Why have measures of earnings quality changed over time? A competing narrative

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Abstract

We contribute to the debate on the reason for the decline in earnings quality (EQ) documented by prior literature. We dissent from Srivastava (2014)'s conclusion that "each new cohort of listed firms exhibits lower earnings quality than its predecessors, mainly because of higher intangible intensity". Instead, we argue that the downward trend in EQ measures is explained by changes in firms' economic risk and operational efficiency associated with "broadening of the kinds of firms publicly traded" (Fama and French (2004)). The association of intangible intensity to EQ measures is spurious and disappears when controlling for the mentioned firm's characteristics.

Keywords: Earnings quality; Expectations Formation Pertinence; non-linear association; non-parametric regression; cohorts

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1 Introduction

While previous literature documented sustained decline of earnings quality (EQ) over the last few decades, there is disagreement about the reasons behind this phenomenon. To shed light on this issue, the researcher, commonly, tries to establish an association between the EQ decline and changes in some firm characteristics. In a second step, the changes in firm characteristics may receive an macroeconomic explanation.

For example, Srivastava (2014) claims that the biggest factor behind the decline of three commonly-used EQ measures (earnings volatility, matching of revenues and expenses, and value relevance of earnings) is "the widening gap between the intangible intensities of the new- and seasoned-firm segments" (page 198)[1].

This identification is at odds with other references in the literature. Irvine and Pontiff (2009) explains the steady upwards trend in earnings volatility over the period 1970-2005 by an "increase in the idiosyncratic volatility of fundamental cash flows" while Donelson et al. (2011) claims that the decline in matching of revenues and expenses is "primarily attributable to an increase in the incidence of large special items"[2].

[1] Based on this association, it concludes that the evolution towards a "21st century firm" characterized by higher knowledge intensity is responsible for the ever lower levels of earnings quality.

[2] Note that both Irvine and Pontiff (2009) and Donelson et al. (2011) associate the trend towards a lower EQ to "the well-documented increase in competition in the U.S. economy over the last four decades". However, more recent evidence shows the need for a more nuanced explanation since it argues that, over the last two decades, "the nature of U.S. product markets has undergone a shift that has potentially weakened competition across the majority of industries" (Grullon et al. (2019)). The cited paper also documents that the aggregate Asset Utilization (sales divided by total assets) has declined over over the period 1972-2014.

Less directly related, Bushman et al. (2016) argues that the dramatic decrease in the magnitude of the correlation between accruals and cash flows (another commonly-used EQ measure) is mainly due to "economic shocks and greater prominence of non-timing accruals". Moreover, different from the conclusion of Srivastava (2014), it finds that "the coefficient on *SG&A* intensity remains [...] insignificant" in the multiple regression used to disentangle the contribution of competing firm characteristics. Its effect "is subsumed by other explanatory variables".

In this paper, we revisit the analysis in Srivastava (2014) and try to reconcile these apparently dissimilar findings. We identify an association between the EQ decline and the combination of higher firm-specific economic risk (visible in augmented firm's cash flow volatility) and declining firm operational efficiency (as measured by firm's asset utilization). We show that, while significantly negative when considered alone, the association of Srivastava (2014)'s proxy for intangible intensity to the three EQ proxies is strongly reduced or disappears completely when controlling for these two factors[3]. In a time-series analysis, we show that the changes in the level of firm-specific economic risk and operational efficiency explain most of the EQ measures decline. In contrast to that, if one controls just for the intangible intensity measure, most of the evolution of the EQ measures rests unexplained.

If the narrative underlying Srivastava (2014) is that the evolution towards a

[3]In other words, the effect of intangibles intensity on the three EQ measures in Srivastava (2014) might be subsumed by other explanatory variables. Note that this finding matches the results in Bushman et al. (2016). In statistical terms, Srivastava (2014)'s identification of the intangible intensities as the factor behind the decline of the EQ measures might be the result of an analysis affected by omitted variable bias.

"21st century firm" characterized by higher knowledge intensity is responsible for the ever lower levels of earnings quality, our account associates the decline in the EQ measures with the arrival on the market of riskier, less efficient firms, most likely due to changes in the fundamental economics of new firms seeking capital (Fama and French (2004)).

Which of the two is a more truthful explanation for the decline of the EQ measures is not only a question for academic debate as the two alternative narratives pass contrasting judgments on the accounting standards. If the increase in the intangible intensity is at the bottom of the decline in EQ, the trend might be taken as proof of the failure of accounting reporting to appropriately record the risks and returns of intangible investments, a particularly severe implication. If, contrary, the explanation for lessening of EQ lies with the facilitated access to public equity financing of weaker, riskier firms, the downwards trend is evidence of a well-functioning reporting system that recognizes and measures the increasing weaknesses in the firm population.

From a methodological point of view, our analysis has a few particularities. The first consists in re-defining the EQ measure that quantifies the association of earnings to prices. Srivastava (2014) measures this association by the adjusted-R^2 of the regression of annual stock returns on the levels of, and changes in, annual earnings (Easton and Harris (1991), Lev and Zarowin (1999)). Such a measure is not suited for the conditional analysis needed to disentangle the impact of different changing firm characteristics competing to explaining the decreased earnings association with prices. Moreover, Kang and Starica (2016) argues that neither the price-level nor the returns-earnings regressions are necessarily able to

correctly infer the economic relation between prices and accounting variables[4].

As a remedy, we use the Expectation Formation Pertinence (EFP) research design (Kang and Starica (2016)) which decomposes prices into *a valuation incorporating expectations of future income formed only on the basis of the level of reported earnings* plus *an investors' adjustment* reflecting other information (than reported earnings). The association measure of this research design is the absolute valuation error and amounts to the proportion of the price corresponding to earnings expectations shaped by information other than the current values of earnings. This measure can be consistently estimated from the data and is fit for a multivariate conditional regression analysis: one can directly regress it on competing firm characteristics, so addressing the omitted variable bias in individual analyses.

The second methodological particularity concerns the implementation of the conditional analysis of the association of EQ measures and various firm characteristics. As the assumption of a linear association is not plausible we use the linear regression as a tool for *testing differences in mean*. Concretely, instead of using the numerical values of firm characteristics directly in the multivariate regression, we convert them in *level indicators* and test if firms with values under/above the reference level have lower/higher EQ measures.

[4]The price-level and the returns-earnings regressions are empirical specifications of a version of the Residual Income (RI) valuation model that is not necessary a regression

2 Motivation

2.1 Changes in the fundamental characteristics of U.S. firms.

The growing body of accounting literature that investigates the impact of the recent economic developments in the U.S. business environment has documented several mechanisms of change with clearly defined impact on the fundamentals of firms over the last four decades or so. Among them we found the following two to be important for our analysis.

First, changes to the fundamental economics of new firms seeking capital gave weaker firms and firms whose expected payoffs are further in the future access to public equity financing. Fama and French (2004) explains the developments in new firms financing through a change in the supply conditions[5] for funding of new lists occurring slowly during the 1980s and 1990s, while Brown and Kapadia (2007) emphasize an increase in financial sophistication of the U.S. capital market. As a result, the profitability and the operational efficiency of the newly listed firms has become progressively more left skewed, with large losses more likely (Fama and French (2004)), while their cash flows have decreased and become more volatile (Brown and Kapadia (2007)).

Second, as the US economy moved towards a knowledge based economy, there was an increase in the intangible capital (innovation, advertising, information technology, human capital, and customer relations). Newer listings are characterized by higher average intangible intensity (Francis and Schipper (1999),

[5]Specifically, a downward shift in the supply curve for funding of new list lowers the expected return resulting in positive market values for weaker firms and firms with more distant future payoffs.

Srivastava (2014)).

Both mechanisms of change in the fundamentals of U.S. firms have, possibly, consequences on the EQ measures. For example, firms with more volatile cash flows tend to have more volatile earnings (Lang et al. (2006), Barth et al. (2008)). The rise in earnings volatility should also lower their relevance to prices (Elliott and Hanna (1996)). Higher cash flow volatility and lower operational efficiency might make covering of expenses a more challenging task for the enterprise (see evidence in Section 6.2).

The immediate expensing of intangible investment may also reduce matching. Moreover, their yearly variation should increase the volatility of earnings as revenues fluctuations do not match those of the intangible investments. In addition, earnings variability of intangible-intensive firms might augment due to higher uncertainty about future benefits of their investments (Kothari et al. (2002)).

2.2 Changes in EQ measures

Contemporaneously, several studies documented sustained lessening of the quality of earnings manifested in a decline in both their relevance (Lev and Zarowin (1999), Collins et al. (1997)) and matching of concurrent revenues and expenses (Dichev and Tang (2008), Donelson et al. (2011)) as well as an increase in their volatility (Givoly and Hayn (2000), Dichev and Tang (2009)). Srivastava (2014) sheds light on the *nature* of the decline of three EQ measures by documenting that "the bulk of the changes in EQ measures over the last 40 years is due to the assimilation of newly listed firms into the firm population and not to changes in the EQ measures of existing firms" (the so-called *new listing* phenomenon, see

Brown and Kapadia (2007)). In other words, most of the observed decline in the EQ measures reflects *changes in the sample of firms*[6].

2.3 Which mechanism of change explains the EQ evolution?

The extensive evidence of a decline in EQ measures naturally leads to the question: *Which one among the changing firm characteristic highlighted above (that is, economic risk, operational efficiency, and intangible capital intensity) is associated to the decrease in the EQ?*

Srivastava (2014) asserts that "the biggest factor behind the new-list effect is the widening gap between the intangible intensities of the new- and seasoned-firm segments" (page 198). This statement is based on an analysis consisting of sets of regressions of the EQ measures (as dependent variables) on one (or more) of the annual difference (between new- and seasoned- firms) in special items, revenue volatility, and SG&A intensity.

The conclusion of Srivastava (2014) is contentious because *it does not appropriately consider the mechanism of change associated to an increase in the economic riskiness of firms and a drop in their operational efficiency*. The only variable somewhat related to this mechanism of change in Srivastava (2014), the revenue volatility, does not capture the increase economic riskiness of firms: in the sample we analyze, the correlation of volatility of cash flows to that of revenues is only 19%. By not considering the actual variables associated to the decline in the

[6]The 'new-listing' pattern of change is not common to all EQ measures. Bushman et al. (2016) "provide compelling evidence suggesting that the documented attenuation in the accrual–cash flow relation is not driven by the change in the sample composition, in contrast to the findings of Srivastava [2014] for earnings quality metrics".

EQ measures (economic risk and operational efficiency) and choosing to analyze a variable that is correlated with them (*SG&A* intensity), the analysis in Srivastava (2014) yields biased inferences.

To disentangle the contributions of different mechanisms of change, we emphasize a firm-year approach (as opposed to the cross-sectional perspective in the analysis we revisit). That is, the EQ measures are constructed for each firm-year observation using firm's recent history previous to the current year. Since they are not estimated cross-sectionally, we have firm-year idiosyncratic EQ values that can be subjected to a multivariate analysis yielding unbiased estimates of the impact of competing firm characteristics on the EQ measures.

Our analysis indicates that the evolution of firm characteristics associated to changes to the fundamental economics of new firms seeking capital (higher economic risk and lower operational efficiency), i.e. the mechanism of change not considered by the analysis in Srivastava (2014), explain the structure of change in the three EQ measures.

3 Related literature

3.1 New-listing phenomenon

Brown and Kapadia (2007) introduced the "new listing effect" in the context of the increase in firm-specific risk in the U.S. stock market. They argue that the increase in idiosyncratic risk (as measured by the idiosyncratic stock return volatility) is related to more volatile firms (with respect to cash flows as well as returns) being listed through initial public offerings. As a result of increasingly risky firms be-

ing listed publicly, the overall composition of publicly traded firms has changed significantly over the last 40 years.

Over-time increases (decreases) in a given firm's characteristic (e.g., risk, intangible intensity, efficiency, etc.) can take different forms with the two extremes being a pervasive change where the characteristic of most firms in the sample increases (decreases) over time, at one end of the spectrum, and a "new listing effect"-type of change, at the other end.

The later evolution is defined by two conditions. First, successive cohorts must display increasing (decreasing) levels of the characteristic. Second, each cohort should evolve, roughly, around its initial level showing no evident trend. As a result, the increase (decrease) over time in the characteristic of interest is explained mostly by changes in the level of the characteristic between successive listing cohorts. The intra-cohort changes over time are, in this case, less important than the inter-cohort level shifts of the characteristic. Most importantly, the structure specific to the "new listing effect" suggests fundamental changes in the character of the typical publicly traded firm.

3.2 Intangible intensity explains the decline in EQ measures

Srivastava (2014) argues that, as the United States had moved from being primarily an industrial economy to becoming mainly a knowledge-based economy, there has been a dramatic increase over time in firms' average intangible intensity as measured by research and development (R&D) expenses, market-to-book ratios, and selling, general, and administrative (*SG&A*) expenses.

It documents the "new-listing effect" in the context of earnings quality. It

shows that most of the decline in three EQ measures, that is, earnings volatility, matching and value relevance, over the last 40 years is due to the assimilation of newly listed businesses into the firm population and not to the decline in the EQ measures of existing firms[7].

It uses *SG&A* intensity as a proxy for intangible intensity because "firms typically expense in-house intangible expenditures through SG&A accounts" and finds that "the biggest factor behind the new-list effect is the widening gap between the intangible intensities of the new- and seasoned-firm segments".

3.3 New listings' riskier fundamentals

The last forty years have brought dramatic changes to the fundamental economics of new firms seeking capital and to the economic environment in which the businesses evolve. These changes were associated with mutations in the fundamentals of typical publicly traded firm. Fama and French (2004) document sharp changes in the profitability and growth of IPOs (with profitability becoming more left skewed and growth more right skewed) associated, most likely, to change in the supply conditions for funding of new lists occurring slowly during the 1980s and 1990s.

Besides arguing that newly listed companies are (return) riskier, Brown and Kapadia (2007) also document that new firms are characterized by progressively

[7]Towards this end, the changes in average EQ measures over the sample period of 1970 to 2009 are separated into "new-list" and "seasoned-firm" effects. The seasoned-firm effect reflects the decline in average EQ measures with no new firms joining the firm sample. The "new listing" effect sums the change in average EQ measures that results from of the addition of successive new wave of firms. The paper finds that the new-list effect contributes as much as 73.9%, 80.0%, and 92.9% to the changes in average relevance, matching, and volatility, respectively, from the period 1970-1974 to the period 2005-2009.

deteriorating fundamentals. Their asset tangibility and profit margins are both diminishing significantly while the values for older firms remain nearly constant. Moreover, "the cash flows of the "average" firm have decreased and become more volatile". Taken together, their evidence suggests that "the expected payoffs of newly listed firms are becoming progressively further in the future and hence, are more difficult to forecast".

Irvine and Pontiff (2009) document "a significant increase over time in the idiosyncratic volatility of firm-level earnings, cash flows, and sales". They also argue that, over the period 1964-2003, the magnitude of the increase in the idiosyncratic volatility of sales, cash flows, and earnings is large enough to explain the dramatic increase in stock market's idiosyncratic stock-return volatility over the same period (Campbell et al. (2001)).

4 Methodological aspects

As mentioned in the introduction, the earnings relevance, one of the three EQ measures in Srivastava (2014), defined as the adjusted-R^2 of the regression of annual stock returns on the levels of, and changes in, annual earnings, is ill-suited for a conditional analysis[8]. Moreover, neither the price-level nor the returns-earnings regressions are necessarily able to correctly infer the economic relation between prices and accounting variables[9].

[8]While the value relevance measure assigns the same value to all firms in a cross-section, a conditional analysis needs firm-specific measures of the level of association of earnings with prices.

[9]The price-level and the returns-earnings regressions are empirical specifications of Ohlson's version (Ohlson (1995)) of the Residual Income (RI) valuation model. This version is not necessarily a regression and estimating a linear relation between prices and bottom line accounting

To address these two issues, we employ the Expectation Formation Pertinence (EFP) research design of Kang and Starica (2016) which we briefly resume in the next section. For more details, see the cited reference.

4.1 An alternative to the earnings relevance quality measure

Research that examines the association of accounting amounts to equity market values requires a research design composed of three elements: first, a *valuation model* to designate the firm attributes that affect value and their relation to value, second, a *practical stipulation of the model* for empirical tests, and, third, a *measure of association*.

4.1.1 Value relevance research design

Holthausen and Watts (2001) gives a synthesis of the *modus operandi* of a *relative association study* conducted in the value relevance framework: "*Relative association studies* compare the association between stock market values (or changes in values) and alternative bottom-line measures [...]. These studies usually test for differences in the R^2 of regressions using different bottom line accounting numbers. The accounting number with the greater R^2 is described as being more value-relevant."

A frequently employed specification of the research design triad in such studies consists of Ohlson's linear solution to the RI equation (as valuation model), the price-levels regression (or returns-earnings regression[10]) estimated on cross-

variables yields coefficients that do not reflect the economic relation in the RI model (for a proof of this statement, see Kang and Starica (2016)).

[10]While, for the sake of simplicity, we make our argument around the price-level regression, it

sectional data (as empirical stipulations of the model):

$$P_{i,t} = \beta_0 + \beta_1 NI_{i,t} + \beta_2 B_{i,t} + \varepsilon_{i,t},$$

and regression's R^2 (as measure of association).

Extant literature has highlighted issues concerning each one of the three elements of the mentioned research design. Firstly, the shortcomings of the Ohlson version of the RI model are tied to the *linear assumptions* on the dynamic of the residual earnings (Holthausen and Watts (2001)). Secondly, the estimation of price-levels and returns-earnings regressions is potentially impaired by bias due, on one hand, to error terms correlated with the independent variables (Lo (2005), Barth and Clinch (2009)) and, on another hand, to coefficients that are functions of firm-specific risk characteristics and industry-specific dynamic of the residual earnings (Kothari and Shanken (2003)), and hence not cross-sectionally constant[11]. Finally, the use of regression's explanatory power as an association measure is controversial due to the fact that R^2 is a combination of parameters relevant to the economic relation being inferred (the variance of the error term) and of parameters of the population (the variability of the dependent variable in the sample) (Gu (2007)). This mixture makes it difficult to trace whether a change in the explanatory power is due to differences in the economic relation or to differences between samples.

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also applies to the returns-earnings regressions

[11] One can prove that these two causes of inconsistency are *structural* and hence not easily avoidable in an empirical setting. In particular, Ohlson's linear expression of the relation between value and accounting numbers, the *raison d'être* of the two specifications, is not itself a regression. Consequently, its two empirical specifications are *by definition* ill-suited for consistent estimation.

4.1.2 Expectation Formation Pertinence (EFP) research design

The alternative research design addresses the issues listed above. It starts from the observation that a *non-linear* regression relation between prices and earnings always exists (while a linear regression most likely will not). Hence the price $P_{i,t}$ can be decomposed as the sum of the best non-linear prediction of value based on the observed earnings ($\mathbb{E}[P_{i,t}\,|\,NI_{i,t}]$) and an adjustment term which reflects all other information available to investors:

$$P_{i,t} = \mathbb{E}[P_{i,t}\,|\,NI_{i,t}] + \varepsilon_{i,t} := \mathbf{m}_i(NI_{i,t}) + \varepsilon_{i,t}, \tag{1}$$

where $\mathbb{E}[P_{i,t}\,|\,NI_{i,t}]$ stands for the conditional expectation[12] of P given NI. From a statistical point of view, investors' adjustment is regression's error term that is orthogonal[13] to the predictor, that is, $\mathbb{E}[\varepsilon_{i,t}\,|\,NI_{i,t}] = 0$.

Why non-linear regression. Estimating a linear relation between earnings and price when the true regression relation is a non-linear one, will yield coefficients that do not reflect the economic relation in (1) and that, consequently, cannot be used to test hypothesis[14].

The function $\mathbf{m}$ can be *consistently* estimated on cross-sections of firms by employing proven inference techniques from the field of non-parametric regression. Its estimate, $\widehat{\mathbf{m}}$, is theoretically guaranteed to be *unbiased* (see Kang and

[12] It is a well-known fact that $\mathbb{E}[P\,|\,NI]$ is a (generally) *non-linear* function of NI. It is also the best predictor (in the L^2-norm) of P when one knows NI.

[13] This condition guarantees the consistent estimation of $\mathbf{m}$ and is violated if a linear regression is estimated instead.

[14] This is, fundamentally, the explanation of the well-known bias issue that affects the price-levels or the returns-earnings regressions (Lo (2005), Barth and Clinch (2009)). Estimating a *non-linear* regression resolves the issue.

Starica (2016)).

Assuming that prices follow the RI valuation relation (Preinreich (1936) and (1938), Edwards and Bell (1961), Peasnell (1982))

$$P_{i,t} = B_{i,t} + \sum_{u=1}^{\infty} \frac{\mathbb{E}_t[NI_{i,t+u} - r_{i,t} \times B_{i,t+u-1}]}{(1+r_{i,t})^u} = B_{i,t} + \sum_{u=1}^{\infty} \frac{\mathbb{E}_t[RI_{i,t+u}]}{(1+r_{i,t})^u}, \qquad (2)$$

(r_t denotes the price of equity risk at time t, $\mathbb{E}_t$ stands for market's expectation conditional on all information available at time t, while *RI* stands for the abnormal earnings $NI - r \times B_{-1}$), Kang and Starica (2016) show that the regression function **m** in the decomposition (1) can be expressed as:

$$\mathbf{m}_i(NI_{i,t}) = B_{i,t} + \sum_{u=1}^{\infty} \frac{\mathbb{E}[RI_{i,t+u} \,|\, NI_{i,t}]}{(1+r_{i,t})^u}. \qquad (3)$$

By comparing the expression in (3) to the RI representation (2), one notes that the regression function **m** is a *valuation where the expectations of future abnormal earnings are informed* only *by the level of earnings* $NI_{i,t}$.

Empirical specification. The main determinants of the future evolution of abnormal earnings are firm's cost of equity, its growth profile and, possibly, its level of accounting conservatism[15] (Kang and Starica (2016)). Hence, for the firms in a cross-section t (and belonging to industry I), the empirical specification of the RI economic relation (2) is:

$$P_{i,t} := \mathbf{m}_{I,t}(NI_{i,t};\, r_{i,t},\, g_{i,t},\, C_{i,t}) + \varepsilon_{i,t}, \qquad (4)$$

[15] How current abnormal earnings forecast future earnings might depend on how the earnings are constructed.

where $r_{i,t}$ stands for firm's cost of equity, g_i denotes firm's earnings growth and C_i, its conservative accounting level and where the error term $\varepsilon_{i,t}$ satisfies the *orthogonality condition*

$$\mathbb{E}_t[\varepsilon_i \,|\, NI_i] = 0.$$

The regression in (4) is estimated cross-sectionally, for each industry[16].

Firm-specific measure of association. Since the regression function can be interpreted as a valuation, the size of the estimated regression error

$$|\widehat{\varepsilon}_{i,t}| = |P_{i,t} - \hat{\mathbf{m}}_{I,t}|$$

quantifies the extent to which future earnings expectations are shaped by information *other than* the level of earnings. For a given pair (i,t), we define the *absolute relative valuation error* to be the firm-year-specific measure of association (Expectation Formation Pertinence) for the data entry (i,t):

$$EFP_{i,t} := \left|\frac{\widehat{\varepsilon}_{i,t}}{P_{i,t}}\right| = \left|\frac{P_{i,t} - \hat{\mathbf{m}}_{I,t}}{P_{i,t}}\right|. \tag{5}$$

It amounts to the proportion of the price corresponding to earnings expectations shaped by information other than the current value of earnings.

An example. This research design is particularly useful when investigating if earnings' association with prices depends on a given firm characteristic. An example of such a research question would be: 'Are earnings of firms in earlier cohorts more relevant to investor's price setting than those of firms listed later?' In

[16]The underlying assumption is that firms sharing the same industry code have similar risk profile.

the outlined *Expectation Formation Pertinence* framework, the researcher would split the sample conditional on the level of firm's characteristic (in the case of the example into competing subsets of earlier-listed and more recently-listed firms) and test for differences in the median size of the absolute pricing error calculated on the sub-samples. She would interpret statistically significant differences as evidence of the impact of the given firm's characteristic on the predictor's pertinence to the expectation formation. In our example, if firms in earlier cohorts command higher valuation accuracy than firms in later waves, we would answer the research question positively.

4.2 The association of firms characteristics and EQ measures

This section presents methodological aspects related to the estimation of the relation between firm characteristics and EQ measures. The multiple regression is the natural tool to use for attaining our goal of disentangle the individual association of firm characteristics, such as intangible intensity, operational efficiency, cash flow volatility, to earnings quality measures. It allows to quantify the impact of a firm characteristic while holding the level of the other constant. However, there is no reason to assume a linear relation between the level of the quality constructs and firm characteristics. Contrary, it is very plausible that the change in the association with EQ corresponding to an incremental change in the value of a firm characteristic will depend on the level of firm's characteristic. As a consequence, the use of the plain vanilla linear regression might not be suitable.

To avoid the assumption of linearity in the relation between regressor and independent variables, we make use the linear regression as a tool for *testing dif-*

ferences in mean as follows (see also Hardy (1993)).

It is well known that, when the independent variable in a linear regression is a indicator variable, *testing the null hypothesis of zero regression coefficient is equivalent to testing that the means of the dependent variable conditional on the presence or absence of the character modeled by the binary variable are equal* (see, e.g., Stock and Watson (2012)). In particular, if the indicator variable models contrasting values of a given character (e.g. high vs. low), a significant non-zero regression coefficient of the binary variable indicates statistically distinct means of the dependent variable conditional on the level of the character modeled by the indicator variables.

This observation motivates our use of the linear regression: instead of plugging the numerical values of firms characteristics directly in a linear multivariate regression, we convert them in level indicators and test if firms with values under/above the reference level have lower/higher associated EQ measures.

Next we specify the notation[17] needed to present our analysis. Formally, we split the range of values of the firm character[18] *Ch* in $l+1$ intervals of equal probability[19], $(a_{min}, a_1], (a_1, a_2], \ldots, (a_{l-1}, a_l], (a_l, a_{max})$, and construct the l indicator functions

$$D^{(Ch,k)}, \quad k \in \{1, 2, \ldots, l\},$$

modeling the different levels of the character *Ch*. The left-out level (in this case, the smaller values of the character) will be the reference level. We hence replace

[17] For the sake of simplicity we only formalize the case of one independent variable.
[18] In the sequel, *Ch* will be *SG&A* intensity, CFO volatility or asset utilization.
[19] In this case a_i is the $i/(l+1)$-quantile.

the classical linear regression

$$EQ_i = \gamma_0 + \gamma\, Ch_i + \varepsilon_i,$$

by its corresponding version in levels:

$$EQ_i = \gamma_0 + \gamma_1 D_i^{(Ch,1)} + \gamma_2 D_i^{(Ch,2)} + \ldots + \gamma_l D_i^{(Ch,l)} + \varepsilon_i, \tag{6}$$

with $D^{(Ch,k)}$ as above.

In this set-up[20], a significant non-zero regression coefficient of the k-th indicator variable γ_k means that the mean EQ measure *conditional on the character Ch taking values in the k-th bracket of its range,* $(a_{k-1}, a_k]$, is statistically different from EQ's mean value when conditioning with the character's reference values, $(a_{min}, a_1]$. Significant non-zero coefficients are evidence of association of firm's characteristic Ch to the EQ measure.

We will use the following short-hand notation for regressions of the type (6):

$$EQ_i = \gamma_0 + \gamma \times D_i^{(Ch)} + \varepsilon_i. \tag{7}$$

4.3 Changes of EQ measures over time - the cohort story

To analyze the changes of the EQ measures over time[21] and to determine which firm characteristics are associated with these dynamics we use two types of conditional means.

[20] The set-up is particularly relevant to the static analysis in Section 6.2.1.

[21] This section is particularly relevant to the dynamic analysis in Section 6.2.2.

Construct for testing the 'new-listing' effect. To evaluate the impact of cohort membership on the EQ measures and statistically test the "new-listing" effect, we compare the yearly *mean EQ measures conditional on belonging to cohort Co*:

$$\mathbb{E}[EQ_t \,|\, Co]. \tag{8}$$

More specifically, for two given cohorts, i and j, cohort membership at year t is associated with differences in the level of the EQ measure iff

$$\mathbb{E}[EQ_t \,|\, C_i] \neq \mathbb{E}[EQ_t \,|\, Co_j].$$

Construct for testing the cross-sectional association. We use the yearly *mean EQ measure conditional on both membership in cohort Co and the level of firm characteristics Ch at time t*:

$$\mathbb{E}[EQ_t \,|\, Co, Ch_t] \tag{9}$$

to determine if the dynamics of a firm characteristic *Ch* matches the evolution of the EQ measures. We conclude that this is the case if controlling for the level of the character *Ch* cancels (or substantially reduces) the differences between the conditional cohort means:

$$\mathbb{E}[EQ_t \,|\, Co_i, Ch_t] \approx \mathbb{E}[EQ_t \,|\, Co_j, Ch_t].$$

4.3.1 Estimation of the two conditional means

To infer the first construct, $\mathbb{E}[EQ_t \,|\, Co]$, the mean EQ (at time t) conditional on membership in cohort Co, we estimate the following unbalanced time-fixed effect panel linear model on a 3-year moving window centered at year t:

$$EQ_{i,u} = \mu(t) + \beta_1(t) D_{i,u}^{(Co_1)} + \beta_2(t) D_{i,u}^{(Co_2)} + \ldots + \beta_m(t) D_{i,u}^{(Co_m)},$$

where $u \in \{t-1,\, t,\, t+1\}$ and $D^{(Co_j)}$ stands for the dummy variable corresponding to membership in cohort j. There are $m+1$ cohorts at year t, $Co_0, Co_1, \ldots, Co_m$ and cohort 0 is taken as reference. With the short-hand notation in (7), the regression above can be written as:

$$EQ_{i,u} = \mu(t) + \beta(t) \times D_{i,u}^{(Co)} + \varepsilon_{i,u}, \quad u \in \{t-1,\, t,\, t+1\}.) \tag{10}$$

The parameters in (10) have intuitive interpretations:

$$\begin{aligned} \mu(t) &= \mathbb{E}[EQ_t \,|\, Co_0], \\ \beta_j(t) &= \mathbb{E}[EQ_t \,|\, Co_j] - \mathbb{E}[EQ_t \,|\, Co_0], \quad j \in \{1, 2, \ldots, m\}. \end{aligned}$$

In words, $\mu(t)$ is the mean EQ of the reference cohort 0 in year t, while $\beta_j(t)$ is the incremental change in mean EQ of firms belonging to cohort j over the mean EQ in the reference cohort during the year t. Coefficients $\beta_j(t)$ strictly greater (smaller) than 0 provide evidence of lower (higher) mean EQ for firms in cohort j with respect to reference cohort (in the year t), i.e. evidence of the 'new-listing' effect.

To estimate the second construct, $\mathbb{E}[EQ_t \,|\, Co, Ch_t]$, the mean EQ (at time t) conditional on belonging to cohort Co and on the level of firm characteristic Ch, we add the level indicators of the characteristic Ch we want to control for to the explanatory variables in (10), yielding the following regression:

$$EQ_{i,u} = \mu(t) + \beta(t) \times D_{i,u}^{(Co)} + \gamma(t) \times D_{i,u}^{(Ch)} + \varepsilon_{i,u}, \tag{11}$$

where $D^{(Ch)}$ denotes the vector of indicator function levels of firm's characteristic Ch as introduced in section 4.2 (see also the notation convention (7)).

The parameters in (11) can be easily interpreted:

$$\begin{aligned}
\mu(t) &= \mathbb{E}[EQ_t \,|\, Co_0,\, D^{Ch,0}], \\
\beta_j(t) &= \mathbb{E}[EQ_t \,|\, Co_j,\, Ch_t] - \mathbb{E}[EQ_t \,|\, Co_0,\, Ch_t], \quad j \in \{1, 2, \ldots, m\}.
\end{aligned}$$

In words, $\mu(t)$ is the mean EQ of firms in the reference cohort 0 in year t whose characteristic Ch_t belongs to the reference interval, while $\beta_j(t)$ is the incremental change in mean EQ of firms belonging to cohort j (over the mean EQ in the reference cohort) *holding the level of the firm characteristic Ch constant*. Coefficients $\beta_j(t)$ strictly greater (smaller) than 0 provide evidence of lower (higher) mean EQ for firms in cohort j with respect to reference cohort (in the year t) when holding the level of the firm characteristic Ch constant, i.e. evidence against an association of changes in the EQ measures to the evolution of the character Ch.

4.3.2 Statistical hypothesis testing set-up

In the analysis to follow, the reference cohort will be that of the seasoned firms, that is, the firms that were listed before 1970. Formally, for a given year t, we perform the following hypothesis test:

$$\begin{aligned} H_0: &\quad \beta_j(t) = 0 \\ &\quad \text{vs.} \\ H_1: &\quad \beta_j(t) > 0 \quad (\beta_j(t) > 0), \end{aligned} \tag{12}$$

with $j \in \{1, 2, \ldots, m\}$.

The test[22] is performed by constructing a 95% one-sided confidence interval for the coefficient $\beta_j(t)$ that we display around $\beta_j(t)$ and verifying if 0 belongs to it. If it does, the null is not rejected. If it does not (and the estimated coefficient is strictly positive/negative), that is,

$$\mathbb{E}[EQ_t \,|\, Co_j] >(<) \mathbb{E}[EQ_t \,|\, Co_0]$$

or

$$\mathbb{E}[EQ_t \,|\, Co_j, Ch_t] >(<) \mathbb{E}[EQ_t \,|\, Co_0, Ch_t],$$

we conclude that the average EQ measure in the later cohort j is higher (lower) than that of seasoned firms.

[22] We do not present the results of testing hypothesis in tables, as usual in the accounting literature as we perform a very large number of them (for every year, pair of cohorts and 29 levels of each of the explanatory variables). Nevertheless, the results of all the tests can be read from the graphs we display as explained in this section.

As the year t moves through the sample, the estimation of the regressions (10) and (11) yield m curves, that is, $\beta_j(t)$, $j = 1,2,\ldots,m$ which follow the time evolution of the incremental increase/decrease of the EQ measure for firms in cohort j relative to the reference cohort of seasoned firms. The results of the empirical analysis in section 6 will be presented in the form of graphs displaying these m curves together with the m one-sided 95% confidence intervals for hypothesis testing.

5 Variables, sample, and cohort construction

Following Srivastava (2014), we define accruals (TACC) as change in Current Assets (ACT) minus change in Cash (CHE) minus change in Current Liabilities (LCT) minus change in Tax Payable (TXP) minus Depreciation and Amortization (DP), scaled by average Total Assets (Compustat AT) for the year. Up to 1988, cash flow from operations is defined as the difference between earnings (Compustat IB) and accruals. To address the fact that the balance sheet-based accruals might be affected by measurement errors (Hribar and Collins (2002)), after 1989, we use cash flows from operations as disclosed on the statement of cash flows.

5.1 Key variable definitions

SG&A **intensity.** Following Dichev and Tang (2008) and Srivastava (2014), we compute total expenses by subtracting income before extraordinary items (Compustat IB) from revenues (Compustat $SALE$). We measure the *SG&A* expenses by the Compustat data item $XSGA$, and define the *SG&A* intensity as the proportion

the *SG&A* expenses represent in the firm-year's total expenses, that is, as the ratio between *XSGA* and total expenses.

Earnings and cash flow volatility. Following Givoly and Hayn (2000) and Dichev and Tang (2009) we scale earnings and cash flows from operations by the average of the beginning and ending of the year total assets and estimate the standard deviations of these variables for each firm-year using at least four values[23] of the eight most recent annual observations ($t-7$ through t).

Matching. Following Dichev and Tang (2008), we measure matching by the correlation between contemporaneous revenues and total expenses scaled by the average of the beginning and ending of the year total assets, $cor(Revenues, Expenses)$, estimated for each firm-year (i,t) on the sample of at least four values of the eight most recent annual observations ($t-7$ through t).

Although yielding identical results (albeit with significantly wider confidence intervals), we prefer this definition to estimating the matching regression:

$$\begin{aligned} Revenues_{i,u} = b_{1,i}(t) + b_{2,i}(t)\ Total\ Expenses_{i,u-1} + b_{3,i}(t)\ Total\ Expenses_{i,u} \\ + b_{4,i}(t)\ Total\ Expenses_{i,u+1} + \varepsilon_{i,u}, \end{aligned} \tag{13}$$

on 2 triplets[24], $(t+1,t,t-1)$ and $(t,t-1,t-2)$, and measuring matching by the regression coefficient on the contemporaneous expenses $b_{3,i}(t)$ as in Srivastava (2014). The reason is the poor ratio number of data points to number of parameters to estimate. The regression definition of matching would estimate 4 parameters

[23]The sample contains firm-year with available data for at least 4 of the last 8 most recent years.

[24]The firm population of Srivastava (2014) consists of "all non-financial firms that in a sample formation year have assets, earnings, and revenue data from the previous two years, the current year, and the next year."

with 2 data points.

Earnings Expectation Formation Pertinence. To construct the firm-year measure of pertinence we first consistently estimate the regression in (4) for each industry I and year t in the sample. We use firm's size (as measured by market value) as a second proxy of risk (industry membership being the other), as well as the P/B ratio as measures of the level of conservatism. The growth proxy is mean earnings growth (both calculated on firm's most recent 8-year history , $t-7$ through t). The *absolute relative valuation error* defined in (5) is our measure of the expectation formation pertinence of earnings[25].

Asset Utilization. Median *Asset Utilization* is constructed as the median value of the ratio of sales to total assets over the most recent 8 years. Asset Utilization ratio measures how efficiently firms manage their assets to generate sales.

5.2 Cohort definition

Following Srivastava (2014), we classify the firms in the sample in five cohorts. The reference cohort Co_0, ($j=0$) is formed by the firms that entered the data base before 1970. The other cohorts initiate at regular ten year intervals and contain the firms that are listed during the 10 years after the starting year. This yields four more cohorts, that is, $Co_1 = 1970-1979$ ($j=1$), $Co_2 = 1980-1989$ ($j=2$), $Co_3 = 1990-1999$ ($j=3$), and $Co_4 = 2000-2009$ ($j=4$). We start following the cohorts 10 years after their inception. That gives us 47 years of follow-up for the reference cohort, 37 years for the first cohort, 27 for the second, 17 years for

[25]The results are robust to alternative proxying of size by sales or total assets, of growth by mean sales growth, or of the level of conservatism by the conservatism index in Penman and Zhang (2002).

the third, and 7 years for the fourth.

5.3 Sample

The sample, obtained from Compustat (accounting information) and CRSP (prices) data bases, covers the 55-year period between 1962 and 2016 and contains all firm-year observations with non-missing values of the variables needed to define the EQ measures as well as the three fundamental firm's characteristics. For calculating volatilities and correlations, we required that the firm-year had at least four non-missing values in the eight most recent years.

Figure 1: Yearly sample size

The sample consists of 189,107 firm-year observations and contains 16,834 distinct firms. The yearly sample size is displayed in Figure 1. The non-linear valuation regression is estimated on sub-samples defined by the intersection of year, industry (Fama-French 12 industries) and cohort. The results reported in the paper were obtained using the Random Forest estimation approach (Breiman (2001), James et al. (2014)).

Variable	Mean	SD	10%	25%	50%	75%	90%
Panel A: EQ measures							
$\sigma(NI)$	0.09	0.12	0.01	0.02	0.04	0.09	0.20
$\rho(Rev, Exp)$	0.90	0.22	0.72	0.92	0.98	1.00	1.00
EFP	0.45	0.75	0.04	0.10	0.22	0.46	1.04
Panel B: Firm's explanatory characteristics							
$SG\&A$	0.27	0.18	0.08	0.14	0.23	0.36	0.53
$\sigma(CFO)$	0.09	0.08	0.02	0.04	0.06	0.10	0.17
$SALE/AT$	1.31	0.80	0.44	0.78	1.19	1.65	2.24

Table 1: **Descriptive statistics.** *Panel A:* EQ measures. *Panel B:* Firm characteristics.

Table 1 displays the summary statistics of the EQ measures (Panel A) and the explanatory firm characteristics (Panel B). The variables were winsorized at the 1% level.

	$\sigma(NI)$	$\rho(Rev, Exp)$	EFP	$SG\&A$	$\sigma(CFO)$	$SALE/AT$
$\sigma(NI)$	1.00	-0.62	0.37	0.32	0.57	-0.17
$\rho(Rev, Exp)$	-0.44	1.00	-0.25	-0.27	-0.19	0.46
EFP	0.34	-0.20	1.00	0.10	0.22	-0.12
$SG\&A$	0.37	-0.24	0.13	1.00	0.24	-0.23
$\sigma(CFO)$	0.64	-0.24	0.25	0.33	1.00	0.10
$SALE/AT$	-0.14	0.31	-0.09	-0.26	-0.01	1.00

Table 2: **Correlation between regression variables (EQ measures and explanatory characteristics).** *Lower triangle:* Pearson correlation, *Upper triangle:* Spearman correlation. The vertical/horizontal lines separate the dependent variables from the independent ones.

Table 2 displays the values of Spearman (upper triangle) and Pearson (lower triangle) correlation between regression variables (EQ measures and explanatory firm characteristics). The table shows that the conditions for the occurrence of the omitted variable bias in individual regressions are fulfilled: riskier fundamentals

might determine the EQ measures (lines 1 to 3 and columns 2 and 3 in Table 2) and are correlated with the *SG&A* intensity (line 4 and columns 2 and 3 in Table 2).

6 Empirical results

6.1 Patterns of change in the EQ measures and firm's characteristics

This section investigates the time evolution of the EQ measures and that of firm characteristics possibly associated to them. We document different patterns of change. We calculate and display the median value of each variable conditional on the cohort and year. The conditional median is calculated on a moving window of size three. This yields fives curves describing the change over time of the cohort-specific average attribute. The results are displayed in Figure 2 for the three EQ measures and Figure 3 for the three fundamental firm characteristics, respectively.

Figures 2 and 3 show that successive cohorts display increasing levels of earnings and cash flow volatility, expectation formation pertinence, *SG&A* intensity, and decreasing levels of matching and accounting operational efficiency, respectively. The evolution of the EQ measures show a rather clear pattern of listing effect, the cohorts evolving, roughly, around their initial level and showing little evidence of a common trend. The variation of the expectation formation pertinence is more pronounced with evident swings around the internet bubble and the 2008 financial crisis. The firm characteristics display a more complex dynamic

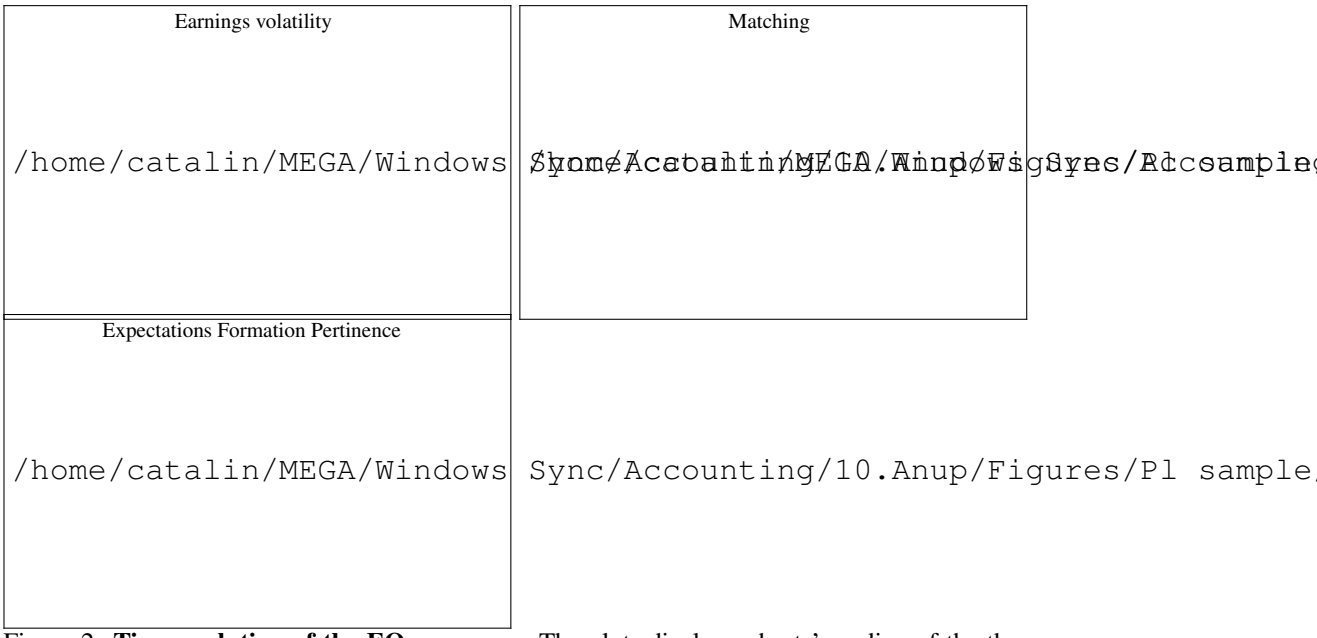

Figure 2: **Time evolution of the EQ measures.** The plots display cohorts' median of the three EQ measures estimated on a three-year moving window. Earnings volatility ($\sigma(NI)$) (top-left), the $corr(Rev, Exp)$ ($\rho(REVT, EXP)$) (top-right), and EFP, the absolute value of the relative error of the pricing regression (4) (bottom). All three measures show evidence of the "listing effect".

of change with a pronounced decline of the measure within each of the cohorts ($\sigma(CFO)$ and $SALE/AT$). It is worth noting that the last cohort (which is not covered by the analysis in Srivastava (2014)) displays a significantly lower levels of *SG&A* intensity. The statistical significance of the differences between the mean EQ measures of different cohorts is tested in the first top-left graphs in Figures 7, 8, and 9.

6.2 Firm characteristics associated with the EQ measures

To identify the firm characteristics that might explain the decline in EQ measures we performed two sets of analyses. The first one is static, i.e. the analyses are done on the polled data (from 1963 to 2016), while the second one is dynamic i.e.

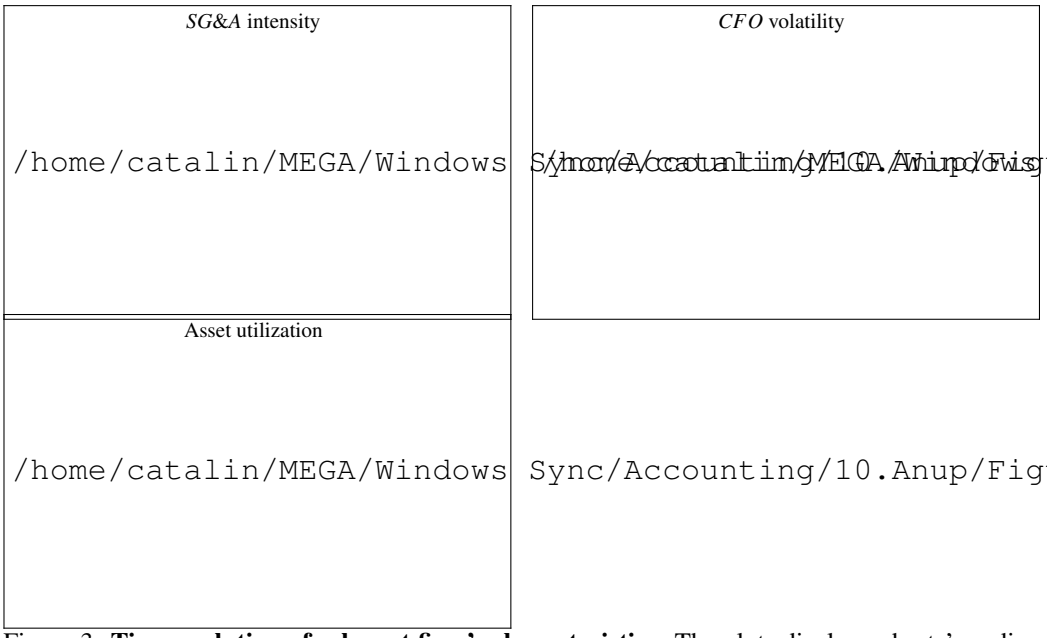

Figure 3: **Time evolution of relevant firm's characteristics.** The plots display cohorts' median firm's characteristic value estimated on a three-year moving window: *SG&A* intensity (top-left), CFO volatility ($\sigma(CFO)$) (top-right), Asset Utilization (SALE/AT) (bottom-left). The last two measures display a more complex dynamic of change with a pronounced decline of the measure within each of the cohorts.

the analyses are performed cross-sectionally. The two sets of tests serve different ends and complement each other.

The pooled analyses investigate which firm characteristics are (statistically) consistently associated with the EQ measures. It regresses the EQ measures on all firm characteristics together. It shows that the association of *SG&A* intensity to EQ measures, although significant in a regression on *only* its levels, is significantly reduced once we control for the level of firm characteristics related to risk and operational efficiency. The strongly significant coefficients of the *SG&A* intensity levels in the simple regression are due to the omitted variable bias. Our analysis finds a statistically consistently association of EQ measures to measures of economic risk and operational efficiency but not to knowledge intensity (as measured

by the *SG&A* intensity).

The cross-sectional analyses investigate the degree to which the evolution of different firm characteristics is associated to the decline in the EQ measures. It regresses the EQ measures on separate sets of competing firm characteristics and evaluates how much the differences in the time dynamics of cohort mean EQ measures are reduced by controlling with each of the sets of firm characteristics competing to explain the EQ decline.

6.2.1 Static analysis

The statistical set-up is the one described in Section 4.2. The analyses in this section show that the association of *SG&A* intensity to EQ measures, although significant in a regression on *only* the levels of *SG&A* intensity, is significantly reduced once we control for the level of firm characteristics related to risk and operational efficiency. The strongly significant coefficients of the *SG&A* intensity levels in the simple regression are due to the omitted variable bias. Our analysis finds a statistically consistently association of EQ measures to measures of economic risk and operational efficiency but not to knowledge intensity (as measured by the *SG&A* intensity).

We pool all cross-sections in the sample and ran two regressions for each EQ measure which differ through the set of the independent variables. The first set contains only the level indicators of the *SG&A* intensity:

$$EQ_i = \gamma_0 + \gamma^{(u)} \times D_i^{SGA} + \varepsilon_i. \tag{14}$$

The estimated coefficients $\gamma^{(u)}$ (uncontrolled) reflect the association without controlling for possible bias due to omitted characteristics. The second set adds the level indicators of the firm characteristics related to risk and operational efficiency:

$$EQ_i = \gamma_0 + \gamma^{(c)} \times D_i^{SGA} + \gamma_1 \times D_i^{\sigma(CFO)} + \gamma_s \times D_i^{SALE/AT} + \varepsilon_i \qquad (15)$$

The second regression yields consistent estimates, $\gamma^{(c)}$ (controlled), of the association of the *SG&A* intensity to EQ measures. It also indicates if the fundamental firm characteristics are significantly associated to the EQ measures.

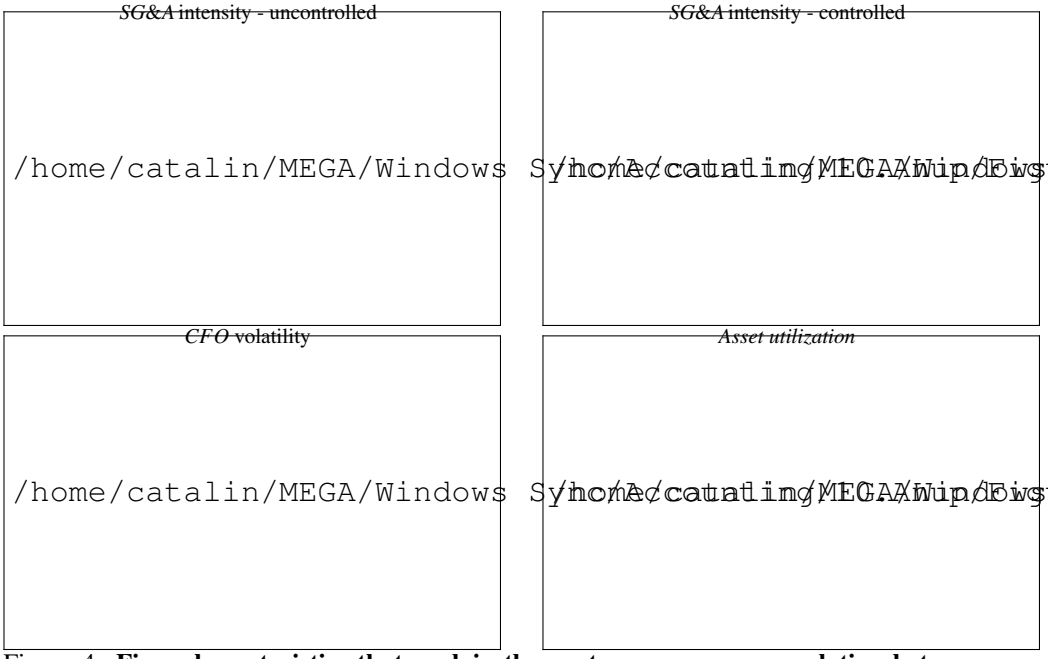

Figure 4: **Firm characteristics that explain the contemporaneous correlation between revenues and expenses.** The figure displays the coefficients of the level indicators corresponding to the characteristics named in the title of the graph in the simple regression (14) (top-right: $\gamma^{(u)}$) and in the multiple regression (15) (the other graphs), together with their 95% confidence intervals. We note that the association of the *SG&A* intensityis much reduced by controlling characteristics.

We structured the estimating set-up as follows. First, we divided the range

of all (continuous) independent variables, that is, firm characteristics that might explain the EQ measure, in 30 intervals of equal probability. Then, we created 29 dummy variables indicating that the explaining characteristic belongs to each one of these intervals but one, the reference level.

A coefficient of the j-th indicator ($1 \leq j \leq 30$, reference level excluded) significantly different from zero provides statistical evidence on the difference between the mean EQ measures of firms with values of the firm characteristic in the j-th interval and the mean EQ measure of firms with value of the characteristic in the reference interval. Significant negative/positive coefficients indicate that the characteristic is associated with the EQ measure.

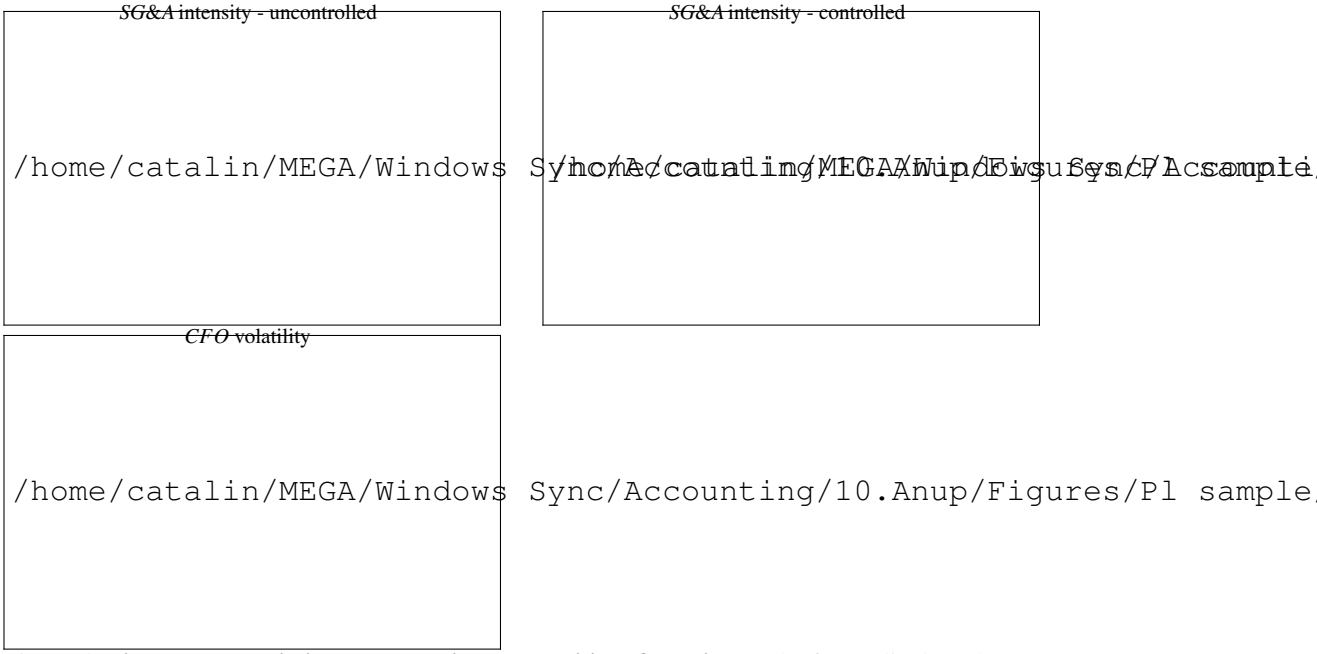

Figure 5: **Firm characteristics that explain the volatility of earnings.** The figure displays the coefficients of the level indicators corresponding to the characteristics named in the title of the graph in the simple regression (14) (top-right: $\gamma^{(u)}$) and in the multiple regression (15) (the other graphs), together with their 95% confidence intervals. We note that the association of the *SG&A* intensity practically vanishes when controlling with other fundamental firm characteristics.

Given the large number of parameters involved and tests performed, the results

of the analysis are presented through graphs instead of tables. For a given EQ measure and a given firm characteristic, we display three curves. The first one traces the 29 coefficients of the indicator variables modeling the levels of the firm characteristic and is shown using a full line. The other two trace the lower and the upper limits of the 29 95%-confidence intervals[26] and are shown as dotted lines. Such a graph tests 29 hypothesis of equal mean EQ measure (that is, association of firm's characteristic with the EQ measure), one for each of the levels 1 to 30 of firm's characteristic, the reference level excepted. The tests are done by checking if 0, the null difference between the two mean EQ measures, belongs to each of the 29 confidence intervals.

Figures 4, 5, and 6 display the results of the estimation of the specifications (14) and (15) for the volatility of earnings, the contemporaneous correlation between revenues and expenses and the Expectations Formation Pertinence of earnings, respectively. The first row of each figure displays the estimated coefficients $\gamma^{(u)}$ (uncontrolled) (left) and $\gamma^{(c)}$ (controlled) (right). The other graphs display the coefficients of the level indicators of the characteristics that are *significantly* associated to the corresponding EQ measure.

Figure 4 shows that firms with lower asset utilization and firms with more volatile cash flows have lower correlations of contemporaneous revenues and expenses. Figures 5 and 6 present evidence that earnings of firms facing higher economic risk (as measured by the volatility of cash flows from operations) are

[26]The confidence intervals are based on heteroskedasticity-consistent (HC) estimation of the covariance matrix of the coefficient estimates in the regression model. Long and Ervin (2000) conduct a simulation study of HC estimators in the linear regression model (HC0 to HC3; HC0 is White's estimator (White (1980)) while the other estimators are refinements of this), recommending to use of the so-called HC3 estimator which we used consistently through the analysis. Qualitatively identical results were obtain using alternative HC estimators.

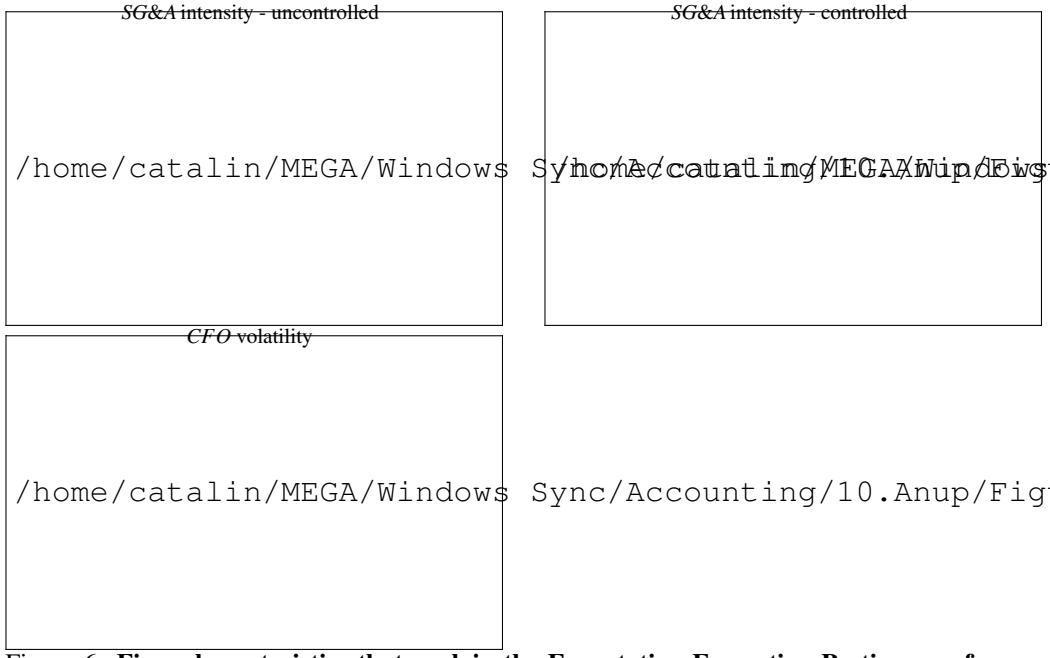

Figure 6: **Firm characteristics that explain the Expectation Formation Pertinence of earnings.** The figure displays the coefficients of the level indicators corresponding to the characteristics named in the title of the graph in the simple regression (14) (top-right: $\gamma^{(u)}$) and in the multiple regression (15) (the other graphs), together with their 95% confidence intervals. We note that the association of the *SG&A* intensity practically vanishes when controlling with other fundamental firm characteristics.

more volatile and inform less the expectation formation process.

The three analyses reported in this section show that, in a static set-up, the association of intangible intensity to the EQ measure under discussion is largely spurious, that is, it mostly disappears when we control for operational efficiency and riskiness fundamental characteristics. We will see in the next section that controlling for these characteristics greatly reduces the "listing effect" dynamic of the three EQ measures.

6.2.2 Dynamic analysis

In this section we present the results of the investigation on the degree to which the evolution of different firm characteristics is associated to the decline in the EQ measures. The statistical set-up is the one described in Section 4.3. The results are presented in three similar figures of four graphs each, one for each of the EQ measures. The figures report the outcomes of a large number of hypothesis test, as detailed in Section 4.3.2.

In a first step, for each of the three EQ measures we estimate the simple regression (10) on each cross-section between 1970 and 2016:

$$EQ_{i,t} = \mu(t) + \beta(t) \times D_{i,t}^{(Co)} + \varepsilon_{i,t}.$$

This step quantifies and tests the differences between averages of the EQ measure conditional on the cohort. This step quantifies and tests the differences between averages of the EQ measure conditional on the cohort.

The top-left graph of each figure report the coefficients

$$\beta_j(t) = \mathbb{E}[EQ_t)\,|\,Co_j] - \mathbb{E}[EQ_t)\,|\,Co_0]$$

and their one-sided 95% confidence levels, as a function of t, the fiscal year. They are color-coded: red for the 1970-1979 cohort, green for the 1980-1989 cohort, blue for the 1990-1999 cohort, and black for the 2000-2009 cohort (in increasing order for earnings volatility and expectation formation pertinence and in decreasing order for matching).

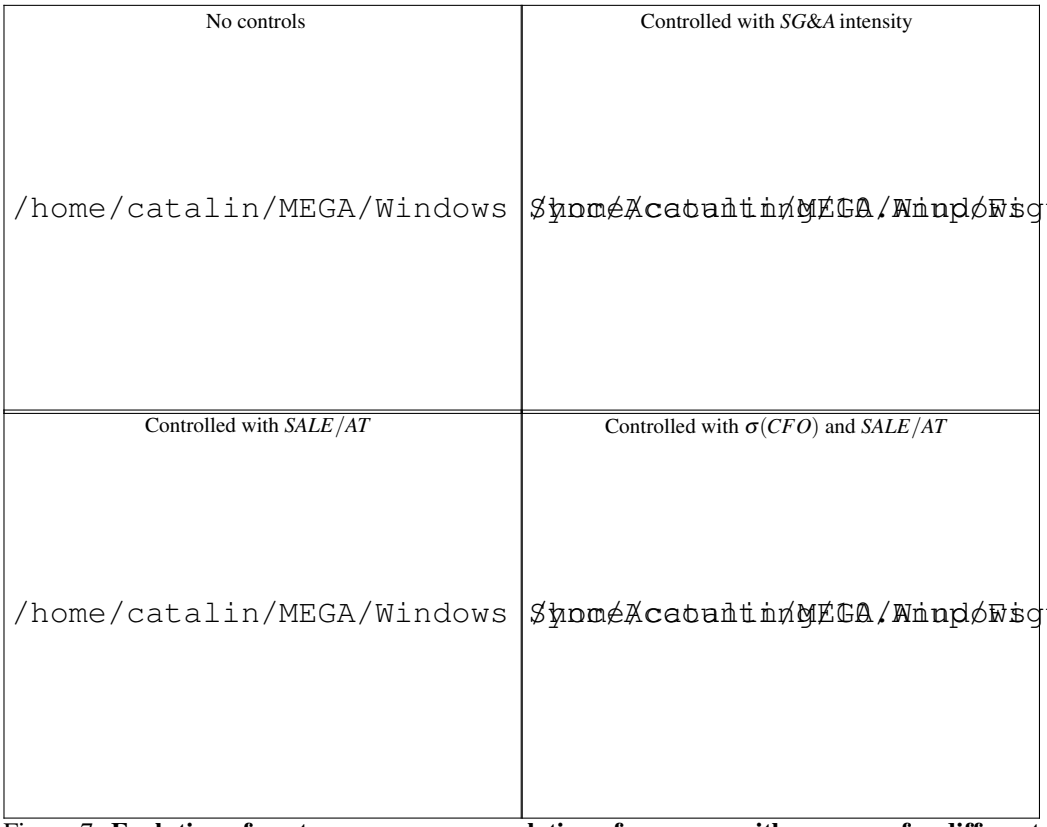

Figure 7: **Evolution of contemporaneous correlation of revenues with expenses for different cohorts - hypothesis tests**. The curves track the coefficients $\beta_j(t)$ (j from 1 to 4, color-coded: red, green, blue, and black, in decreasing order) in the simple regression (10) (top-left) and in the multiple regression (11) where the controlling characteristic(s) appear in the title of the graphs (the other graphs), as a function of t, the year. The shaded areas dropping from (around) the curves $\beta_j(t)$, $j = 1,2,3,4$, represent the 95% one-sided (two-sided) confidence bands for the difference $\mathbb{E}[corr(Rev,Exp)_t \,|\, Co_j] - \mathbb{E}[corr(Rev,Exp)_t \,|\, Co_0]$ (first graph) and $\mathbb{E}[corr(Rev,Exp)_t \,|\, Co_j, Ch] - \mathbb{E}[corr(Rev,Exp)_t \,|\, Co_0, Ch]$ (the other graphs). The x-axis outside shaded area j is statistically significant evidence of lower correlation between revenues and expenses for firms belonging to the cohort j with respect to the 1960-1969 reference Co_0. Controlling with *SG&A* intensity explains little of the differences between later cohorts and the reference. Controlling with $\sigma(CFO)$ and $SALE/AT$ explains, practically, all the differences between the later cohorts and the 1960-1969 reference.

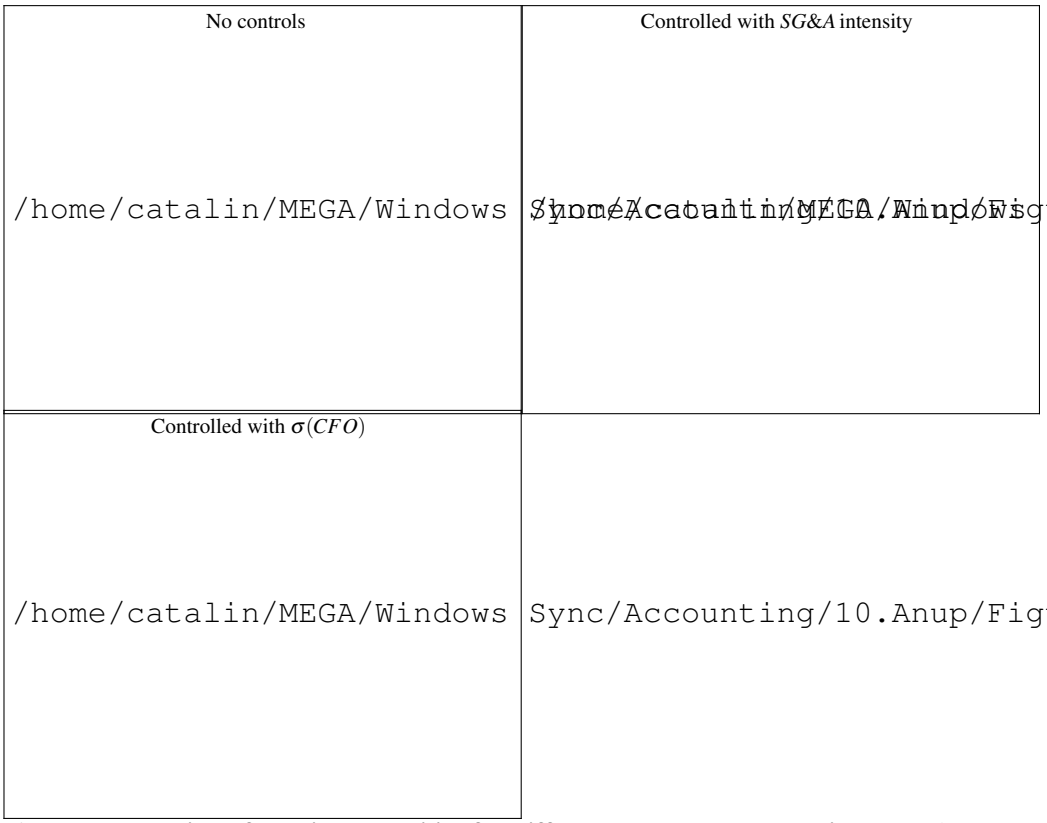

Figure 8: **Evolution of earnings volatility for different cohorts - hypothesis tests**. The curves track the coefficients $\beta_j(t)$ (j from 1 to 4, color-coded: red, green, blue, and black, in increasing order) in the simple cross-sectional regression (10) (top-left) and in the multiple cross-sectional regression (11) where the controlling characteristic(s) appear in the title of the graphs (the other graphs), as a function of t, the year. The shaded areas dropping from (around) the curves $\beta_j(t)$, $j = 1,2,3,4$, represent the 95% one-sided (two-sided) confidence bands for the differences $\mathbb{E}[\sigma(NI)_t \,|\, Co_j] - \mathbb{E}[\sigma(NI)_t \,|\, Co_0]$ (first graph) and $\mathbb{E}[\sigma(NI)_t \,|\, Co_j, Ch] - \mathbb{E}[\sigma(NI)_t \,|\, Co_0, Ch]$ (other graphs). The x-axis outside shaded area j is statistically significant evidence of higher volatility for the earnings of firms belonging to the cohort j with respect to the 1960-1969 reference Co_0. Controlling with *SG&A* intensity does not explain much of the differences between cohorts and the reference. Controlling with $\sigma(CFO)$ explains a large portion of the differences between the later cohorts and the 1960-1969 reference.

In a second step, for each of the three EQ measures we also perform two time series analyses based on the multiple regression (11)

$$EQ_{i,t} = \mu(t) + \beta(t) \times D_{i,t}^{(Co)} + \gamma(t) \times D_{i,t}^{(Ch)} + \varepsilon_{i,t},$$

controlling first, for the *SG&A* intensity and second, for a measure-specific set of the firm characteristics significantly associated with the given EQ measure: the pair of CFO volatility and asset utilization for matching and CFO volatility for the other two EQ measures. The estimation of the cross-sectional multiple regressions brings evidence on the degree of association between changes in the fundamental characteristics documented in section 6.1 and the decline of EQ measures.

The results of the multiple regression analysis are displayed in the other two graphs of each EQ measure-specific figure. These graphs display the coefficients

$$\beta_j(t) = \mathbb{E}[EQ_t \,|\, Co_j, Ch \in \mathcal{S}] - \mathbb{E}[EQ_t \,|\, Co_0, Ch \in \mathcal{S}]$$

and their one-sided 95% confidence levels, as a function of t, the fiscal year as follows. The top-right graph corresponds to controlling for the level of *SG&A* intensity, the bottom-left, for the measure-specific set of significantly associated firm characteristics.

The shaded areas dropping from (or surrounding) the curves $\beta_j(t)$, $j = 1,2,3,4$, represent the 95% one-sided (two-sided) confidence bands for the difference

$$\mathbb{E}[EQ_t \,|\, Co_j] - \mathbb{E}[EQ_t \,|\, Co_0]$$

in the top-left graphs or

$$\mathbb{E}[EQ_t \,|\, Co_j, Ch \in \mathcal{S}] - \mathbb{E}[EQ_t \,|\, Co_0, Ch \in \mathcal{S}]$$

in the other graphs. The x-axis outside shaded area corresponding to the curve

$\beta_j(\cdot)$ is statistically significant evidence of lower EQ for firms belonging to the cohort j with respect to the 1960-1969 reference Co_0. To put it shortly, the closer the four curves to 0, the more changes in the controlling fundamental firm characteristics explain the differences in the cohort EQ measures.

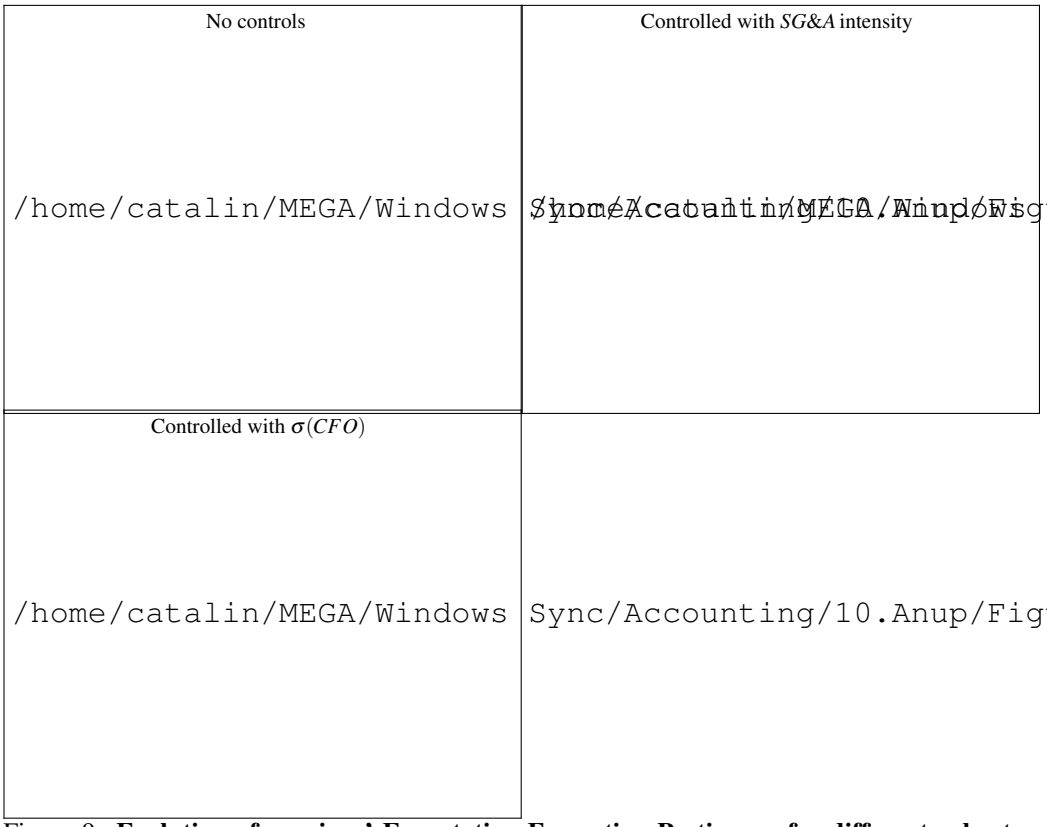

Figure 9: **Evolution of earnings' Expectation Formation Pertinence for different cohorts - hypothesis tests**. The curves track the coefficients $\beta_j(t)$ (j from 1 to 4, color-coded: red, green, blue, and black, in increasing order) in the simple cross-sectional regression (10) (top-left) and in the multiple cross-sectional regression (11) where the controlling characteristic(s) appear in the title of the graphs (the other graphs), as a function of t, the year. The shaded areas dropping from (around) the curves $\beta_j(t)$, $j = 1,2,3,4$, represent the 95% one-sided (two-sided) confidence bands for the difference $\mathbb{E}[EFP(NI)_t\,|Co_j] - \mathbb{E}[EFP(NI)_t\,|Co_0]$ for the first graph and $\mathbb{E}[EFP(NI)_t\,|Co_j, Ch] - \mathbb{E}[EFP(NI)_t\,|Co_0, Ch]$ for the other graphs. The x-axis outside shaded area k is statistically significant evidence of lower earnings' pertinence for firms belonging to the cohort j with respect to the 1960-1969 reference Co_0. Controlling with *SG&A* intensity does not explain much of the differences between cohorts and the reference. Controlling with $\sigma(CFO)$ explains most of the differences between the later cohorts and the 1960-1969 reference.

Figures 7, 8, and 9 present the results. They show that controlling with *SG&A* intensity

explains little of the differences between cohorts and the reference while controlling for economic risk and operational efficiency explains most of the differences between the EQ measures of later cohorts and those of the 1960-1969 reference.

The results do not change if instead of firm characteristics we control with the idiosyncratic component with respect to the competing set of explanatory variables. The idiosyncratic component of *SG&A* intensity is the error term of a non-linear regression of *SG&A* intensity on CFO volatility and asset utilization. The idiosyncratic components of CFO volatility and asset utilization are the error terms of the non-linear regressions of each of the two firm characteristics on *SG&A* intensity.

7 Robustness

The results are robust to a number of alternative specifications. We estimated the non-linear regression yielding the EFP measure using other non-linear methods. We used the conservatism index in Penman and Zhang (2002) as an alternative measures of the level of conservatism to the P/B ratio. We used total assets as an alternative to the market value as a proxy for risk. We measured matching by the b_3 coefficient in the regression (13). We varied the number of different levels we split the ranges of the firm characteristics. We used *R&D* instead of *SG&A* intensity as a proxy of knowledge intensity.

8 Conclusions

The last decades have witnessed significant changes in the business environment with important consequences on the fundamentals of firms. Changes to the fundamental economics of new firms seeking capital gave weaker firms and firms whose expected payoffs are further in the future access to public equity financing. As the US economy moved towards a knowledge based economy, there was a significant increase in the levels of intangible capital. As a consequence, newer listings, in particular, are characterized by higher average intangible intensity.

These changes were paralleled by developments in the quality of reported earnings. While the literature seems to agree on the existence of a downward trend in many of the EQ measures, there is disagreement about the explanation of this evolution.

In a seminal contribution, Srivastava (2014) argues that most of the changes in three important EQ measures, that is, earnings volatility, the matching of revenues and expenses, and the value relevance of earnings, over the last decades can be attributed to "the widening gap between the intangible intensities of the new- and seasoned-firm segments" as a result of the evolution of the US economy from an industrial to a knowledge economy.

In this paper we brought evidence that the explanation in Srivastava (2014) might not hold as the analysis on which it is based does not properly consider other mechanisms of change than the evolution towards a knowledge economy[27]. While significantly negative when considered alone, the impact of intangible intensity

[27] In statistical terms, the analysis might be affected by omitted variable bias.

disappears when controlling for other fundamental characteristics, as operational efficiency and economic risk.

To summarize, we propose an alternative to the narrative developed in Srivastava (2014) which places the evolution towards a "21st century firm" characterized by higher knowledge intensity at the origin of the progressive lessening of earnings quality. Our account associates the decline in the EQ measures with the arrival to the market of riskier, less profitable firms, phenomenon most likely due to changes in the fundamental economics of new firms seeking capital (Fama and French (2004)) and to the increase in financial sophistication of the U.S. capital markets (Brown and Kapadia (2007)).

The issue of which of the two narratives is more likely is not only a question for academic debate as they imply opposing appraisals of current accounting reporting. If the increase in intangible intensity is at its origin, the decline in EQ measures might be seen as a sign of failing accounting standards which are then ill-suited for quantifying and recording the risks and returns of intangible investments. If, contrary, the explanation for lower EQ lies with the facilitated access to public equity financing of weaker firms and firms whose expected payoffs are further in the future, then the evolution of the EQ measures might be interpreted as an expression of a well-functioning accounting standard that accurately reflects the increased weaknesses in the firm population. Our evidence points strongly towards the second assessment.

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