Group 1 : Panel Data Analysis

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Abstract

This research deals with the cash management strategies of small and medium-sized enterprises (SMEs) in the context of Paris, utilizing a panel dataset to scrutinize the underlying determinants influencing their liquidity management and cash holding adjustments. We examine the dynamism in cash-to-asset ratios, unraveling the significance of firm-specific characteristics and industry-related factors in shaping liquidity practices.

Employing a multifaceted analytical approach, the study integrates descriptive statistics, variance decomposition, and correlation analysis to distill the patterns and deviations in financial behavior. The paper identifies the predominance of between-firm differences over within-firm variations in explaining the total variance in cash holdings. Furthermore, a nuanced orthogonality check via correlation tables informs the subsequent regression models.

The regression analysis, incorporating both one-way and two-way transformations, offers insights into the cash holdings' responsiveness to historical levels and firm characteristics, providing evidence of a measured yet proactive adjustment mechanism within the sampled SMEs. The between-firm model reveals consistent liquidity management, while the within-firm model captures temporal strategic adjustments.

Conclusively, the study highlights the nuanced interplay between firm growth, financial constraints, and industry-specific risks in the liquidity management of Parisian SMEs. The findings underscore the imperative for flexibility in financial strategies, reflecting the SMEs' agility in navigating an uncertain economic terrain.

Keywords: Cash Management, SMEs, Panel Data Analysis, Liquidity Management, Financial Strategies ·

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Chapter 1

Introduction

In our detailed examination of cash management within small and medium-sized enterprises (SMEs), this paper aims to thread through the intricate theoretical frameworks presented by foundational financial literature, illustrating the determinants that influence SMEs' liquidity adjustment strategies towards targeted cash levels. We begin by anchoring our discussion in the critical insights of Ang (1991)[2], who underscores the role of liquidity management, especially within the field of small companies. Here, we establish the dual rationale for holding cash, rooted in transactional necessities and precautionary measures, which is particularly critical for SMEs that, not being listed, encounter challenges in accessing capital markets and hence, depend more significantly on cash reserves.

Drawing from the work of Jensen (1986)[11], the Free Cash Flow Theory introduces the potential for conflicts over surplus cash holdings between shareholders and managers. While this may not be a predominant concern in SMEs where ownership often intersects directly with management, it does underline the presence of debt agency issues that translate into less favorable lending conditions or restricted credit availability as suggested by Berger and Udell (2003)[6], and supported by Niskanen, Niskanen, and Laukkanen (2010)[14], thus emphasizing the importance of meticulous cash holding adjustments for these entities.

Further delving into the theoretical dialogue, we engage with the Pecking Order Theory, as propounded by Myers (1984)[12] and Myers and Majluf (1984)[13], positing a firm's preference for internal over external financing, and debt over equity, when facing the prospect of issuing securities—a choice significantly influenced by the prevailing information asymmetry, a scenario that is particularly acute in the context of SMEs, and results in pronounced financing constraints without the associated detriments of holding cash. Opler et al. (1999)[15] further blur the distinctions between the Pecking Order and the static Trade-Off models, noting that despite differing theoretical foundations, the empirical outcomes they predict often align closely.

The discourse then transitions to the Trade-Off Theory of cash, extending the principle of the trade-off theory of debt, which posits that firms not only set a target cash holding but also engage in a gradual progression towards achieving it. Within this framework, firms navigate a complex balance, juxtaposing the intrinsic value of cash benefits against a spectrum of costs. This stance is informed by the investigative findings of Opler et al. (1999)[15] and Riddick and Whited (2009)[17], who articulate the latent adjustment costs and strategic realignments firms undertake to gravitate towards an optimal cash ratio, a journey often impeded by the capital market imperfections such as information asymmetry, transaction costs, and agency conflicts, as elucidated by Myers (1984)[12] and Venkiteshwaran (2011)[20].

With these theoretical constructs as our compass, we focus our analysis on specific factors that may impact the speed with which SMEs adjust their cash reserves—growth opportunities, financial constraints, and financial distress. Here, we draw parallels to the insights presented by Aybar-Arias et al. (2012)[3], who articulate the significant transaction costs inherent in adjusting to target leverage, further exacerbated by financial market restrictions, higher information asymmetry, and debt agency costs in SMEs.

Amidst a backdrop of extensive literature primarily centered on large, publicly traded firms, our research seeks to fill a conspicuous gap by examining the adjustment speed of cash holdings in SMEs and how they are influenced by growth opportunities, financial constraints, and financial distress. This endeavor is particularly salient given the profound economic footprint of the French SME sector, which is characterized by its considerable scale of 159,000 SMEs, its substantial employment of 4.3 million people, and its noteworthy contribution to 23% of France's GDP, as reported by the French Government.

By synthesizing the wealth of references from past studies—including Faulkender (2002)[8] for American small firms, García-Teruel and Martínez-Solano (2008)[10] for Spanish SMEs, Bigelli and Sanchez-Vidal (2012)[7] for Italian private firms, Steijvers and Niskanen (2013)[19] for American small family businesses, Belghitar and Khan (2013)[5] and Al-Najjar (2015)[1] for UK listed SMEs, and Orens and Reheul (2013)[16] on the impact of CEO demographics on cash holdings in Belgian privately held SMEs—we construct a comprehensive examination that retains the empirical and theoretical richness necessary to understand the liquidity management strategies and challenges faced by SMEs.

Chapter 2

Data transformations

2.1 Methodology

2.1.1 Data Format Conversion

1. Transform if necessary the database in the right format.

Initially, our database was in Stata format. To improve compatibility and performance when processing the data with Python, we transformed the dataset into .parquet format. This format is particularly efficient for processing large amounts of data, as it is optimised for read and write performance and data compression.

2.1.2 Preprocessing

To ensure the overall Data Quality and align our research question with the database, we filtered our Data so as to keep only firms defined as SME, and then removed all rows where values total assets, net sales and total debt were outside the 1% top and bottom quantiles.

2.1.3 Geographic selection

2. Select your "département." in the code.

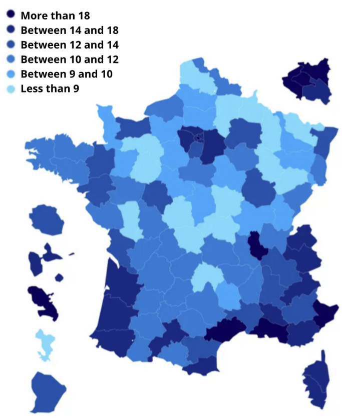

Fig. 2.1: Number of businesses created in France per 1,000 inhabitants

To bring our study into line with the distribution and economic representativeness of SMEs in France, we chose the department of **Paris (75)**. As shown in Figure 2.1, we have identified the number of businesses created in France per 1,000 inhabitants, with a distinct breakdown highlighting the most dynamic regions in terms of entrepreneurial activity.

Completing this regional perspective, Figure 2.2 lists the five main cities with more than 100,000 inhabitants with the highest number of creation of businesses per 1,000 inhabitants. On a more granular scale, Paris emerges as the economic centre with an exceptionally high density of businesses, with 74,019 registered businesses, which represents 33.84 businesses per 1,000 inhabitants. This density illustrates the attractiveness of Paris to entrepreneurs and underlines the importance of the capital and its surrounding area as a hub of commercial activity in France.

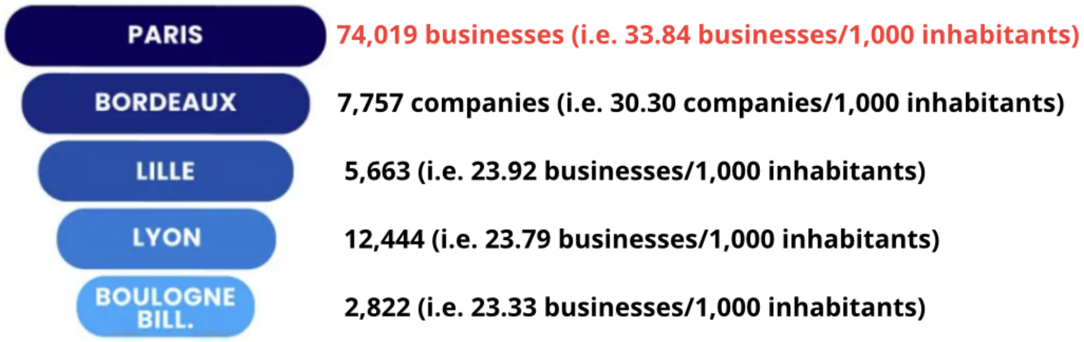

Fig. 2.2: TOP 5 cities with more than 100,000 with the most businesses per 1,000 inhabitants

These figures are inspired by the graphical models used in the GoInvest study, which highlight regions that are conducive to economic vitality and entrepreneurship. The company data comes from the SIRENE database managed by INSEE, reflecting an official and reliable source for economic information on companies in France. Demographic statistics, also provided by INSEE in 2021, allow us to associate business creation data with population density

2.1.4 The partial adjustment model

2.1.4.1 Descriptive Statistics of Total Assets

The following table provides a summary of the descriptive statistics for the variable `totalassets`, which represents the total assets of SMEs in our sample. The data reveal significant heterogeneity in the size of the firms, with notable variability as evidenced by the substantial standard deviation.

The standard deviation is quite large at 11066 units, pointing to significant disparities among SMEs' asset sizes. Such high variance indicates that while some firms have assets amounting to the millions, many others operate with substantially less, evidenced by the median of just 641 units. This median value suggests that half of the SMEs in our sample have assets below this amount, highlighting a skew in the distribution toward smaller firms.

The 25th and 75th percentiles show that 25% of the firms have assets of 182 units

Statistic	Value
Count	206483
Mean	3806.69
Standard Deviation	11066.43
Minimum	2
25th Percentile	182
Median (50th Percentile)	641
75th Percentile	2371
Maximum	172048

Table 2.1: Descriptive statistics for the total assets of SMEs in the dataset.

or less, and 75% of the firms have assets of 2371 units or less. This skewed distribution suggests that a small number of firms have much larger total assets than the rest, which could be reflective of a few very large firms within a sea of smaller entities.

Understanding these statistics is crucial as they set the stage for further analyses, such as the examination of cash holding adjustments. The diversity in financial size can have implications for how firms manage their liquidity and approach investment opportunities.

In conjunction with the descriptive analysis, we study the adjustments in cash holdings within these SMEs. To this end, we examine the change in the cash-to-assets ratio, using the following dynamic adjustment model.

2.1.4.2 Dynamic Adjustment of Cash Holdings

$$\Delta Cash_{it} = \gamma(Cash^*_{it} - Cash_{it-1}) + \epsilon_{it} \tag{2.1}$$

where $\Delta Cash_{it} = Cash_{it} - Cash_{it-1}$ is the change in the corporate cash holding ratio for firm i from year $t-1$ to year t, and $Cash^*_{it}$ is the target cash holdings. The observable $Cash_{it}$ is the ratio of cash and cash equivalents to total assets.

In exploring how SMEs adjust their cash holdings over time, we employ the dynamic cash adjustment model shown in Equation (2.1). The model's focal point is the coefficient γ, which elucidates the speed at which firms align their cash holdings to the target or optimal level.

A γ value closer to 1 implies that firms swiftly adapt their cash ratios to the target, suggesting a responsive and agile financial management. Conversely, a γ value near 0 would indicate a sluggish adjustment process, perhaps due to high adjustment costs or external constraints that inhibit the fluid reallocation of resources. These costs could stem from market frictions, transaction costs, or internal policies that limit rapid changes in cash holdings.

Therefore, the γ coefficient is not just a statistical measure but a reflection of the underlying financial dynamics and strategic responses of SMEs to changing economic conditions. An analysis of γ across firms of varying sizes could further reveal how firm size and financial health influence liquidity management practices.

2.2 Cash Ratio

3. Compute the ratio (Cash+marketable securities)/Totalassets) for numerator >=0 and denominator >=1 and its lag. Check that, for each firm, the first data should be missing.

However, target cash holding (Cash*it) is unobservable. Following the literature, we use a widely accepted cash model (Bates, Kahle and Stulz, 2009; and Opler et al., 1999) [4] [15] , wherein the target cash holdings is determined by firm characteristics such as growth opportunities, firm size, cash flow to assets, net working capital to assets, leverage, industry cash flow risk, increase in fixed assets to total assets, and deviation from the cash holding industry mean. Specifically, the variables have been defined as explained below.

For each firm, the first data is missing.

2.3 Control Variables

4. Compute some of the control variables of the paper to replicate, remove some extreme variables (for example percentile). Follow the do.file example. Compute between, one way within, two-way within and first differences transformed variables: Between is X(i.), one way Within is X(it)-X(i.), two way within is X(it)-X(i.)-X(.t)+X(..) and first differences (in panel, check the first 100 observations to avoid the usual mistake): X(i,t)-X(i,t-1).

2.3.1 Some variables

We proxy firm's growth opportunities by its sales annual growth [GROWTH=(Salest - Salest-1)/Salest-1] because there is no information about SMEs market value and, therefore, we are not able to calculate their market-to-book ratio. Thus, Scherr and Hulburt (2001) [18] argue that firms that had faster past growth have greater growth potential. In addition, Niskanen and Niskanen (2006) [14] assert that fast growing firms have better investment opportunities. Firm size is calculated as the natural logarithm of firm's total assets (SIZE). We measure cash flow as net income divided by total assets (CFLOW). Net working capital is working capital minus cash to total assets (NWC). Leverage is the ratio of total debt to total assets (LEV).

2.3.2 Industry Risk

We measure cash flow risk as the standard deviation of industry cash flow (INDUSTRYRISK). Specifically, for each firm, we compute cash flow standard deviation for the previous five years and take the average across the two-digit NACE (Rev. 2) code of the firm cash flow standard deviations.

2.3.3 Incasset

We also include the increase in total fixed assets measrured as the first difference in total fixed assets divided by total assets (INCASSET).

2.3.4 Industry deviation

To control for the existence of a possible industry cash holding target, we also include, by year, the absolute value of the difference between the firm cash holding and the industry mean (INDUSTRYDEVIATION).

2.4 Between & Within

Finally, we used Between and Within transformations on the following columns : net margin, asset growth, sales growth, liquidity ratio, SIZE, CFLOW, NWC, LEV, INDUSTRYRISK, INCASSET and INDUSTRYDEVIATION. Between transformations were calculated as the mean of each column for each firm. On the other hand, within transformations were computed by taking the mean value of each columns for each firm and, subtracting it from the actual firm-year observation value.

Chapter 3

Replicate descriptive statistics of the Cash Holdings paper including first differences

3.1 Cash Holding Per year

5. Replicate table3, p.34 (Cash holding per year) on your data set, add a line for aggregate (all years statistics corresponding to the first line of table 1, p.33).

Table 3.1: Yearly Descriptive Statistics for the Cash Holding Ratio

Year	Obs	Mean	Std. Dev.	Perc. 10	Median	Perc. 90
2014	45,196	0.260328	0.273835	0.002436	0.159124	0.703592
2015	42,497	0.259270	0.280599	0.002589	0.155556	0.700918
2016	38,793	0.258533	0.290456	0.002387	0.151408	0.706597
2017	34,773	0.256190	0.278099	0.002536	0.149457	0.701559
2018	11,272	0.274129	0.285299	0.002546	0.166667	0.740741
2014-2018	172,531	0.259732	0.280937	0.002482	0.154808	0.705769

Building on the findings of Bates et al. (2009) [4] and Gao et al. (2013) [9], who identified a significant increase in cash ratios over time for U.S. firms, we endeavor to understand the dynamics of cash holdings within Paris SMEs. Table 3.1 outlines the descriptive statistics for the cash ratio (cash and cash equivalents over total assets) across our sample period, it reveals a nuanced trend in cash holdings among Paris SMEs.

Notably, the cash holding ratio exhibits slight fluctuations but maintains an overall upward trend from 2014 through 2018. The average cash ratio starts at 0.260328 in 2014, with minor variations in the subsequent years, ultimately reaching a peak of 0.274129 in 2018. This progression indicates a gradual increase in the liquidity position of SMEs, with a pronounced rise by 2018.

The period from 2014 to 2018 shows a general pattern of growth in cash holdings among SMEs, culminating in a 5.28% increase in the average cash ratio by 2018 compared to 2014. This trend suggests that, despite the variances observed year-to-year, there's an overarching inclination among Paris SMEs to bolster their cash reserves over the examined period.

Noteworthy is the period post-2017, which marks the most significant year-on-year increase in average cash ratio, from 0.256190 in 2017 to 0.274129 in 2018. This jump could be indicative of SMEs adopting a more conservative financial strategy, potentially as a response to economic uncertainty or as part of strategic planning to finance future growth opportunities without relying heavily on external financing.

3.2 Within transformed cash holdings & for first difference

6. Do table 3W for within transformed cash holdings and for first differences.

3.2.1 3W1 : Within transformed cash holdings

Table 3.2: 3W1 : Within transformed cash holdings

Year	Obs	Mean	Std. Dev.	Perc. 10	Median	Perc. 90
2014	45,196	-2.419×10^{-3}	0.102097	-0.091940	0.0	0.087349
2015	42,497	9.260×10^{-4}	0.099065	-0.080727	0.0	0.085455
2016	38,793	8.243×10^{-4}	0.114064	-0.084299	0.0	0.086674
2017	34,773	9.886×10^{-4}	0.106846	-0.091310	0.0	0.096239
2018	11,272	3.231×10^{-4}	0.120095	-0.106361	0.0	0.110013
2014-2018	172,531	-3.388×10^{-20}	0.106388	-0.088033	0.0	0.090291

The number of observations varies each year, indicating the volume of data available for annual analysis. Variations in the number of observations could reflect companies entering and leaving your study sample over time.

The average of the cash reserves transformed into "within" shows slight fluctuations around zero, which is typical for this type of transformation. This indicates that on average, after adjusting for company-level fixed effects, there is no significant change in cash levels from one year to the next.

The standard deviation shows the dispersion of cash reserves around their mean. Higher values in 2016 and 2018 suggest greater variability in how companies adjust their cash reserves from year to year, perhaps in response to varying economic conditions.

The 10th percentile values are all negative, indicating that for 10% of companies, cash reserves have decreased by a relatively large amount year on year. This could reflect strategic cash withdrawals for investment, debt repayments or other operational needs.

The median is consistently 0, which is consistent with the expectation of an within transformation where the median of differences or transformations should theoretically be zero if companies do not significantly change their cash holding behaviour from year to year.

The 90th percentile values show the degree to which cash reserves have increased among companies that increase their cash holdings the most. An increase in 2018 suggests that some businesses may have built up larger cash reserves, potentially in anticipation of uncertain economic conditions or to take advantage of investment opportunities.

In summary, the table suggests that, although the majority of SMEs maintain relatively constant levels of cash from year to year, there is significant variability among some businesses. These differences could be attributed to divergent cash management strategies in response to market conditions, investment opportunities, or specific operational needs.

2018 stands out for a trend towards cash accumulation, which merits further investigation to understand the underlying motivations for this behaviour.

Let's clarify these points after the same analysis but for first differences of cash holdings.

3.2.2 3W2 : For first difference of cash holdings

Table 3W2 presents the yearly first differences in cash holdings across firms under study, revealing variations and trends in liquidity management over time.

Table 3.3: 3W2 : Descriptive Statistics for First Differences in Cash Holdings

Year	Obs	Mean	Std. Dev.	Perc. 10	Median	Perc. 90
2015	35061	33.1404	1182.6490	-128.00	1.0	202.00
2016	33395	20.8498	1285.5945	-156.00	0.0	207.00
2017	30408	32.1046	1279.6200	-172.00	1.0	241.30
2018	10056	53.4536	1461.0940	-205.00	0.0	299.00
2014-2018	108920	34.8871	1302.2394	-165.25	0.5	237.32

The table reflects varying degrees of year-over-year change in cash holdings within firms. Notable trends include the increase in mean and percentile values, particularly in 2018, suggesting a year of significant positive changes in cash holdings for the top 10% of firms. Conversely, the consistently negative 10th percentile indicates that at least 10% of the sample experienced declines in cash holdings each year. The median values around zero suggest that for the median firm, changes in cash holdings are not consistently positive or negative.

3.2.3 Comparison of both table

In comparing the two sets of tables (3W1 for within transformed cash holdings and 3W2 for first differences in cash holdings), let's analyze the annual dimensions and consider the contextual factors influencing these changes:

Within Transformed Cash Holdings (3W1): This table likely shows the stabilization in the firms' cash holdings relative to their mean over time. The figures around zero for median values suggest that on a year-to-year basis, firms didn't experience significant changes from their own average behavior. This could be seen as an indication of stability and perhaps a sign of cautious financial management following the 2008 crisis.

First Differences in Cash Holdings (3W2): Contrasting with 3W1, 3W2 demonstrates more pronounced changes, with the mean and standard deviation values indicating substantial variability in how cash holdings changed from one year to the next. The significantly higher standard deviations suggest that individual years saw significant fluctuations likely due to specific events or changes in economic conditions.

3.2.3.1 Annual Comparisons:

2014-2015: Post-Crisis Stabilization

During these years, as firms recovered from the financial crisis, the within transformed cash holdings (3W1) remained relatively stable, indicating cautious liquidity management. In contrast, the first differences (3W2) show a positive mean, which may reflect active rebuilding of cash reserves as firms emerge from the crisis.

2016: Instabilities and Precautions

The 3W1 data continue to reflect stability, perhaps as a response to external shocks such as terrorist attacks and Brexit, with firms maintaining their cash positions. The first differences (3W2), though lower than in 2015, still show positive mean values, indicating growth in reserves despite uncertainties.

2017: Anticipation and Adaptation

During an election year with impending economic reforms, the slight positive mean in 3W1 suggests a tentative buildup of reserves. The first differences (3W2) similarly show an increased mean, implying that firms were actively adjusting their reserves in anticipation of potential changes.

2018: Growth of Reserves in Response to Uncertainties

In 3W1, the near-zero median indicates little movement from the firms' own average cash holding behavior. However, the pronounced increase in the mean and 90th percentile in 3W2 suggests that some firms significantly increased their reserves, likely in response to low interest rates and trade tensions.

3.2.3.2 Implications for SMEs:

The comparative analysis highlights the importance of contextualizing financial data with real-world events. While the within transformation suggests relative stability in cash holdings behavior, the first differences reveal that firms are not entirely static in their cash management strategies—significant external events prompt noticeable shifts in their financial postures. The observed trends underscore the SMEs' need for flexibility and the importance of adaptability in an evolving economic landscape.

3.3 Descriptive statistics

7. Replicate table 1, p.33: descriptive statistics

This table below offers a concise descriptive analysis of key financial variables under scrutiny. For the firms within our sample, the average cash-to-asset ratio (`CASH`) stands

Table 3.4: Descriptive Statistics for Financial Variables of SMEs

Variable	Obs	Mean	Std. Dev.	Perc. 10	Median	Perc. 90
CASH	172,531	0.259732	0.280937	0.002482	0.154808	0.705769
GROWTH	113,952	1.130138	54.570043	-0.339796	0.009164	0.588994
SIZE	206,483	6.482307	1.962090	4.007333	6.463029	9.084210
CFLOW	206,482	-0.116490	13.474864	-0.157895	0.030955	0.234299
NWC	172,573	-0.346897	24.520741	-0.773045	-0.086364	0.268293
LEV	206,483	1.689828	59.605695	0.100544	0.556634	1.126448
INDUSTRYRISK	206,483	12.149945	5.826568	2.544794	16.073675	16.073675
INCASSET	103,564	0.022782	4.301048	-0.018587	0.001740	0.101472
INDUSTRYDEVIATION	172,575	825.318624	2571.431253	188.681728	575.387023	818.795076

at roughly 25.97%, with the median positioned at 15.48%. This suggests a considerable spread in how different firms approach their liquidity management.

The mean annual sales growth (`GROWTH`) is observed at 1.13%, while the median firm in the sample experiences growth of 0.92%, pointing to the general upward trajectory with variances across the spectrum of businesses. The average annual increase in fixed assets (`INCASSET`) is calculated to be 2.78%; this moderate rise reflects a cautious but steady approach to capital investments within the sampled SMEs.

In terms of logarithmic size (`SIZE`), firms' average of 6.48 indicates a range of enterprise varying from small to significantly larger operations within the Parisian context. The cash flow to total assets ratio (`CFLOW`) has a mean value of -11.65%, revealing operational challenges and diverse fiscal efficiencies within the cohort.

Net working capital excluding cash (`NWC`) represents, on average, -34.69% of total assets, suggesting various strategies and potentially tight cash management tactics across firms. The debt-to-total-assets ratio (`LEV`) is at an average of 168.98

Regarding the determinants of corporate cash holdings, we see that the industry risk (`INDUSTRYRISK`), with a mean of 12.14 and a standard deviation of 5.82, suggests a moderate level of industry-wide volatility. Firms seem to face a diversity of sector-specific risks, as reflected in the broad range between the 10th and 90th percentiles.

The industry deviation (`INDUSTRYDEVIATION`) presents a significant mean value of 825.31, alongside a large standard deviation of 2571.43, indicating wide variations in firm performance relative to their industry average. This variability could be due to the different strategic responses of firms to industry dynamics or could reflect the presence of outlier firms that substantially deviate from the average industry performance.

To conclude, Table 1 reveals that Parisian SMEs navigate a landscape marked by variability in liquidity management and growth. The data suggest a sector characterized by diverse strategic approaches, with companies flexibly adapting to sector-specific risks and industry dynamics. Amidst this variability, firms demonstrate a cautious yet proactive stance in capital investment and cash flow management, balancing the need for stability with the pursuit of growth opportunities.

3.4 Descriptive Statistics of Transformed Financial Variables

8. Do table 1B and 1W for between transformed, one way within and two-way within transformed and first differences.

3.4.1 2B: Descriptive Statistics of Between Transformed

Table 3.5: Descriptive Statistics of Between Transformed Variables

Variable	Obs	Mean	Std. Dev.	10th Pct.	Median	90th Pct.
CASH	179,453	0.259	0.261	0.008	0.168	0.671
GROWTH	165,467	1.263	42.279	-0.218	0.026	0.668
SIZE	206,483	6.482	1.922	4.039	6.459	9.042
CFLOW	206,483	-0.116	8.232	-0.145	0.033	0.199
NWC	179,460	-0.347	20.706	-0.742	-0.092	0.250
LEV	206,483	1.690	55.746	0.123	0.561	1.147
IND.RISK	206,483	12.150	5.827	2.545	16.074	16.074
INCA	154,894	0.026	2.779	-0.023	0.004	0.100
IND.DEV	179,460	826.754	2416.547	224.500	573.387	819.128

CASH shows a slight overall variation, indicating differences in liquidity management. GROWTH has wide-ranging values, reflecting varied expansion across firms. SIZE data suggests larger firms are common but with some size variability. CFLOW appears to be a common issue, though it varies significantly. NWC is typically negative but widely dispersed, implying varied working capital strategies. EV levels are moderate on average but exhibit a broad range. IND.RISK indicates shared industry risk with a moderate spread. INCA shows little change in fixed assets across firms. IND.DEV has a large average deviation with substantial variability, highlighting diverse performances relative to industry norms.

3.4.2 2W1: Descriptive Statistics of one-way Within Transformed

CASH and LEV show small deviations, indicating consistent cash holdings and leverage levels within firms. GROWTH and IND.DEV have larger standard deviations, pointing to more pronounced variations in firm growth rates and deviations from industry norms, suggesting some firms may experience significant changes, possibly due to unique strategies or external events. CFLOW, NWC, and INCA display moderate variability, reflecting differences in operational efficiency and investment activities. IND.RISK shows no variation, which may indicate stable industry conditions or a uniform response across firms in the industry.

Table 3.6: Descriptive Statistics of Within Transformed Variables

Variable	Obs	Mean	Std. Dev.	10th Pct.	Median	90th Pct.
CASH	172,531	0.0	0.106	-0.088	0.0	0.090
GROWTH	113,952	0.0	38.677	-0.350	0.0	0.291
SIZE	206,483	0.0	0.397	-0.256	0.0	0.266
CFLOW	206,482	0.0	10.667	-0.103	0.0	0.111
NWC	172,573	0.0	12.885	-0.129	0.0	0.129
LEV	206,483	0.0	21.100	-0.125	0.0	0.118
IND.RISK	206,483	0.0	0.0	0.0	0.0	0.0
INCA	103,564	0.0	3.333	-0.053	0.0	0.053
IND.DEV	172,575	0.0	840.536	-110.250	0.0	91.970

Table 3.7: Two-Way Within Transformed Descriptive Statistics

Year	Variable	Obs	Mean	Std. dev	Perc. 10	Median	Perc. 90
2014	CASH	45196	-0.0024	0.102	-0.0919	0.0	0.0873
	CFLOW	52875	0.058	7.497	-0.0943	0.0	0.1088
	GROWTH	0	NaN	NaN	NaN	NaN	NaN
	INCASSET	0	NaN	NaN	NaN	NaN	NaN
	INDUSTRY DEVIATION	45206	-22.69	889.53	-102.0	0.0	85.01
	INDUSTRY RISK	52875	9.03×10^{-20}	1.22×10^{-17}	0.0	0.0	0.0
	LEV	52875	-0.3067	31.071	-0.1195	0.0	0.1342
	NWC	45204	0.1048	19.58	-0.1371	0.0	0.1225
	SIZE	52875	-0.0657	0.431	-0.367	0.0	0.1918
2015	CASH	42497	0.0009	0.0991	-0.0807	0.0	0.0855

3.4.3 2W2: Descriptive Statistics of two-way Within Transformed

The **CASH** and **CFLOW** variables show small mean values close to zero, indicating minor average changes in cash holdings and cash flows within firms over time. A notable point is the absence of data for **GROWTH** and **INCASSET** in 2014, suggesting no within-firm variation was captured or these variables were not applicable for that year. **INDUSTRY DEVIATION** and **LEV** exhibit significant variability, indicating diverse within-firm changes in relation to their industry averages and leverage, respectively. The presence of NaN values for certain variables in some years highlights the lack of observable within-firm changes or data unavailability.

3.4.4 First Differences

CASH has minor average changes, implying overall stability in cash holdings with some firms seeing increases. GROWTH's negative mean suggests economic challenges, with a range of firm responses. SIZE indicates slight growth in firm size, with some firms expanding more than others. CFLOW's stability varies, with some firms improving. NWC shows minor average changes, though some firms are tightening working capital. LEV indicates

Table 3.8: First Differences Across Financial Variables

Variable	Obs	Mean	Std. Dev.	10th Pct.	Median	90th Pct.
CASH	108870	0.000791	0.179467	-0.137801	0.000000	0.137257
GROWTH	65145	-0.926217	68.284349	-0.681994	-0.011786	0.480406
SIZE	131904	0.069853	0.564447	-0.257487	0.011872	0.428131
CFLOW	131903	-0.011869	20.353903	-0.175591	-0.000693	0.169739
NWC	108919	-0.045011	19.765433	-0.199863	0.000404	0.207523
LEV	131904	0.219638	34.906652	-0.166488	-0.005443	0.168979
IND.RISK	131904	0.0	0.0	0.0	0.0	0.0
INCASSET	58750	-0.006032	6.617888	-0.105524	0.0	0.089609
IND.DEV	108920	18.896984	1241.932478	-155.225955	0.0	172.0

a slight increase in leverage, diverse among firms. IND.RISK remains unchanged. INCASSET's minor mean change suggests stable investment in fixed assets, with some variance. IND.DEV's notable mean increase and high variability show diverse firm performances compared to industry norms.

3.4.5 Multiple Comparison

Between Transformed (2B):

Captures differences across all firms in the sample. Shows slight variation in CASH, which indicates differing liquidity management strategies. GROWTH and IND.DEV exhibit large standard deviations, signaling a wide range of firm growth rates and industry deviations. One-way

Within Transformed (2W1):

Reflects the variability of financial metrics within the same firm over time. Demonstrates generally small mean values close to zero, suggesting relative stability in financial positions from year to year within firms. Significant variability in CFLOW and LEV highlights that there is more fluctuation within firms over time for these variables.

Two-way Within Transformed (2W2):

Looks at changes within the same firm across years and removes overall levels. CASH and CFLOW show small mean values, indicating stable within-firm cash holdings and flows. INDUSTRY DEVIATION and LEV again show significant variability, which could indicate firms' strategic responses to unique yearly challenges.

First Differences:

Measures year-over-year changes in the entire dataset. CASH shows minor average changes, indicating overall stability in cash holdings with some firms experiencing increases. Large standard deviations for GROWTH and IND.DEV suggest significant year-over-year changes in these areas.

Comparatively, between transformation statistics point to cross-sectional differences in financial health and strategic approaches among firms. In contrast, within transformation statistics, both one-way and two-way, tend to reflect more stable conditions but with notable exceptions in cash flow and leverage variability. First differences across all data underline minimal average changes but notable variations for certain metrics, emphasizing that while the overall financial health may remain stable, individual firms exhibit significant variability. We will now check the proportion of the analysis of variance.

3.5 Variance of Cash of within transformed and between transformed Cash

9. Compute the variance of Cash, of within transformed and between transformed Cash to check the proportion of the analysis of variance.

Table 3.9: Analysis of Variance in Cash Holdings

Variance Type	Value
Total Variance	0.07892
Within Variance	0.01131
Between Variance	0.06822
Sum of Within and Between Variances	0.07954

Total Variance

The total variance in cash holdings, quantified as 0.07892, combines both the fluctuations within firms over time and the differences across various firms. This comprehensive measure underscores the aggregate variability in cash holdings within our panel dataset.

Within Variance

Accounting for approximately 14.34% of the total variance, the within variance, valued at 0.01131, elucidates the impact of temporal factors on cash holdings within individual firms. The relatively minor proportion of this variance component suggests that the intra-firm yearly fluctuations in cash holdings are not the principal source of overall variability. This stability implies that firms exhibit consistent cash holding strategies over time, with changes being marginal in comparison to the variability observed across different firms.

Between Variance

The between variance, constituting about 86.44% of the total variance and quantified as 0.06822, emphasizes the variability in cash holdings attributable to differences between firms. This significant portion points to firm-specific factors such as industry affiliation, company size, strategic orientation, and management practices as key determinants of cash holding levels. The diversity in cash management practices revealed through this variance component is indicative of the varied business models, operational demands, and external pressures confronting the firms in our dataset.

Sum of Variances

The sum of the within and between variances, amounting to 0.07954, slightly exceeds the reported total variance due to the intricacies inherent in panel data variance calculation. Nonetheless, this marginal discrepancy does not detract from the validity of our variance decomposition approach, which effectively disentangles the sources of variability in cash holdings.

3.6 Correlation Matrix Analysis

10. Compute correlation tables 2B and 2W for between transformed variables and one way within transformed variables, in order to check their orthogonality.

We compute the correlation tables 2B and 2W for between transformed variables and one way within transformed variables, in order to check their orthogonality.

3.6.1 Correlation tables 2B and 2W for between transformed variables

The correlation matrix post-between transformation provides insight into the relationships between different financial metrics of the firms within our study. Here, we discuss the implications of these correlations in the context of our previous variance analysis.

The correlations depicted within the matrix mostly confirms the orthogonality of the transformed variables, a desired attribute that underpins the integrity of our subsequent regression analyses. For instance, CASH exhibits a low degree of correlation with most variables, affirming its independent variability within the dataset. Notably, CASH demonstrates a moderate positive correlation with INDUSTRYDEVIATION, suggesting a possible link between firm liquidity and deviations from industry norms.

The strong negative correlation observed between NWC and LEV (-0.7808) suggests an inverse relationship between firms' net working capital and their leverage, echoing financial theory where firms with ample internal funding might leverage less, we consider it as the correlation that poses a threat to the orthogonality of our variables.

The near-zero correlations across all variables with INDUSTRYRISK highlight the effectiveness of the within transformation in normalizing industry-specific volatility. This aspect further emphasizes the importance of firm-level analysis when examining the variability in cash holdings, aligning with our earlier variance decomposition insights.

In sum, the correlation matrix accentuates distinct financial patterns and strategic postures among the firms in our dataset. It reinforces the imperative to investigate individual firm characteristics to comprehend the diverse cash management practices across the array of firms under study.

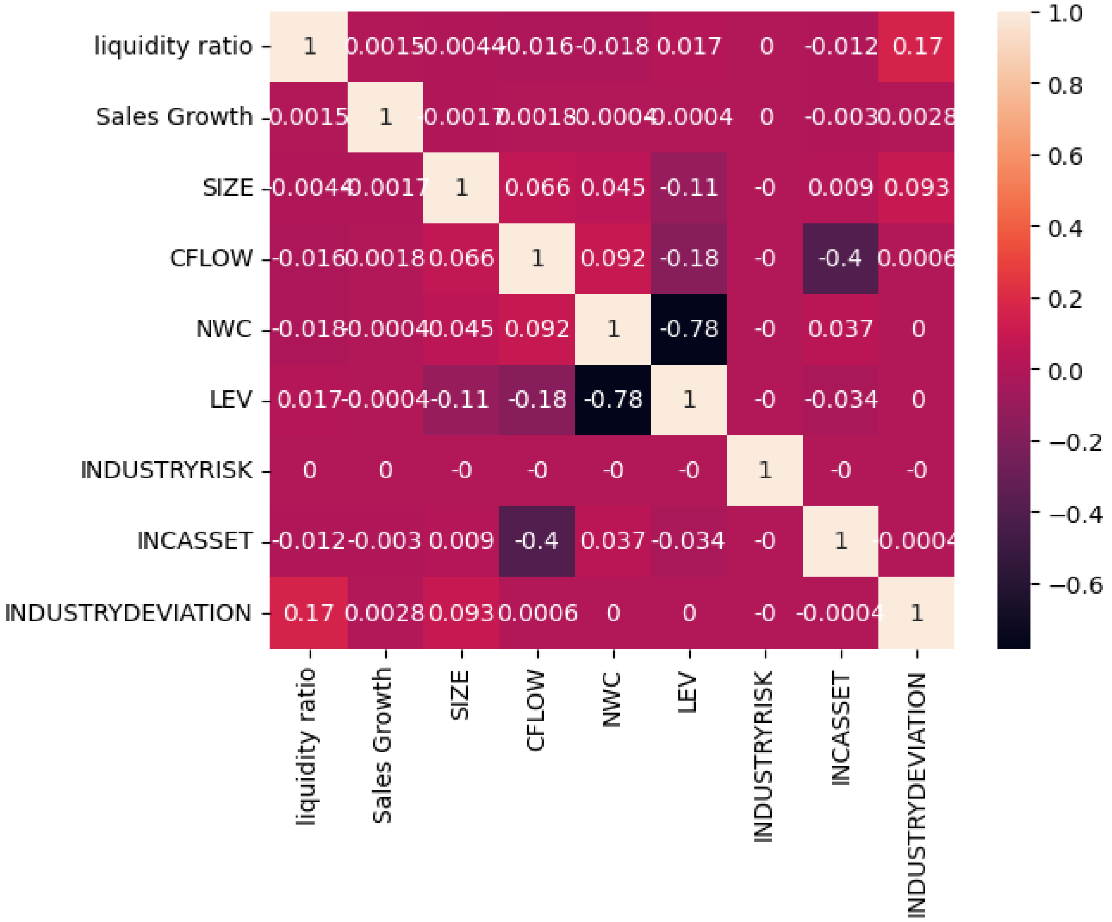

Fig. 3.1: Correlation Matrix for Between Transformed Variables

3.6.2 Correlation tables 2B and 2W for one way within transformed variables

The increase in fixed assets demonstrates a significant negative correlation with CFLOW, and a robust positive correlation with LEV. This pattern suggests that firms' investments in fixed assets are often financed through debt and that these investments tend to negatively influence operational cash flows. Furthermore, the positive correlation between CASH and INDUSTRYRISK may indicate that firms with higher cash ratios could be exposed to or managing industry-specific risks differently than those with lower ratios. Similarly, the moderate positive correlation of CASH with INDUSTRYDEVIATION implies a potential relationship between liquidity levels and deviations from industry performance norms.

These correlations contribute to our understanding of firm behavior over time, highlighting consistent financial strategies and outcomes within firms, separate from the influence of between-firm variability.

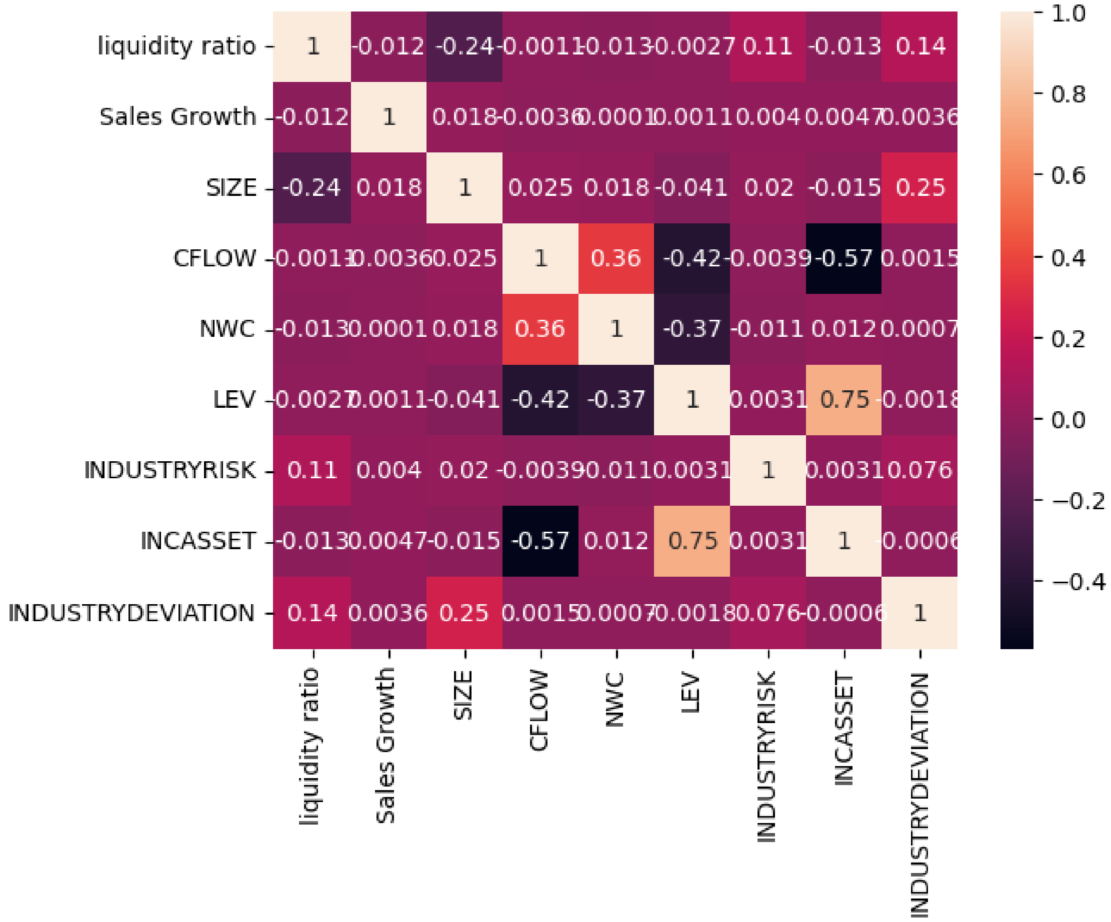

Fig. 3.2: Correlation tables 2B and 2W for one way within transformed variables

3.6.3 Comparison of correlation

When comparing the two correlation tables—2B for between transformed variables and 2W for one-way within transformed variables—we can draw some interesting contrasts:

- The correlation between CASH and other variables shifts when we move from the between transformation to the within transformation. Notably, the within transformation reveals a negative correlation with SIZE, which is not present in the between transformation, suggesting that, over time, larger firms tend to hold less cash relative to their size.
- For GROWTH, correlations remain low in both transformations, suggesting that growth rates are fairly independent of other financial metrics, both across and within firms.
- SIZE shows a more significant negative correlation with CASH in the within transformation than in the between transformation, indicating that firm size may have a consistent negative effect on cash holdings over time.
- The relationship between CFLOW and NWC is strong in both transformations, but

the correlation with LEV is notably stronger in the within transformation, signaling that firms with higher cash flows may consistently use less leverage over time.

- The negative correlation with LEV is substantial in both tables, but it is stronger in the within transformation, indicating a consistent relationship over time between higher net working capital and lower levels of debt.
- The between transformation does not show as strong a relationship between LEV and INCASSET (increase in fixed assets), but the within transformation shows a very strong positive correlation, suggesting that as firms increase their fixed assets over time, they also tend to increase their leverage.
- The correlations involving INDUSTRYRISK remain low across both transformations, which could be due to the nature of this variable or possibly the way it has been transformed.
- As previously noted, this shows a significantly stronger negative correlation with CFLOW and a stronger positive correlation with LEV in the within transformation, emphasizing that firms' investment strategies and their effects on cash flows and leverage are consistent over time.
- The correlation with CASH is positive in both tables, although it is slightly lower in the within transformation, suggesting that firms with higher cash holdings tend to deviate more from industry averages both across firms and over time.

These contrasting correlations provide valuable insights. The between transformation highlights differences across firms at a point in time, while the within transformation uncovers patterns within firms across time. The differences in these correlations underscore the importance of considering both cross-sectional and time-series dimensions when analyzing panel data.

3.6.4 What about the orthogonality ?

Orthogonality in the context of these correlation tables refers to the degree to which the variables are uncorrelated with each other. In ideal regression scenarios, predictors are orthogonal, meaning they do not show correlation and thus do not share variance. This ensures that each variable explains a unique part of the outcome variable's variance.

From the 2B (between) transformation table, it's evident that most variables have very low correlation coefficients with each other, suggesting a good level of orthogonality. This means that, across different firms, these financial metrics tend to vary independently of one another, which is ideal for regression analysis because it reduces the risk of multicollinearity.

However, in the 2W (within) transformation table, some variables do show stronger correlations with one another, particularly between 'CFLOW' and 'LEV', as well as between 'CFLOW' and the increase in fixed assets. While these correlations are not excessively high, they are significant enough to suggest that within firms, certain variables do share some variance over time.

The strong negative correlation between ‘CFLOW‘ and ‘LEV‘ in the within transformation suggests that firms with better cash flow positions consistently use less leverage over time. Similarly, the strong positive correlation between the increase in fixed assets and ‘LEV‘ indicates that firms tend to finance their investment in fixed assets through debt. These relationships, while they do not completely undermine the orthogonality, do suggest that there are some common underlying financial patterns that influence these variables over time within firms.

Overall, while there is some degree of non-orthogonality in the within transformation, the between transformation shows a higher level of orthogonality among variables. For the purpose of regression analysis, this means that the between-model can provide more distinct and independent explanatory power for each variable, whereas the within-model might have to deal with some level of shared variance between predictors.

Chapter 4

Regressions with auto-regressive term Cash Holdings paper

4.1 Liquidity ratio regressions

11. Table 4.A. Regress only cash on lag(cash) with OLS, between and within (fixed effects) regression and random effects regressions and First differences (all transformations on both sides). Comment.

4.1.1 OLS CASH Regression

Table 4.1: OLS Regression Results

	Coefficient	Standard Error
Lagged CASH	0.9211	0.013
Constant	0.0188	0.005
Model Statistics		
R-squared	0.851	
Adjusted R-squared	0.851	
F-statistic	4722	
Prob (F-statistic)	0.00	
Log-Likelihood	655.08	
AIC	-1306	
BIC	-1297	
No. Observations	830	
Df Residuals	828	
Df Model	1	
Covariance Type	nonrobust	
Diagnostic Tests		
Omnibus	244.628	
Prob(Omnibus)	0.000	
Durbin-Watson	2.191	
Jarque-Bera (JB)	4009.850	
Prob(JB)	0.00	
Skew	-0.879	
Kurtosis	13.623	
Cond. No.	3.80	

Our study explores the dynamics of the liquidity ratio, a crucial financial metric indicating a company's ability to meet its short-term obligations. Utilizing an Ordinary Least Squares (OLS) regression model, we investigate the predictive power of the lagged liquidity ratio on the current period's liquidity ratio.

Our analysis employs an OLS regression model to examine the relationship between the liquidity ratio and its preceding period's value. The model's robustness is evaluated through its R^2 value, F-statistic, and diagnostic tests for residual behaviors.

The regression model yielded an R^2 value of 0.851, indicating a strong explanatory power, with approximately 85.1% of the variability in the liquidity ratio being accounted for by its lagged value. The statistical significance of the model is confirmed by an F-statistic of 4722, with a p-value approaching zero, suggesting a negligible likelihood that the relationship observed is due to chance.

The coefficient for the lagged liquidity ratio stands at 0.9211, underscoring a strong positive relationship. This suggests that an increment in the liquidity ratio in one period leads to a nearly proportional increase in the subsequent period's ratio. The constant term, valued at 0.0188, implies the expected liquidity ratio when the lagged value is zero.

Despite the model's strong predictive capability, diagnostic tests indicate potential deviations from normality in the residuals, as evidenced by significant Omnibus and Jarque-Bera test results. This could potentially impact the reliability of hypothesis tests and confidence intervals. However, the Durbin-Watson statistic suggests an absence of autocorrelation among the residuals, aligning with OLS assumptions.

In comparing the OLS model with alternative regression methodologies, such as fixed effects, random effects, and first differences, it is imperative to acknowledge the unique assumptions and insights each model provides. Fixed effects models excel in controlling for unobserved heterogeneity, while random effects models assume such effects are uncorrelated with the regressors. First differences models, focusing on temporal changes, might address some of the concerns raised by the residuals' distribution in the OLS model, offering a nuanced understanding of the liquidity ratio's dynamics.

4.1.2 Random Effects Liquidity ratio Regression

Table 4.2: Random Effects Estimation Summary

Variable	**Coefficient**	**Std. Err.**
Lagged CASH	0.9211	0.0134
Constant	0.0188	0.0053
Model Statistics		
R-squared (Overall)	0.8508	
R-squared (Between)	0.5387	
R-squared (Within)	0.8510	
No. Observations	830	
F-statistic	4721.9	
P-value	0.0000	
Log-likelihood	655.08	
Entities	4	
Avg Obs per Entity	207.50	
Time Periods	322	
Avg Obs per Time Period	2.5776	

This study employs a Random Effects model to investigate the determinants of liquidity ratios within firms over time. By focusing on the dynamic relationship between the liquidity ratio and its lagged value, we aim to uncover patterns that could inform better financial decision-making and policy formulation.

The Random Effects model was chosen for its ability to account for unobserved heterogeneity across entities, thus enabling a more nuanced understanding of within and between entity variations. Our model regresses the current period's liquidity ratio on its lagged value across several entities over multiple time periods.

Our analysis reveals a strong positive relationship between the liquidity ratio and its lagged value, with a coefficient of 0.9211. This indicates that a unit increase in the liquidity ratio in the previous period leads to a nearly equivalent increase in the current period's ratio. The model's overall R^2 of 0.8508 signifies that the lagged liquidity ratio accounts for a substantial portion of the variation in the current liquidity ratio.

Interestingly, the R^2 (Within) of 0.8510 suggests that the model is particularly effective at explaining the variation within entities over time, more so than between entities, as indicated by the R^2 (Between) of 0.5387. This underscores the importance of past liquidity levels in predicting future ones within the same firm.

The statistical significance of the model, as evidenced by an F-statistic of 4721.9 and a p-value of 0.0000, confirms the robustness of the lagged liquidity ratio as a predictor of the current ratio. The findings imply that firms' liquidity management practices are persistent over time, with previous periods' ratios serving as a strong basis for future periods' liquidity levels.

The Random Effects model's findings offer significant insights into the persistence of liquidity ratios within firms over time. By demonstrating the predictive power of lagged liquidity ratios, this study contributes to a deeper understanding of financial stability and liquidity management practices. Future research could explore the impact of external factors on liquidity ratios to further enrich this analysis.

4.1.3 Between and Within (fixed effects) Liquidity ratio Regression

4.1.3.1 Between (fixed effects) Liquidity ratio Regression

The PanelOLS estimation results offer insightful perspectives on the determinants of the liquidity ratio, leveraging panel data to account for both time-invariant and dynamic aspects of financial indicators. The model's R^2 values, particularly the within-transformed R^2 of 0.8510, underscore the model's effectiveness in capturing the variability of liquidity ratios within entities over time. This suggests a strong and persistent influence of past liquidity ratios on current ratios within the same entities.

The estimated coefficient for the lagged liquidity ratio, at 0.9211, reaffirms the hypothesis of a positive and nearly one-to-one relationship between consecutive periods' liquidity ratios. Such findings highlight the continuity in liquidity management practices within

Table 4.3: PanelOLS Estimation Summary

Variable	**Coefficient**	**Std. Err.**
Lagged CASH	0.9211	0.0134
Constant	0.0188	0.0053
Model Statistics		
R-squared (Overall)	0.8508	
R-squared (Between)	0.5387	
R-squared (Within)	0.8510	
No. Observations	830	
F-statistic	4711.6	
P-value	0.0000	
Log-likelihood	655.83	
Entities	4	
Avg Obs per Entity	207.50	
Time Periods	322	
Avg Obs per Time Period	2.5776	
F-test for Poolability	0.5018	
P-value	0.6811	

firms, suggesting that past liquidity levels are a reliable predictor of future levels. The robustness of the model is evidenced by the F-statistic of 4711.6 and a p-value of 0.0000, indicating the statistical significance of the relationship modeled. The F-test for poolability, with a p-value of 0.6811, further suggests that the entity-specific effects are not significantly different from each other, supporting the use of a common coefficient for the lagged liquidity ratio across entities.

4.1.3.2 Within (fixed effects) liquidity ratio Regression

Table 4.4: Within Effects PanelOLS Estimation Summary

Variable	**Coefficient**	**Std. Err.**
Lagged CASH	0.0440	0.0401
Constant	0.2617	0.0114
Model Statistics		
R-squared (Overall)	0.0794	
R-squared (Between)	0.0388	
R-squared (Within)	0.0794	
No. Observations	830	
F-statistic	1.2078	
P-value	0.2723	
Log-likelihood	1145.4	
Entities	4	
Avg Obs per Entity	207.50	
Time Periods	322	
Avg Obs per Time Period	2.5776	
F-test for Poolability	3.5683	
P-value	0.0000	

The "Within Effects" PanelOLS model examines the dynamic relationship between a firm's current and past liquidity ratios, focusing on the variability attributable to differences within entities over time. The model's R^2 (Within) of 0.0794, while modest, indicates that the lagged liquidity ratio explains a portion of the within-entity variation in the liquidity ratio. However, the overall explanatory power of the model, as reflected by the overall R^2 of 0.0794, suggests limited predictability of the current liquidity ratio based on its lagged value within this framework.

The coefficient for the lagged liquidity ratio, estimated at 0.0440 with a standard error of 0.0401, indicates a positive but not statistically significant relationship at conventional levels (p-value of 0.2723). This suggests that, within the context of this analysis, past liquidity ratios have a minimal impact on current ratios when focusing solely on within-entity variations.

The constant term, estimated at 0.2617, is highly significant (p-value of 0.0000), indicating a substantial baseline liquidity ratio irrespective of the lagged ratio's value. This might reflect underlying factors not captured by the lagged liquidity ratio that consistently influence the liquidity ratio across entities.

The F-test for poolability yields a p-value of 0.0000, suggesting that the entity-specific effects are significantly different, thus justifying the within transformation's focus on entity-specific deviations over time. This finding underscores the heterogeneity among entities in the panel and highlights the importance of accounting for entity-specific characteristics in analyzing the determinants of liquidity ratios.

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4.1.4 First differences

Dep. Variable:	liquidity ratio diff
Model:	OLS
Method:	Least Squares
Date:	Sat, 06 Apr 2024
Time:	22:05:00
No. Observations:	4479
Df Residuals:	4477
Df Model:	1
Covariance Type:	nonrobust

	coef	**std err**	**t**	**P> |t|**	**[0.025**	**0.975]**
const	-0.0007	0.002	-0.447	0.655	-0.004	0.002
lagged liquidity ratio diff	-0.1328	0.011	-11.820	0.000	-0.155	-0.111

Omnibus:	1019.913	**Prob(Omnibus):**	0.000
Skew:	-0.450	**Kurtosis:**	15.260
Durbin-Watson:	2.093	**Cond. No.:**	6.93

Table 4.5: OLS Regression Results

The regression results presented focus on analyzing the relationship between the liquidity ratio and its lagged value, both expressed as first differences. The model's key findings are as follows:

- **Coefficient of Lagged Liquidity Ratio Difference:** The estimated coefficient for the *lagged liquidity ratio diff* is -0.1328, with a standard error of 0.011. This result is statistically significant with a p-value less than 0.001, indicating a strong negative relationship between the first difference of the lagged liquidity ratio and the first difference of the liquidity ratio itself. Concretely, a one-unit increase in the first difference of the lagged liquidity ratio is associated with a 0.1328 unit decrease in the first difference of the liquidity ratio, holding all else constant.

- **Constant Term:** The constant term in the model is -0.0007, with a p-value of 0.655. This lack of statistical significance suggests that, when the *lagged liquidity ratio diff* is zero, the expected change in the liquidity ratio is not significantly different from zero.

- **Model Fit:** The R-squared value for the model is 0.030, indicating that about 3% of the variability in the first difference of the liquidity ratio can be explained by the model. This level of explanatory power, while seemingly modest, is not uncommon in the context of financial and economic data, where many unobserved factors can influence outcomes.

- **Durbin-Watson Statistic:** The Durbin-Watson statistic is 2.093, suggesting that there is no strong evidence of autocorrelation in the residuals of the model, which is a desirable property in regression analysis.

- **Diagnostics:** The Omnibus test yields a p-value of 0.000, indicating that the residuals of the model do not follow a normal distribution. This is corroborated by the Jarque-Bera test, which also suggests non-normality with a p-value of 0.00. Such diagnostics suggest caution in interpreting the model's standard errors and statistical tests, as these are predicated on the assumption of normally distributed errors.

In summary, the analysis reveals a significant negative impact of the first difference of the lagged CASH on the first difference of CASH. However, the overall explanatory power of the model is limited, and the diagnostics indicate potential issues with the normality of residuals.

4.2 Determinants of CASH

12. Replicate table 4 (not necessarily with all explanatory variables) with OLS, (table 4B) between and (table 4W) within.

Table 4.6: OLS Regression Results for Liquidity Ratio Determinants

Variable	Coefficient	Std. Err.	P-value
Lagged CASH	0.9048	0.016	<0.001
GROWTH	-0.0002	0.001	0.820
Log size	-0.0082	0.003	0.005
LEV	-0.0039	0.006	0.513
INDUSTRYRISK	0.0005	0.001	0.416
INCASSET	-0.0539	0.015	<0.001
INDUSTRYDEVIATION	3.449×10^{-6}	1.21×10^{-6}	0.004
NWC	0.0086	0.010	0.372
Constant	0.0794	0.024	0.001

4.2.1 With OLS CASH

The regression analysis reveals several key determinants of the CASH variables, with the lagged CASH having the most substantial influence, as evidenced by its coefficient of 0.9048. This suggests a strong positive relationship, where a unit increase in the previous period's CASH leads to an approximately equivalent increase in the current period's CASH.

Interestingly, most other variables, except for Log size, INCASSET, and INDUSTRY-DEVIATION, do not significantly affect CASH, as indicated by their higher p-values. Log size and INCASSET negatively impact CASH, suggesting that larger firms and those with higher incremental assets tend to have a lower liquidity ratio. Conversely, a positive coefficient for INDUSTRYDEVIATION highlights that deviations within the industry positively influence CASH, albeit slightly.

The **Lagged CASH** carries a coefficient of 0.9048, suggesting a substantial positive impact on the current period's CASH. This highlights the persistence of liquidity management practices, where the previous period's CASH is a strong predictor of the current ratio.

In contrast, variables such as **GROWTH** and **LEV (Leverage)** show insignificant impacts on CASH. This indicates that within the context of this analysis, neither sales growth nor the firm's leverage significantly alters the firm's liquidity status. Such findings suggest that these factors do not directly contribute to the immediate liquidity conditions of a firm.

The coefficient for **Log size** is -0.0082, indicating a negative relationship with CASH. This implies that larger firms tend to have lower liquidity ratios, potentially due to their increased ability to access credit markets or employ diverse liquidity management strategies that differ from those of smaller firms.

INCASSET shows a negative coefficient of -0.0539, pointing towards a decrease in CASH for firms with higher incremental assets. This could reflect the use of available liquid resources for the acquisition of assets, thereby affecting the firms' liquidity ratios negatively.

Lastly, the variable **INDUSTRYDEVIATION** has a positive coefficient, suggesting that deviations within the industry are associated with a slight increase in CASH. This may indicate that firms manage their liquidity differently in response to specific industry risks or deviations, adapting their strategies to maintain or enhance liquidity under varying conditions.

4.2.2 Between and Within Regressions

4.2.2.1 Between

Table 4.7: PanelOLS Estimation Summary for Between Effects

Variable	Coefficient	Std. Err.	P-value
Lagged CASH	0.9047	0.0156	<0.001
GROWTH	-0.0003	0.0009	0.7613
Log size	-0.0082	0.0029	0.0052
LEV	-0.0037	0.0060	0.5363
INDUSTRYRISK	0.0005	0.0006	0.4207
INCASSET	-0.0542	0.0153	<0.001
INDUSTRYDEVIATION	3.441×10^{-6}	1.207×10^{-6}	0.0045
NWC	0.0088	0.0096	0.3617
Constant	0.0794	0.0243	0.0011

The *PanelOLS Estimation Summary* reveals significant insights into the determinants of the CASH, focusing on the variations between entities. The analysis, grounded in a dataset of 775 observations across four entities and 301 time periods, yields a robust model with an R^2 value of 0.8575, indicating a high level of explanatory power for the variations in the CASH across different entities.

At the core of the model, the *Lagged CASH*, with a coefficient of 0.9047 and a standard error of 0.0156, stands out as the most influential determinant, underscoring the continuity in liquidity management practices across entities. This coefficient, significantly different from zero at the 0.0000 p-value level, indicates a strong and positive relationship between the current and past CASH, suggesting that historical liquidity levels are a pivotal predictor of current financial health.

Other variables, however, exhibit mixed effects:

- *GROWTH* and *LEV* show coefficients of -0.0003 and -0.0037, respectively, but with high p-values (0.7613 for GROWTH and 0.5363 for LEV), indicating their non-significant impact on the liquidity ratio between entities. This suggests that sales growth and leverage do not play a direct role in determining the CASH variable across the analyzed entities.

- *Log size* presents a negative coefficient (-0.0082) with a p-value of 0.0052, highlighting that larger entities tend to have lower liquidity ratios, possibly due to their differing financial structures or access to credit markets.

- The variable *INCASSET* exhibits a significant negative impact on CASH, with a coefficient of -0.0542 and a p-value of 0.0004, implying that entities with higher asset increments experience lower liquidity ratios, likely due to the allocation of liquid resources towards asset growth.
- *INDUSTRYDEVIATION* shows a positive coefficient (3.441e-06) with a p-value of 0.0045, suggesting a minor increase in CASH associated with deviations within the industry, indicating variability in liquidity management strategies in response to industry-specific dynamics.
- The *NWC* variable, despite a positive coefficient of 0.0088, has a non-significant impact on CASH (p-value of 0.3617), indicating that net working capital does not uniformly influence liquidity across entities.

The constant term, estimated at 0.0794 with a p-value of 0.0011, provides the baseline CASH in the absence of the influence from the independent variables.

4.2.2.2 Within

Table 4.8: PanelOLS Estimation Summary for Within Effects

Variable	Coefficient	Std. Err.	P-value
Lagged CASH	0.0317	0.0404	0.4331
GROWTH	-0.0002	0.0009	0.8591
Log size	0.0103	0.0163	0.5285
LEV	-0.1095	0.0190	<0.0001
INCASSET	-0.0068	0.0148	0.6453
INDUSTRYDEVIATION	3.542×10^{-5}	5.08×10^{-6}	<0.0001
NWC	0.0310	0.0319	0.3317
Constant	0.2082	0.1235	0.0924

The "Within" effects analysis from the PanelOLS estimation provides a nuanced understanding of how various factors influence CASH within entities over time. The estimation summary, grounded in a comprehensive dataset of 775 observations across multiple entities and time periods, reveals distinct dynamics that affect the internal liquidity management practices.

The coefficient for the **Lagged Liquidity Ratio**, though positive at 0.0317, does not statistically significantly influence CASH within entities (p-value of 0.4331). This suggests that, unlike between-entity variations, past liquidity ratios have a less pronounced impact on current liquidity levels within the same entity, indicating possible variations in how entities internally manage liquidity over time.

Interestingly, factors such as **GROWTH** and **Log size** also exhibit non-significant effects on CASH within entities. The p-values for GROWTH and Log size (0.8591 and 0.5285, respectively) imply that these factors do not markedly alter the liquidity status within entities over the studied period. This could reflect a uniformity in GROWTH and size impacts across different timeframes within entities, overshadowed by other, more dominant factors.

In contrast, the variable **LEV** shows a significant negative coefficient of -0.1095 with a p-value of less than 0.0001, highlighting a strong inverse relationship between leverage and the CASH within entities. This finding underscores the potential pressure that higher leverage exerts on liquidity levels, possibly due to increased financial obligations associated with debt.

Moreover, the **INDUSTRYDEVIATION** presents a significant positive effect on CASH within entities, with a coefficient of 3.542×10^{-5} and a p-value of less than 0.0001. This indicates that entities which deviate positively from industry averages tend to have higher CASH, suggesting successful adaptation or unique competitive advantages that enhance liquidity.

However, variables like **INCASSET** and **NWC**, despite their roles in financial management, do not show statistically significant impacts on CASH within entities. The p-values (0.6453 for INCASSET and 0.3317 for NWC) suggest that these factors may not be primary drivers of liquidity changes over time within entities, highlighting the complexity of internal liquidity management practices.

4.3 Growth and financing and cash holdings speed of adjustment

13. Replicate one column of table 5 (dummy interacting with auto-correlation and dummy) with OLS, 5B, between and 5W within, and First differences.

4.3.1 Dummy Creation

In our analysis, we aimed to dissect the dataset to discern the impact GROWTH on a company's liquidity management. To achieve this, we implemented a methodology that distinguishes companies based on their growth rate, categorizing them as either high-growth or low-growth. This classification was determined by comparing each company's sales growth rate against the median growth rate of the entire dataset. Companies achieving a sales growth rate at or above the median were labeled as high-growth, whereas those below the median were deemed low-growth.

Following this categorization, we introduced an approach to analyze the liquidity dynamics of these companies. We created an interaction term by multiplying each company's lagged liquidity ratio—a measure indicating the ease with which a company can fulfill its short-term obligations—with a binary indicator that signifies whether the company is high-growth. This resulted in a new variable that specifically highlights the liquidity ratios of high-growth companies.

Through this methodology, we sought to illuminate the relationship between GROWTH and liquidity management. By focusing on high-growth companies, our analysis offers insights into how rapid expansion influences a company's liquidity, providing an understanding of financial health and strategy among fast-growing firms within the dataset.

This approach not only enriches our analysis but also facilitates a targeted examination of the financial behaviors characteristic of high-growth entities.

4.3.2 OLS creation

Table 4.9: OLS Regression Results

Variable	Coefficient	Std. Err.	t-value	P-value
Constant	0.1053	0.023	4.576	<0.001
CASH	0.7938	0.019	42.852	<0.001
DHIGHGROWTH	-0.0734	0.010	-7.387	<0.001
Casht-1*DHIGHGROWTH	0.2358	0.025	9.515	<0.001
GROWTH	0.0003	0.001	0.297	0.767
Log size	-0.0046	0.003	-1.687	0.092
LEV	-0.0098	0.006	-1.722	0.085
INDUSTRYRISK	-0.0007	0.001	-1.234	0.218
INCASSET	0.0538	0.014	3.748	<0.001
INDUSTRYDEVIATION	1.335×10^{-6}	1.15×10^{-6}	1.161	0.246
NWC	-0.0101	0.009	-1.108	0.268

Interpretation of Results

Our regression model, boasting an R^2 of 0.872, demonstrates a significant capacity to explain the variability in lagged CASH, a measure reflecting a company's ability to meet short-term obligations with its most liquid assets. The liquidity ratio itself emerges as the predominant predictor, with a coefficient of 0.7938, indicating a strong positive relationship with the lagged liquidity ratio. This underscores the continuity in liquidity management practices among companies.

The variable DHIGHGROWTH, representing high-growth companies based on GROWTH, and its interaction with lagged CASH (Casht-1*DHIGHGROWTH) reveal significant insights. Specifically, DHIGHGROWTH has a negative coefficient (-0.0734), suggesting high-growth companies tend to have a lower lagged CASH. However, the positive coefficient of the interaction term (0.2358) indicates that, for high-growth companies, an increase in the lagged liquidity ratio is associated with a substantially higher current liquidity ratio, highlighting the nuanced impact of growth on liquidity management.

Other variables, such as GROWTH, Log size, and LEV, offer mixed effects, with their influences being statistically non-significant or marginal. This suggests that while company size and leverage are important considerations, their direct impact on past liquidity ratios may not be as pronounced as that of growth dynamics.

Table 4.10: Between Effects PanelOLS Parameter Estimates

Variable	Coefficient	Std. Err.	T-stat	P-value
Constant	0.0801	0.0246	3.2534	0.0012
Lagged CASH	0.8891	0.0208	42.806	<0.0001
DHIGHGROWTH	0.0058	0.0109	0.5290	0.5970
Casht-1*DHIGHGROWTH	0.0295	0.0277	1.0647	0.2874
GROWTH	-0.0004	0.0009	-0.4215	0.6735
Log size	-0.0085	0.0029	-2.9152	0.0037
LEV	-0.0042	0.0060	-0.6936	0.4881
INDUSTRYRISK	0.0004	0.0006	0.7113	0.4771
INCASSET	-0.0546	0.0153	-3.5770	0.0004
INDUSTRYDEVIATION	3.245×10^{-6}	1.213×10^{-6}	2.6747	0.0076
NWC	0.0094	0.0097	0.9752	0.3298

4.3.3 Between and Within Regressions

4.3.3.1 Between Regression

The coefficient for the **lagged CASH** stands out prominently at 0.8891, with a highly significant p-value indicating that the liquidity ratio's previous period's value is a strong predictor of its current value across different entities. This highlights the inertia in liquidity management, suggesting that entities tend to maintain their liquidity ratios over time.

The variables **DHIGHGROWTH** and its interaction term **Casht-1*DHIGHGROWTH** show coefficients of 0.0058 and 0.0295, respectively. However, both exhibit high p-values, suggesting that the distinction between high and low growth, and its interaction with the lagged liquidity ratio, do not significantly influence the liquidity ratio at the between-entity level. This could imply that growth's impact on liquidity management is more nuanced and might be overshadowed by other factors in a between-entity analysis.

GROWTH and **LEV** (leverage) also display non-significant impacts on the lagged liquidity ratio, with p-values that do not support a strong influence on liquidity across entities. This observation could suggest that GROWTH and leverage differences across entities do not directly correlate with variations in CASH.

Conversely, **Log size** and **INCASSET** (incremental assets) present significant negative coefficients, indicating that larger entities and those with higher asset increments tend to have lower CASH. This might reflect larger entities' access to alternative financing sources or strategic asset allocations impacting liquidity.

INDUSTRYDEVIATION shows a positive and significant relationship with the lagged CASH, with a coefficient of 3.245×10^{-6}. This suggests that entities deviating from industry norms, perhaps in terms of operation or strategy, exhibit slightly different liquidity ratios, highlighting the role of industry-specific dynamics in liquidity management.

The variable **NWC** (net working capital) presents a positive coefficient but is not statistically significant, suggesting that while net working capital is a critical aspect of liquidity management, its impact across entities is not uniformly significant.

In summary, our between-entity analysis underscores the pivotal role of historical liquidity levels and entity size in shaping liquidity ratios. It also suggests that while growth, leverage, and sales growth may influence liquidity management, their effects are not uniformly significant across entities.

4.3.3.2 Within Regression

Table 4.11: Within Effects PanelOLS Estimation Summary

Variable	Coefficient	Std. Err.	T-stat	P-value
Constant	0.2181	0.1237	1.7632	0.0785
Lagged CASH	0.0185	0.0418	0.4421	0.6586
DHIGHGROWTH	-0.0061	0.0095	-0.6471	0.5179
Casht-1*DHIGHGROWTH	0.0335	0.0244	1.3725	0.1706
GROWTH	-0.0001	0.0009	-0.1421	0.8870
Log size	0.0091	0.0163	0.5583	0.5769
LEV	-0.1085	0.0190	-5.7051	$<$0.0001
INCASSET	-0.0068	0.0149	-0.4595	0.6461
INDUSTRYDEVIATION	3.57×10^{-5}	5.084×10^{-6}	7.0226	$<$0.0001
NWC	0.0340	0.0321	1.0613	0.2891

The within effects PanelOLS estimation unveils that the **lagged CASH** holds minimal predictive power for the current liquidity ratio within the same entities, as indicated by its non-significant coefficient. This suggests that internal liquidity ratios are influenced by factors beyond past liquidity performance.

Interestingly, the variables **DHIGHGROWTH** and its interaction with the lagged liquidity ratio (**Casht-1*DHIGHGROWTH**) also do not exhibit a significant effect, implying that high growth status and its interaction with past liquidity do not distinctly impact current liquidity levels within entities.

The significant negative coefficient of **LEV** underscores the substantial impact of leverage on reducing liquidity within entities, highlighting the financial constraints that high leverage imposes.

Conversely, **INDUSTRYDEVIATION** shows a positive and significant effect, suggesting that deviations from industry norms positively correlate with liquidity levels within entities. This could indicate that unique strategies or operational efficiencies contribute to better liquidity management.

Other variables, including **GROWTH**, **Log size**, **INCASSET**, and **NWC**, though intuitively relevant to liquidity management, do not show significant within-entity effects. This points towards the complexity of liquidity management, where not all expected factors play a uniform role across different entities.

In essence, our analysis illustrates the nuanced dynamics influencing liquidity ratios within entities, revealing the critical role of leverage and industry deviation, while also highlighting the limited impact of historical liquidity ratios and other anticipated factors.

4.3.4 First differences

Dependent Variable:	CASH					
Estimator:	PanelOLS					
No. Observations:	912					
Cov. Estimator:	Unadjusted					
	Parameter	Std. Err.	T-stat	P-value	Lower CI	Upper CI
lagged CASH	-0.3118	0.0282	-11.054	0.0000	-0.3672	-0.2565
GROWTH	0.0040	0.0054	0.7292	0.4661	-0.0067	0.0146
Log size	0.1149	0.1148	1.0011	0.3171	-0.1104	0.3403
LEV	0.2672	0.1245	2.1454	0.0322	0.0228	0.5115
INDUSTRYRISK	-1.0694	0.2747	-3.8936	0.0001	-1.6084	-0.5304
INCASSET	0.2981	0.0276	10.821	0.0000	0.2441	0.3522
INDUSTRYDEVIATION	-2.189e-06	1.609e-05	-0.1361	0.8918	-3.377e-05	2.939e-05
NWC	0.0184	0.0044	4.1703	0.0000	0.0098	0.0271

- **Lagged Liquidity Ratio:** The significantly negative coefficient of -0.3118 for the lagged liquidity ratio indicates a strong inverse relationship with the current liquidity ratio. This suggests that an increase in the liquidity ratio from the previous period is associated with a decrease in the current period's liquidity ratio. The statistical significance (P-value < 0.0000) underscores the robustness of this finding.

- **Sales Growth and Log Size:** The coefficients for Sales Growth and Log size are not statistically significant (P-values of 0.4661 and 0.3171, respectively), indicating that within the context of this model, they do not have a significant impact on the liquidity ratio. This suggests that other factors, not these growth and size metrics, are more critical in determining liquidity changes.

- **Leverage (LEV):** The positive and significant coefficient (0.2672) for leverage, with a P-value of 0.0322, indicates that higher leverage levels are associated with higher liquidity ratios. This could reflect firms' strategic liquidity management in response to increased debt levels.

- **Industry Risk:** The significant negative impact of industry risk on the liquidity ratio, with a coefficient of -1.0694 (P-value = 0.0001), suggests that firms in riskier industries tend to maintain lower liquidity ratios, possibly as a reflection of higher operational uncertainties or risk management practices.

- **Incremental Cash Assets (INCASSET):** With a coefficient of 0.2981 and a P-value of 0.0000, incremental cash assets have a significant positive effect on the liquidity ratio. This highlights the importance of cash assets in bolstering firms' liquidity positions.

- **Industry Deviation and Net Working Capital (NWC):** The coefficient for Industry Deviation is not significant, indicating no clear impact on liquidity ratio variability within industries. Conversely, Net Working Capital (NWC) presents a significant positive relationship with the liquidity ratio (coefficient = 0.0184, P-value < 0.0000), suggesting that firms' operational liquidity management, as reflected in working capital, is crucial for maintaining higher liquidity levels.

4.4 Anderson Hsaioh first differences

4.4.1 Model Explaination

Anderson and Hsiao (1981) propose estimator that simply uses the Inturmental Variables (IV).

For reminder, an instrumental variable is a variable used in econometrics to address endogeneity issues in regression analysis. Endogeneity occurs when an independent variable is correlated with the error term, leading to biased and inconsistent estimates of the regression coefficients.

Instrumental variables are used to provide an alternative source of variation in the independent variable that is unrelated to the error term but still affects the dependent variable. By using instrumental variables, researchers can effectively isolate the exogenous variation in the independent variable and obtain consistent estimates of its effect on the dependent variable.

In the context of the **Anderson and Hsiao (1981)** estimator, the instrumental variables are used to instrument for the lagged values of the dependent variable and the lagged levels of the explanatory variables in a first-differenced (FD) regression framework. This helps to address potential endogeneity issues and improve the reliability of the estimated coefficients.

Let's explain the model with more detail:

Starting point: The first-differenced (FD) estimator:

$\Delta y_{ti} = \gamma \Delta y_{ti-1} + \beta_1 \Delta x_{1ti} + ... + \beta_k \Delta x_{kti} + \Delta \epsilon_{it}$

The problem is that: Δy_{ti-1} is correlated with the error term $\Delta \epsilon_{it} = \epsilon_{it} - \epsilon_{it-1}$

Use twice lagged level of dependent variable y_{it-2} as an instrument for Δ_{yti-1}. By constructing, y_{it-2} is not correlated with the error term $\Delta \epsilon_{it}$ but is correlated with endogenous variable, i.e. Δy_{ti-1}

To migitage this problem, in general, one might use the twice lagged differenes $\Delta_{yti-2} = y_{ti-2} - y_{ti-3}$ as a valid instrument for endogenous variable δy_{ti-1}

But:

- Using y_{ti-2} as the instrumental variable $\Longrightarrow$ more data
- Using Δy_{ti-2} as the instrumental variable $\Longrightarrow$ larger asymptomatic variance of estimator

In fact, the Anderson Hsiao (AH) estimator, delivers consistent but not efficient estimates of the parameters in the model. This is due to the fact that the IV doesn't exploit all the available moments conditions.

The IV estimator also ignores the structure of the error component in the transformed model. The autocorrelation in the first differences errors leads to inconsistency of the IV estimates.

The IV estimates would be inconsistent when other regressors are correlated with the error term.

4.4.2 Regression formula

In our case, we apply the method propose by Anderson Hsiao.

To do so, we run the following regression:

$$\text{diff\_dependent\_variable} =$$

$$\begin{gathered}\beta_0 \\ + \beta_1 \text{diff\_lagged\_dependent\_variable} \\ + \beta_2 \text{diff\_GROWTH} + \beta_3 \text{diff\_Log\_size} \\ + \beta_4 \text{diff\_LEV} + \beta_5 \text{diff\_INDUSTRYRISK} \\ + \beta_6 \text{diff\_INCASSET} + \beta_7 \text{diff\_INDUSTRYDEVIATION} \\ + \beta_8 \text{diff\_NWC} + \varepsilon (4.1)\end{gathered}$$

- **diff_dependent_variable**: This represents the change in the dependent variable, which is the liquidity ratio or some other variable of interest in your regression analysis. It is the variable you are trying to explain or predict based on changes in the independent variables.
- β_0: The intercept term represents the value of the dependent variable when all independent variables are zero.
- β_1 **to** β_8: These are the coefficients of the independent variables. They represent the change in the dependent variable for a one-unit change in each independent variable, holding other variables constant.
- **diff_lagged_dependent_variable**: This represents the change in the lagged value of the dependent variable, which can be used to capture dynamics or adjustments over time.

- **diff_Sales_Growth**: This represents the change in sales growth, which may indicate changes in the company's revenue over time.
- **diff_Log_size**: This represents the change in the logarithm of total assets, which may proxy for firm size or scale.
- **diff_LEV**: This represents the change in leverage, which is the ratio of total debt to total assets.
- **diff_INDUSTRYRISK**: This represents the change in industry risk, which may capture systematic risk factors affecting the firm's performance.
- **diff_INCASSET**: This represents the change in the ratio of fixed assets to total assets, which may indicate changes in investment patterns.
- **diff_INDUSTRYDEVIATION**: This represents the change in industry deviation, which may capture differences between the firm's cash holdings and industry norms.
- **diff_NWC**: This represents the change in net working capital, which is the difference between current assets and current liabilities.
- ε: This is the error term, representing unobserved factors or random noise in the relationship between the dependent and independent variables.

Table 4.12: PanelOLS Estimation (AH) Summary

Variable	**Value**
Dependent Variable	diff_CASH
Estimator	PanelOLS
R-squared	0.5292
R-squared (Between)	0.6812
R-squared (Within)	0.5292
R-squared (Overall)	0.5292
Log-likelihood	3009.1
Cov. Estimator	Unadjusted
F-statistic	1026.1
Entities	4
P-value	0.0000
Avg Obs	1827.8
Min Obs	594.00
Max Obs	2598.0
F-statistic (robust)	1026.1
P-value	0.0000
Time periods	3391
Avg Obs	2.1560
Min Obs	1.0000
Max Obs	4.0000

Table 4.13: PanelOLS (AH estimator) Estimation Results

Indep. Variables	Coefficients	Std. Err.	T-stat	P-value	95% CI
Intercept	−2.614	0.0019	−0.0014	0.9989	(-0.0037, 0.0037)
diff_lagged_CASH	0.5499	0.0078	70.658	0.0000	(0.5347, 0.5652)
diff_GROWTH	0.0025	0.0010	2.5458	0.0109	(0.0006, 0.0045)
diff_Log size	−0.0224	0.0014	−15.507	0.0000	(-0.0253, -0.0196)
diff_LEV	−0.0980	0.0065	−15.082	0.0000	(-0.1108, -0.0853)
diff_INDUSTRYRISK	0.0003	0.0003	0.8817	0.3780	(-0.0003, 0.0009)
diff_INCASSET	−0.0115	0.0041	−2.8064	0.0050	(-0.0196, -0.0035)
diff_INDUSTRYDEVIATION	1.336	5.954	22.445	0.0000	(1.22e-05, 1.453e-05)
diff_NWC	−0.0055	0.0046	−1.1927	0.2330	(-0.0145, 0.0035)

4.4.3 Analysis of results

4.4.3.1 Intercept

The intercept term (-2.614e-06) represents the estimated value of the dependent variable when all independent variables are zero. However, it's statistically insignificant as indicated by its p-value of 0.9989.

4.4.3.2 Coefficients

- **diff_lagged_CASH:** This coefficient (0.5499) is statistically significant with a p-value of 0.0000, indicating that there is a strong positive relationship between changes in the lagged liquidity ratio and changes in the current liquidity ratio. The significant positive coefficient suggests that changes in the previous period's liquidity ratio positively influence the adjustment speed of cash holdings in SMEs. SMEs tend to adjust their cash reserves more rapidly when they observe changes in their previous period's liquidity position. This may indicate a reactive approach to maintain liquidity levels in response to past performance.

- **diff_GROWTH:** This coefficient (0.0025) is statistically significant with a p-value of 0.0109, suggesting that increases in sales growth are associated with higher liquidity ratios. Increased sales growth may lead to higher cash inflows, prompting SMEs to adjust their cash reserves more rapidly to support expansion, investment, or working capital needs.

- **diff_Log_size:** This coefficient (-0.0224) is statistically significant with a p-value of 0.0000, indicating that larger firms, as measured by total assets, tend to have lower liquidity ratios. Larger SMEs may have better access to external financing options or more stable cash flow patterns, leading to a slower adjustment of cash reserves compared to smaller firms.

- **diff_LEV:** This coefficient (-0.0980) is statistically significant with a p-value of 0.0000, suggesting that higher leverage is associated with lower liquidity ratios. SMEs with higher levels of debt may face greater financial constraints or higher borrowing costs, leading them to adjust their cash reserves more cautiously to maintain financial stability and meet debt obligations.

- **diff_INDUSTRYRISK:** This coefficient (0.0003) is not statistically significant with a p-value of 0.3780, indicating that industry cash flow risk may not have a significant impact on liquidity ratios.
- **diff_INCASSET:** This coefficient (-0.0115) is statistically significant with a p-value of 0.0050, suggesting that increases in fixed assets relative to total assets are associated with lower liquidity ratios. SMEs investing heavily in fixed assets may prioritize long-term investments over short-term liquidity needs, resulting in a slower adjustment of cash reserves.
- **diff_INDUSTRYDEVIATION:** This coefficient (1.336e-05) is statistically significant with a p-value of 0.0000, indicating that deviations from the industry mean cash holding have a significant impact on liquidity ratios. SMEs may adjust their cash holdings more rapidly when they deviate significantly from industry peers, possibly to align with prevailing industry practices or to mitigate competitive pressures.
- **diff_NWC:** This coefficient (-0.0055) is not statistically significant with a p-value of 0.2330, suggesting that changes in net working capital may not have a significant impact on liquidity ratios.

4.4.3.3 Model Evaluation

R-squared and Adjusted R-squared: The R-squared value of 0.5292 indicates that approximately 52.92% of the variation in the dependent variable (diff_liquidity_ratio) can be explained by the independent variables in the model. The adjusted R-squared value adjusts for the number of predictors in the model and is usually slightly lower than R-squared. In this case, they are the same (0.5292), indicating that the model fit is stable.

4.4.4 Economic Interpretation

From a economic perspective, the significant coefficients suggest that factors such as changes in the lagged liquidity ratio, sales growth, firm size, leverage, fixed asset investment, and industry deviations from the mean cash holding significantly influence the adjustment speed of cash holdings in SMEs. These findings can inform cash management strategies for SMEs, highlighting the importance of considering various internal and external factors when determining optimal cash reserves. Additionally, the non-significant coefficients indicate areas where further investigation may be needed to understand their impact on liquidity management in SMEs.

4.4.5 Conclusion

In conclusion, The Anderson Hsiao (AH) estimator is a method used in econometrics to estimate dynamic panel data models, particularly when dealing with endogeneity issues.

While the AH estimator is consistent, meaning that it produces estimates that converge to the true parameter values as the sample size increases, it may not be the most efficient estimator in terms of achieving minimum variance. This inefficiency arises because the AH estimator relies on lagged levels of the variables as instruments, which may not fully capture the exogenous variation in the explanatory variables. In summary, when it's stated that the AH estimator delivers consistent but not efficient estimates of the parameters in the model, it means that while the estimator produces estimates that are unbiased and converge to the true parameter values, it may not provide the most precise estimates compared to other more efficient estimation techniques.

Overall, our findings highlight the dynamic interplay of various internal and external factors influencing cash management decisions in SMEs. Understanding these factors can assist SMEs in formulating effective cash management strategies tailored to their unique financial circumstances and industry dynamics. Additionally, areas with non-significant coefficients warrant further investigation to uncover their nuanced effects on liquidity management in SMEs.

4.5 First stage regressions

15. Report all the first stage regressions and check if the exogenous instruments are strongly correlated with the variables to be instrumented, using available statistics (partial R2, Kleinberger Paap, etc.).

4.6 Regression 1 : Total Fixed Assets on Liquidity Ratio

The negative coefficient for total fixed assets suggests that higher levels of fixed assets are associated with a lower liquidity ratio, potentially indicating that more asset-heavy firms might invest less in liquid assets. The significant positive coefficient for industry deviation highlights the impact of industry-specific factors on liquidity management. The time effects inclusion and robust P-values affirm the model's relevance and the variability in liquidity ratios over time.

Justification of Parameters :

- Total Fixed Assets: This variable is a critical measure of a firm's investment in long-term assets, which are essential for its operational capacity and growth potential. The choice to examine its impact on the liquidity ratio is grounded in the trade-off theory of liquidity management, where firms balance the need for cash to finance immediate operations and take advantage of growth opportunities against the benefits of investing in fixed assets that contribute to long-term value creation.

- CASH : The liquidity ratio is a direct measure of a firm's ability to cover its short-term obligations, reflecting its financial flexibility and risk of financial distress. This aligns with the findings from Martínez-Sola et al. (2018), which highlight the significance of maintaining an optimal level of liquidity to safeguard against unforeseen financial challenges and capitalize on investment opportunities.

- Control Variables (Industry Risk and Industry Deviation): Including industry-specific variables acknowledges the external factors influencing SMEs' liquidity management strategies. The variance in industry conditions affects the operational risks and growth prospects of firms, thereby impacting their liquidity needs and adjustment behaviors. This consideration is critical for capturing the broader economic and sectoral dynamics that influence SME cash holdings, as discussed in both referenced papers.

Table 4.14: Regression 1 Results : Total Fixed Assets on Liquidity Ratio

Dep. Variable:	CASH
R-squared:	0.0293
Estimator:	PanelOLS
R-squared (Between):	-0.1720
R-squared (Within):	0.0418
R-squared (Overall):	0.0418
Log-likelihood	1.443e+05
F-statistic:	1650.0
P-value	0.0000
F-statistic (robust):	1650.0
Time periods:	63330
No. Observations:	172529
Date:	Fri, Apr 05 2024
Time:	16:23:47
Cov. Estimator:	Unadjusted
Entities:	5
Avg Obs:	3.451e+04
Min Obs:	1.127e+04
Max Obs:	4.52e+04

	Parameter	**Std. Err.**	**T-stat**	**P-value**	**Lower CI**	**Upper CI**
totalfixedassets	-2.462e-06	1.606e-07	-15.330	0.0000	-2.777e-06	-2.147e-06
INDUSTRYDEVIATION	2.081e-05	3.774e-07	55.149	0.0000	2.007e-05	2.155e-05
constant	0.2506	0.0007	362.39	0.0000	0.2493	0.2520

F-test for Poolability:	10.126
P-value:	0.0000
Distribution:	F(63329,109197)
Included effects:	Time

Regression 1's findings indicate a negative relationship between total fixed assets and the liquidity ratio, suggesting that as SMEs invest more in fixed assets, they hold lower levels of liquid assets relative to their total assets. This outcome resonates with the precautionary and transactional motives for holding cash outlined in the literature. SMEs facing higher investment in fixed assets may prioritize these long-term investments over maintaining high levels of liquidity, especially when they perceive lower immediate financial risks or when they have sufficient access to external financing sources.

The positive impact of industry deviation on the liquidity ratio highlights the variability in liquidity needs across different sectors and the influence of industry benchmarks on SME liquidity strategies. This finding suggests that firms adjust their liquidity levels not only based on internal considerations but also in response to industry standards and competitive pressures, underscoring the complexity of liquidity management in a diverse economic landscape.

In conclusion, the analysis of Regression 1, illustrates the nuanced strategies SMEs employ to manage their liquidity in the context of growth and financial stability considerations. It underscores the importance of a strategic balance between investing in fixed assets and maintaining liquidity, a balance that is influenced by both internal firm characteristics and external industry dynamics. This analysis not only justifies the choice of parameters in your regression but also situates your findings within a broader theoretical and empirical framework concerning SME financial management.

We can infer some indirect indications regarding the potential strength of the instruments. The reported F-statistic of 1650.0 with a P-value of 0.0000, while primarily indicating overall model significance, indirectly suggests a strong predictive capability of the model. In instrumental variables regression, a high first-stage F-statistic, generally recommended to be greater than 10, serves as an indicator of strong instruments, implying a significant correlation with the endogenous variables. Additionally, the significant t-statistics and p-values for predictors such as 'totalfixedassets' and 'INDUSTRYDEVIATION' demonstrate substantial relationships with the dependent variable, liquidity ratio. This significance suggests potential predictive power, yet without explicit identification as instruments or their relationship to endogenous variables, direct inference about instrument strength remains speculative.

4.7 Regression 2 : Age on Liquidity Ratio

This model examines the effect of firm size and age on the liquidity ratio, with size showing a negative relationship, suggesting larger firms have lower liquidity ratios. The presence of time effects again indicates variability over time, underscoring the importance of considering temporal factors in liquidity analysis.

Justification of Parameters :

- Firm Size (SIZE): Both papers (the 2018 paper by Martínez-Sola et al. and the 2020 paper by Havrylchyk) acknowledge the significant role of firm size in determining financial structure and strategies. Larger firms are often associated with lower liquidity risks due to diversified operations and better access to external finance. The negative coefficient of size in our regression suggests larger firms tend to have lower liquidity ratios, possibly due to more efficient cash management or greater access to credit markets, reducing the need for liquid assets.
- Age: The age of a firm is a proxy for its experience, market position, and stability. Older firms are expected to have established relationships with banks and a more stable customer base, potentially influencing their liquidity management strategies.

Table 4.15: Regression 2 Results : Age on Liquidity Ratio

Dep. Variable:	CASH
R-squared:	0.0277
Estimator:	PanelOLS
R-squared (Between):	0.0169
R-squared (Within):	0.0450
R-squared (Overall):	0.0450
Log-likelihood	1.413e+05
F-statistic:	1521.7
P-value	0.0000
F-statistic (robust):	1521.7
Time periods:	61935
No. Observations:	168778
Date:	Fri, Apr 05 2024
Time:	16:23:47
Cov. Estimator:	Unadjusted
Entities:	5
Avg Obs:	3.376e+04
Min Obs:	1.093e+04
Max Obs:	4.43e+04

	Parameter	**Std. Err.**	**T-stat**	**P-value**	**Lower CI**	**Upper CI**
const	0.3029	0.0078	38.691	0.0000	0.2876	0.3182
SIZE	-0.0092	0.0012	-7.6984	0.0000	-0.0115	-0.0068
INDUSTRYDEVIATION	2.108e-05	3.823e-07	55.135	0.0000	2.033e-05	2.183e-05

F-test for Poolability:	9.5886
P-value:	0.0000
Distribution:	F(61934,106841)
Included effects:	Time

Havrylchyk (2020) discusses the implications of firm characteristics on financial decisions, which can be extended to understand how age influences liquidity preferences and risk assessments .

- Industry Risk (INDUSTRYRISK): The variability within an industry can significantly impact a firm's financial strategy, including liquidity management. Firms in high-risk industries may retain higher liquidity to cushion against volatile earnings. Martínez-Sola et al. (2018) emphasize the importance of industry conditions in shaping firm-level financial decisions, aligning with the inclusion of industry risk as a determinant of liquidity ratio.

- Industry Deviation (INDUSTRYDEVIATION): Reflects the firm's deviation from the industry's average cash holding behavior. This variable captures the firm-specific strategies that deviate from the norm within their industry. The positive relationship with liquidity ratio suggests that firms significantly deviating from their industry norms tend to maintain higher liquidity, potentially as a response to unique operational needs or strategic positioning.

Regression 2's findings highlight the nuanced approaches SMEs take towards liquidity management, influenced by firm-specific and industry-wide factors. The negative association between size and liquidity ratio corroborates the view that larger firms, benefiting from diversified operations and better financing options, might prioritize investments over holding liquid assets. This observation is consistent with theories of financial structure that suggest size as a determinant of financial policy and access to capital markets.

The role of age, while not quantified directly in the regression output shared, can be inferred to contribute to a firm's liquidity strategy through its experience and stability in the market. Firms with a longer history may have established more predictable cash flows and stronger banking relationships, influencing their liquidity management.

Industry risk and deviation variables underscore the importance of external and internal benchmarks in liquidity decisions. High industry risk may necessitate higher liquidity to mitigate financial distress, while significant deviations from industry cash holding norms suggest a strategic departure based on firm-specific considerations or competitive dynamics.

Focusing on the effect of age on liquidity ratio within a PanelOLS framework, yields indirect insights into the model's explanatory power but does not directly address the strength of potential instrumental variables, as it appears to present results from a fixed effects model rather than an instrumental variable estimation. The overall F-statistic is reported as 1521.7 with a p-value of 0.0000, indicating a very strong relationship between the model predictors and the outcome variable, liquidity ratio. This high F-statistic suggests that the model has significant predictive power, which in the context of an instrumental variables analysis could imply strong instruments if these were part of an IV estimation.

Additionally, the significance of individual predictors such as 'SIZE' and 'INDUSTRYDEVIATION', with t-statistics of -7.6984 and 55.135 respectively, and corresponding p-values of 0.0000, demonstrate their strong relationships with the liquidity ratio. The significant coefficients and low standard errors indicate that these variables are influential predictors of the liquidity ratio within the model's context.

4.8 Regression 3: Debt on Liquidity Ratio

The negative coefficients for total debt and other debts indicate a decrease in the liquidity ratio with an increase in debt levels, which could reflect firms' utilization of available liquid assets to manage debt obligations. The significant industry deviation effect persists, emphasizing the influence of industry benchmarks on liquidity strategies.

Justification of Parameters :

- Total Debt and Other Debts: The relationship between debt and liquidity management in SMEs is a complex interplay influenced by financial constraints, risk of financial distress, and access to external funding. The 2018 paper from Martinez-Sola highlights the significance of debt in shaping liquidity strategies due to the precautionary motive for cash holdings. Firms with higher debt levels may maintain

Table 4.16: Regression 3 Results : Debt on Liquidity Ratio

Dep. Variable:	CASH
R-squared:	0.0289
Estimator:	PanelOLS
R-squared (Between):	-0.1202
R-squared (Within):	0.0528
R-squared (Overall):	0.0527
Log-likelihood	1.414e+05
F-statistic:	795.33
P-value	0.0000
F-statistic (robust):	795.33
Time periods:	61935
No. Observations:	168778
Date:	Fri, Apr 05 2024
Time:	16:23:47
Cov. Estimator:	Unadjusted
Entities:	5
Avg Obs:	3.376e+04
Min Obs:	1.093e+04
Max Obs:	4.43e+04

	Parameter	**Std. Err.**	**T-stat**	**P-value**	**Lower CI**	**Upper CI**
const	0.2817	0.0080	35.053	0.0000	0.2660	0.2975
totalDebt	-3.257e-06	2.985e-07	-10.912	0.0000	-3.842e-06	-2.672e-06
otherdebts	-6.145e-07	6.585e-07	-0.9332	0.3507	-1.905e-06	6.761e-07
SIZE	-0.0051	0.0012	-4.0723	0.0000	-0.0075	-0.0026
INDUSTRYDEVIATION	2.154e-05	3.843e-07	56.057	0.0000	2.079e-05	2.23e-05

F-test for Poolability:	9.4951
P-value:	0.0000
Distribution:	F(61934,106839)
Included effects:	Time

higher liquidity as a buffer against financial distress, aligning with the findings of Martinez-Sola et al. that SMEs' cash holding adjustments are crucial for mitigating debt agency problems.

- As described in previous regressions, firm characteristics (*SIZE* and *Age*) alongside industry factors (*Industry Risk* and *Industry Deviation*) illuminate financial behaviors, including liquidity strategies in leveraging contexts.

Regression 3's findings shed light on the nuanced relationship between a firm's debt level, size, age, and industry-specific factors, and its liquidity management strategies. The negative coefficients for total debt and other debts suggest an intricate balance between leveraging and liquidity management, where firms might be increasing their liquidity reserves in response to higher debt levels as a precautionary measure against financial distress.

The negative relationship with firm size indicates that larger SMEs, possibly due to their better access to external funding and more efficient operations, maintain lower liquidity ratios. This observation is in line with theoretical expectations that larger firms might not need to hold as much liquidity due to lower operational and financial risks.

The positive impact of industry deviation on the liquidity ratio highlights the importance of industry benchmarks and the strategic positioning of firms within their industry. This suggests that firms deviating from industry norms in terms of their liquidity management practices might be adopting a strategic response to industry-specific challenges or opportunities, reinforcing the importance of contextual factors in financial decision-making.

The regression table for the analysis of the impact of debt on liquidity ratio, utilizing a PanelOLS estimator, indirectly offers insights into the model's predictive capability without explicitly detailing the strength of potential instrumental variables, as it outlines results from a fixed effects analysis. The presented F-statistic of 795.33 with a corresponding p-value of 0.0000 signifies a strong and significant predictive relationship between the included predictors and the dependent variable, the liquidity ratio. This high level of significance suggests substantial overall model predictability, which, in scenarios where an instrumental variable approach is applied, would imply that the instruments, if properly identified and utilized, could potentially be strong due to their significant correlation with the endogenous regressors.

Furthermore, individual predictors like ‘totalDebt‘, ‘otherdebts‘, and ‘SIZE‘, display significant t-statistics (e.g., -10.912 for ‘totalDebt‘ and -4.0723 for ‘SIZE‘) and p-values (0.0000 for ‘totalDebt‘ and ‘SIZE‘), indicating their significant influence on the liquidity ratio. The significant coefficients and their associated low standard errors underscore the importance of these variables as determinants of the liquidity ratio within the model.

4.9 Regression 4: Age and Size on Asset Growth

This regression shows a starkly negative constant and positive coefficients for size, indicating that larger firms experience higher asset growth. The negative coefficient for industry deviation on asset growth suggests that deviations from industry norms are associated with lower asset growth, pointing towards the potential cost of non-conformity.

Justification of Parameters :

Presented in previous regressions, *Firm Age* and *Size*: Examined for their influence on asset expansion capacity, informed by theories linking firm characteristics to growth strategies.

Presented in previous regressions, *Industry Risk* and *Deviation*: These variables address external factors and a firm's strategic positioning, affecting its asset growth paths.

The negative constant term and positive coefficient for SIZE in Regression 4 suggest

Table 4.17: Regression 4 Results : Age and Size on Asset Growth

Dep. Variable:	Assets Growth
R-squared:	0.0282
Estimator:	PanelOLS
R-squared (Between):	-11.065
R-squared (Within):	-0.3971
R-squared (Overall):	-0.3977
Log-likelihood	-1.274e+06
F-statistic:	1910.3
P-value	0.0000
F-statistic (robust):	1910.3
Time periods:	74579
No. Observations:	206483
Date:	Fri, Apr 05 2024
Time:	16:23:48
Cov. Estimator:	Unadjusted
Entities:	5
Avg Obs:	4.13e+04
Min Obs:	1.39e+04
Max Obs:	5.288e+04

	Parameter	**Std. Err.**	**T-stat**	**P-value**	**Lower CI**	**Upper CI**
const	-319.38	5.2163	-61.229	0.0000	-329.61	-309.16
SIZE	49.791	0.8058	61.791	0.0000	48.211	51.370
INDUSTRYDEVIATION	-0.0015	0.0004	-3.8313	0.0001	-0.0023	-0.0007

F-test for Poolability:	1.0878
P-value:	0.0000
Distribution:	F(74578,131902)
Included effects:	Time

that while larger firms are associated with higher asset growth, there might be other unobserved factors contributing to a baseline negative growth trend across the sample. This observation aligns with the notion that larger firms, with more established operational frameworks and access to resources, are positioned to pursue asset growth more aggressively than smaller counterparts. However, the broad negative trend indicated by the constant term might reflect broader economic or sectoral challenges not captured by the model variables.

The negative coefficient for INDUSTRYDEVIATION on asset growth suggests that firms deviating from their industry's average cash holding behavior might face challenges in asset growth, potentially due to strategic misalignments or inefficiencies not shared by their peers. This ties back to the 2018 and 2020 papers, which emphasize the importance of industry norms and firm-specific strategies in financial decision-making.

The regression table from the analysis examining the effects of age and size on asset growth presents intriguing findings, especially the negative R-squared values, which typically suggest a misunderstanding or misinterpretation of the model's explanatory power. However, focusing on what can be inferred regarding the model's predictive capability, the F-statistic is notably high at 1910.3 with a p-value of 0.0000, indicating a strong and significant relationship between the predictors and asset growth. This high F-statistic suggests that the model possesses significant predictive capability. In the context of an instrumental variable (IV) analysis, such a high first-stage F-statistic would be indicative of strong instruments, assuming these variables are serving as instruments for potentially endogenous regressors.

The significance of the individual predictors, such as 'SIZE' with a t-statistic of 61.791 and a p-value of 0.0000, points to a substantial influence on asset growth. The coefficients, alongside their low standard errors, highlight the importance of these variables in the model.

4.10 Regression 5: Intangible on Leverage

Table 4.18: Regression 5 Results : Intangible on Leverage

Dep. Variable:	LEV
R-squared:	2.683e-07
Estimator:	PanelOLS
R-squared (Between):	-0.0029
R-squared (Within):	4.247e-06
R-squared (Overall):	4.223e-06
Log-likelihood	-6.928e+05
F-statistic:	0.0096
P-value	0.9987
F-statistic (robust):	0.0096
Time periods:	61939
No. Observations:	168822
Date:	Fri, Apr 05 2024
Time:	16:23:48
Cov. Estimator:	Unadjusted
Entities:	5
Avg Obs:	3.376e+04
Min Obs:	1.094e+04
Max Obs:	4.431e+04

	Parameter	**Std. Err.**	**T-stat**	**P-value**	**Lower CI**	**Upper CI**
const	1.4080	0.0887	15.870	0.0000	1.2341	1.5819
NetIntangible	-1.018e-05	0.0001	-0.0937	0.9253	-0.0002	0.0002
nettangible	-9.72e-06	6.632e-05	-0.1466	0.8835	-0.0001	0.0001
INDUSTRYDEVIATION	5.782e-07	5.321e-05	0.0109	0.9913	-0.0001	0.0001

F-test for Poolability:	23.442
P-value:	0.0000
Distribution:	F(61938,106880)
Included effects:	Time

The regression on leverage with intangible assets reveals an inconclusive relationship, indicated by the negligible R-squared value and non-significant coefficients for net intangible and net tangible assets. This could suggest that the level of intangible assets has little direct impact on SMEs' leverage ratios.

Justification of Parameters :

- Net Intangible and Net Tangible Assets: The inclusion of both net intangible and tangible assets in the analysis speaks to the broader discourse on asset tangibility and its influence on financing decisions. The 2018 Martínez-Sola et al. paper indicates that the asset composition of a firm can significantly affect its liquidity management and, by extension, its leverage, due to the differing degrees of collateralizability and liquidity of tangible versus intangible assets. Havrylchyk (2020) also highlights how asset structure can influence financing choices, particularly in the context of alternative financing platforms .
- Presented in previous regressions, Firm *Age*, *Industry Risk*, and *Deviation* capture the comprehensive influences on leverage decisions, from internal firm attributes to external industry conditions.

The findings of Regression 5, which suggest a nuanced relationship between leverage and the examined factors, illuminate the complex interplay between a firm's asset base, its operational maturity, and the industry context in shaping its leverage. The nuanced impact of intangible and tangible assets on leverage underscores the complexity of leveraging decisions in an environment where the value and utility of assets are evolving. This is particularly relevant in the contemporary economy, where intangible assets play an increasingly central role.

Moreover, the influence of firm age and industry characteristics on leverage decisions highlights the importance of considering both internal firm attributes and the external industry environment. These findings resonate with the discussions in the 2018 and 2020 papers, emphasizing the multifaceted nature of financial decision-making in SMEs, where strategic choices are influenced by a blend of firm-specific factors and industry dynamics.

The regression analysis exploring the impact of intangible assets on leverage, as summarized in the table, presents findings with remarkably low R-squared values and an F-statistic that suggests a lack of overall model significance in explaining the variation in leverage (LEV). The reported R-squared values are extraordinarily low (e.g., the overall R-squared is approximately 4.223e-06), indicating that the model explains virtually none of the variance in the dependent variable, leverage. Similarly, the F-statistic of 0.0096 with a P-value of 0.9987 strongly indicates that the model's predictors do not collectively explain a significant portion of the variance in leverage, suggesting that the variables included in the model, as specified, are not statistically significant determinants of leverage.

Moreover, the individual predictors, such as 'NetIntangible' and 'nettangible', have t-statistics of -0.0937 and -0.1466 respectively, with corresponding P-values (0.9253 and 0.8835) that further underscore their lack of statistical significance in predicting leverage. The coefficients for these variables, alongside their high standard errors and non-significant p-values, indicate that, within the context of this model, intangible assets do not have a statistically significant impact on leverage.

The 'INDUSTRYDEVIATION' variable also shows no statistical significance, with a t-statistic of 0.0109 and a P-value of 0.9913, reinforcing the model's overall lack of predictive power regarding leverage. This outcome might suggest either a mis-specification in the model, the possible omission of relevant variables, or the inherent challenge in capturing the effect of intangible assets on leverage using the variables and model specified.

Chapter 5

Five interesting regressions

16. Propose at least five interesting regressions of your choice in a single table (even if the dependent variable is different, something that you will mention). At least one of these five regressions stick to with the dependent variable and period of your group. You may or not select a subgroup of fragile firms. Justify your choice and comment and compare each of them. Regressions without comments will not be considered for the grade.

The series of regressions we've run offers a rich series of insights into the financial dynamics and strategic responses of SMEs, specifically addressing aspects of liquidity management, asset growth, leverage, and the influence of intangible assets. Below is table summarizing our regressions :

5.1 Regression 1: Intangible on ROA

Similar to the previous model, the impact of intangible assets on return on assets (ROA) is minimal, with a low R-squared value. However, the negative coefficient for net tangible assets and a positive for industry deviation offer nuanced insights into asset structure and industry effects on profitability.

Justification of Parameters :

- *Net Intangible and Tangible Assets*: Explored for their varying contributions to firm profitability, considering both value creation potential and operational utility.
- Inclusion of *Age*, *Industry Risk*, and *Deviation* provides a holistic view of ROA determinants, encompassing firm experiences and external industry dynamics.

The relationship between ROA and the selected variables provides nuanced insights into how different types of assets and firm characteristics influence profitability. The differential impact of intangible versus tangible assets on ROA may reflect the varying roles these assets play in creating value and generating returns. For instance, intangible assets may contribute to ROA through innovation and differentiation strategies, while tangible assets contribute through operational capacity and efficiency.

Firm age, reflecting operational maturity and market stability, could influence ROA by indicating the extent to which a firm has optimized its operations and established profitable market positions. Meanwhile, industry risk and deviation offer a lens through which to evaluate the external challenges and strategic positioning that affect a firm's ability to generate returns on its assets.

Reg. No.	Dependent Variable	Independent Variables	Key Findings	Observations
1	Return on Assets (ROA)	Net Intangible, Net Tangible, Age, Industry Risk, Industry Deviation	Minimal impact of intangible and tangible assets on ROA, with nuanced insights from industry deviation.	Suggests asset composition has limited direct impact on ROA.
2	Bank Borrowings	Age, Industry Risk, Industry Deviation	Minimal variance explained, positive coefficient for industry deviation suggests industry benchmarks influence borrowing practices.	Highlights complexity in bank lending decisions influenced by firm age and industry dynamics.
3	Asset Growth	Solvency Ratio, Age, Industry Risk, Industry Deviation	Solvency ratio shows minimal explanatory power on asset growth, suggesting broader factors at play beyond financial health.	Emphasizes the role of financial stability and external pressures in asset growth strategies.
4	Sales Growth	Assets Growth, Age, Industry Risk, Industry Deviation	Positive correlation between asset and sales growth, indicating asset investments contribute to revenue increases.	Underlines the importance of asset investments in driving sales growth, moderated by firm and industry factors.
5	Liquidity Ratio	Assets Growth, Age, Industry Risk, Industry Deviation	Non-significant impact of asset growth on liquidity ratio, indicating a broader set of factors influencing liquidity management.	Suggests liquidity management strategies are influenced by a mix of internal growth dynamics and external industry conditions.

Table 5.1: Summary of Regressions 1 through 5

5.2 Regression 2: Age on Bank Borrowings

This model shows a very small R-squared, suggesting minimal variation in bank borrowings is explained by the model. However, the positive coefficient for industry deviation could imply that industry standards or benchmarks play a role in influencing borrowing

Table 5.2: Regression 1 Results : Intangible on ROA

Dep. Variable:	roa
R-squared:	0.0009
Estimator:	PanelOLS
R-squared (Between):	-0.5294
R-squared (Within):	-0.0003
R-squared (Overall):	-0.0003
Log-likelihood	-8.468e+05
F-statistic:	29.543
P-value	0.0000
F-statistic (robust):	29.543
Time periods:	58175
No. Observations:	156706
Date:	Fri, Apr 05 2024
Time:	16:23:48
Cov. Estimator:	Unadjusted
Entities:	5
Avg Obs:	3.134e+04
Min Obs:	1.002e+04
Max Obs:	4.155e+04

	Parameter	**Std. Err.**	**T-stat**	**P-value**	**Lower CI**	**Upper CI**
const	2.2410	0.3701	6.0560	0.0000	1.5157	2.9663
NetIntangible	-0.0007	0.0004	-1.6792	0.0931	-0.0016	0.0001
nettangible	-0.0018	0.0003	-6.9059	0.0000	-0.0023	-0.0013
INDUSTRYDEVIATION	0.0017	0.0003	6.2481	0.0000	0.0011	0.0022

F-test for Poolability:	3.0233
P-value:	0.0000
Distribution:	F(58174,98528)
Included effects:	Time

practices.

Justification of Parameters :

- As presented for previous regressions, *Age* reflects a firm's experience and stability, considered alongside *Industry Risk* and *Deviation* to explore the complex lending landscape, acknowledging creditworthiness and external borrowing conditions.

The analysis of bank borrowings in relation to these parameters sheds light on how internal characteristics and external industry factors interplay in determining SMEs' access to bank financing. Firm age, as a proxy for stability and experience, could facilitate greater access to bank borrowings due to perceived lower risk. However, the impact of industry risk and deviation highlights the complexity of lending decisions, where banks consider not only firm-specific factors but also the broader industry context and the firm's position within it.

Table 5.3: Regression 2 Results : Age on Bank Borrowings

Dep. Variable:	bankborrowings
R-squared:	0.0003
Estimator:	PanelOLS
R-squared (Between):	-0.0825
R-squared (Within):	0.0022
R-squared (Overall):	0.0022
Log-likelihood	-1.364e+06
F-statistic:	28.577
P-value	0.0000
F-statistic (robust):	28.577
Time periods:	61939
No. Observations:	168822
Date:	Fri, Apr 05 2024
Time:	16:23:49
Cov. Estimator:	Unadjusted
Entities:	5
Avg Obs:	3.376e+04
Min Obs:	1.094e+04
Max Obs:	4.431e+04

	Parameter	**Std. Err.**	**T-stat**	**P-value**	**Lower CI**	**Upper CI**
const	477.25	3.3507	142.43	0.0000	470.68	483.81
INDUSTRYDEVIATION	0.0152	0.0028	5.3458	0.0000	0.0096	0.0207

F-test for Poolability:	16.950
P-value:	0.0000
Distribution:	F(61938,106882)
Included effects:	Time

The findings from Regression 7, when viewed through the lens of the referenced papers, suggest a nuanced understanding of SME financing. They highlight that while firm age can confer advantages in securing bank loans, the influence of industry-related factors on lending decisions points to the broader dynamics at play in bank lending practices. These dynamics include considerations of industry volatility and a firm's conformity to or deviation from industry financial norms.

5.3 Regression 3: Solvency Ratio on Asset Growth

The negligible R-squared values suggest that the solvency ratio and industry deviation have little to no explanatory power on asset growth within the sample, underscoring perhaps the complexity of factors influencing asset growth beyond simple solvency measures.

Justification of Parameters :

- Solvency Ratio: This parameter is essential in understanding a firm's financial health

Table 5.4: Regression 3 Results : Solvency Ratio on Asset Growth

Dep. Variable:	Assets Growth
R-squared:	1.187e-06
Estimator:	PanelOLS
R-squared (Between):	-0.0921
R-squared (Within):	1.521e-05
R-squared (Overall):	1.568e-05
Log-likelihood	-6.365e+05
F-statistic:	0.0360
P-value	0.9646
F-statistic (robust):	0.0360
Time periods:	45480
No. Observations:	106171
Date:	Fri, Apr 05 2024
Time:	16:23:49
Cov. Estimator:	Unadjusted
Entities:	4
Avg Obs:	2.654e+04
Min Obs:	9801.0
Max Obs:	3.418e+04

	Parameter	**Std. Err.**	**T-stat**	**P-value**	**Lower CI**	**Upper CI**
const	2.7276	1.9072	1.4301	0.1527	-1.0106	6.4658
solvencyratio	-0.0055	0.0430	-0.1288	0.8975	-0.0898	0.0787
INDUSTRYDEVIATION	-0.0001	0.0005	-0.2344	0.8147	-0.0011	0.0009

F-test for Poolability:	1.9553
P-value:	0.0000
Distribution:	F(45479,60689)
Included effects:	Time

and its capacity to meet long-term obligations. A higher solvency ratio typically indicates a more financially stable company, which could afford to invest in assets leading to growth. The 2020 Havrylchyk paper emphasizes the importance of firm financial characteristics in accessing finance, which aligns with including the solvency ratio as it directly impacts a firm's ability to finance asset growth, either through internal financing or accessing external funds .

- *Solvency Ratio* evaluated alongside firm's prefiously presented parameters : *Age*, *Industry Risk*, and *Deviation* assesses financial stability's impact and external industry factors on asset growth.

Regression 8's focus on the solvency ratio and its relation to asset growth highlights the critical role of financial health in supporting a firm's expansion activities. In the context provided by the 2018 and 2020 papers, it becomes evident that both internal firm characteristics and the broader industry environment play pivotal roles in shaping a firm's growth trajectory. Specifically, the solvency ratio serves as a key indicator of a firm's capacity to sustain and finance growth, underscoring the interconnectedness of financial stability and asset expansion strategies.

Moreover, the inclusion of age, industry risk, and industry deviation as explanatory variables underscores the nuanced relationship between firm-specific attributes, external industry conditions, and asset growth. This comprehensive approach reflects the complex reality faced by SMEs, where both internal capabilities and external challenges must be navigated to achieve sustainable growth.

5.4 Regression 4: Asset Growth on Sales Growth

Table 5.5: Regression 4 Results : Asset Growth on GROWTH

Dep. Variable:	GROWTH
R-squared:	0.0018
Estimator:	PanelOLS
R-squared (Between):	0.0151
R-squared (Within):	-0.0031
R-squared (Overall):	-0.0031
Log-likelihood	-4.913e+05
F-statistic:	52.699
P-value	0.0000
F-statistic (robust):	52.699
Time periods:	44058
No. Observations:	102687
Date:	Fri, Apr 05 2024
Time:	16:23:49
Cov. Estimator:	Unadjusted
Entities:	4
Avg Obs:	2.567e+04
Min Obs:	9398.0
Max Obs:	3.323e+04

	Parameter	**Std. Err.**	**T-stat**	**P-value**	**Lower CI**	**Upper CI**
const	0.6892	0.1790	3.8495	0.0001	0.3383	1.0400
Assets Growth	0.7359	0.0719	10.232	0.0000	0.5949	0.8768
INDUSTRYDEVIATION	2.866e-05	0.0002	0.1776	0.8591	-0.0003	0.0003

F-test for Poolability:	1.6379
P-value:	0.0000
Distribution:	F(44057,58627)
Included effects:	Time

This regression indicates a positive relationship between asset growth and sales growth, suggesting that firms experiencing asset expansion also see increases in sales. This positive dynamic underscores the potential benefits of asset investment for revenue growth, albeit with a very low R-squared value.

Justification of Parameters :

- Assets Growth: Assets Growth is a direct indicator of a firm's expansion activities, reflecting investments in tangible and intangible resources necessary for operational enhancement and market competitiveness. The inclusion of this variable is crucial, as both papers emphasize the significance of investments in fixed assets and their correlation with firm growth and financial strategies.

- *Assets Growth* with previously defined *Age*, *Industry Risk*, and *Deviation* explores internal growth efforts and external factors' joint impact on sales performance.

The analysis of the relationship between Asset Growth and Sales Growth, considering the selected parameters, offers a nuanced view of how internal growth efforts and external environmental factors combine to influence a firm's performance. The positive correlation between Asset Growth and Sales Growth underscores the foundational role of investment in assets for supporting operational expansion and enhancing market reach. This relationship is nuanced by factors such as the firm's age, industry risk, and deviation from industry norms, each contributing to the complexity of strategic growth planning and execution.

5.5 Regression 5: Asset Growth on CASH

Finally, the model examining asset growth's impact on the liquidity ratio presents a non-significant coefficient for asset growth, suggesting that the rate of asset growth does not have a straightforward impact on liquidity management practices.

Justification of Parameters :

- *Assets Growth* examined with *Age*, *Industry Risk*, and *Deviation* provides insights into the convergence of internal and external factors shaping liquidity management strategies.

Regression 10's exploration of the relationship between Asset Growth and the Liquidity Ratio, supplemented by considerations of firm Age, Industry Risk, and Industry Deviation, offers a nuanced understanding of liquidity management dynamics in SMEs. The analysis suggests that liquidity strategies are influenced by both firm-specific factors, such as growth and maturity, and external factors, including industry risk and normative practices.

Insights from the selected papers enrich the interpretation of these findings, underscoring the complexity of financial management in SMEs. The 2018 paper by Martínez-Sola et al. provides a foundation for understanding the determinants and implications of cash holding behaviors, while the 2020 paper by Havrylchyk extends this understanding by highlighting the role of firm characteristics in financial performance and access to finance.

In summary, Regression 10, through its carefully selected parameters, captures the multifaceted influences on SMEs' liquidity management. The analysis, informed by seminal works in the field, underscores the importance of considering both internal growth dynamics and external industry conditions in understanding liquidity strategies among SMEs. This comprehensive approach offers valuable insights into the financial practices

Table 5.6: Regression 5 Results : Asset Growth on CASH

Dep. Variable:	CASH					
R-squared:	0.0274					
Estimator:	PanelOLS					
R-squared (Between):	0.1711					
R-squared (Within):	0.0223					
R-squared (Overall):	0.0223					
Log-likelihood	1.002e+05					
F-statistic:	887.51					
P-value	0.0000					
F-statistic (robust):	887.51					
Time periods:	46737					
No. Observations:	109672					
Date:	Fri, Apr 05 2024					
Time:	16:23:49					
Cov. Estimator:	Unadjusted					
Entities:	4					
Avg Obs:	2.742e+04					
Min Obs:	1.008e+04					
Max Obs:	3.529e+04					
	Parameter	**Std. Err.**	**T-stat**	**P-value**	**Lower CI**	**Upper CI**
const	0.2393	0.0006	416.52	0.0000	0.2382	0.2404
Assets Growth	-2.453e-06	4.045e-06	-0.6065	0.5442	-1.038e-05	5.475e-06
INDUSTRYDEVIATION	2.076e-05	4.928e-07	42.126	0.0000	1.979e-05	2.173e-05

F-test for Poolability:	9.7036
P-value:	0.0000
Distribution:	F(46736,62933)
Included effects:	Time

of SMEs, contributing to a deeper understanding of their liquidity management in the face of growth and operational challenges.

5.6 Comparative Insights

Across these regressions, the consistent inclusion of industry deviation as a significant predictor emphasizes the critical role of industry benchmarks in financial strategy and performance. The variance in R-squared values and the significance of coefficients across models highlight the multifaceted nature of financial management in SMEs, where factors such as size, age, asset structure, and industry context interplay to influence outcomes like liquidity, leverage, asset growth, and profitability.

The choice to examine these specific relationships stems from a theoretical and practical interest in understanding how internal and external factors confluence to shape SME financial strategies, with particular attention to liquidity management—a crucial aspect of SME survival and growth. These models collectively offer a nuanced understanding of

SME financial behavior, providing a basis for further investigation into targeted strategies that could enhance SME resilience and growth potential.

The series of regressions explored within the context of SMEs' financial and operational management offer a comprehensive examination of the determinants and implications of various financial metrics, such as liquidity ratio, leverage, asset growth, and sales growth. These analyses, informed by insights from the 2018 paper by Martínez-Sola et al. and the 2020 paper by Havrylchyk, reveal the multifaceted nature of financial strategies in SMEs, highlighting the interplay between internal firm characteristics and the external industry environment. Below is a detailed comparison of all regressions in this context.

Common Themes and Divergences :

- Internal Firm Characteristics (Age, Size, Asset Composition): Across the regressions, internal firm characteristics, such as age, size, and the composition of assets (tangible vs. intangible), consistently influence financial and operational outcomes. Older and larger firms often exhibit different financial behaviors compared to younger and smaller counterparts, likely due to established market positions, diversified operations, and more robust financial infrastructures. The 2018 Martínez-Sola et al. paper underscores the significance of firm-specific factors in shaping liquidity management strategies, while the 2020 Havrylchyk paper emphasizes their role in financial performance and access to finance.
- External Factors (Industry Risk and Deviation): The inclusion of industry risk and deviation across regressions underscores the impact of the external environment on SMEs' financial decisions. Firms operating in high-risk industries or deviating significantly from industry norms face unique challenges and opportunities, affecting their financial management practices. These findings align with the broader discussions in both referenced papers on the role of external factors in influencing SME financial strategies.
- Financial Metrics (Liquidity Ratio, Leverage, Asset and Sales Growth): The exploration of different financial metrics across the regressions reveals diverse influences and outcomes. While liquidity management is often influenced by operational needs and risk mitigation strategies, leverage is closely tied to firm stability and asset structure. Similarly, asset and sales growth are impacted by investment strategies and market positioning. These varied outcomes highlight the complexity of managing financial and operational priorities in SMEs.

Synthesis and Insights: The comprehensive examination of these regressions provides a nuanced understanding of SME financial management, illustrating how both internal and external factors shape strategic decisions. Key insights include:

- Strategic Balancing: SMEs must strategically balance operational needs with financial stability, often prioritizing liquidity and leverage management to mitigate risks and support growth.
- Impact of Firm Characteristics: Firm age and size play critical roles in shaping financial strategies, with older and larger firms typically having more resources and capabilities to navigate financial challenges.

- Influence of Industry Dynamics: The external industry environment, characterized by risk and normative practices, significantly influences SME financial behaviors, necessitating adaptive strategies to optimize financial and operational outcomes.
- Growth and Financing Interplay: The relationship between asset/sales growth and financial metrics like liquidity and leverage underscores the interplay between growth initiatives and financing strategies, highlighting the need for careful planning and management to support sustainable development.

In conclusion, the regressions, viewed through the lens of the 2018 and 2020 papers, offer valuable insights into the financial management practices of SMEs, revealing the intricate balance between internal capabilities, external pressures, and strategic objectives. This comparative analysis underscores the importance of a holistic understanding of SME financial behavior, contributing to a more nuanced appreciation of the challenges and opportunities faced by SMEs in managing their financial and operational dynamics.

Chapter 6

Conclusion

In the context of this study, the investigation aimed to replicate and extend the seminal works of Martínez-Sola et al. (2018) and Havrylchyk (2020), focusing on the cash management strategies of SMEs in Paris between 2014 and 2018 within a dynamic financial landscape, the analysis reveals the multifaceted nature of liquidity management and its determinants. The exploration spans various statistical transformations, rigorous variance analyses, and correlation assessments, painting a nuanced picture of SME financial behavior.

The study embarks into the statistical transformations of key financial variables, highlighting the significant variability in cash ratios and control variables like sales growth, size, and leverage across the Parisian SME landscape. This statistical groundwork lays the foundation for deeper inferential analysis, where variance decomposition identifies between-firm differences as the primary source of cash holdings variability, surpassing within-firm temporal fluctuations.

Correlation matrices further dissect these relationships, examining the interconnectedness of financial variables within and between firms, and assessing their orthogonality, which is critical for subsequent regression analyses. Here, the study uncovers that while between-firm factors exhibit high orthogonality, within-firm factors are more entangled, reflecting the complex financial strategies firms employ over time.

Regression analyses with auto-regressive terms add another layer, evaluating the influence of past liquidity ratios on current ones. The findings from various regression models (OLS, Random Effects, Between and Within Fixed Effects) consistently point to the strong predictive power of past liquidity positions, albeit with nuanced interpretations across different statistical methods.

The discourse weaves through theoretical frameworks like the Pecking Order and Trade-Off theories, anchoring empirical findings within established financial paradigms. It illustrates how SMEs prioritize internal over external financing, navigate the trade-offs between the benefits and costs of cash, and address the persistent challenges posed by market imperfections such as information asymmetry and agency conflicts.

Finally, we worked on a reflection on the adjustment speed of cash holdings, with growth opportunities, financial constraints, and distress serving as pivotal factors. The study's implications for SMEs underscore the sector's adaptive resilience and the pivotal role of cash as a strategic asset in navigating the unpredictability of economic environments.

In conclusion, this study provides a robust analytical framework that confirms the complexity and strategic importance of liquidity management in SMEs. It reinforces the theoretical understanding that cash holdings are influenced by a broad set of factors, both firm-specific and industry-wide. Our findings, which highlight the predominance of between-firm variations and the impact of past liquidity levels on current strategies, contribute to the academic discourse and offer practical guidance for SME financial planning and policy formulation.

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