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Firm performance revisited: Idiosyncratic macroeconomic exposure and firm size

Evidence from the United States

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Abstract

A systematic approach is adopted to incorporate exogenous macroeconomic information into firm-level performance assessment based on firm fundamentals. A large sample of US-based firms over the 2009-2017 time period is used, with both domestic and foreign sales subject to regional-specific macroeconomic conditions, measured via real GDP growth rates. The construction of a new macroeconomic exposure measure improves firm performance analysis. The results show that the effect of idiosyncratic macroeconomic exposure in conjunction with firm size is more prevalent for small-sized firms to determine performance. Secondly, performance of domestic firms is negatively affected by macroeconomic exposure in contrast to exporting firms. Therefore, this study contributes to the theoretical and empirical literature on firm performance by analyzing the sensitivity of firms, contingent on size, to macroeconomic exposure changes.

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1. Introduction

This paper exploits the linkages between firm size and idiosyncratic macroeconomic exposure to assess performance. Prior research has focused on firm size alongside many other firm fundamentals to determine firm performance. However, relatively little has been done to incorporate firm-specific macroeconomic conditions into performance analyses based on firm size. The increased cross-country connectivity and internationalization of firm operations have revealed the importance of international economic and financial markets. This suggests that a firm-specific macroeconomic exposure framework contingent on firm size, viewed as on one of the key firm fundamentals in assessing performance (see e.g. Lee et al., 2009), is indispensable. Furthermore, Fort et al. (2013) argue the lack of research into the performance outcomes discrepancy between small and large firms following macroeconomic fluctuations.

Incorporating the macroeconomic environment into firm-level performance analysis is a broad question as the set of macroeconomic factors worth considering is large. To define firm-level exposure, first the distinction is made between domestic and exporting firms because cross-country investments and sales are bound to be affected by macroeconomic factors. I create a new measure, $MACRO_{i,t}$, which encompasses the firm-specific geographical sales revenue and regional real GDP growth rates, following the original framework of Li et al., (2014), to accurately determine firm-specific macroeconomic exposure.

The sample consists of 1980 US based firms over the 2009-2017 time period, with a relatively smaller fraction selling only domestically and the majority operating in both the domestic and foreign market, i.e. exporters. The importance of incorporating firm size into the analyses becomes evident when firm size cohorts are constructed and interacted with the macroeconomic exposure variable $MACRO_{i,t}$. Two widely acknowledged proxies for firm size are used, total firm assets (see e.g. Lee et al., 2009) and total number of employees (see e.g. Fort et al., 2013). Two primary results arise: an overall increase of 1 percent in real GDP growth improves firm performance, measured through return on assets (ROA), for small firms based on assets by 16.93 basis points and by 50.5 basis points for small firms based on number of employees. This gives rise to the main finding that there exists a performance outcome differential between small and large firms following changes in their firm-specific macroeconomic exposure. These findings can be explained through discrepancies between small and large firms via the credit channel (Gertler and Gilchrist, 1994), the ease of shifting internal capital and cross-subsidies (Hovakimian,

2011) and acquiring investment liquidity (Shaver, 2011). Furthermore, the descriptive ability of $MACRO_{i,t}$ is apparent and outlines that dissimilar firms experience different performance outcomes contingent on idiosyncratic macroeconomic exposure, suggesting that firms selectively pursue projects and dynamically allocate assets, following macroeconomic fluctuations.

An important contribution from this study is introducing a detailed framework that identifies and exploits the linkages between firm performance and the firm-specific macroeconomic environment by incorporating the size of the firm. Prior research, has examined interlinkages between firm fundamentals and macroeconomic factors on stock returns (Cohen and Frazzini, 2008; Menzly and Ozbas, 2010) and the response of firms following business cycles based on age and size (Fort et al., 2013). This paper distinguishes from these prior studies as the theoretical model to identify these linkages is enhanced by constructing an idiosyncratic firm macroeconomic factor. Furthermore, the set-up of the study is related to the framework of Li et al. (2014), however, different in several key aspects: i) the performance of firms is assessed, both via accounting- and economic profits, ii) firm size is analyzed in combination with macroeconomic exposure, iii) real GDP growth rates are used instead of forecasts, iv) a more recent time period is taken and v) the geographical dispersion of sales is allocated to more delineated regions[1].

A distinction is made between the internal and external environment of the firm to explain firm performance. The main question states: 'Does incorporating firm-specific macroeconomic exposure of US firms improve performance analysis and do small and large firms experience different performance outcomes following macroeconomic exposure changes?

The remainder of the paper is outlined as follows. Section 2 discusses the theoretical framework that links macroeconomic exposure with firm size to assess performance. Section 3 provides the data sourcing process. Section 4 has the methodology and empirical strategy. Section 5 shows the results and discusses the economic relevance of the outcomes. Section 6 discusses a potential transmission mechanism and the implications for firms. Section 7 concludes the paper, provides avenues for future research and discusses the limitations.

[1] The first difference provides a complete different direction of research than these prior studies. The second and third distinctions align more with the goal of this paper to improve firm-performance analysis and fourthly the recent time period covers the current stance of the macro-economy, providing firms with a strategy plan based on present macroeconomic conditions. The fifth difference provides a more accurate picture of a firm's macroeconomic exposure and increases the internal validity of the study compared to prior work.

2. Literature review

2.1. Background

Many theories exist in the literature that explain the effect of various factors on firm performance, both via accounting, financial and economic indicators (see e.g. Hansen and Wernerfelt, 1989; Hawawini et al., 2003). Hansen and Wernerfelt (1989) develop an integrated model and find that both these firm-specific and industry-specific effects are significant determinants of firm performance. This paper follows their idea developed to combine microeconomic firm fundamentals with the macroeconomic environment to establish an integrated model that explains firm performance. The majority of prior research lacks explicit inclusion of information external to the firm. Disaggregating sales into geographical regions potentially identifies links to such external performance drivers, proxied by region-specific macroeconomic conditions.

2.2. Firm size - performance relationship

Many authors have examined the interlinkage between firm performance and a wide array of factors, including firm-specific characteristics and industry elements[2]. Lee (2009) states that the absolute size of the firm is evaluated as an accurate and key determinant for firm performance. Observed as a firm-specific resource, firm size can be seen as a diversification strategy and reflects positioning in the market and industry. This paper builds on the pioneering work of Baumol (1959) and uses the following theoretical mechanism of the firm size-profitability relationship: 'the absolute size of the firm can have a causal impact on firm performance through efficiency gains, economies of scale and exploitation of diversification opportunities'.

The author states that the increase in capital due to fiercer competition raises total firm profits, and incumbent firms are pushed up to higher tiers within the imperfectly competing capital groups, potentially raising investment returns. His proposition is explained through the importance of firm size, as relatively large firms have access to the same options as smaller firms do, but have the additional ability to exploit scale opportunities. Baumol's (1959) theory is central in this paper, as a distinction is made between domestically operating firms (domestic) and firms with positive foreign sales revenue (exporters). Hall and Weiss (1967) confirm his theory and also state that

[2] The interlinkage between microeconomic intangible firm fundamentals and the macro-economy is paramount to firm performance analysis. Seminal papers discuss the managerial networking perspective (Peng and Luo, 2000), nested heterogeneity (Felin and Hesterly, 2007) and idiosyncratic firm routines and capabilities (Abell et al., 2008). For the sake of brevity, these theories are not discussed in this paper.

large firms are more efficient than their smaller counterparts. Lee (2009) shows that a positive relationship exists between firm size and profits but at a diminishing rate for large firms[3].

On the contrary, Dhawan (2001) states that relatively small firms are more productive and risky compared to large firms due to their efficiency seeking behavior to combat uncertainties in the market, i.e. the risk-return tradeoff. The findings display the importance of firm heterogeneity contingent on size and show that small firms are relatively more profitable, have a higher probability of bankruptcy and face more difficulties in acquiring external capital. According to Ballantine et al. (1993), in terms of management decision-making, managers of large firms seek growth opportunities instead of high return projects as larger firms are better able to predict future performance. Small firms, on the contrary, have relatively large sales to assets ratios, and sustain higher profit ratios[4]. A related strand of literature looks at the effect of firm size on growth, contingent on financial, legal and corruption constraints (Beck et al., 2005). They state that relatively small firms are more adversely affected by these constraints than large firms in pursuing growth strategies. Angelini and Generale (2008) confirm this theory of a negative relationship between firm size and various constraints and find that constrained firms are on average smaller.

Firm type: domestic versus exporting firms

The firm size differential between domestic and exporting firms explains firm heterogeneity and is the potential cause of performance disparities between firms. The focus is not to disentangle the direction of causality but to establish a general understanding of the firm size effect on performance based on single- against multi-country macroeconomic exposure.

A seminal paper by Bernard and Jensen (1999) states that exporting firms are larger, extra productive and relatively capital- and technology intensive compared to non-exporting firms. In addition, exporters' productivity grows slower than non-exporters' productivity. The analysis of Michel and Shaked (1986), compares financial performance of domestic and multinational corporations, conditional on a broad spectrum of market-based measures of performance. Their main findings suggest that domestic firms face extra systematic and total risk, have lower access

[3] Other factors observed at the industry level, i.e. market concentration, barriers to enter the market and firm-specific strategic decision-making, are key determinants of profitability (Caves and Pugel, 1980) but not discussed here.
[4] Other theories explain the relationship through X-inefficiencies of large absolute scale (Shepherd, 1972), intra-plant and external motivational efficiency and nonmarket input efficiency (Leibenstein, 1966) and different firm's strategic objectives (Caves and Porter, 1977).

to capital and most importantly exceed the risk-adjusted performance[5] of multinational corporations. In addition, multinational corporations are larger in size but this does not appear to have a significant impact on the performance differential.

2.3. Macroeconomic environment

The inclusion of the macro-economy to determine performance and firm-level exposure to fluctuations has received little attention, especially compared to microeconomic firm fundamentals[6]. These prior studies mainly include internal firm information but neglect the impact of external drivers. Therefore, the literature on the impact of the broad macro-economy on firm performance has to be revisited and expanded due to the greater integration of financial and economic factors and increased dynamics of the macroeconomic environment (Oxelheim, 2003).

Oxelheim (2003) develops a framework to measure the impact of the volatile macro-economy on firms' performance and competitiveness. He proposes a multivariate analysis, MUST[7]-framework, comprised of prior firm fundamental performance and exposure to macroeconomic risks. Through this framework, firms can distinguish profits coming from intrinsic firm competitiveness and from macroeconomic changes. These macroeconomic changes include a vast number of external drivers that influence the firm's operating capabilities, for instance Oxelheim and Wihlborg (2008), stress the importance of market price variables, such as exchange rate movements, inflation rates and interest rates. The authors focus on the effect of changes in these price variables to reflect the overall macroeconomic environment. In addition, observing these macroeconomic fluctuations, tangible firm-wide, can also contribute to improve risk- and strategic management to enhance overall performance. Broadstock et al. (2011) support this view on macroeconomic fluctuations and the importance for firms to predict future earnings to make business decisions. The authors investigate the relationship between twenty-three macroeconomic variables and future earnings with an earnings forecasting model and find a significant relationship between macroeconomic information and the firm's future earnings.

McNamara and Duncan (1995) utilize a principal components framework employing thirty-three economic variables, based on key macroeconomic behavioral theories to end up with

[5] The assumption of perfect integration of national capital markets, minor transaction costs and rational investors.
[6] The literature focuses on firm management to control and influence performance indicators to enhance profits, via firm size (Baumol, 1959), cash flows (Dechow, 1994) and geographical location of earnings (Thomas, 2000).
[7] Macroeconomic uncertainty strategy

three key indicators to measure performance[8]. The authors incorporate fundamental indicators as proxies for business performance in conjunction with macroeconomic variables, outlining an underlying theoretical framework for the effect of the macroeconomic environment on ROA. This simplistic framework relates current ROA to its one-year lagged value and stance of the economy. The authors solely use the one-year lagged ROA as the plots depict a one period lag autoregressive process. The national economy is influenced by governmental decision-making affecting demand for goods and services of firms in a certain year and consequently determining a firm's return on assets. The competences of firm management will ultimately determine the effectiveness to use production factors, resulting in heterogeneous firms. The authors state that ROA is correlated with changes in the economy and the relationship has the following general form:

$$ROA_{(i,t)} = \alpha + \beta_1 ROA_{(i,t-1)} + \beta_2 Economy_{(t)} + \varepsilon_{i,t} \quad (1)$$

The relationship in Eq. (1), forms the basis of this paper *(see section 4)*. By incorporating various essential firm fundamentals, the micro-perspective, and using real GDP growth rates, covering the macro-economic perspective, this paper attempts to estimate the combined effect on performance. Firm-specific macroeconomic exposure is hard to measure, but real GDP provides an overall measurement of the stance of the macro-economy and in combination with sales revenue of firms to these regions, subject to different GDP growth rates, provides the best proxy. To account for the wide variability in the macroeconomic environment and keep track of the actual goal of the paper, a restricted focus is applied[9]. Therefore, this study focuses on real GDP reflecting general economic conditions (Lee, 2009) and consequently reducing the dimensionality of the issue. According to Lee (2009), real GDP reflects the business cycle of a country and is therefore interesting to track in this framework as region-specific growth is linked to geographical segmentation of firm sales revenue. Furthermore, many authors have argued that firm performance depends significantly on the total business cycle. For instance, Domowitz (1986) states that price-cost margins are sensitive to overall demand fluctuations and stresses the importance of cyclical patterns and the effect on firm performance.

Bartram and Bodnar (2012) geographically segment their data into local and foreign exposure to the macro-economy but do not account for variation in the foreign exposure.

[8] The three indicators: real Gross Domestic Product (GDP), total after tax profits and the rate of the Treasury note.
[9] Due to the long and broad list of macroeconomic variables to include, many authors have utilized a principal component analysis to impose structure and restrict their analysis to a selected group of macroeconomic variables (see Stock and Watson, 2004 who provide an overview).

Therefore, this paper extends their line of research for a large sample and includes region-specific exposure of geographical sales revenue. In a related study, Li et al. (2014) employ real GDP forecasts as an indication of expected country level performance. This paper builds on their work, and uses real GDP growth rates of geographical regions, to distinguish between macroeconomic exposure of domestic versus exporting firms. Firms characterized as exporters, i.e. with positive foreign sales revenue, are exposed to real GDP growth of regions where revenue is generated, allowing for heterogeneous firms' exposure measurement. Furthermore, the performance outcome based on firm size in conjunction with the relevance of macroeconomic exposure and firm fundamentals can be viably estimated. By constructing a new variable $MACRO_{i,t}$, following Li et al. (2014), combining geographical sales revenue with regional level real GDP growth rates, is an attempt to improve firm performance analysis. The method constitutes the basis for the interactive effect of firm size and macroeconomic exposure on firm performance.

2.4. Firm size and the macro-economy

Finding the specific role that firm size plays in translating business cycle movements into performance will help to examine the potential performance outcome discrepancy following macroeconomic exposure changes. Fort et al. (2013) investigate the cyclicality of job dynamics for heterogeneous firms in size and age by looking at various indicators of the business cycle and the state of financial markets. The authors distinguish between various ways to determine the business cycle[10], and examine the responses of firms based on their size to business cycle shocks, i.e. recessions and financial crises. Firm size groups are defined, where small firms have fewer than 20 employees and large firms have over 500 workers. In addition, they distinguish on firm age and incorporate medium sized firms into the analysis. However, one of the main limitations of their study is the use of only 30 observations, making comparison across firms rather arbitrary. The findings suggest that especially younger and smaller firms are negatively affected by contractions in the economy. Secondly, small firms exhibit more cyclical sensitivity and experience greater reduction in employment relative to large firms during a recessive period. Their methodological approach quantifies these economic contractions by the growth forecasts of real GDP of a certain country. One important missing factor in the literature outlined here, is the distinction in firm performance between firm size and geographical sales dispersion. Therefore,

[10] Unemployment rate, net employment, real GDP growth and deviation from the trend of the unemployment rate.

this paper incorporates a more extensive data set to ensure external validity of the results and stronger estimation certainty of the performance outcome discrepancy based on size.

Furthermore, the authors argue the ongoing debate and ambiguity in the literature about the response of small vis-à-vis large firms to movements in the business cycle, economic growth and various financial shocks, e.g. monetary policy, financial crises, financing constraints, market imperfections and employment changes. Most importantly, small firms compared to large firms, have a disproportionate response following shocks to financial markets and monetary policy. For instance, Sharpe (1994) discusses the implications of cyclical employment while Fazzari et al. (1988) are focused on the access of firms to capital markets. The conceptual underpinning, according to Gertler and Gilchrist (1994), is the financial transmission mechanism. This mechanism exploits cross-sectional consequences of monetary policy on capital market access, using firm size as a proxy, while controlling for the macro-economy. The findings suggest comparable responses of small and large firms when credit condition become more flexible but inventories and sales decrease significantly more for small firms during contractionary periods of the credit market. Thus, large firms have a greater ability to internally shift resources to departments within the firm affected harshly by the recession. These seminal papers form the basis of firm responses to the various aspects of the business cycle. However, Chari et al. (2007) are hesitant to conclude that small firms do exhibit more cyclicality relative to large firms because of the heavy dependence on the specific characteristics of the designated time period and explicit indicators and underlying causes of the business cycle. The authors do confirm the results of Gertler and Gilchrist (1994) for their specified timeframe but find that small firms are more sensitive to monetary policy shocks while large firms are more responsive to recessions identified by the National Bureau of Economic Research (NBER). From this disparity, the authors conclude the absence of a response differential based on size.

2.5. Macroeconomic exposure and firm size affect performance

Following this intense debate, Fort et al. (2013) mention the gap in the literature of the response of firms to the business cycle subject to their size. They state that their empirical model is unable to identify asymmetric responses of firms to different stages of the economy, i.e. contractionary against expansionary periods. They highlight the necessity of pinpointing the different firm performance outcomes following business cycle shocks based on firm size to better assess future

performance and inform management. The theoretical mechanism that explains the increased vulnerability of small firms following business cycle shocks remains unidentified. Therefore, to clarify on this issue, this paper tries to identify the potential differential performance outcome of small and large firms confronted with changing macroeconomic exposure.

The tightening of monetary policy increases interest rates and consequently borrowing and spending decrease. Consumers have lower demand for goods and services and GDP decreases which results in declining sales revenue of firms. The decrease in total sales changes firm macroeconomic exposure away from the market where the largest downturn occurs. Moscarini and Postel-Vinay (2012) argue that small firms are more sensitive to aggregate economic changes due to the affordability and availability of credit, as outlined by Gertler and Gilchrist (1994).

2.5.1. Macroeconomic movements and value of assets

In a seminal paper, Gertler and Gilchrist (1994) discuss the indirect theoretical mechanism how small and large are affected by the macro-economy. The authors create an indicator of sales and find that sales of small firms decrease more during monetary contraction, providing evidence in support of the mechanism that tightening of monetary policy increases the difficulties for small firms in accessing the credit market. Two conceptual underpinnings are outlined for this finding. Firstly, large firms facing demand fluctuations are more likely to smooth this variation over time by contracting out operations to small firms during economic expansions. While recessive periods stimulate large firms to keep all businesses and operations within the firm. Secondly, on average, small firms tend to be active in cyclical industries more than their larger counterparts.

In an important paper, Campello et al. (2010) examine whether firms during a recession were credit constrained and the consequences for their operations. The evidence suggests that firms that are constrained plan larger reductions in spending on capital and employment. Credit constrained firms sell more assets in order to fund their operations, forego otherwise fruitful opportunities for investment and cancel attractive projects. In addition, firms spent more cash and acquire more from existing lines of credit because future access might become more difficult. This builds on the mechanism outlined by Gertler and Gilchrist (1994), that small firms experience more difficulties in acquiring external capital during economic contractions. This theoretical mechanism can explain why small firms relative to large firms are more likely to experience a decrease in return on assets following a macroeconomic downturn.

2.5.2. Macroeconomic movements and number of employees

Following recessive periods, large firms reduce proportionally more jobs in comparison with small firms when the unemployment rate is high, consistently above the cyclical trend (Moscarini and Postel-Vinay, 2012). On the contrary, large firms tend to create more jobs when the unemployment rate lies under the trend rate. Prior research focuses on the effect on firm ROA resulting from changes in the workforce (Cascio et al., 1997). Firms either reduce their workforce to enhance performance and competitiveness or as a cost-reducing measure to combat economic downturns. The authors provide evidence that firms that purely reduce the number of employees has a negligible impact on firm performance. Whereas firms that simultaneously reduce employment and restructure their asset base are able to achieve higher returns on assets. Changing the workforce allegedly enhances productivity of the survivors and cut costs resulting in higher performance. Following their study, Espahbodi et al., (2000) state that poorly performing firms that downsize and subsequently increase assets, experience larger improvements in operating performance[11].

2.5.3. Macroeconomic movements and overall firm performance

According to Li et al., (2014) firms with a proportionally large exposure to countries with relatively high positive growth forecasts are expected to perform well. The authors expect a positive coefficient on macroeconomic exposure, because the variable measures the geographical exposure of firms' sales, proportionally to the divergent macroeconomic environments of the recipient regions. Therefore, the larger the exposure variable, the better the performance prospects for the firm and the higher the return indicators. Real GDP growth rates are a benchmark for firm performance, and larger firms presumably adapt more easily to changes in the macroeconomic environment. Two conceptual underpinnings could explain performance differences between firms based on their size when confronted with changing macroeconomic exposure. Firstly, Hovakimian (2011) looks at internal capital allocation or cross-subsidies across the business cycle of financially constrained firms. The framework follows the reasoning of Gertler and Gilchrist (1994), and states that conglomerates (large firms), are more effective at re-allocating funds from low to high profitable segments during recessions. Secondly, Lu and Beamish (2001) assign the performance divergence to the proposition of a U-shaped relationship for small and medium sized firms due to

[11] Downsizing the firm can be defined by lay-offs of workers and/or selling assets. Lay-offs are intended to increase efficiency whereas selling firm assets will lower expenses on depreciation and consequently cut the cost of sales.

the liability of foreignness and an inverted U-shaped relationship for large firms because of high costs of coordination at advanced stages of internalization. In response to these studies, Lu and Beamish (2004) propose a framework showing a horizontal S-shaped curve portraying decreased firm performance at the first stage with increased global diversification followed by performance improvements of internationalization, and deteriorating again for almost fully diversified multinationals. Thus, different phases of performance exist subject to the global exposure of firms.

2.6. Hypotheses

The first hypothesis focuses on dispersed geographical sales revenue and the macroeconomic conditions in the recipient countries and whether this information is valuable to determine performance. Firms with positive sales revenue outside the domestic market are exposed to more macroeconomic variation than solely domestically operating firms. The fast changes in the geographical sales dispersion of firms and cross-country differences in economic conditions suggest that firm performance is highly uncertain and dependent on many factors. A larger exposure of firms to countries with larger positive real GDP growth rates will increase performance. The following hypothesis is constructed for both the domestic and exporting firms and includes their individual exposure to real GDP growth rates. This prediction is tested by exploring whether including $MACRO_{i,t}$ improves analyzing firm performance. The standard model to analyze firm performance is a modified random walk that recognizes mean reversion. Firm fundamentals are used to isolate discrepancies in persistence of performance (Hou et al., 2012).

H1: Combining firm-specific geographical sales dispersion proportionately with region-specific macroeconomic conditions improves firm performance analysis.

The second hypothesis combines both macroeconomic exposure and firm size. Firm size is a key firm fundamental determining performance and macroeconomic exposure is different for exporting via-à-vis domestic firms and varies across exporting firms. Real GDP growth rates are a benchmark for future firm performance, and larger firms can more easily adapt to changes in the macroeconomic environment due to internal capital allocation and diversification strategies.

H2: Small firms experience larger fluctuations in performance following changes in macroeconomic exposure ($MACRO_{i,t}$).

3. Data

3.1. Data sources

The main variables utilized in the models are decomposed into two components: firm fundamentals and macroeconomic variables affecting both domestically oriented firms and exporting firms. Most importantly, the geographic segment data on sales revenue is acquired from Compustat for the domestic firms and from FactSet Fundamentals for the exporting firms. The market data and firm-specific operating indicators are mainly obtained from the Orbis database. Furthermore, the OECD database is utilized for the real GDP growth rates for all the countries in the analysis[12].

3.2. Sample characterization

The sample consists of non-financial firms, compiled of both domestic and exporting firms, paving the way for firms' performance comparison based on macroeconomic conditions and size. Exporting firms have positive sales revenues generated domestically and abroad, whereas domestic firms only generate sales revenue in the home market. The firms all have their headquarters located in the United States and are representative for the industrial companies in the country, due to the wide range of firms, both geographically spread over the country and varying in size. The firms have been generating revenue in at least one year over the past nine years, from 2009-2017[13]. Contrary to prior research, this study employs a larger sample relative to reasonably comparable studies (see e.g. Balakrishnan et al., 1990; Roberts, 1989). The sample consists of 1980 firms stretching between 12.000 and 13.000 firm-year observations dependent on the availability of performance indicator data. This particular sample is chosen because US firms bear large distributional variability in their geographical sales revenue which makes inference more assignable to a certain cause. Furthermore, the United States has experienced large macroeconomic turbulence over the past years (e.g. financial crisis and expansionary FED monetary policy[14]) and therefore constitutes an interesting sample. This specific time period is analyzed due to the availability and completeness of the data and because analyzing the nearest time period provides the most accurate implications for firms in the near future.

[12] To estimate the other macroeconomic variables, the Thomson Reuters Datastream can be accessed to estimate exchange rate volatility of US firms concomitant to geographical exposure. While the IMF provides inflation rate data.
[13] Allowing for natural firm dynamics of entering and exiting the market.
[14] The US Federal Reserve System (FED) has kept interest rates artificially low for a long time, presumably to facilitate more investment and expenditures to boost the economy.

Table 1—Summary statistics

	Observations	Mean	Standard deviation	Min.	Max.
$MACRO_{i,t}$	15,993	1.919	1.619	-2.776	8.620
ROA	17,098	2.643	17.015	-99.798	99.854
ROE	16,418	5.492	67.156	-999.054	942.091
Profit margin	16,592	5.086	19.777	-99.411	97.148
Total assets	17,308	5,793,856	2,350,000,000	0.050	78,200,000,000
Number of employees	16,314	13079.220	62905.210	1	2,300,000
Capital	17,201	300466.400	2,590,617	0	6,930,000,000
Liquidity ratio	17,301	2.220	3.476	0.001	90.080
Leverage ratio	17,301	0.211	0.239	0	7.423

Notes: Summary statistics for all variables of the 1980 firms in the sample from 2009-2017. Table 1 presents the number of observations, mean, standard deviation, minimum and maximum values of the variables. $MACRO_{i,t}$ is constructed according to the structure outlined in the methodology section. The performance ratios are provided along with the firm fundamentals. The main dependent variables, ROA, ROE and Profit margin are percentages, as well as the liquidity and leverage ratio.

4 Methodology

4.1. Baseline strategy

Numerous performance ratios have been used in the literature, e.g. return on assets (ROA), return on equity (ROE), earnings before interest and taxes (EBIT) and sales growth, to measure firm financial performance. These measures are favored over more firm-specific ratios due to their general availability and stronger external validity. First of all, in this study, and consistent with previous research (McNamara and Duncan, 1995; Benner and Veloso, 2008), firm performance is measured through return on assets. ROA reveals the amount of profit a firm generates in comparison to its total assets. The authors mention that ROA most closely proxies for firm fundamental operating capability, which is at the essence of performance. The capability of managers to utilize production factors idiosyncratically, will determine firm-specific performance, and be decisive in differentiation from competitors. Therefore, to obtain a complete analysis of firm performance, these differences have to be captured by performance indicators (i.e. ROA) due to their relative time-invariance (Issah and Antwhi, 2017). Furthermore, unlike other ratios outlined above, ROA is less subjectable to short-term manipulations of income statements since asset investments constitute a long-term approach, which complicates short-term adjustments. This indicator captures both inherent performance and operating capability in a complete manner. In addition, Chen and Lee (1995) argue that forecasting future cash flows, to calculate the economic

rate of return, is highly uncertain and ROA is the nearest proxy for firm performance. Secondly, ROE is included as the ratio reflects the return generated on shareholder equity based on externally acquired capital. The theoretical approach of Hall and Weiss (1967) is constructed on the persuasion that managers act accordingly to the best interest of the ultimate owners, who desire profit maximization. Therefore, ROE reflects firm efficiency to generate profits on invested capital and thus successfully undertake projects. Thirdly, profit margin is included as one of the performance ratios, calculated as the net income divided by revenue. Intuitively, a decrease in production costs due to more efficient use of firm fundamentals increases the profit margin. ROA and ROE, are merely indicators based upon historical accounting measures, and to complement the study the profit margin is included to provide an economic perspective (Chen and Lee, 1995).

Cornett et al. (2007) states that firm size is an indispensable factor to keep in mind when studying firm performance, and uses the logarithm of total firm assets at the end of the year in US Dollars as the proxy. Secondly, Fort et al. (2013) define firm size by taking the logarithm of the total number of employees. This measure enables the authors to trail employment dynamics following business cycle shocks. Adding the macroeconomic exposure component ($MACRO_{i,t}$), allows to test these size theories on performance based on firm-specific macroeconomic exposure.

Real GDP growth rates for all individual countries from the OECD database are used as a measure of the stance of the macro-economy. These country specific growth figures are combined into different regions, based on relative GDP of the individual countries, to calculate the real GDP growth rate for a region, i.e. $[\text{Performance}]_{t,r}$. The geographical sales figures of the US firms are interacted with the macroeconomic conditions of the recipient regions. After gathering the sales data for firm *i* in year *t* to region *r*, the sum is taken of this value to obtain $Sales_{i,t,r}$. The weights are constructed based on the geographical sales of a firm to a specific region at the beginning of the period (*see section 4.2.*). The last step is to standardize the regional level sales in order to sum to one for every firm-year observation, to estimate the macroeconomic exposure indicator:

$$MACRO_{i,t} = w_{i,r} \sum_{r} Sales_{i,t,r} * [Performance]_{t,r}, \qquad where \sum_{r} w_{i,r} = 1 \quad (2)$$

This approach to quantify the country-specific performance factors submerged to US firms selling abroad captures variation over time and across firms and therefore constitutes an accurate measure of macroeconomic exposure. Sales figures are used as a proxy for firm geographical exposure because the data coverage of geographical earnings is restricted. Sales disclosures of the firms are

drawn from the annual reports. Unfortunately, firms utilize heterogeneous approaches to disclose geographical sales data across firms as well as over time. Therefore, mapping geographical sales regions per firm over time is challenging. I use a standard tree structure for re-allocating sales at the aggregated regional level to selected individual countries based on based on a GDP weighted scale[15] (Roberts, 1989). This approach allows for the relative importance of economic activity in a region because more prevalent countries receive more sales in that particular year. This method potentially raises measurement error issues because the allocation of sales to these regions are sensitive to the macroeconomic environment of the countries. However, Balakrishnan et al. (1990) alleviate this issue by showing that there exists a close match between real sales disclosures and implied geographical sales based on a GNP weighted approach. Secondly, many geographical sales disclosures are untraceable to the actual recipient country and therefore unable to credibly be allocated to a specific region. Therefore, these sales are attributed to the region 'Non-US', being exposed to global macroeconomic conditions.

4.2. Weights and size cohorts

One of the issues related to tracking sales to geographical regions over time, keeping into account relative performance of the regions, is the potential correlation of sales weights to regions with firm fundamentals. Eaton (2011) states that high productivity firms self-select into the relatively more difficult markets. If these markets prove to experience larger growth rates, then the model might suffer from endogeneity as the baseline instruments of the model are correlated with productivity, hence performance. Therefore, the firm's decision to increase its proportional share of sales to a certain region due to a florescent growth prospective, biases the results. To alleviate this issue, the weights of geographical sales are constructed at the start of the period, ensuring exogeneity of regional growth movements. This allows for estimating firm performance differences, contingent on size, driven by exogenous movements in macroeconomic exposure.

Secondly, broad[16] size cohorts are constructed based on the size of the firm in the beginning of the period. By applying this approach, firms are not able to switch between cohorts in order to increase the internal validity of measuring the idiosyncratic macroeconomic exposure effect. The

[15] E.g. sales allocated to region 'North-America' disaggregated into US, Canada and Mexico based on relative GDP.
[16] Haltiwanger, Jarmin and Miranda (2013) have utilized more detailed firm size groups, but the focus of this paper is the performance movement of firms based on their size when confronted with business cycle fluctuations. For that purpose and that most studies have employed less refined sample groups, this approach suffices for size distinction.

firm size cohorts are constructed based on the value of assets[17] by taking the median value and dividing the firms into two sample groups. Furthermore, two different measures of the number of employees are used. Firstly, the median number of employees is taken and firms are subdivided into groups below and above the median. Secondly, following Fort et al., (2013) who have attribute small, medium and large firms to groups, I combine the small and medium firms based on total employees into the small and medium-sized enterprises (SME) category and all the firms above the 500 employee threshold into the Non-SME category. Table 2 outlines the descriptive statistics for the size cohorts and the corresponding values of $MACRO_{i,t}$. A quick glance over the table shows the relatively high comparability of $MACRO_{i,t}$ for the size cohorts[18].

Table 2—Summary statistics of $MACRO_{i,t}$ for the firm size cohorts

Firm			$MACRO_{i,t}$					
Size cohort	Characteristic	Range	Obs.	Mean	St. Dev.	25	50	75
Small	Assets	< median	7,578	1.892	1.636	1.677	2.275	2.744
Large	Assets	> median	8,415	1.943	1.603	1.677	2.364	2.813
Small	Employees	< median	7,524	1.864	1.635	1.647	2.273	2.692
Large	Employees	> median	8,379	1.971	1.603	1.677	2.391	2.853
SME	Employees	0 - 499	11,214	1.952	1.607	1.677	2.368	2.827
Non-SME	Employees	≥ 500	4,779	1.841	1.643	1.602	2.273	2.641

Notes: firm exposure variable ($MACRO_{i,t}$) for the different size cohorts. The median values of the firm size are taken to distinguish between small and large firms. The number of observations, mean, standard deviation and quartile distribution for $MACRO_{i,t}$ per size cohort are outlined.

4.3. Geographical sales

Following the analysis of Li et al. (2014), a division is made at the aggregated regional level. The authors distinguish between four main groups, i.e. North-America, Europe, Asia and Rest of the World (RoW), however, this approach limits the focus on only certain regions and increases the likelihood of measurement error. Therefore, I apply a more detailed scope to narrow down the different effects more thoroughly by creating additional regions. These regions consist of Latin America (All Americas excluding the US and Canada), United States, Europe, Asia (including Australia and New Zealand), Canada, Non-US and Rest of the World (mainly Africa, the Middle-

[17] Total assets is more accurate compared to sales as entering particular markets or fields is hampered by the difficulty of financing large sums of assets. In addition, total assets are superior to using total equity, as the size of financing is relevant, irrespective of the financing method, to determine the firm's opportunities (Hall and Weiss, 1967).
[18] Figure 1 in the appendixes shows the variation of MACRO over the sample period 2009-2017.

East and Central Asia). To increase validity of the US based sample, Latin America and Canada are added to the analysis compared to Li et al. (2014) due to the relative importance of US sales in these specific regions. To accurately map the $MACRO_{i,t}$ variable for a certain firm in a specific year, the following structure is employed, where the sum of geographical sales adds up to one:

$$MACRO_{i,t} = \%\, Sales\ to\ Europe * [Performance\ Europe]_t + \%\, Sales\ to\ Asia + [Performance\ Asia]_t + \%\, Sales\ to\ Latin\ America * [Performance\ Latin\ America]_t + \%\, Sales\ to\ Canada * [Performance\ Canada]_t + \%\, Sales\ to\ US * [Performance\ US]_t + \%\, Sales\ to\ RoW * [Performance\ RoW]_t + \%\, Sales\ to\ Non-US * [Performance\ Non-US]_t \quad (3)$$

4.4. Regression specification

A systematic panel regression approach is adopted to incorporate exogenous macroeconomic information into firm-level performance assessment based on firm fundamentals. The first analysis focuses on assessing whether incorporating $MACRO_{i,t}$ improves performance measurement of firms. The dependent variables (ROA, ROE and Profit margin) are taken as proxies for firm performance, and the independent variables are lagged one year to account for potential endogeneity and path-dependency, whereas the $MACRO_{i,t}$ exposure variable is analyzed in year *t*:

$$Firm\ performance_{i,t} = \alpha + \beta_1 Firm\ performance_{i,t-1} + \beta_2 MACRO_{i,t} + \beta_n X_{i,t-1} + \varepsilon_{i,t} \quad (4)$$

Secondly, the interaction between firm size and $MACRO_{i,t}$ is analyzed to find the importance of firm size on performance contingent on macroeconomic exposure. This allows for estimating the responsiveness of firms to macroeconomic exposure based on their size. The regression in Eq. (5) is performed with two different proxies for firm size, total assets and total number of employees:

$$Firm\ performance_{i,t} = \alpha + \beta_1 Firm\ performance_{i,t-1} + \beta_2 MACRO_{i,t} + \beta_3 MACRO_{i,t} * Log\ value\ of\ assets_{i,t} + \beta_4 MACRO_{i,t} * Log\ number\ of\ employees_{i,t} + \beta_n X_{i,t-1} + \varepsilon_{i,t} \quad (5)$$

The X in Eqs. (4) and (5) represents a vector of firm fundamentals: liquidity ratio, number of employees, total assets, capital and leverage.

4.5. Set of control variables

The control variables employed in the analysis are firm fundamentals and internal drivers of performance (see Appendix C for descriptions of the variables). Following the analysis on the interaction between firm-specific macroeconomic exposure and size, both total assets and total number of employees are included into the models to control for firm size. I expect a positive coefficient on both β_7 and β_8 in Eq. (5) following Lee et al., (2009), who state that the absolute size of the firm positively impacts performance. In addition, capital is essential as opportunities to acquire capital are heavily dependent on size. Beck et al. (2005) argue that large firms can internalize capital allocation rather than accessing financial markets and intermediaries, allowing firms to improve stability to exogenous shocks. According to agency theory, higher leverage lowers agency costs and thereby reduces operational inefficiencies leading to improved firm performance (Margaritis and Psillaki, 2010). Furthermore, Dhawan (2001) argues that small firms exhibit a higher probability of bankruptcy due to credit constraints and the liquidity ratio contains explanatory power in determining performance. The response of firms to macroeconomic changes is dependent on its access to capital, current liquidity and the leverage ratio (*see section 2.5*). These firm fundamentals determine if the firm is forced to sell-off or able to acquire assets and hire or fire employees ensuing exogenous changes, consequently paramount in assessing performance.

4.6. Identification strategy

Previous literature has generally had the limitation that short time windows were used in the empirical analysis with only modest and infrequent business cyclicality. Therefore, the causal effect of the business cycle is hard to measure as studies have not been able to accurately compare responses over different cyclical periods for heterogeneous firms. To overcome this common limitation, this study employs variation across a geographical as well as a time sphere.

Various authors state that firms react differently to macroeconomic shocks based on their size (see e.g. Sharpe, 1994; Gertler and Gilchrist, 1994; Fort et al., 2013). Therefore, the distinction between small and large firms is vital, allowing for assessing firm behavior in response to macroeconomic changes to improve performance. Dummy variables are created to separate size cohorts, and interacted with the macroeconomic exposure component. Only the interaction of $MACRO_{i,t}$ with the small-sized cohorts are included because of multicollinearity reasons.

This paper estimates multivariate regressions where the performance indicators in each year of the sample period are a function of several and divergent firm fundamentals and macroeconomic exposure. However, various problems arise by estimating this regression model. Due to the uncertainty to credibly state the strict exogeneity of the explanatory variables, a method is chosen to have a restriction on the serial correlation of the errors. In these cases, incorporating lagged values of the dependent variable changes into valid instruments in the differenced equations that are associated to future time periods. The econometric model employed in this paper, exhibits high expectation of an autoregressive error of at least order one, due to the nature of the variables[19]. Changes in many of the explanatory variables are bound to happen in the next periods due to the adjustment period until management's decisions actually have an effect on performance.

Due to the nature of the variables, potential endogeneity issues arise. Many recent papers outline the possibility to reduce endogeneity problems by replacing the suspected endogenous variables with their lagged values[20]. Following Cornett et al. (2007), lagging organizational performance variables allows governance structures to adjust that influence performance in the adjacent period and helps mitigating issues of simultaneity. Omitted variables bias could be present if certain firm fundamentals are not included into the regression model, however, the current selection is based on seminal papers, thus minimizing the risk of omitting variables that could potentially explain the performance of firms. Lastly, reverse causality issues could arise because firm performance indicators potentially influence the explanatory variables directly. For instance, return on assets affects the capital base of the firm, leading to regressors that are correlated with the error term. Therefore, to avoid these problems, regressions are performed both with lagged values of suspected endogenous variables as well as lagged changes to avoid these issues.

4.7. Generalized Methods of Moments (GMM) model

One of the limitations of the main econometric approach *(see section 4.4.)*, is the use of fixed individual effects for within-group estimators of dynamic models, leading to inconsistent estimators when the sample size increases (Nickell, 1981). The so-called 'Nickell bias' requires cautious inference of the main results and therefore, the Arellano and Bond (1991) model is

[19] Both the Wu-Hausman test and Durbin Chi^2 test reject the null hypothesis of exogenous variables and conclude that the independent firm variables are endogenous.

[20] E.g. Clemens et al. (2012) state: "We avoid poor-quality instrumental variables and instead address potential biases from reverse and simultaneous causation by the more transparent methods of lagging and differencing".

included to account for this bias. Applying a difference GMM model, which takes the lagged values of explanatory variables that potentially suffer from endogeneity, reduces this problem. GMM is used in this study because it most accurately estimates the relevant parameters based on the unbalanced panel data set, which alleviates the potential self-selection impact of firms in the sample (Arellano and Bond, 1991). Later empirical work (see Arellano and Bover, 1995; Blundell and Bond, 1998) shows that lagged levels are frequently poor instruments for first differenced equations, therefore the system GMM approach is performed to ensure consistent estimators in my finite sample[21]. Given the nature of this study with geographical sales revenue dispersed over countries, time-invariant characteristics of countries play a role. Therefore, applying the dynamic panel-data GMM model, using first-differences of both the dependent and independent variables, controls for these potential biased estimators. A benefit of using the GMM estimator is its design for relatively small time samples, (t=9 in this study) with a large number of observations (N=1980). Furthermore, the GMM model incorporates both past and current information and by applying the second lags of the differenced dependent variables accounts for the time-invariant unobserved components. However, including the lagged dependent variable potentially leads to autocorrelation. To cope with that problem, the lagged dependent variable (ROA_{t-1}) is first-differenced and additionally instrumented with its prior levels in Eq. (6):

$$Firm\ performance_{(i,t)-(i,t-1)} = \alpha + \beta_1\ Firm\ performance_{(i,t-1)-(i,t-2)} + \beta_2\ MACRO_{(i,t)-(i,t-1)} + \beta_3\ MACRO\ x\ small\ size\ cohort_{(i,t)-(i,t-1)} + \beta_n\ X_{(i,t)-(i,t-1)} + \varepsilon_{(i,t)-(i,t-1)} \quad (6)$$

5. Results

Table 3 reports the outcomes of the regression specification in Eq. (5), in which firm performance is instrumented by various measures of performance ratios and macroeconomic exposure addressed to the firm. The regression is estimated on a pooled cross section sample of US firms while clustering the robust standard errors by firms to control for autocorrelation and heteroscedasticity. Fixed effects are included in the model to eliminate time-invariant variables by the within estimator of the coefficients on the time varying covariates. The model of Eq. (5) is

[21] The results obtained from the system GMM approach, provide suggestive evidence confirming the main findings of the difference GMM approach. The system GMM tables are excluded for the sake of brevity.

estimated for three different performance measures: i) ROA, ii) ROE and iii) Profit margin to analyze the broad spectrum of firm performance indicators. The variables in the regression are winsorized at the 1 percent level rather than trimmed[22]. The R-squared's of the models are not very high, however, the residual plots show evenly spread residuals allowing for accurate inference.

The main variables of interest presented in table 3 are the exposure variable $MACRO_{i,t}$[23] and the interaction terms of the exposure variable $MACRO_{i,t}$ with the two firm size cohorts *(see table 2)* to test the hypotheses. The interaction terms provide a clear understanding of the relationship between firm size and geographical macroeconomic exposure on firm performance.

5.1. Baseline results

The first important observations from the results presented in table 3, outline the lagged values of the dependent variables. Performance is mean reverting[24] for all six regression specifications, covering three firm performance measures, due to the positive and significant coefficients of the lagged variable. This finding is in line with prior research (see e.g. McNamara and Duncan, 1995), and based on Eq. (1), that the current firm performance ratio is subject to the one-period lagged prior performance and the current stance of the macro-economy. Observing the mean reversion characteristic of the performance variables has important economic implications for long-term growth perspectives and geographical sales dispersion (Shaver, 2011).

Changes in firm performance are not related to variations in firm-specific macroeconomic exposure (β_2 is not statistically significant). This finding suggest that the inclusion of $MACRO_{i,t}$ has no effect on firm performance, providing insufficient evidence in support of hypothesis 1. The model of Eq. (5) estimates the interaction between firm-specific macroeconomic exposure and size on performance. A detailed fragmentation analysis is required to obtain the estimates of within-sample differences in firm size and therefore the size cohorts are constructed. The main results presented in table 3 outline the performance differentials based on two equally sized subsamples, below and above the median value of assets. The interaction term between $MACRO_{i,t}$ and the size cohort of small value of assets, provides evidence of a statistically significant difference between small and large firms following exogenous movements in firm-specific macroeconomic exposure.

[22] The tails of the distribution are important and winsorizing reduces the skewness, often present in financial data.
[23] Using GDP growth rates from the International Monetary Fund (IMF) provides similar results as the OECD data.
[24] By means of various unit root tests; the null hypothesis that the panel contains a unit root is rejected and the tests state the presence of trend stationarity in the dependent performance variables, consistent with prior literature.

To assess the overall effect to small firms, the coefficients of β_2 ($MACRO_{i,t}$) and β_3 ($MACRO_{i,t}$ x small $assets_{i,t}$) are accumulated, resulting in a coefficient of 0.1693. In terms of economic relevance, an overall increase of 1 percent in real GDP growth equiproportional to the firm's macroeconomic exposure enhances performance, measured via the return on assets, for small firms by 16.93 basis points. Results are robust to using the SME and non-SME size cohort distinction.

Table 3—Baseline results

	(1)	(2)	(3)	(4)	(5)	(6)
Dependent variables	ROA	ROE	Profit margin	ROA	ROE	Profit margin
ROA_{t-1}	0.187***			0.189***		
	(0.027)			(0.0248)		
$MACRO_{i,t}$	0.070	3.897	0.427	0.380	4.451	0.426
	(0.484)	(5.557)	(0.438)	(0.410)	(5.263)	(0.407)
$MACRO_{i,t}$ x small assets	0.099***	0.103	0.003			
	(0.031)	(0.258)	(0.034)			
$MACRO_{i,t}$ x small employees				0.125**	0.044	-0.039
				(0.059)	(0.482)	(0.081)
Liquidity ratio $_{t-1}$	-0.181**	0.046	-0.087	-0.203**	0.017	-0.089
	(0.092)	(0.473)	(0.155)	(0.089)	(0.493)	(0.155)
Capital $_{t-1}$	0.0963	0.312	0.485***	0.140	0.442	0.530***
	(0.167)	(0.640)	(0.179)	(0.173)	(0.662)	(0.181)
Total assets $_{t-1}$	-2.651***	-9.629***	-2.930***	-2.701***	-11.260***	-2.634***
	(0.752)	(3.203)	(0.761)	(0.774)	(3.197)	(0.770)
Total employees $_{t-1}$	-0.966	4.369	-1.044	-0.766	5.094	-1.283
	(0.695)	(3.415)	(0.882)	(0.685)	(3.743)	(0.876)
Leverage $_{t-1}$	-0.168	10.490	-3.586**	-0.402	12.420	-4.477**
	(2.153)	(11.090)	(1.795)	(2.210)	(11.09)	(1.815)
ROE $_{t-1}$		0.105***			0.107***	
		(0.030)			(0.031)	
Profit margin $_{t-1}$			0.205***			0.205***
			(0.023)			(0.023)
Constant	44.810***	90.450**	50.270***	43.880***	107.300***	48.730***
	(8.156)	(36.590)	(8.978)	(8.164)	(36.460)	(8.993)
Year dummies	Yes	Yes	Yes	Yes	Yes	Yes
Observations	12,764	12,261	12,327	12,514	12,024	12,086
R-squared	0.059	0.017	0.065	0.059	0.018	0.066
Number of companies	1,752	1,730	1,733	1,751	1,729	1,731

Notes: All the performance indicators are regressed on lagged values of the independent variables and one-year lag of the dependent variable. The interaction terms are constructed by multiplying the macroeconomic exposure variable, $MACRO_{i,t}$, with the small size cohorts (table 2). Logarithms are taken of total employment, total assets and capital. The remaining firm fundamentals and performance indicators are ratios. All specifications include year dummies. Robust standard errors in parentheses. ***, **, and * denote statistical significance at the 1, 5, and 10 percent levels respectively.

The second principal result follows from regression specification (4) in table 3, and shows that the interaction of $MACRO_{i,t}$ with the below median cohort of employees in the sample is significant and positively related to performance ($\beta_3 = 0.125$). Therefore, small firms experiencing an increase in the regional growth of its major sales locations, thus higher $MACRO_{i,t}$, leads to performance improvements via a higher return on assets. Again adding the coefficients of $MACRO_{i,t}$ and the interaction term, reveals an improvement of 50.5 basis points in firm performance following an overall 1 percent increase in real GDP growth equally spread over the sales regions[25]. The estimation results show that small sized firms are more sensitive to movements in the macroeconomic conditions associated with idiosyncratic exposure, consistent for both size proxies for the main performance indicator ROA, confirming the second hypothesis. Thus, the interlinkage between firm size and macroeconomic exposure suggests that an exogenous decrease in firm-specific $MACRO_{i,t}$, e.g. the firm's geographical exposure is mainly targeted towards regions experiencing economic downturns, will lead to a decline in ROA.

Several theoretical mechanisms can explain these findings. First of all, small firms exhibit more difficulties in obtaining external credit and access to the credit market tightens more for small firms compared to large firms during economic downturns. The exclusion to the credit market forces small firms to forego profitable investments earlier than large firms (Gertler and Gilchrist, 1994), and consequently operating returns deteriorate more. Secondly, the possibility of easily shifting internal capital, cross-subsidies and change investments from low to high performing business segments, conditional on relative regional growth rates, is more prevalent for large firms compared to small firms (Hovakimian, 2011). Furthermore, the author states that the harder it is to obtain external credit, the more efficiently it is allocated to alternative investment projects. In a similar vein, Shaver (2011) finds evidence of geographic sales diversification reducing the constraints firms face in acquiring investment liquidity and increasing the likelihood of pursuing strategic investments, otherwise unattainable. Therefore, the main conclusion from this analysis and contribution to the literature, is that small firms, based on total assets and total number of employees, are more affected to direct changes in macroeconomic exposure than large firms.

[25] Or equivalently, a one standard deviation increase in macroeconomic exposure (1.619) increases performance of small firms by 16.028 percentage points based on assets and 20.238 percentage points based on the number of employees (calculated as 1.619*0.099*100 = 16.028 and 1.619*0.125*100 = 20.238).

5.2. Domestic versus exporting firms

The outcomes of table 4, based on the model in Eq. (4), show that the firm size variable is dependent on the construction of subsamples based on the firms' main geographical activities, i.e. domestic and exporting firms. The added value of this model is testing the general informational content of the geographical macroeconomic exposure component on performance, facing only the domestic market or both markets. Secondly, the separate analysis of firms allows for assessing if macroeconomic information is useful to estimate firm performance independent of the geographically spread, and potentially distorted, sales data. In addition, the model examines whether the results are not caused by domestic and foreign simultaneous movements in demand, but rather firm-specific macroeconomic exposure fluctuations.

Table 4—Domestic versus exporting firms

	(1) Full sample	(2) Domestic	(3) Exporters
ROA_{t-1}	0.187***	0.099**	0.263***
	(0.027)	(0.044)	(0.026)
$MACRO_{i,t}$	0.136	-0.545*	0.394*
	(0.185)	(0.314)	(0.220)
Liquidity $ratio_{t-1}$	-0.170*	-0.172*	-0.104
	(0.090)	(0.097)	(0.201)
$Capital_{t-1}$	0.119	0.109	0.153
	(0.168)	(0.269)	(0.220)
Total $assets_{t-1}$	-3.293***	-2.544**	-3.955***
	(0.707)	(1.140)	(0.807)
Total $employees_{t-1}$	-0.935	-1.539	-0.246
	(0.696)	(1.038)	(0.904)
$Leverage_{t-1}$	-0.501	-0.160	-0.844
	(2.113)	(3.328)	(2.401)
Constant	54.810***	48.660***	58.360***
	(6.920)	(11.320)	(8.041)
Year dummies	Yes	Yes	Yes
Observations	12,764	4,961	7,803
R-squared	0.053	0.028	0.089
Number of Companies	1,752	689	1,063

Notes: Regression specification (1) shows the full sample, (2) only domestic firms and (3) only exporting firms on ROA. Roughly 60 percent of firm-year observations from the full sample belong to the exporting group, making comparison credible due to the proximity in size of the groups. All the regression specifications include year dummies for the analyzed years. Robust standard errors in parentheses. ***, **, and * denote statistical significance at the 1, 5, and 10 percent levels respectively.

The model shows inconclusive results for the inclusion of $MACRO_{i,t}$ on firm performance based on the full sample in specification (1). Separating into domestic and exporting firms provides a contradictory result, with $\beta_2 = -0.545$ for the $MACRO_{i,t}$ variable of domestically oriented firms and $\beta_2 = 0.394$ for exporting firms (both coefficients are statistically significant). This result is striking because it reveals the comparative advantage of firms having the possibilities to shift between markets to align with firm-specific macroeconomic exposure. Domestic firms (column 2) have their operations fixed in the home market and are only subject to macroeconomic movements in that particular market. A negative coefficient on $MACRO_{i,t}$ for domestic firms suggests that firms seek increased operational efficiency following the weakening of the competitive position and only pursue high return projects because of the deteriorated exposure. When the domestic market grows, then firms choose a broader range of investment projects, paying less attention to quickly obtained returns and rather focus on the long-term strategy, thus decreasing the performance ratios. The primary finding from the analysis in table 4, suggests that having knowledge of cross-country real GDP growth is paramount in determining firms' performance. Another reason for the negative relationship could stem from the nature of the sample, as the US have experienced some turbulent macroeconomic times in the past 10 years. Firms that exhibit a large exposure to economically fast growing countries, will outperform other firms. Thus, the domestic sample has suffered from the meager macroeconomic times in the US (Li et al., 2014).

5.3. Difference GMM approach

Table 5 and Appendix B report the estimation results of the relationship between small sized firms and macroeconomic exposure on firm performance, when all variables are expressed in first differences. Incorporating the year dummies increases the likelihood that the assumption of no correlation across individuals in the idiosyncratic disturbances holds. When testing the model for zero autocorrelation in first-differenced errors suggests that no autocorrelation is present in the model. Furthermore, the output shows evidence against the null hypothesis of valid overidentifying restrictions, however the rejection is attributed to heteroscedasticity coming from the process of generating the data and controlled for with the robust standard errors. In contrast to the initial model, the lagged dependent variables are now negatively correlated with the error whereas table 3 shows a positive correlation, which biases coefficient estimates upwards.

The inclusion of $MACRO_{i,t}$ tests the prediction stated in hypothesis 1 and resultant improves the firm performance model, significant in model specifications (3) – (6), thus confirming the hypothesis. Efficiency-seeking behavior, pursuing relatively more high growth projects and ease of operational re-allocation are the driving forces underlying this result.

Table 5—GMM model

	(1)	(2)	(3)	(4)	(5)	(6)
Dependent variables	ROA	ROE	Profit margin	ROA	ROE	Profit margin
$ROA_{(t-1)-(t-2)}$	-0.443***			-0.685***		
	(0.025)			(0.038)		
$D.MACRO_{(t-1)-(t-2)}$	0.109	-0.921	0.709**	0.769**	3.033**	0.967**
	(0.309)	(1.321)	(0.358)	(0.367)	(1.436)	(0.376)
$MACRO_{(t-1)-(t-2)}$ x small assets	-0.025	-0.035	-0.037*	-0.018	-0.104	-0.034*
	(0.020)	(0.080)	(0.022)	(0.019)	(0.075)	(0.021)
Liquidity $ratio_{(t-1)-(t-2)}$	0.484***	1.622***	0.818***	0.482***	1.786***	0.748***
	(0.114)	(0.615)	(0.185)	(0.097)	(0.472)	(0.175)
Capital $_{t-(t-1)}$	-0.501	1.903	-0.523	-0.532	0.174	-0.647*
	(0.345)	(2.375)	(0.391)	(0.346)	(1.895)	(0.390)
Total assets $_{t-(t-1)}$	13.140***	59.390***	10.560***	12.270***	58.940***	10.510***
	(1.447)	(11.790)	(1.562)	(1.465)	(11.390)	(1.388)
Total employees $_{t-(t-1)}$	-1.569*	-3.159	-3.179***	-1.188	-1.643	-2.597***
	(0.942)	(5.418)	(1.059)	(0.849)	(5.462)	(0.912)
Leverage $_{t-(t-1)}$	-23.140***	-109.100***	-23.820***	-19.020***	-109.50***	-19.510***
	(6.023)	(23.290)	(4.099)	(6.090)	(22.950)	(4.477)
$ROE_{(t-1)-(t-2)}$		-0.529***			-0.827***	
		(0.031)			(0.052)	
Profit $margin_{(t-1)-(t-2)}$			-0.412***			-0.680***
			(0.019)			(0.025)
$ROA_{(t-2)-(t-3)}$				-0.413***		
				(0.031)		
$ROE_{(t-2)-(t-3)}$					-0.556***	
					(0.064)	
Profit $margin_{(t-2)-(t-3)}$						-0.353***
						(0.025)
Constant	-0.775*	-5.960***	-1.692***	-2.016***	-11.120***	-2.515***
	(0.415)	(2.041)	(0.467)	(0.405)	(2.168)	(0.452)
Year dummies	Yes	Yes	Yes	Yes	Yes	Yes
Observations	8,930	8,498	8,526	7,248	6,859	6,888
Number of companies	1,716	1,665	1,665	1,668	1,611	1,613

Notes: Baseline GMM model with the one year lagged first differenced interaction of small sized firms based on value of assets multiplied with the macroeconomic exposure variable. All the regression specifications include year dummies for the analyzed years. Robust standard errors in parentheses. ***, **, and * denote statistical significance at the 1, 5, and 10 percent levels respectively.

The results presented in table 5 provide inconclusive results on ROA, however the alternative specifications in appendix B in columns (1) and (4), outlining small sized firms based on the number of employees, confirm that an increase in macroeconomic exposure for small firms improves performance. Overall, the results in tables 3 and 5 show that small firms are more affected by macroeconomic exposure changes and imply that a 10 percent exogenous rise in macroeconomic exposure ($MACRO_{i,t}$) is associated with a 0.05 to 0.125 unit increase in performance (ROA). Reasonably, the results could be driven by the general consensus in the literature that domestically oriented firms tend to be smaller than their exporting counterparts (Bernard and Jensen, 1999). However, no major differences are observed between domestic and exporting firms, ruling out the factor that more productive firms are exporters in this sample[26].

In model specifications (3) and (6), the interaction terms have negative coefficients, meaning that an exogenous change in the macroeconomic exposure for small firms negatively affects its performance, based on profit margin. Secondly, the first differenced two lagged MACRO variables are positive and significant for all model specifications, i.e. (4) – (6). As the dummy variable controls for the small asset firms, the first differenced MACRO variable reflects the changes applicable for large firms following macroeconomic exposure fluctuations. The positive coefficients suggest that a lagged two year positive difference of macroeconomic exposure leads to an amelioration of large firms' performance.

6. Discussion

Macroeconomic exposure may be related across markets due to credit market imperfections and short-term liquidity needs to finance projects. Changes in macroeconomic exposure conditions can distort the extent to which firms can finance their operations and can ultimately restrict production. The findings in table 3 show that the coefficients for 'liquidity ratio' are significant and negative for ROA. Thus, an increase in a firm's liquidity ratio weakens its performance. To elaborate on this finding, table 6 provides a preliminary exploration of the role of the liquidity mechanism as a transmission channel underlying the disparity in performance outcome of small and large firms following macroeconomic exposure changes. As outlined by Gertler and Gilchrist (1994), small firms face relatively more difficulties in accessing credit markets with deteriorating economic

[26] Bar charts show no major differences between the firm groups. This increases the validity of inference based solely on the linkage between firm-specific macroeconomic exposure and size on performance.

conditions. Including the interaction terms of the macroeconomic exposure for small (model 1 and 2) and large firms (model 3 and 4) with the liquidity ratio, provides evidence that small firms are indeed more affected by the likelihood of accessing liquidity[27]. A one standard deviation (3.476) increase in the liquidity ratio, improves performance, measured via ROA, by 80.33 basis points[28].

Table 6—Liquidity channel

Dependent variable: ROA	(1)	(2)	(3)	(4)
ROA_{t-1}	0.185***	0.190***	0.189***	0.191***
	(0.0266)	(0.0246)	(0.0266)	(0.0247)
MACRO	-0.167	-0.0550	-0.110	-0.145
	(0.474)	(0.466)	(0.434)	(0.478)
MACRO x small assets x liquidity	0.0171***			
	(0.00418)			
MACRO x small employees x liquidity		0.0340***		
		(0.00880)		
MACRO x large assets x liquidity			0.00545**	
			(0.00240)	
MACRO x large employees x liquidity				0.0191**
				(0.00851)
MACRO x Liquidity	0.214	0.181	0.250***	0.229***
	(0.128)	(0.119)	(0.0857)	(0.0861)
Liquidity $ratio_{t-1}$	-0.834***	-0.796***	-0.813***	-0.762***
	(0.321)	(0.286)	(0.234)	(0.239)
Constant	46.91***	45.40***	45.51***	44.50***
	(8.278)	(8.273)	(8.182)	(8.259)
Firm controls	Yes	Yes	Yes	Yes
Year dummies	Yes	Yes	Yes	Yes
Observations	12,764	12,514	12,764	12,491
R-squared	0.067	0.066	0.061	0.061
Number of companies	1,752	1,751	1,752	1,743

Notes: Models 1 and 2 present the interaction terms of small firms' macroeconomic exposure with the liquidity ratio based both size proxies. Whereas, models 3 and 4 present the results for large firms. Robust standard errors in parentheses. ***, **, and * denote statistical significance at the 1, 5, and 10 percent levels respectively.

Therefore, small firms that are able to obtain external credit are able to pursue high growth projects and increase overall performance. These results are preliminary but potentially supportive of the liquidity channel in explaining the disparity in performance outcome based on firm size.

[27] Models 1 and 2 of table 6 show a positive and significant coefficient for small firms based on two proxies, whereas the interaction term between MACRO and liquidity for the full sample is insignificant, providing evidence of a statistically significant difference between small and large firms subject to acquiring liquidity.

[28] Calculated as 3.476 * (0.2311) * 100 = 80.33, with 0.2311 the sum of the coefficients β_3 and β_7 (0.0171 + 0.214).

Other possible mechanisms that account for small firms being more susceptible to changes in firm-specific macroeconomic exposure are related to the firm's customer base and product portfolio. Fort et al. (2013) mention that small firms have a relatively local customer base, reducing the potential tradability of the good to foreign markets resulting in less geographically spread clientele. Therefore, small firms are proportionately more reliant on the domestic market and infrequently sell abroad reducing business diversification that balances macroeconomic exposure (Shaver, 2011). Secondly, the product portfolio of small firms is less expansive and diverse relative to large firms and therefore small firms face larger consequences of exogenous demand shocks.

The findings of this paper have implications for the transmission of domestic and foreign macroeconomic shocks, such as demand and monetary shocks and financial crises, to firms varying in size. Results show that small firms with proportionately smaller macroeconomic exposure of sales to foreign markets are relatively more affected by changes in the foreign macro-economy. Therefore, to mitigate the consequences of macroeconomic fluctuations on business performance, firms have to address various international markets and diversify their product portfolio.

7. Conclusion

Using a large firm-level database on US firms combining firm fundamentals, geographical sales information and destination specific macroeconomic conditions over the period 2009-2017, I show that small firms are more responsive to exogenous changes in firm-specific macroeconomic exposure compared to large firms.

The empirical strategy identifies variations in firm performance outcomes driven by exogenous changes in firm-specific macroeconomic exposure based on firm size differences. Prior literature has lacked attention to the effect of firm-specific macroeconomic exposure on performance contingent on size. Firstly, the inclusion of the macroeconomic exposure variable does not directly influence performance of firms. Results show that exogenous movements in firm-specific macroeconomic exposure on performance is especially prevalent when comparing domestic and exporting firms. Diversification by selling to more markets than only the domestic market leads to enhanced performance. Furthermore, the negative relationship for domestic firms suggests that increasing sales to the domestic market with growing GDP leads to deterioration of performance based on return on assets, because less profitable investment projects are pursued. The GMM model provides evidence that including the idiosyncratic firm macroeconomic exposure

variable improves performance analysis. Efficiency-seeking behavior, pursuing relatively more high growth projects and ease of operational re-allocation affect macroeconomic exposure and consequently performance. The second main finding from the paper shows that small firms' performance, validated for total assets and number of employees, is more susceptible to changes in the macroeconomic environment, holding geographical sales dispersion and firm size fixed at the beginning of the period. Overall, the results imply that a 10 percent exogenous rise in firm-specific macroeconomic exposure ($MACRO_{i,t}$) is associated with a 0.05 to 0.125 unit increase in firm performance (ROA).

An alternative transmission mechanism for the performance outcome discrepancy could stem from the liquidity channel. Small firms face more difficulties in acquiring external capital leading to a deterioration of performance as potentially fruitful projects are not undertaken as internal capital shifting is relatively difficult.

Besides the macroeconomic exposure that firms face by selling to other countries based on foreign GDP growth rates, the firms also have to bear other macroeconomic price risks. Because many periods of fluctuations in the business cycle of a domestic economy are linked to market price variable changes that occur in that particular economy or in other countries. The underlying mechanisms of these changes are shocks to the macro-economy and market disturbances (Oxelheim and Wihlborg, 2008). The authors mainly discuss three major market price variables, i.e. interest rate, exchange rate and the inflation rate. Especially, these latter two cross-country price variables differ substantially between regions and therefore firms' geographical sales dispersion is highly subjective to them. Outlining these alternative measures of the macroeconomic environment improves firm-performance analysis and are interesting advances for future research.

A few limitations of this paper are concerned with the disclosure of firm sales data that complicates allocating sales to the specified regions. Secondly, the weights are constructed based on the beginning of the sample period, however, this construction could still suffer from endogeneity as firms have rational expectations of future growth regions leading to self-selection of firms into high growth markets.

The results seek to identify external drivers of firm performance by combining idiosyncratic macroeconomic exposure with firm fundamentals and tries to improve the understanding of performance outcome differences between small and large firms.

Appendixes

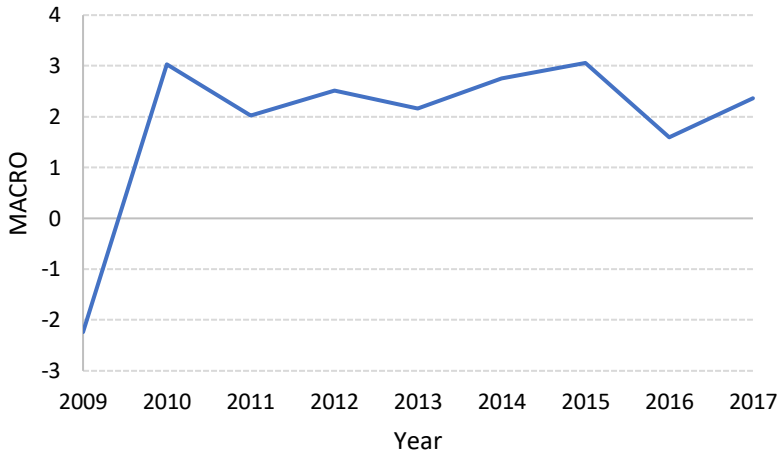

Figure 1. Macroeconomic exposure

Notes: The aggregate movement of the MACRO exposure variable over the full sample period for all firms is portrayed. The low spike in 2009 is associated with the global financial crisis while subsequent years show a more cyclical pattern. *Source:* Author's calculations based on the macroeconomic exposure variable $MACRO_{i,t}$ based on the initial framework of Li et al., (2014).

Appendix A—Correlation matrix

Variables	MACRO	ROA	ROE	Profit margin	Total assets	Number of employees	Capital	Liquidity ratio
MACRO	1							
ROA	0.0628*	1						
ROE	0.0467*	0.6054*	1					
Profit margin	0.0719*	0.7689*	0.4763*	1				
Total assets	0.0245*	0.0421*	0.066*	0.0928*	1			
Number of employees	0.0218*	0.1146*	0.155*	0.0618*	0.4973*	1		
Capital	0.0117	0.0436*	0.0458*	0.0806*	0.3475*	0.2722*	1	
Liquidity ratio	0.003	0.0684	-0.001*	0.0762*	-0.0667*	-0.1038*	-0.0194*	1
Leverage	-0.0115*	-0.1015*	0.0085*	0.0122*	0.092*	0.0705*	0.0313*	-0.1369*

Notes: The asterisk denotes a significant pairwise correlation between the two variables based on the 10 percent level of significance.

Appendix B—GMM model with small firms based on number of employees

	(1)	(2)	(3)	(4)	(5)	(6)
Dependent variables	ROA	ROE	Profit margin	ROA	ROE	Profit margin
$ROA_{(t-1)-(t-2)}$	-0.442***			-0.685***		
	(0.0248)			(0.0381)		
$MACRO_{t-(t-1)}$	-0.169	-0.686	0.516	0.503	2.695*	0.731**
	(0.285)	(1.256)	(0.337)	(0.333)	(1.429)	(0.367)
$MACRO_{t-(t-1)}$ x small	0.051	-0.174	-0.008	0.059*	-0.101	0.016
employees	(0.035)	(0.171)	(0.044)	(0.034)	(0.146)	(0.040)
Liquidity ratio $_{t-(t-1)}$	0.486***	1.627***	0.817***	0.483***	1.788***	0.746***
	(0.114)	(0.619)	(0.185)	(0.097)	(0.474)	(0.175)
Capital $_{t-(t-1)}$	-0.497	1.886	-0.525	-0.526	0.164	-0.645*
	(0.346)	(2.373)	(0.391)	(0.347)	(1.897)	(0.390)
Total assets $_{t-(t-1)}$	13.130***	59.360***	10.520***	12.250***	58.780***	10.450***
	(1.447)	(11.820)	(1.564)	(1.465)	(11.410)	(1.387)
Total employees $_{t-(t-1)}$	-1.647*	-2.941	-3.187***	-1.276	-1.544	-2.632***
	(0.938)	(5.343)	(1.056)	(0.846)	(5.403)	(0.911)
leverage $_{t-(t-1)}$	-23.160***	-109.200***	-23.840***	-19.010***	-109.500***	-19.490***
	(6.020)	(23.280)	(4.101)	(6.086)	(22.940)	(4.475)
$ROE_{(t-1)-(t-2)}$		-0.529***			-0.827***	
		(0.031)			(0.052)	
Profit $margin_{(t-1)-(t-2)}$			-0.412***			-0.680***
			(0.019)			(0.025)
$ROA_{(t-2)-(t-3)}$				-0.413***		
				(0.031)		
$ROE_{(t-2)-(t-3)}$					-0.556***	
					(0.064)	
Profit $margin_{(t-2)-(t-3)}$						-0.353***
						(0.025)
Constant	-0.753*	-5.936***	-1.666***	-1.993***	-11.060***	-2.489***
	(0.412)	(2.039)	(0.465)	(0.402)	(2.166)	(0.453)
Year dummies	Yes	Yes	Yes	Yes	Yes	Yes
Observations	8,930	8,498	8,526	7,248	6,859	6,888
Number of companies	1,716	1,665	1,665	1,668	1,611	1,613

Notes: GMM baseline model including the interaction of macroeconomic exposure with small firms based on the total number of employees. The interaction term is significant for ROA with a two lagged differenced dependent variable included in model (4) and close to the 10 percent significance level with a one year lagged differenced dependent variable in model (1). Robust standard errors in parentheses. ***, **, and * denote statistical significance at the 1, 5, and 10 percent levels respectively.

Appendix C—Description of variables

Variable	Description
MACRO	The sum of a firm's geographical sales exposure to various regions and multiplied with the GDP growth rates of these specific regions
ROA	The ratio of firm profits to total assets
ROE	The return generated on shareholder equity of the firms based on externally acquired capital
Profit margin	Net income divided by revenue
Liquidity ratio	Ratio of liquid assets to the liabilities of the firm
Capital	The value of tangible financial assets and externally obtained credit to pursue investment projects
Total assets	Total assets at the end of the fiscal year
Total number of employees	Total number of people employed at the firm at the end of the year
Leverage	Long-term firm debt divided by the total amount of assets
Sales	Total firm sales revenue in the fiscal year (in USD thousands)
Domestic firms	Firms that only sell to the domestic (US) market
Exporting firms	Firms that sell to both the domestic (US) as well as international markets

Notes: The table provides the descriptions of the variables included in the analyses and used throughout the paper.

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