qualitatively: advertising still goes from negative or zero to increasingly positive (non-statistically different from zero) for

[11] 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 in median and high-growth firms.

Table 3
Fixed-effects, GMM and quantile regression estimation of Eq. (1) for each period. All firms, 1979–2018.

	FE	GMM	QR (%) 10	25	50	75	90
Period1979–1988,obs=27,165							
$GROWTH_{t-1}$		0.101***	0.182***	0.161***	0.155***	0.126***	0.047***
		(0.023)	(0.015)	(0.010)	(0.008)	(0.010)	(0.014)
$(CAPX/SALES)_{t-1}$	0.085***	0.107***	0.006	0.023***	0.049***	0.082***	0.134***
	(0.012)	(0.018)	(0.012)	(0.007)	(0.008)	(0.010)	(0.015)
$(R\&D/SALES)_{t-1}$	0.030***	0.020	−0.030	0.020	0.034***	0.062***	0.067***
	(0.010)	(0.017)	(0.022)	(0.013)	(0.006)	(0.009)	(0.014)
$(ADV/SALES)_{t-1}$	0.010	−0.003	−0.062***	−0.030***	0.006	0.042***	0.101***
	(0.012)	(0.019)	(0.016)	(0.006)	(0.006)	(0.011)	(0.017)
$SIZE_{t-1}$	−0.142***	0.102***	0.027***	0.011***	0.001**	−0.008***	−0.020***
	(0.009)	(0.011)	(0.002)	(0.001)	(0.001)	(0.001)	(0.001)
AGE_t	−0.019*	−0.029***	0.005***	−0.001	−0.005***	−0.011***	−0.020***
	(0.010)	(0.003)	(0.001)	(0.001)	(0.000)	(0.001)	(0.001)
[Pseudo-]R^2	0.070		0.068	0.052	0.073	0.135	0.209
AR-1		0.000					
AR-2		0.708					
Hansen test		0.163					
Period 1989–1998,obs=31,190							
$GROWTH_{t-1}$		0.134***	0.197***	0.193***	0.211***	0.177***	0.097***
		(0.023)	(0.013)	(0.009)	(0.010)	(0.011)	(0.012)
$(CAPX/SALES)_{t-1}$	0.066***	0.105***	0.039***	0.042***	0.055***	0.094***	0.127***
	(0.013)	(0.022)	(0.011)	(0.006)	(0.007)	(0.009)	(0.019)
$(R\&D/SALES)_{t-1}$	0.014***	−0.003	−0.049***	−0.021***	0.004	0.033***	0.060***
	(0.005)	(0.010)	(0.008)	(0.004)	(0.004)	(0.006)	(0.005)
$(ADV/SALES)_{t-1}$	0.005	0.009	−0.061***	−0.021**	0.005	0.040***	0.099***
	(0.009)	(0.016)	(0.012)	(0.008)	(0.005)	(0.009)	(0.013)
$SIZE_{t-1}$	−0.102***	0.118***	0.031***	0.013***	0.001**	−0.009***	−0.023***
	(0.008)	(0.011)	(0.002)	(0.001)	(0.001)	(0.001)	(0.001)
AGE_t	−0.007	−0.016***	−0.001*	−0.001***	−0.003***	−0.006***	−0.010***
	(0.009)	(0.001)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
[Pseudo-]R^2	0.039		0.067	0.049	0.088	0.157	0.212
AR-1		0.000					
AR-2		0.002					
Hansen test		0.000					
Period 1999–2008,obs=29,062							
$GROWTH_{t-1}$		0.065***	0.169***	0.162***	0.201***	0.176***	0.119***
		(0.024)	(0.013)	(0.010)	(0.010)	(0.012)	(0.013)
$(CAPX/SALES)_{t-1}$	0.070***	0.064***	0.013	0.028***	0.046***	0.069***	0.070***
	(0.012)	(0.019)	(0.009)	(0.009)	(0.008)	(0.011)	(0.012)
$(R\&D/SALES)_{t-1}$	0.022***	0.011	−0.051***	−0.019***	0.005	0.033***	0.061***
	(0.003)	(0.007)	(0.006)	(0.004)	(0.003)	(0.006)	(0.004)
$(ADV/SALES)_{t-1}$	0.044***	0.086***	−0.007	0.019***	0.033***	0.057***	0.091***
	(0.007)	(0.014)	(0.008)	(0.006)	(0.004)	(0.006)	(0.010)
$SIZE_{t-1}$	−0.125***	0.094***	0.019***	0.008***	−0.001**	−0.011***	−0.021***
	(0.007)	(0.013)	(0.002)	(0.001)	(0.001)	(0.001)	(0.001)
AGE_t	−0.054***	−0.007***	0.001***	−0.000**	−0.001***	−0.002***	−0.004***
	(0.009)	(0.001)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
[Pseudo-]R^2	0.133		0.077	0.048	0.087	0.170	0.259
AR-1		0.000					
AR-2		0.982					
Hansen test		0.237					
Period 2009–2018,obs=23,773							
$GROWTH_{t-1}$		0.042	0.112***	0.148***	0.153***	0.093***	0.010
		(0.029)	(0.016)	(0.011)	(0.011)	(0.012)	(0.018)
$(CAPX/SALES)_{t-1}$	0.064***	0.065***	0.032**	0.054***	0.060***	0.095***	0.091***
	(0.015)	(0.021)	(0.015)	(0.006)	(0.007)	(0.010)	(0.013)
$(R\&D/SALES)_{t-1}$	0.023***	−0.013	−0.051***	−0.025***	−0.004**	0.029***	0.067***
	(0.004)	(0.009)	(0.005)	(0.003)	(0.002)	(0.006)	(0.004)
$(ADV/SALES)_{t-1}$	0.051***	0.099***	0.020**	0.020***	0.043***	0.063***	0.088***
	(0.009)	(0.017)	(0.009)	(0.005)	(0.006)	(0.006)	(0.012)
$SIZE_{t-1}$	−0.080***	0.081***	0.026***	0.010***	0.000	−0.007***	−0.018***
	(0.010)	(0.017)	(0.001)	(0.001)	(0.001)	(0.001)	(0.002)
AGE_t	0.016	−0.005***	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	0.078		0.117	0.066	0.068	0.139	0.237
AR-1		0.000					
AR-2		0.339					
Hansen test		0.122					

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. GMM estimations are obtained by the Arellano-Bond two-step difference GMM. All instruments include up to four year lags. ar1p and ar2p are Arellano-Bond test of first order and second order autocorrelation in the errors. Hansen is the Hansen-Sargan test of overidentifying restrictions for all instruments. Standard errors for the quantile regression coefficients are obtained using 150 bootstrap replications. I have included the R2 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%.

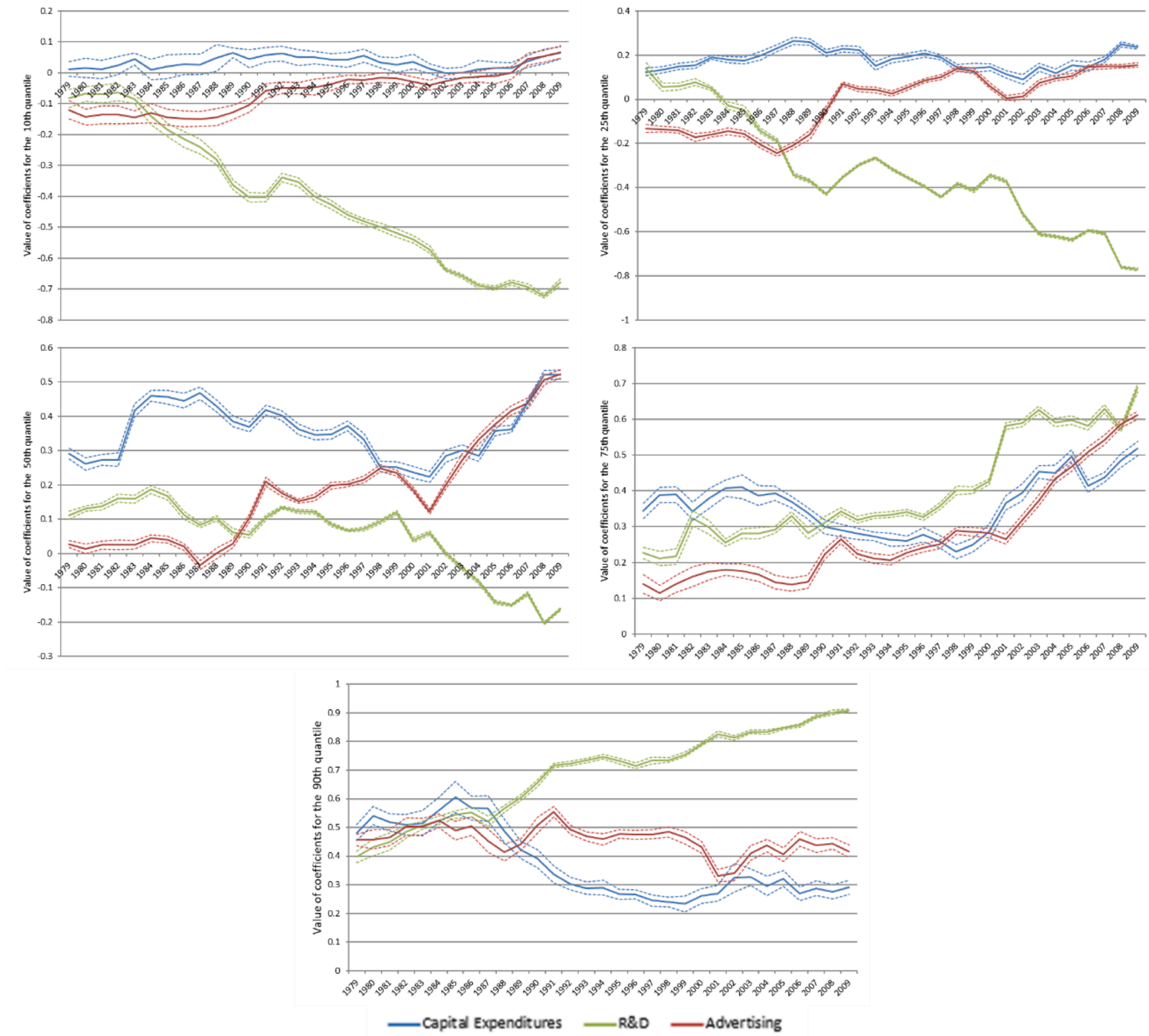

Fig. 3. Quantile regression standardized results of Eq. (1) for a moving 10-year window. Dotted lines indicate the 95% confidence interval. All firms, 1979–2018.

QR25 and QR50 (QR10). The reverse is verified for R&D for those types of firms.

The main difference once ‘healthcare, medical equipment and drugs’ is removed is that results for R&D in QR75 resemble QR50 rather than QR90. Whereas an increase in one standard deviation of R&D represents 14.46 and 21.43% of growth standard error during the first period for QR75 and QR90, during the last period those values go to 8.75% (non-different form zero) and 52.57%.

Some further issues are considered 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 A3). 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 A4). Third, I apply the fixed-effects quantile regression estimator developed in Canay (2011) that allows to remove firms’ constant unobservable heterogeneity (Table A5). 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 (Table A6).

In all cases, the main results of (a) increasingly positive results of advertising for all types of firms except the top decile, (b) increasingly positive results of R&D for fast-growth firms only, (c) increasing penalty of R&D for non-fast-growth firms, and (d) declining/stable contribution of capital expenditures are maintained.

7. Discussion and concluding remarks

This paper has presented evidence of a shift in the way firms are growing in the knowledge economy, with a higher prevalence of intangible investment and a lower contribution of capital expenditures using listed 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 spending, measured by advertising. Whereas the former has a

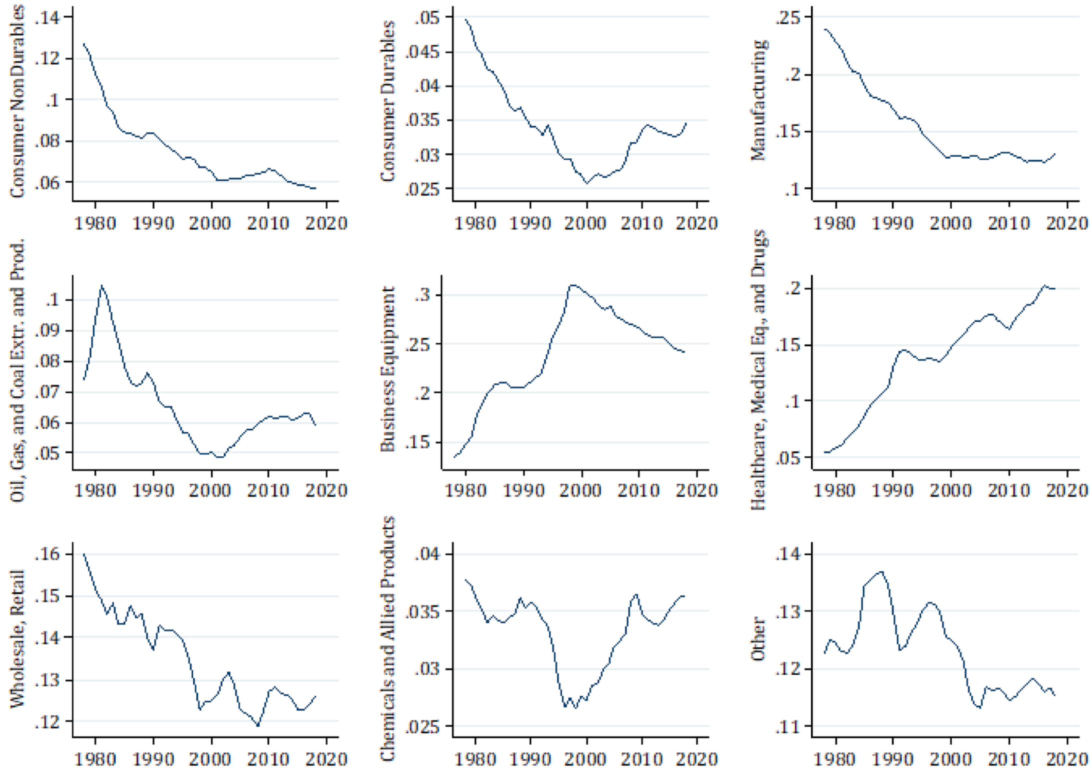

Fig. 4. Percentage of firms from each sector in the sample.

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

positive, increasing over time effect for high-growth firms, the latter has a similar effect for all types of firms except for the top decile. Capital expenditures' contribution, on the other hand, remained stable for all except the top decile for whom it diminished its growth contribution.

The literature on intangibles has indicated different reasons for the growing importance of intangible investment. In an increasingly globalized world, they build up distinctive or strategic features of the firm, harder to imitate by others (Haskel and Westlake 2017, p. 186; Kay 1993) fostered by more stringent intellectual property regimes (Dreyfuss and Frankel, 2014). 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 et al., 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 and Rao, 2008; García-Manjón and 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 approximately 90% of growth's standard deviation for the top decile. This picture contrasts with the 1979–1988 period when it represented 33.5%.

This growing relevance goes in line with those studies highlighting the path-dependent or cumulative 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 by means of quantile regressions, but also a corollary. Firms that 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. Therefore, the results show a cumulative concentration of positive effects of R&D on high-growth firms and negative effects on slow-growth firms in line with theories of firms' stratification across the innovation race and ownership of intellectual property rights (Rikap, 2021; Schwartz, 2022).

For all types of firms except the top decile, other types of intangible investments seem to be more successful in terms of keeping or expanding their market share: advertising. Slow-growth and the median firm start with either negative or zero contributions of advertising to growth and end with positive effects. The top quartile also verifies an increased contribution. A possible interpretation of the stable impact for the top decile is that these firms are typically younger and therefore more involved in the development of novel goods and services. Here, R&D is logically connected to that end and therefore a better use of resources to gain market share and move forward in the innovation race vis-à-vis advertising. On the other hand, slow-growth firms, typically bigger and older, are those which can turn advertising into more enduring effects in terms of market value (Hirschey and Spencer, 1992). These firms may be in a technologically dependent position, having lost their ability to innovate (Rikap and Lundvall, 2021) and/or in more traditional industries (Lazonick, 2009) so advertising their already existing products becomes a more efficient way to use their resources and defend/expand their market share.

All in all, the results presented in this paper show that a significant proportion of US firms have turned to intangible investments for their growth prospects. The flip side of this strategy has been a progressive abandonment of more traditional tangible outlays. These results are verified for all types of firms as can be seen in Fig. 3. Hence, the results obtained in this paper support the idea of substitution between tangible and intangible investment (Alexander and Eberly, 2018; Antonelli et al., 2023).

Finally, this paper opens different avenues for future research. It is the first to include advertising expenditures on growth equations with significant results for all types of firms and hence stressing the need for further research into this type of intangible investment. In line with this, while R&D tends to be concentrated in a few industries, advertising is more equally distributed offering more possibilities to explore its behavior. Finally, the results highlight a significant drop in growth experienced in the early 2000s, which affected all types of firms. This decrease coincided with an overall reduction or stagnation in intangible investment, along with further reductions in capital expenditures marking what could be interpreted as a different phase in the regime of accumulation (Auvray et al., 2021). Further studies should also focus on the specific drivers of this phenomenon.

Author agreement statement

I the undersigned declare that this manuscript is original, has not been published before and is not currently being considered for publication elsewhere.

I confirm that the manuscript has been read and approved by all named authors and that there are no other persons who satisfied the criteria for authorship but are not listed.

I understand that the Corresponding Author is the sole contact for the Editorial process.

Declaration of Competing Interest

The author declares no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

Data availability

The authors do not have permission to share data.

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Supplementary materials

Supplementary material associated with this article can be found, in the online version, at doi:10.1016/j.strueco.2023.05.001.

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