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The Impact of Supply Chain Relationships on ESG Reporting and Profitability in the Global Automotive Industry

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ABSTRACT

We examine the influences of 11 global automotive industry OEM firms on their Tier 1 and Tier 2 suppliers' environmental, social, and governance (ESG) reporting and profitability. Linking 11 of the largest automotive manufacturers with 600 of their Tier 1 and Tier 2 suppliers, we empirically examine the relationships between ESG reporting and profitability along each global supply chain. We find there are statistically significant impacts from OEM's ESG scores on the ESG of their suppliers. We also find that ESG scores of firms are generally not significantly related to their accounting profits, but are more significantly related to their Tobin's Q, reflecting a stronger influence of ESG reporting on share values of firms than on internal accounting measures.

Keywords: ESG, Supply Chain, Profitability, Stakeholders, Automotive Industry

Data Availability: Data are available from the sources cited in the text

I. INTRODUCTION

Investors are increasingly interested in sustainable investing opportunities. In a 2019 Morningstar study based on a nationally representative sample of 948 respondents, over 72% of the respondents chose equities that had some sustainability focus versus focusing only on financial returns (Sin & Lamas, 2019). This interest has grown even more over the past two years (Lane, 2021). The Global Sustainable Investment Alliance reports over $35 trillion of sustainable assets under management in 2020, an increase of 15% over 2018, and a total of 36% of total assets under management (Global Sustainable Investment Alliance, 2021). There is also increasing attention to climate change and environmental concerns as evidenced in the August 9, 2021 United Nations report on climate change (Masson-Delmotte et al., 2021), and President Biden's August 5, 2021 executive order that by 2030, 50% of car sales in the US must be electric vehicles (The White House, 2021).

However, there exists significant concerns about the credibility of corporate environmental, social, and governance (ESG) reports to reflect actual practices and impacts. This skepticism is so great that the term "greenwashing" has been coined to describe the practice of a firm "presenting itself as environmentally friendly in an attempt to obscure its past or current practices that are harmful to the environment" (Merriam-Webster Online Dictionary, 2021; Polman, 2021). Addressing these credibility concerns will be a key to focusing corporate efforts to actually undertaking the sustainability challenges rather than simply producing glossy sustainability reports to satisfy investors.

One of the primary challenges in credible ESG reporting is the complexity and lack of transparency in global supply chains. It can be particularly difficult for multinationals to monitor and report on the environmental and social policies and practices of their lower Tier suppliers that compete primarily on factors such as quality, cost and delivery. Often lower tier suppliers lack sophistication in ESG reporting, and operate in countries that do not have a similar tradition of environmental and labor regulations as the OEMs. (Villena & Gioia, 2018). To address the challenges of harmonizing global sustainability disclosures, the IFRS Foundation created the International Sustainability Standards Board in fall 2021, which will incorporate the industry sustainability standards of the US SASB and the more general guidelines of the Task Force on Climate Related Financial Disclosures (TCFD). In March 2022, the ISSB issued exposure drafts on their proposed disclosure guidelines and is seeking comments by the end of July 2022. Their goal is to simultaneously address and harmonize with new disclosure proposals by the US SEC and European EFRAG to create better investor focused risk and opportunity disclosures that can be used by firms worldwide. The European Financial Reporting Advisory Group (EFRAG) (Slomp, Lemessiou, & Prete, 2021) has been leading the world in developing

meaningful ESG reporting standards to address the European Green Deal aimed at revitalizing economic growth. EFRAG ESG standards also address a broader stakeholder view of disclosure. Many questions remain regarding implementation of the disclosure standards, auditing and verification of the information, as well as integration with other more traditional financial disclosures formats, timing and dissemination methods. Developing credible, verifiable ESG reporting mechanisms and encouraging firms to implement them throughout their supply chain will be critical to obtaining the investment capital, skilled workforce, and regulatory approvals needed within the cost and profitability constraints of global competition.

We examine ESG reporting by understanding the relationships between OEMs and their suppliers in the global automotive supply chain. We also examine the relationship between ESG and financial performance along the supply chain. Our research aims to provide insight into ESG and sustainability reporting by identifying meaningful linkages between ESG actions and ESG reporting, and in turn, linkages to the financial performance of these manufacturers. The research questions we seek to answer are:

- **Question 1:** Do original equipment manufacturers (OEMs) influence the ESG practices, reporting, and outcomes of their Tier 1 and Tier 2 suppliers?

Because financial performance and profitability is essential to firm survival, our second research question is:

- **Question 2:** How do firm ESG practices, reporting, and outcomes influence firm financial performance along the supply chain?

By examining the influences of crucial stakeholders along the supply chain in the global automotive and auto parts industry, our research addresses the complexity of sustainable business and reporting in one of the planet's largest and most important manufacturing sectors in

terms of environmental, human capital, and societal impact. The automotive industry supply chain is the ideal focus for this research not only because of its impact on global GDP and employment, but also because of the life cycle environmental impact of the end-product in addition to the manufacturing process. Transportation is the largest contributor to greenhouse gas emissions (EPA, 2021) and the increasing attention to climate change as well as to urban traffic congestion and noise is foreshadowing a global transition from internal combustion engines to electric cars, ride sharing, and other innovations that are profoundly changing the industry. Focusing on the global automotive industry will allow us to focus on the challenges of meeting sustainability and profitability goals simultaneously in an evolving competitive landscape.

The global focus on climate change and social justice has elevated attention to ESG reporting in the past few years. Our study seeks to provide more clarity about whether and how large firms influence the ESG activities and profits of firms with which they have economic relationships. The next section summarizes the prior literature and the hypotheses we have developed to address our research questions. Section 3 provides details about the global automotive supply chain relationships, and related descriptive statistics of the firm level data we use to test our hypotheses. Section 4 provides the results of our statistical analysis and tests of hypotheses. Section 5 provides a discussion of the results and contributions of the research, while section 6 provides limitations and directions for further research.

1. PRIOR LITERATURE AND THEORETICAL FRAMEWORK

Research on sustainable practice adoption in global supply chains is rather limited (Kano, Tsang, & Yeung, 2020). Over the past 40 years, global value chains have evolved from vertically integrated organizational structures to distinct forms of asymmetrical networks with

orchestrating firms, often OEMs, providing a key role in selecting network participants, coordinating the inclusion of non-business intermediaries, leading joint strategizing, particularly in the development of new products for the market, providing financial and relational capital, monitoring multilateral feedback mechanisms, and influencing rules for equitable value distribution in terms of technological sharing as well as financial rewards (Kano, 2018). With increased focus on the environmental and societal impacts of global firms, understanding and coordinating ESG activities and outcomes along the global value chain is increasingly important (Institute for Supply Management, 2021).

Since the 1980s, manufacturing competitiveness has been framed by the quality-cost-time triangle. Traditional quality management assumptions about a trade-off between quality and cost (Garvin, 1993; Hayes, Hayes, & Wheel-wright, 1984; Skinner, 1969) were replaced by the "quality is free" cumulative model (Ferdows & De Meyer, 1990; Nakane, 1986; Rosenzweig & Roth, 2004; Schonberger, 1982). Further focus on manufacturing flexibility and the increasing use of automation and technology resulted in the integrative model (Hayes & Pisano, 1996; Schmenner & Swink, 1998) that recognized that tradeoffs assumed in a static model may be overcome by process improvements and other innovations that change the nature of these tradeoffs by advancing the production performance frontier.

Today ESG needs to be included as a new dimension of competitiveness in the manufacturing strategy paradigm. An increasing focus on sustainability, environmental, and social justice elements are driving investment capital, customer preferences, and regulatory requirements for firms around the globe. This wave of focus on ESG will transform the quality-cost-time triangle in manufacturing, to a quality-cost-time-ESG diamond. We propose that soon manufacturing firms around the globe will need to include ESG considerations throughout their

manufacturing strategy and across their supply chains (See Figure 1).

[Insert figure 1 here]

While the quality and flexibility movements of the 1980s were driven primarily by customer preferences (both end-use consumers and firms along the value chain) and cost, the adoption of this new diamond manufacturing paradigm will be driven by two additional powerful forces external to the firm: investors and regulators. As regulators demand more reporting and accountability for sustainability and social impact metrics along the value chain, firms and their suppliers will need to compete on all four of these dimensions simultaneously.

2.1 Global Value Chains

The primary issue we examine in this research is the management of ESG in the OEM and supplier firms in the global automotive industry value chain. Kano et al. (2020) provides a multidisciplinary literature review of global value chains (GVC), drawing works from the last 20 years. They created a framework to organize their examination of GVCs classifying articles into macro-level influences, including cultural institutional, geographical and economic characteristics of the home/host locations; micro-level influences including behavioral assumptions of decision makers in lead firms and peripheral units; and GVC level characteristics including structural and strategic governance issues. They found that while a great deal of research has been published there is not yet a dominant theory of GVC. They identified knowledge gaps and called for further empirical research regarding the measurement of geographic dispersion of GVCs, including firm level GVC mapping and linking locations with detailed data on flows of services and skills, employment, revenue and value creation as well as identification of where the most value is generated in the network. They also call for more research on the affect of the lead firm on structural and strategic governance, and the impact of

family firm-led GVCs. Our approach of specifically identifying Tier 1 and Tier 2 suppliers of major OEMs in Asia, the EU and US, and linking them in terms of revenue flows addresses these gaps in the literature.

Villena and Gioia (2018) made an exploratory attempt at examining linkages in the supply chain by conducting a qualitative analysis of three multinationals in different industries and 9 Tier 1 and 22 Tier 2 suppliers in their GVC. They developed a conceptual model for managing supply chain sustainability and conducted in-depth interviews supplemented by archival reports to validate their model. They found that lower tier suppliers pose the most risk for MNCs, as these lower tier suppliers often have little expertise and few systems in place for monitoring sustainability. However, increasing pressure by regulators and other stakeholders, and the reputation risk created by suppliers makes it imperative for MNCs to better monitor ESG throughout their GVC. Our study of these supply chain linkages in the automotive industry is much more comprehensive, examining the OEMs that represent over 80 percent of world market share and linkages with over 600 of their Tier 1 and Tier 2 suppliers. In one of the few large empirical studies linking GVCs, Wang, Li, Wu, and Anupindi (2021) identified supplier networks of 2258 focal firms in a variety of industries using the FactSet Revere database to determine whether the financial risks (volatility) of Tier 1 and 2 supplier firms resulted in greater risk for their focal firm customers. They also examined whether external shocks (power outages and natural disasters) affecting supplier firms impacted focal firm risk or stock returns. While their findings are significant, the focus of the studies are primarily of benefit to investors and do not provide management or other GVC participants with insights to make foresighted decisions.

Numerous ESG reporting standards and database firms have developed (Siew, 2015). For example, the Sustainability Accounting Standards Board (SASB) has led efforts in the US to

develop industry specific reporting standards, which are now the second most commonly used reporting regime (KPMG IMPACT, 2020). Fortunately, the SASB and the Integrated Reporting Framework joined forces to create the Value Reporting Foundation, which is now collaborating with the IFRS Foundation and others to create the International Sustainability Standards Board to harmonize standards of sustainability disclosures and reporting. When implemented, these standards will better enable firms to efficiently report ESG data that is both industry specific and useful across diverse domains (GRI and SASB, 2021).

An increasing number of firms are participating in the Carbon Disclosure Project (CDP) reporting, including at least five of the OEM firms in our sample. Since greenhouse gas emissions are increasingly the focus of concerns about climate change, many firms are also using the GHG Protocol standards[1]. The GHG Protocol Corporate Accounting and Reporting Standard provides requirements and guidance for companies and other organizations preparing a corporate-level GHG emissions inventory. The standard covers the accounting and reporting of seven greenhouse gases covered by the Kyoto Protocol – carbon dioxide (CO2), methane (CH4), nitrous oxide (N2O), hydrofluorocarbons (HFCs), perfluorocarbons (PCFs), sulphur hexafluoride (SF6) and nitrogen trifluoride (NF3).” Many firms are reporting Scope 1 emissions from their own production process and more are also reporting Scope 2 emissions from purchased or acquired electricity, steam, heat, and cooling. While Scope 3 emissions along the value chain are not as commonly reported, increased investor and regulatory pressure, are driving firms to integrate the environmental impacts of their suppliers in their reporting.

Similarly OEM firms are increasingly concerned about the reputation risks that could occur from societal harm by their suppliers, particularly child labor practices and illegal activities that would be reflected in low social and governance ratings. For example, Chakravarthy,

[1] Available at https://ghgprotocol.org/product-standard

deHaan, and Rajgopal (2014) find that firms strive to build up reputation after a restatement, targeting capital providers and other stakeholder groups such as customers. In addition, Herremans and Nazari (2016) indicate that managers are motivated by external stakeholders to develop sustainability reporting control systems. The timing of adopting corporate social responsibility reporting is also affected by external stakeholders (Bhimani, Silvola, and Sivabalan (2016). Finally, She (2021) examines a disclosure regulation enacted in California mandating that firms disclose how they conduct due diligence to address their suppliers' human rights abuses, and finds that treated firms increase their supply chain due diligence, and their suppliers' human rights performance improves following the regulation. We therefore propose our first set of hypotheses relating to the influence of OEM ESG policies on the ESG of their suppliers.

H1a: OEM ESG scores will be positively correlated to their Tier 1 supplier ESG scores.

H1b: Tier 1 ESG scores will be positively correlated to Tier 2 ESG scores.

In many accounting studies, culture and legal institutions are found to influence disclosures. L.L. Luo and Tang (2016) examine a sample of 1,762 firms from 33 countries, and find that cultural dimensions of masculinity, power distance, and uncertainty avoidance are strongly and consistently related to carbon disclosure propensity. More recently, using an international sample obtained from the Climate Disclosure Project, L. Luo, Wu, and Zhang (2021) find that corporate carbon transparency and disclosure is greater when managers' compensation contracts are better aligned with stakeholder interests and that this positive relationship is stronger in countries or regions with a code law legal system, with an inefficient rule of law, that show strong social norms toward climate change, that feature collectivist societies, and that have a long-term orientation. The EU has traditionally focused on integrated

reporting of societal as well as financial impacts. Recently the EU has announced an increasing focus on reporting standards to support the European Green Deal. We therefore expect that there will be a significant level of influence of European OEMs on their supplier ESG and Environmental Scores. The US EPA has also adopted a GHG reporting program and publishes firm level data on their website (EPA, 2022). We therefore expect that the influence of OEM firms on their Tier 1 and Tier 2 suppliers ESG may vary depending on the cultural, institutional, and regulatory regime in the OEM home country.

H1c: The relationships between OEM ESG and Environmental scores and Tier 1 supplier ESG and Environmental scores will differ by OEM.

H1d: The relationships between OEM ESG and Environmental scores and Tier 2 supplier ESG and Environmental scores will differ by OEM.

2.2 ESG and Profitability

Interest in why firms conduct ESG activity, and whether ESG improves the firm's financial performance is longstanding. Increasing levels of investment capital seek opportunities to invest in firms that can show both high returns and high levels of ESG. The results of prior research on the linkage between ESG and profits are mixed, and more importantly, our understanding of the mechanisms and factors affecting this relationship remains fragmented. A meta-analysis of 198 studies from the business and accounting literature examining the relationship between sustainability performance and financial performance was conducted in Lu and Taylor (2016). The research findings are mixed, however, the meta-analysis suggests that sustainability performance likely increases a firm's financial performance, especially in the long run. In comparison to social factors, environmental sustainability was found to contribute more to the positive ESG to financial performance relationship. In addition, they found that ESG appears to

be more highly correlated with accounting-based measures of performance than with share price performance indicators. Multi-industry, pre-2000 studies, and non-U.S. sample firms seem to show a stronger impact on the positive relationship between ESG and financial performance, perhaps because of the longer experience of reporting ESG factors in the integrated reporting system in Europe.

A comprehensive review of studies between 1980 and 2019 examining the relationship between ESG with corporate financial performance is conducted in Huang (2021). It is noted that much of the research focuses on observable end outcomes of ESG and financial performance, with comparatively little work that conceives ESG as part of overall firm activity. The studies show the strongest relationship between ESG measures and operational performance measures, with declining correlation coefficients to accounting measures and to stock market performance measures. This comprehensive review (Huang, 2021) concluded that scholars need a more holistic and multi-disciplinary approach to ESG research, with less focus on outcomes without sufficiently understanding the motivators and causality of the relationship as well as ESG's place in overall firm strategy (Grewatsch & Kleindienst, 2017; Ullmann, 1985). There is also a need to better understand company processes by which ESG actions lead to particular outcomes (Aguinis & Glavas, 2012; Gautier & Pache, 2015; Hang, Geyer-Klingeberg, & Rathgeber, 2019; Wood, 2010), and in turn to better understand the levers by which motivators are transformed into outcomes for the firm.

With regard to the impact of ESG on profit, particularly in manufacturing firms, common wisdom may suggest that sustainability increases cost. However, the interactive effects are more complicated. Customers may be willing to buy more sustainable products at higher prices, thereby offsetting the higher costs and even creating higher profit margins. This may be

especially true if regulatory requirements or other motivators result in greater transparency about GHG or other ESG factors along the supply chain. Traditional investment theory would suggest that if ESG investment leads to lower risk, we would expect market returns for such firms to also be lower. However this does not seem to be the case. Indeed, meta-analysis (Huang, 2021; Lu & Taylor, 2016) of existing studies on the relationship between ESG performance and financial performance (Aguinis & Glavas, 2012; Bénabou & Tirole, 2010; Gautier & Pache, 2015; Grewatsch & Kleindienst, 2017; Hang et al., 2019; Ullmann, 1985; Wood, 2010) calls for more comprehensive analysis and more insightful conclusions.

Matsumura, Prakash, and Vera-Munoz (2014) found that firms that disclosed carbon emissions in the CDP were more highly valued than firms that did not disclose. Khan, Serafeim, and Yoon (2016) hand-mapped sustainability investments classified as material for each industry into firm-specific sustainability ratings and find that firms with good ratings on material sustainability issues significantly outperform firms with poor ratings on these issues. In contrast, firms with good ratings on immaterial sustainability issues do not significantly outperform firms with poor ratings on the same issues. Christensen, Serafeim, and Sikochi (2022) found that there is considerable disagreement in ESG ratings, that raters disagree more about ESG outcome metrics than input metrics (policies), and that disclosure appears to amplify disagreement more for out- comes. They find that greater ESG disagreement is associated with higher return volatility, larger absolute price movements, and a lower likelihood of issuing external financing.

ESG is increasingly becoming a competitive advantage for firms appealing to socially conscious customers. Firms with high ESG are also attractive to investors, and could pose lower risks, thereby resulting in a lower cost of capital. The question is whether these market and cost advantages are shared among the players along the value chain, resulting in superior financial

performance outcomes along the supply chain, and not only for the OEM firm that consumers recognize. This leads to the following hypotheses:

H2a: Tier 1 supplier financial performance will be positively correlated with their own ESG scores and also their OEM firm ESG scores.

H2b: Tier 2 supplier financial performance will be positively correlated with their own ESG, their Tier 1 customer ESG and their OEM firm ESG scores.

2. METHODS

3.1 Global Value Chains

To test our research questions and hypotheses, we first identify significant firms in the global value chains of the largest OEM firms in the automotive industry. The eleven OEMs in our study are Ford, GM, BMW, Daimler, Volkswagen, Renault, Stellantis, Honda, Nissan, Toyota and Hyundai. These firms account for 80 percent of the world market share and span three continents, with sales, subsidiaries, and supplier operations in virtually every country. Using the Bloomberg Supply Chain function, we identify the top 12 to 15 tier one suppliers for each OEM, and in turn the top 15 tier two suppliers for each of the tier one suppliers. This process results in an initial linked data set of 751 firms, consisting of the 11 OEMs, 83 tier one suppliers and 657 tier two suppliers. We note that many suppliers are shared by more than one OEM, or more than one tier one supplier, especially in the US and EU.

Figures 2, 3, and 4 graphically illustrate the eleven industry global value chains for each continent. In the figures, circles represent OEMs and squares represent Tier 1 suppliers. (Due to the large number of Tier 2 suppliers, they are not included in these figures but are included in our other analysis models.) Node size is proportional to the firm size measured by revenues. The length of the connecting lines reflects the percentage of the supplier's revenue that comes from

the OEM customer, with shorter lines representing that a higher percentage of the Tier 1 supplier revenue comes from that OEM customer. We use blue for European firms, red for North American firms, and yellow for Asian firms. Color intensity indicates higher ESG disclosure scores. In Asia, there is a much greater level of exclusivity in the Tier one suppliers compared to the US and EU, where suppliers often participate in more than one value chain as indicated by multiple lines to the Tier 1 supplier. That said, there are a few firms that serve virtually all OEMs. These firms include large suppliers such as Continental, Denso, Magna, ZF Friedrichshafen, Aisin and others that are known to be among the largest 50 automotive suppliers in the world.

[Insert figure 2, 3, and 4 here]

3.2 ESG and Financial Data

Next we gathered financial data and ESG data for 2010-2020 for the firms in these global value chains. ESG data is gathered from two sources – the Bloomberg ESG data set and Refinitiv database. In addition to scores, the Refinitiv database includes information about a variety of ESG policies, actions and outcomes regarding engagement with customers, suppliers, employees, regulators, etc., as well as ESG outcome measures. Financial data from DataStream/Worldscope is available for all OEMs, 81 of 83 Tier 1 suppliers and 565 of 657 Tier 2 suppliers. Logically this is because some of the suppliers included in the Bloomberg supply chain data are not publicly held. Table 1 provides descriptive statistics for the OEMs in each continent and their related Tier 1 and Tier 2 suppliers. We can see that US OEMs are about 10 times the size of their Tier 1 suppliers and 23 times their Tier 2 suppliers based on median sales values. In the EU, OEM are about 7.6 times larger than Tier 1 suppliers and 14.5 times Tier 2 suppliers. In Asia, the size differences are even smaller on average with OEMs being 6.4 times larger than

their Tier 1 suppliers and 11 times larger than their Tier 2 suppliers. Interestingly, despite the size differences, the profitability of OEMs and their suppliers do not vary so dramatically, with median EBIT to sales percentages hovering in the 6 to 9 percent range for all continents and levels in the value chain.

[Insert Table 1 here]

3.3 Profitability and Financial Performance

Financial data for all firms was obtained from DataStream/Worldscope for 2010-2020. Table 1 contains the descriptive statistics for the firms in each continent's OEM's global value chain.

To provide insight on our two research questions we perform a variety of graphical, correlational and regression analyses to explore how ESG initiatives and outcomes occur along each supply chain. We also analyze how profits are shared along each OEM global supply chain and the linkages between ESG and profits. There are a variety of financial metrics we use to indicate the firm's performance, profitability and efficiency. Profitability measures include Return on Assets (ROA), EBIT to sales, and Tobin's Q.

3. RESULTS

4.1 Global Value Chains and ESG

The first research question asks how OEMs influence the ESG practices, reporting and outcomes of their Tier 1 and Tier 2 suppliers. Figures 5, 6, and 7 provide the 10 year trends for the 11 OEMs and their Tier 1 and Tier 2 suppliers' sales, EBIT/Sales, ESG scores and Environmental scores. Rather than 11 separate sets of graphs for each OEM supply chain, we group the OEM global value chains by continent, with OEMs represented by circles, Tier 1 by squares and Tier 2 by triangles. Different OEMs and their value chains are represented by different colors and line patterns. This analysis allows us to visually examine whether OEM

annual profits and ESG scores trend similarly to the annual mean sales, profits and ESG scores of their Tier 1 and Tier 2 suppliers.

[Insert Figure 5, 6, and 7 here]

In each set of trend graphs panel a shows the ten-year sales trends, panel b shows the ten-year profitability (EBIT/Sales) of the firms in each supply chain by continent, panel c shows the ten-year trend in the overall ESG score and panel d shows the ten-year trend in environmental score. The figures make it easy to visualize the size differentials between firms in the supply chain, and highlight that, while smaller, the lower tier suppliers are often more profitable that their OEM and Tier 1 customers. That said, OEM ESG scores tend to be higher than their suppliers, although there seems to be a general improvement and convergence in ESG scores over the ten-year time period.

To measure whether OEM ESG scores are significantly correlated with other variables and the outcomes along the value chain we computed the Spearman correlation coefficients between OEM ESG overall scores with all variables and illustrate them in Figure 8. Most correlations are relatively weak – less than positive 0.20 or negative 0.20. The most significant negative correlations reflect a negative relationship between ESG and firm size. The highest positive correlations are between OEM ESG and OEM Leverage. The highest OEM ESG scores are in the US and Europe, while the lowest OEM ESG scores for OEMs and suppliers are in Asia. There is a positive but relatively weak relationship between OEM ESG scores and Tier 1 ESG scores.

We next use regression analysis to further explore research question 1 about the influence of OEM firms on the ESG of their suppliers. Tables 2, 3 and 4 contain a series of regression models in which the Tier 1 and Tier 2 supplier ESG scores serve as dependent variables. Table 2

column 1 shows that OEM ESG scores are significantly related to the ESG scores of their Tier 1 suppliers. In column 2 we examine the impact of both OEM ESG and Tier 1 firm ESG on the Tier 2 firm ESG scores. We see that while OEM firm ESG has no significant influence on Tier 2 ESG scores, the more direct link from the Tier 1 supplier customer is very significant. These results support our hypotheses H1a and H1b, and are consistent with Villena and Gioia (2018) who found that MNEs have little control over downstream suppliers.

[Insert Table 2 here]

Table 3 provides more insight into the specific OEM firm impact on their Tier 1 suppliers by including OEM firms as independent dummy variables (column 1 and 3) and the OEM ESG scores (column 2 and 4) as independent variables. Columns 1 and 2 use Tier 1 ESG scores as the dependent variable and Columns 3 and 4 use the Tier 1 Environmental scores as the dependent variable. We also include supplier size, leverage and book to market value as control variables. In all the models we see that supplier firm size is significant and positively related to ESG scores. We see in column 1 that Tier 1 supplier ESG scores are positively related to being in Ford's and Stellantis' value chains, while Tier 1 suppliers in GM, Hyundai, and Toyota, and to a less significant degree, Volkswagen have lower ESG scores as indicated by the statistically significant negative coefficient. In column 2 we test whether the OEM ESG scores are related to their Tier 1 supplier ESG scores. The significance levels are lower, with only Toyota and Hyundai being negatively related at the .05 level and Nissan at the .10 level. In Columns 3 and 4 the dependent variable is the Tier 1 supplier Environmental score. Using OEM dummy variables we find that a negative affect for Tier 1 supplier Environmental scores for Hyundai followed by GM and then Volkswagen. Only Stellantis suppliers seem to have higher Environmental scores. Using the OEM Environmental scores as the independent variable, we find negative effects for

Honda, then Hyundai and Daimler.

[Insert Table 3 here]

We also computed the economic significance of the results. OEM ESG scores range from an average of .76 in Asia to .89 in the EU and have a standard deviation of .11. The average Tier 1 ESG firm score is .705. We computed that if the OEM ESG score increased by one standard deviation, the average magnitude change in the Tier 1 ESG score would be .056 which is about 8 percent of the average[2]. It is difficult to determine, but we do not believe that most users of ESG data would consider these impacts significant. The lack of significant positive effects leads us to conclude that most OEMs have a very limited meaningful impact on the ESG and environmental outcomes of their Tier 1 suppliers. While the overall models were significant, providing support for H1c, it is hard to conclude that OEMs are able to positively influence the ESG practices of their Tier 1 suppliers.

Table 4 explores whether OEMs influence the ESG and Environmental practices of their Tier 2 suppliers. For the Tier 2 firms, book to market becomes a significant control variable along with size. Column 1 shows that ESG scores of BMW Tier 2 suppliers are statistically higher while Nissan's Tier 2 suppliers are lower, though with weaker statistical significance. Column 2 shows that Tier 2 supplier ESG scores for Hyundai, Nissan and Toyota, and to a lesser extent Volkswagen, are negatively related to the OEM ESG score. There are no positive relationships, indicating that an improvement in OEM firm ESG scores does not seem to trickle down positively through the supply chain. Column 3 and 4 address the Tier 2 Environmental scores. In column 3, we see that Tier 2 environmental scores for Toyota are significantly higher than the mean, and to a lesser extent Renault and BMW. Using OEM Environmental scores in

[2] The mean of the Tier 1 ESG score is .705. The coefficient on Tier 1 ESG score is .511. The standard deviation of Tier 1 ESG score is .11. Therefore, the change in the Tier 1 ESG score for one standard deviation change in the OEM ESG score is calculated by .511 multiplied by 0.11 which equals .056.

column 4, we find only negative relationships for GM, Hyundai and Daimler. We also computed models combining the Tier 1 and Tier 2 suppliers into one data set and found similar findings (not shown). While the supplier ESG scores may differ between the OEM value chains, the supplier ESG scores are not positively correlated with the ESG scores of the OEMs. Therefore, we find little support for H1c and H1d, and cannot conclude that different OEM's ESG practices are significantly influencing the ESG practices of their suppliers. For the most part, we conclude that OEM firm ESG scores have little meaningful relationship to their Tier 1 and Tier 2 suppliers' ESG scores.

4.2 Global Value Chains, ESG and Profitability

The second research question addresses how the supplier-customer relationship ESG affects firm profitability. Table 5 contains regression models for Tier 1 supplier firm profitability. We use three measures of profitability– ROA, EBIT margin, and Tobin's Q. Independent variables for each model include control variables for size, leverage and book to market (or ROA for Tobin's Q). Independent variables of interest are the Tier 1 firm's own ESG score and the ESG scores of their OEM customers. The table shows that firms with more leverage and higher book to market, have lower ROA and EBIT margin. The firm's own ESG score is not significantly related to any profit measures. OEM ESG scores are weakly significant to ROA but significantly and positively related to Tobin's Q, providing some support for H2a.

[Insert Table 5 here]

Table 6 contains regression models for Tier 2 supplier firm profitability. Independent variables include the Tier 2 firm's ESG score, their Tier 1 customer's ESG score and the OEM lead firm ESG score. The ROA of Tier 2 suppliers is significantly related to their own ESG score and to the OEM ESG score. The Tier 2 firm EBIT margin is also significantly related to the

OEM firm ESG score, but not the Tier 1 customer. However, for Tier 2 firm Tobin's Q, the Tier 1 customer ESG and OEM firm ESG are both significantly positively related, providing support for Hypothesis 2b. We computed the economic significance of these results and found that a one standard deviation increase in Tier 1 supplier ESG would result in a 9 percent increase in Tobin's Q for the Tier 2 supplier[3]. While these results are difficult to interpret, it may be that these smaller supplier firm stock prices benefit from being associated with a more reputable customer base and supply chain. We also know that on average, OEMs in the EU and US have higher ESG scores than Asian firms, so Tier 2 suppliers in those chains might have higher market values and accounting profits which may explain these results.

[Insert Table 6 here]

4. DISCUSSION

Our results show that there are significant relationships between OEM firm ESG practices and their suppliers OEM practices and profits. However, the economic magnitude of these relationships is not great. Contrary to some conventional wisdom, while OEM firms are larger than their suppliers, they are not necessarily more profitable. In fact, in some supply chains the Tier 2 suppliers are the most profitable. To meet today's challenges to achieve greater ESG as well as profitability, firms may need to modify their business models by engaging differently with customers, suppliers, and other stakeholders, developing new sustainable products and services, training and realigning their workforce, accelerating their digital capabilities, investing in sustainable technology and processes, and optimizing their asset base. The business challenge is to better understand and enhance sustainable and responsible manufacturing while supporting the

[3] The mean of the *Tier 2 Tobin's Q* is 1.548. The coefficient on Tier 1 ESG score is .759. The standard deviation of Tier 1 ESG score is .19. Therefore, the change in the *Tier 2 Tobin's Q* for one standard deviation change in the Tier 1 ESG score is calculated by .759 multiplied by 0.19 which equals .144.

ability of firms to remain globally competitive on the dimensions of cost, quality and delivery that have been cornerstones of manufacturing for many years. Achieving this goal will provide firms with the necessary capital to innovate through research and development and upgrade and transition their physical resources to compete in the evolving automotive industry. It will also provide insight on regulatory policy and workforce needs. Developing new capabilities in ESG reporting will enable established companies and entrepreneurs to operate profitably while reducing the impact of manufacturing on the environment and addressing global challenges such as climate change, improving the health and quality of life of the workforce, and meeting societal expectations of social justice.

To meet the challenge of environmental regulations, manufacturers are beginning to embrace the opportunity to build their expertise and abilities in ESG to use as a competitive advantage in the marketplace. Similar to the quality movement in the 1980s, firms that embrace a continuous improvement approach to sustainability stand to achieve synergies with cost reduction, differentiation in the marketplace supporting higher price points, and the ability to attract and retain a higher quality workforce. And as in the management of quality, effective management of sustainability will require careful measurement and monitoring of processes and the involvement of a well-trained and engaged workforce. Technological innovations will also become increasingly important as cleaner energy production and recycling and treatment of waste will be imperative. Firms with a record of success in ESG will also have access to the capital they need for research and development and physical expansion. This superior access to capital combined with a well-trained workforce will always be a competitive advantage for manufacturing firms.

Our study contributes to the literature by analyzing the interrelationships among players along the global supply chain, and examining the specific firm relationships rather than generic industry connections. As such, it is designed to provide greater insights into how firms are impacted by these economic relationships. Focusing on a key global industry with elements of traditional manufacturing, increasing levels of high technology, and supply chains in a variety of countries with different cultures and stages of development our findings provide insights that are of use to both academic scholars and practitioners.

5. LIMITATIONS AND DIRECTIONS FOR FUTURE RESEARCH

Our research has several limitations with regard to data availability. Although we covered a large segment of the automotive industry, the number of firms we included in our supply chains are only a fraction of the industry. Also, we were unable to obtain data on Chinese OEM joint ventures, which are among the largest unit manufacturers. although most of the product is sold within China. Similarly, we did not include Indian OEMs or new electric vehicle OEMs. These firms are currently a small fraction of the market but will become more important in the future. The ESG data for this was largely drawn from Refinitiv, and many firms are not included in their database. The alternative ESG data from Bloomberg was even more limited. Furthermore, the ESG scores for these firms do not seem highly correlated, indicating the possibility for measurement error that could affect our results. Future research should integrate more qualitative data and information through interviews with OEM and supplier firm representatives as well as discussions with consultants in public accounting and other external verification experts to gain greater insights about the relationships between the firms, their stakeholders, and the challenges of ESG reporting.

Appendix A. Definition of Variables

Variable	Measure	Source
ESG score	ESG overall scores reported by Refinitiv	Refinitiv
ENV score	Environmental scores reported by Refinitiv	Refinitiv
SOC score	Social scores reported by Refinitiv	Refinitiv
GOV score	Governance scores reported by Refinitiv	Refinitiv
Net Income	Net income (item 7220)	Datastream/Worldscope
Sale	Sales (item 1001)	Datastream/Worldscope
Total Assets	Total assets (item 2999)	Datastream/Worldscope
EBIT/Sale	Earnings before income taxes to sales ratio calculated by earnings before income taxes (item 18191) divided by sales (item 1001)	Datastream/Worldscope
Leverage	Leverage calculated by total liabilities (item 3351) divided by total assets (item 2999)	Datastream/Worldscope
BTM	Book-to-market ratio calculated by book equity (item7220) divided by market capitalization (item 7210)	Datastream/Worldscope
ROA	Return on assets calculated by net income (item 7220) divided by total assets (item 7230)	Datastream/Worldscope
Tobin's Q	Tobin's q calculated by total assets (item7230) plus market capitalization (item 7210) minus book value of equity (item 7220) divided by total assets (item 7230)	Datastream/Worldscope
Size	Natural logarithm of total assets (item 7230)	Datastream/Worldscope
Ford	An indicator equal 1 if the firms are in Ford's supply chain; 0 otherwise	Bloomberg
GM	An indicator equal 1 if the firms are in Ford's supply chain; 0 otherwise	Bloomberg
BMW	An indicator equal 1 if the firms are in BMW's supply chain; 0 otherwise	Bloomberg
Daimler	An indicator equal 1 if the firms are in Daimler's supply chain; 0 otherwise	Bloomberg
Renault	An indicator equal 1 if the firms are in Renault's supply chain; 0 otherwise	Bloomberg
Stellantis	An indicator equal 1 if the firms are in Stellantis's supply chain; 0 otherwise	Bloomberg
Volkswagen	An indicator equal 1 if the firms are in Volkswagen's supply chain; 0 otherwise	Bloomberg
Nissan	An indicator equal 1 if the firms are in Nissan's supply chain; 0 otherwise	Bloomberg
Honda	An indicator equal 1 if the firms are in Honda's supply chain; 0 otherwise	Bloomberg
Hyundai	An indicator equal 1 if the firms are in Hyundai's supply chain; 0 otherwise	Bloomberg
Toyota	An indicator equal 1 if the firms are in Toyota's supply chain; 0 otherwise	Bloomberg

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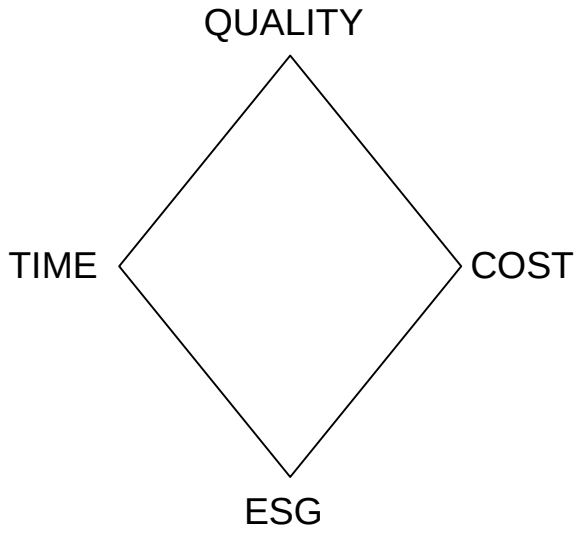
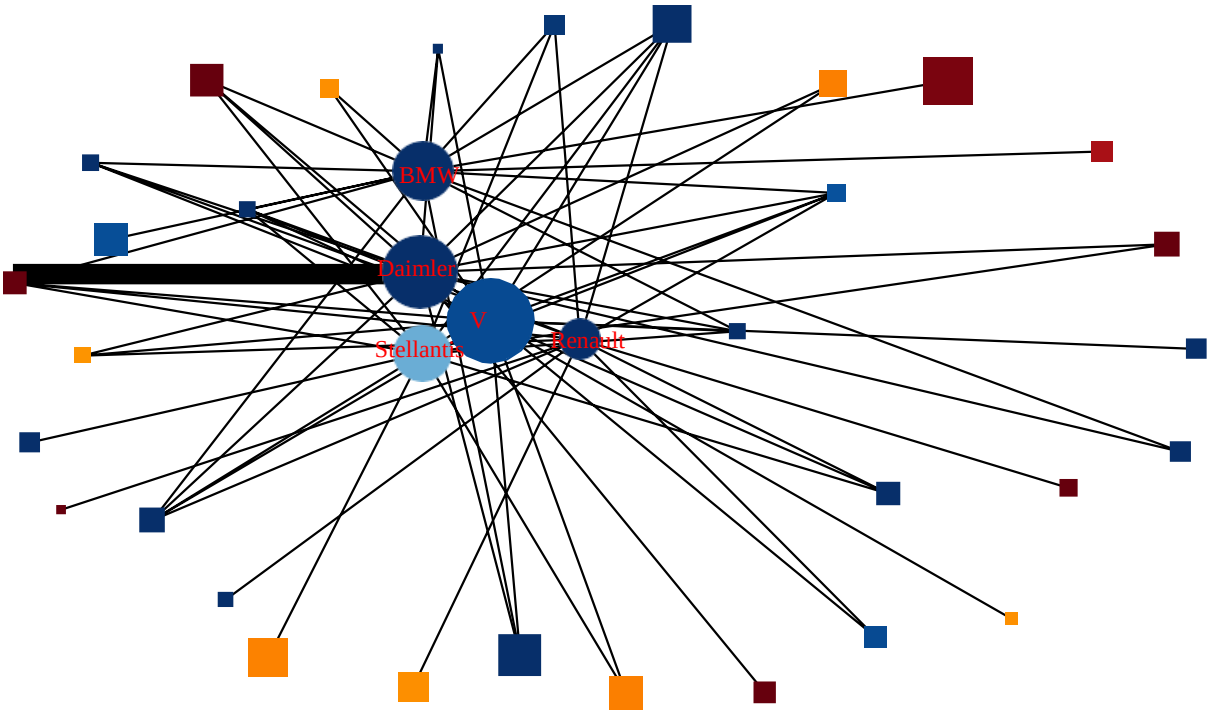
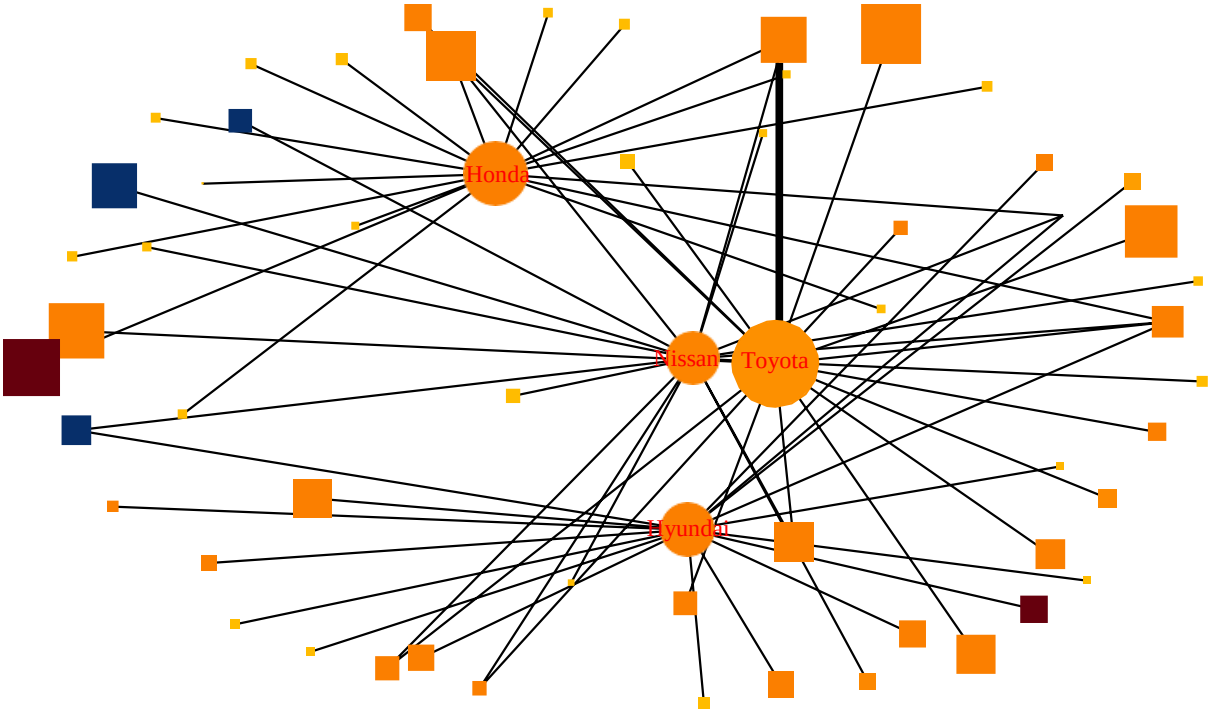


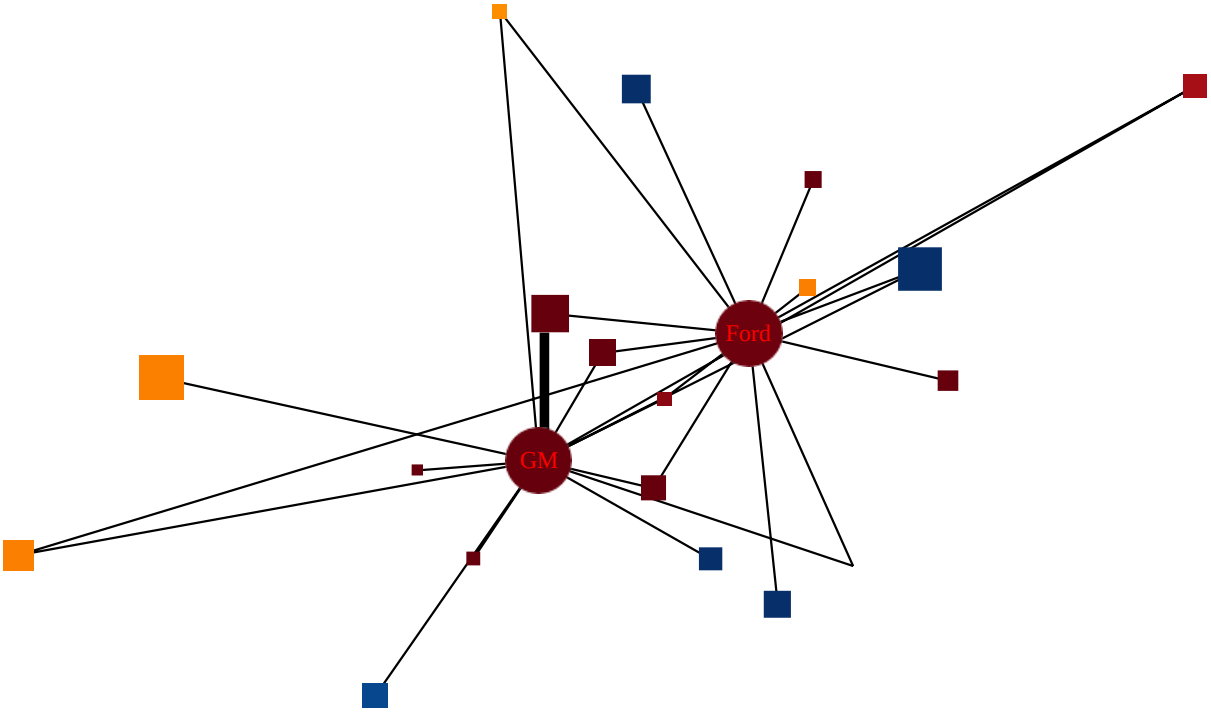
Figure. 1: Quality-Time-Cost-ESG Diamond



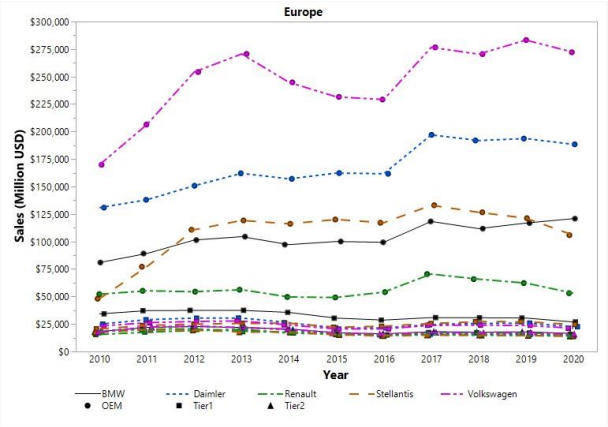
node size: proportional to sales
node shape: circles are OEMs, squares are Tier 1 suppliers
node color: blue for European, red for North American, yellow for Asian
node color intensity: darker for higher ESG scores, lighter for lower ESG scores distance between OEM and Tier 1: shorter for high percentage of revenue from OEM
Figure. 2: Visualization of the supply chain networks of European OEMs.



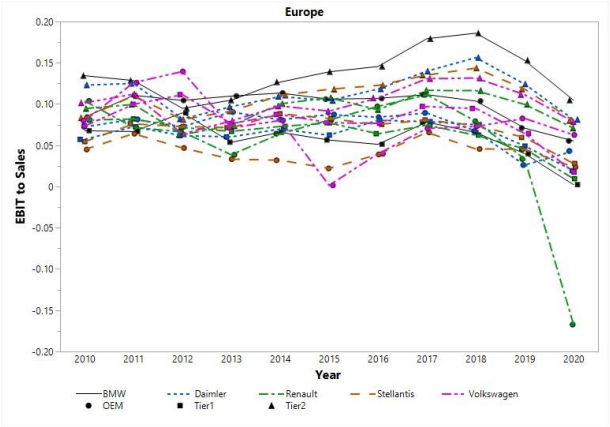
node size: proportional to sales
node shape: circles are OEMs, squares are Tier 1 suppliers
node color: blue for European, red for North American, yellow for Asian
node color intensity: darker for higher ESG scores, lighter for lower ESG scores distance between OEM and Tier 1: shorter for high percentage of revenue from OEM
Figure. 3: Visualization of the supply chain networks of Asian OEMs.



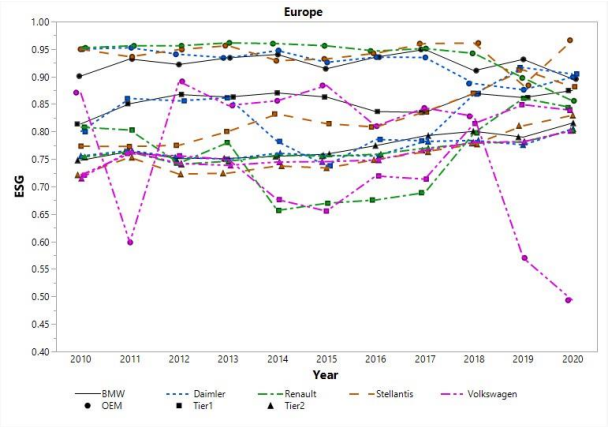
node size: proportional to sales
node shape: circles are OEMs, squares are Tier 1 suppliers
node color: blue for European, red for North American, yellow for Asian
node color intensity: darker for higher ESG scores, lighter for lower ESG scores distance between OEM and Tier 1: shorter for high percentage of revenue from OEM
Figure. 4: Visualization of the supply chain networks of American OEMs.



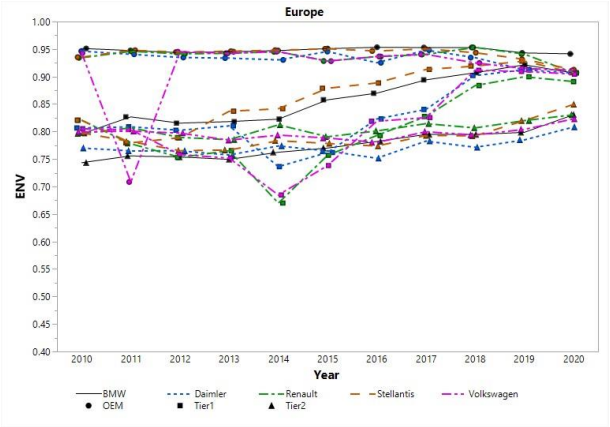
(a) Sales



(b) EBIT/Sales

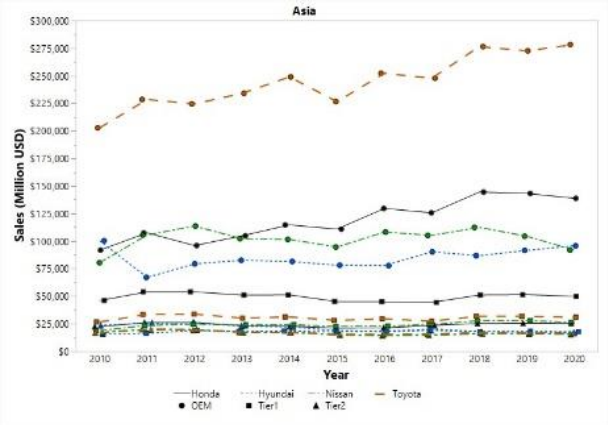


(c) ESG Scores

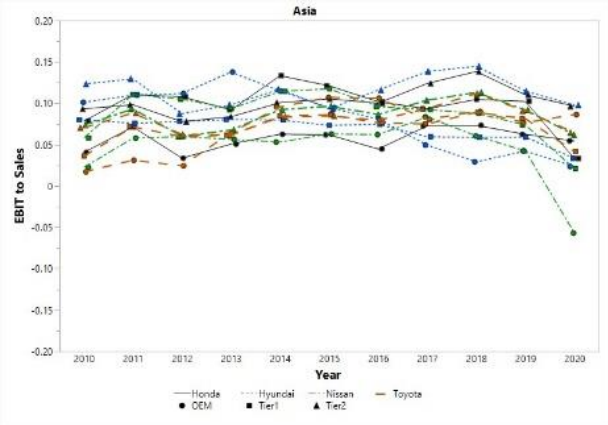


(d) Environmental Scores

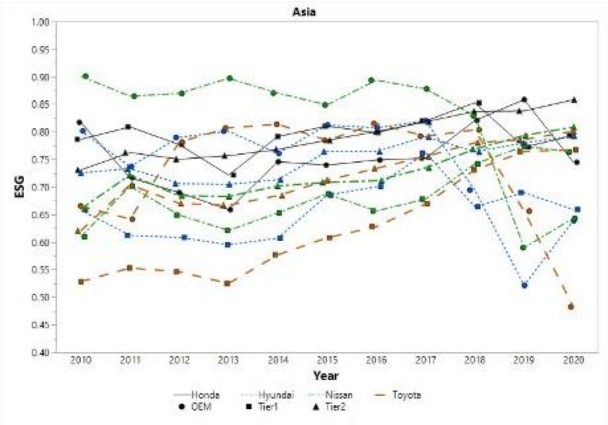
Figure. 5: Trends of key variables of European OEMs and their Tier 1 and Tier 2 suppliers



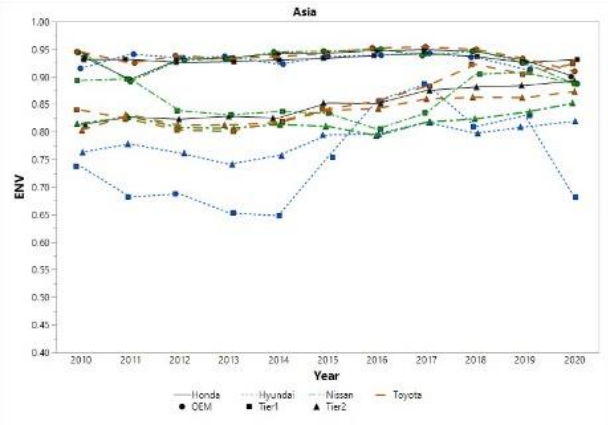
(a) Sales



(b) EBIT/Sales

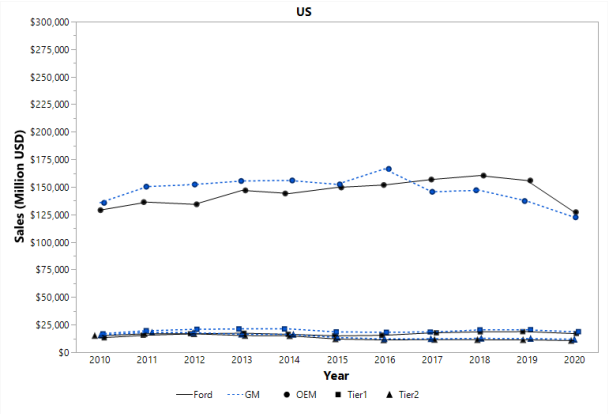


(c) ESG Scores

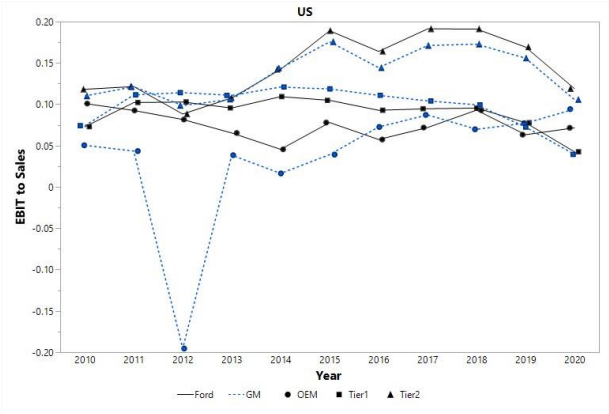


(d) Environmental Scores

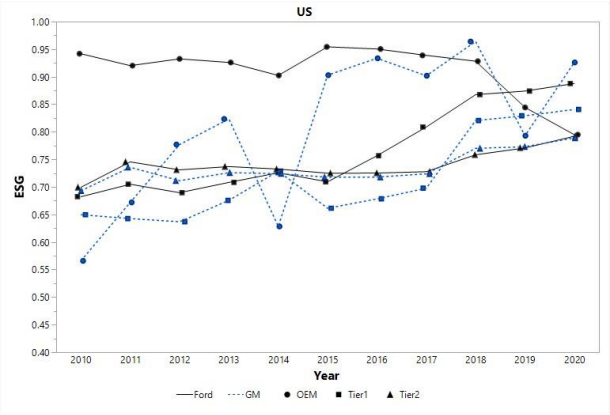
Figure. 6: Trends of key variables of Asian OEMs and their Tier 1 and Tier 2 suppliers



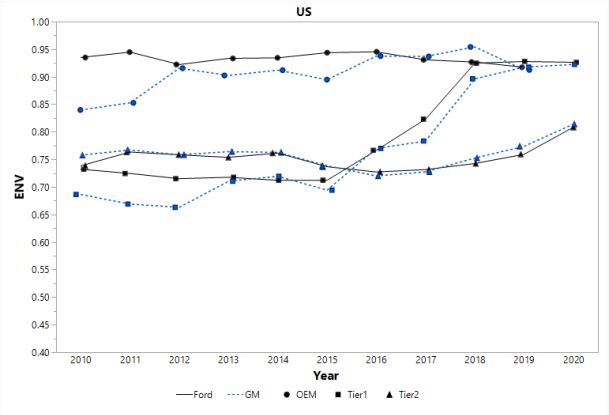
(a) Sales



(b) EBIT/Sales



(c) ESG Scores



(d) Environmental Scores

Figure. 7: Trends of key variables of U.S. OEMs and their Tier 1 and Tier 2 suppliers

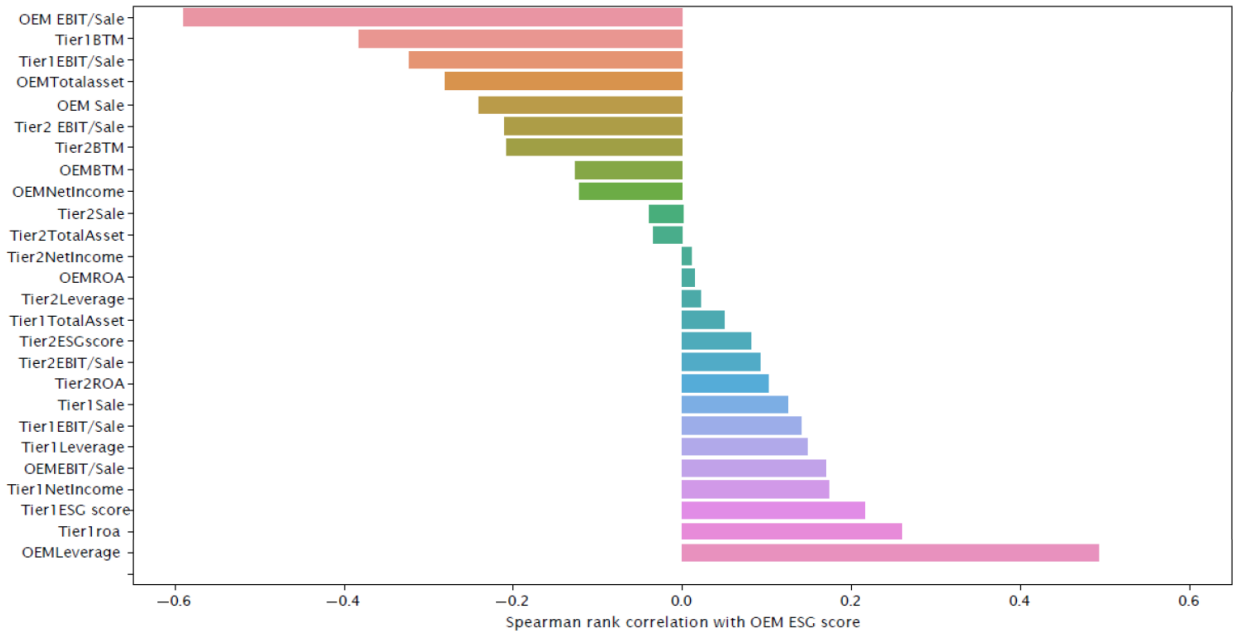


Figure. 8: Visualization of Spearman rank correlations between OEMs' ESG scores and quantitative and encoded categorical variables.

Table 1. Descriptive Statistics by Continent

Panel A. Europe (*N* is the number of firm-year data samples from 2010 to 2020)

	OEM (*N* = 55)		Tier 1 (*N* = 279)		Tier 2 (*N* = 1,666)	
Variable	Mean	Median	Mean	Median	Mean	Median
Net Income (in millions)	6,207	6,021	1,175	642	1,055	351
Sale (in millions)	136,385	119,253	23,570	16,635	17,875	8,682
Total Assets (in millions)	222,640	184,831	24,507	14,558	24,015	10,354
EBIT/Sale	0.07	0.07	0.08	0.07	0.12	0.08
Leverage	0.75	0.75	0.57	0.57	0.55	0.55
BTM	1.17	1.07	0.60	0.50	0.62	0.51
ROA	0.03	0.03	0.05	0.05	0.04	0.04
Tobin's Q	1.00	0.99	1.49	1.33	1.65	1.35
ESG Score	0.90	0.93	0.79	0.84	0.76	0.84
ENV Score	0.94	0.94	0.84	0.93	0.77	0.90
SOC Score	0.90	0.92	0.79	0.87	0.74	0.84
GOV Score	0.66	0.73	0.52	0.55	0.58	0.68

Panel B. Asia (*N* is the number of firm-year data samples from 2010 to 2020)

	OEM (*N* = 44)		Tier 1 (*N* = 315)		Tier 2 (*N* = 1,485)	
Variable	Mean	Median	Mean	Median	Mean	Median
Net Income (in millions)	6,685	4,753	1,129	568	1,120	361
Sale (in millions)	137,562	106,525	27,812	16,635	19,366	9,796
Total Assets (in millions)	212,870	160,331	28,441	16,717	27,067	11,959
EBIT/Sale	0.06	0.06	0.07	0.06	0.10	0.07
Leverage	0.63	0.61	0.54	0.55	0.53	0.52
BTM	1.15	0.98	0.91	0.83	0.71	0.66
ROA	0.03	0.03	0.04	0.04	0.04	0.04
Tobin's Q	0.99	1.01	1.24	1.08	1.50	1.21
ESG Score	0.76	0.79	0.65	0.72	0.74	0.81
ENV Score	0.93	0.94	0.82	0.93	0.81	0.91
SOC Score	0.84	0.85	0.71	0.81	0.76	0.86
GOV Score	0.22	0.17	0.21	0.11	0.43	0.30

Panel C. U.S. (*N* is the number of firm-year data samples from 2010 to 2020)

	OEM (*N* = 22)		Tier 1 (*N* = 179)		Tier 2 (*N* = 953)	
Variable	Mean	Median	Mean	Median	Mean	Median
Net Income (in millions)	6,003	6,381	805	564	875	302
Sale (in millions)	146,025	148,304	16,522	14,078	13,618	6,470
Total Assets (in millions)	190,382	189,612	14,506	11,221	19,622	8,882
EBIT/Sale	0.06	0.07	0.09	0.07	0.14	0.09
Leverage	0.82	0.83	0.56	0.56	0.56	0.54
BTM	0.64	0.64	0.53	0.48	0.60	0.50
ROA	0.03	0.03	0.06	0.07	0.04	0.04
Tobin's Q	1.11	1.10	1.54	1.37	1.63	1.37
ESG Score	0.86	0.91	0.75	0.81	0.74	0.81
ENV Score	0.92	0.93	0.80	0.92	0.75	0.90
SOC Score	0.74	0.79	0.70	0.80	0.72	0.82
GOV Score	0.82	0.83	0.55	0.63	0.58	0.68

Table 2. Regression Results for ESG Scores along the Supply Chain.

Tables 2 reports the regression results for ESG scores along the supply chain. Dependent variables are tier 1 and tier 2 suppliers' ESG scores. $x = 1$ when the dependent variable is Tier 1's ESG scores, $x = 2$ when the dependent variable is Tier 2's ESG scores. *t* values are reported in parentheses. ***, **, * Denote significance at the 1, 5, and 10 percent levels, respectively. All variables are defined in Appendix A. All continuous variables are winsorized at 1st and 99th percentile. All standard errors are clustered at the firm level.

Variable	*Tier 1 ESG Score*	*Tier 2 ESG Score*
Intercept	-2.132***	-1.700***
	(-4.53)	(-8.91)
OEM *ESG score*	0.511***	0.142
	(4.09)	(1.52)
Tier 1 *ESG score*		0.261***
		(4.91)
Tier x *Size*	0.100***	0.092***
	(5.06)	(13.93)
Tier x *Leverage*	0.151	-0.028
	(0.77)	(-0.46)
Tier x *BTM*	0.002	-0.004
	(0.07)	(-0.20)
Year fixed effect	Yes	Yes
Nation fixed effect	Yes	Yes
Adjusted R^2	0.243	0.289
N	538	2,301

Table 3. Regression Results for Tier 1 ESG and Environmental Scores.

Table 3 reports the regression results for Tier 1 ESG and Environmental Scores. Dependent variables are Tier 1 suppliers' *ESG scores* or *ENV scores*. *t* values are reported in parentheses. ***, **, * Denote significance at the 1, 5, and 10 percent levels, respectively. All variables are defined in Appendix A. All continuous variables are winsorized at 1st and 99th percentile. All standard errors are clustered at the firm level.

Variable	*ESG scores* OEM dummy	*ESG scores* OEM *ESG scores*	*ENV scores* OEM dummy	*ENV scores* OEM *ENV scores*
Intercept	-1.905***	-1.963***	-1.283**	-1.214**
	(-3.86)	(-3.87)	(-2.45)	(-2.12)
Tier 1 *Size*	0.115***	0.114***	0.092***	0.087***
	(5.37)	(4.65)	(4.04)	(3.36)
Tier 1 *Leverage*	-0.056	0.092	-0.003	0.077
	(-0.51)	(0.47)	(-0.03)	(0.45)
Tier 1 *BTM*	0.018	0.026	0.024	0.035
	(0.72)	(0.70)	(0.87)	(0.96)
Ford	0.135***	0.167	0.040	0.029
	(3.16)	(1.49)	(0.79)	(0.22)
GM	-0.099**	-0.060	-0.097**	-0.168
	(-2.32)	(-0.50)	(-2.16)	(-1.55)
BMW	0.012	0.024	-0.022	-0.004
	(0.23)	(0.18)	(-0.46)	(-0.04)
Daimler	0.060	0.095	0.003	-0.200*
	(1.16)	(0.50)	(0.05)	(-1.71)
Renault	-0.009	0.036	0.002	-0.014
	(-0.18)	(0.34)	(0.04)	(-0.21)
Stellantis	0.169***	0.229	0.105**	0.139
	(3.18)	(1.36)	(2.02)	(0.96)
Volkswagen	-0.112*	-0.068	-0.091*	-0.050
	(-1.88)	(-0.45)	(-1.76)	(-0.54)
Nissan	-0.074	-0.244*	0.018	0.038
	(-1.20)	(-1.90)	(0.33)	(0.35)
Honda	-0.001	-0.386	-0.029	-0.258*
	(-0.01)	(-1.65)	(-0.45)	(-1.93)
Hyundai	-0.136***	-0.233**	-0.119**	-0.162*
	(-2.99)	(-2.07)	(-2.23)	(-1.92)
Toyota	-0.169***	-0.258**	-0.052	-0.049
	(-3.30)	(-2.01)	(-1.04)	(-0.74)
Year fixed effect	Yes	Yes	Yes	Yes
Nation fixed effect	Yes	Yes	Yes	Yes
Adjusted R^2	0.424	0.394	0.264	0.247
N	538	538	522	515

Table 4. Regression Results for Tier 2 ESG and Environmental Scores.

Table 4 reports the regression results for Tier 2 ESG and Environmental Scores. Dependent variables are Tier 2 suppliers' *ESG scores* or *ENV scores*. *t* values are reported in parentheses. ***, **, * Denote significance at the 1, 5, and 10 percent levels, respectively. All variables are defined in Appendix A. All continuous variables are winsorized at 1st and 99th percentile. All standard errors are clustered at the firm level.

Variable	*ESG Score OEM dummy*	*ESG Score OEM ESG Score*	*ENV Score OEM dummy*	*ENV Score OEM ENV Score*
Intercept	-1.381***	-1.293***	-1.496***	-1.466***
	(-8.26)	(-7.40)	(-7.64)	(-7.58)
Tier 2 Size	0.090***	0.094***	0.095***	0.098***
	(12.42)	(12.60)	(11.17)	(11.34)
Tier 2 Leverage	-0.043	-0.065	0.014	0.003
	(-0.73)	(-1.08)	(0.22)	(0.05)
Tier 2 BTM	-0.005	-0.009	0.028***	0.025**
	(-0.27)	(-0.43)	(2.67)	(2.24)
Ford	0.033	-0.124	0.004	-0.112
	(1.19)	(-1.23)	(0.12)	(-1.00)
GM	-0.002	-0.070	-0.042	-0.202**
	(-0.10)	(-0.85)	(-1.33)	(-2.33)
BMW	0.064***	-0.050	0.045*	-0.043
	(2.81)	(-0.72)	(1.80)	(-0.60)
Daimler	0.020	-0.087	-0.035	-0.165*
	(0.69)	(-0.76)	(-1.12)	(-1.83)
Renault	0.034	-0.083	0.060**	-0.021
	(1.56)	(-1.17)	(2.02)	(-0.24)
Stellantis	0.035	0.106	0.027	0.114
	(1.24)	(0.97)	(0.76)	(0.74)
Volkswagen	-0.013	-0.188*	-0.003	-0.025
	(-0.47)	(-1.71)	(-0.11)	(-0.33)
Nissan	-0.060*	-0.489***	0.001	0.027
	(-1.69)	(-2.99)	(0.02)	(0.21)
Honda	0.035	-0.071	0.019	0.027
	(1.13)	(-0.52)	(0.58)	(0.26)
Hyundai	-0.006	-0.251***	-0.024	-0.119**
	(-0.24)	(-3.15)	(-1.00)	(-2.21)
Toyota	0.006	-0.204**	0.099***	0.042
	(0.23)	(-2.48)	(3.87)	(0.82)
Year fixed effect	Yes	Yes	Yes	Yes
Nation fixed effect	Yes	Yes	Yes	Yes
Adjusted R^2	0.291	0.296	0.348	0.336
N	2,301	2,301	2,231	2,215

Table 5. Regression Results for Tier 1 Profitability.

Table 5 reports the Regression results for tier 1 profitability. Dependent variables are tier 1 suppliers' profitability measures: *ROA*, *EBIT/Sale*, and Tobin's *Q*. *t* values are reported in parentheses. ***, **, * Denote significance at the 1, 5, and 10 percent levels, respectively. All variables are defined in Appendix A. All continuous variables are winsorized at 1st and 99th percentile. All standard errors are clustered at the firm level.

Variable	*Tier 1 ROA*	*Tier 1 EBIT/Sale*	*Tobin's Q*
Intercept	0.180	-0.155	0.896
	(1.67)	(-0.99)	(0.88)
Tier 1 ESG score	0.010	-0.050	-0.325
	(0.79)	(-1.41)	(-1.24)
OEM ESG score	0.044*	0.022	0.955***
	(1.86)	(0.86)	(3.90)
Tier 1 Size	-0.004	0.017**	-0.026
	(-0.83)	(2.07)	(-0.56)
Tier 1 Leverage	-0.095***	-0.209***	0.440
	(-4.27)	(-3.43)	(1.06)
Tier 1 BTM	-0.032***	-0.060***	
	(-2.89)	(-3.98)	
Tier 1 ROA			5.693***
			(5.41)
Year fixed effect	Yes	Yes	Yes
Nation fixed effect	Yes	Yes	Yes
Adjusted R^2	0.257	0.416	0.159
N	538	538	538

Table 6. Regression Results for Tier 2 Profitability.

Table 6 reports the Regression results for Tier 2 profitability. Dependent variables are Tier 2 suppliers' profitability measures: *ROA*, *EBIT/Sale*, and Tobin's *Q*. *t* values are reported in parentheses. ***, **, * Denote significance at the 1, 5, and 10 percent levels, respectively. All variables are defined in Appendix A. All continuous variables are winsorized at 1st and 99th percentile. All standard errors are clustered at the firm level.

Variable	*Tier 2 ROA*	*Tier 2 EBIT/Sale*	*Tier 2 Tobin's Q*
Intercept	0.055	-0.111	3.231***
	(1.15)	(-0.83)	(4.84)
Tier 2 ESG score	0.029***	-0.019	0.206
	(2.68)	(-0.67)	(1.09)
Tier 1 ESG score	0.009	0.047	0.759***
	(0.84)	(1.29)	(4.60)
OEM ESG score	0.037*	0.161***	0.698***
	(1.94)	(2.94)	(2.68)
Tier 2 Size	0.001	0.010*	-0.139***
	(0.22)	(1.69)	(-4.59)
Tier 2 Leverage	-0.135***	-0.269***	0.062
	(-4.98)	(-6.37)	(0.28)
Tier 2 BTM	-0.016	-0.043***	
	(-1.54)	(-2.79)	
Tier 2 ROA			4.824***
			(5.73)
Year fixed effect	Yes	Yes	Yes
Nation fixed effect	Yes	Yes	Yes
Adjusted R^2	0.131	0.088	0.181
N	2,301	2,301	2,301