A Framework for Product Impact-Weighted Accounts

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Impact-Weighted Accounts Project Research Report

Abstract

While there has been significant progress in the measurement of an organization's environmental and social impacts from its operations, metrics to evaluate the impact of products once they come to market lag far behind. In this paper, we provide a framework for systematic measurement of product impact in monetary terms and delve into the rationale for the framework's seven elements. We then apply the whole framework to two competitor companies to show the feasibility of measuring product impact and the actionability of the framework. We indicate the value of impact-weighted financial statement analysis with examples of insights enabled by industry-wide product impact measurement. We see our results as a first step, rather than a definitive answer, towards more systematic measurement of product impact in monetary terms that can then be reflected in financial statements with the purpose of creating impact-weighted financial accounts.

Keywords: impact measurement; product impact; ESG; accounting; financial statement analysis

1. Introduction

Given that all companies have impacts on employees, customers and the natural environment, efforts to measure environmental and social impact are crucial. Effective resource management depends upon an accurate understanding of the current baseline and the anticipated path forward. These allow for benchmarking, quantification of under- or out-performance, and the possibility for course correction. Metrics also allow for allocation of resources in markets and the development of price signals. Furthermore, they allow for the design of contracts, such as compensation or lending contracts, which incentivize certain actions. For example, recent efforts include the incorporation of environmental and social metrics in both executive compensation plans and in bank loan contracts. Similarly, they can be included in the design of regulatory incentives, such as tax or subsidy incentives.

The importance of measuring the impacts of companies is highlighted by the significant growth in efforts to understand, measure and improve environmental and social impact. More companies are disclosing environmental, social and governance (ESG) data as customers, employees, investors, and regulators are seeking to incorporate ESG considerations in their decisions. As of 2017, 75% of the largest 100 companies in each of 49 countries (75% of 4,900 companies) were issuing sustainability reports with ESG data, a marked increase from the 12% in 1993.[1] With over $22 trillion in assets under management labeled as ESG and more than $80 trillion publicly committed to integrate ESG data in investment decisions, asset owners and managers have demonstrated a commitment to integrate ESG information in their investment process.[2]

However, our own analysis and other research has indicated that currently most environmental and social metrics disclosed by companies and prescribed by reporting standards pertain to a company's operations, defined as activities that happen within the company's own organizational control or in some cases, in their upstream supply chains.[3] Examples of operational impacts include water consumption, waste generation, carbon emissions, employee health and safety records or diversity and inclusion efforts. While great progress has been made in measuring

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[1] Jose' Luis Blasco, Adrian King, et al., "The road ahead: The KPMG Survey of Corporate Responsibility Reporting 2017," KPMG International, page 9. Accessed July 9, 2019.

[2] Global Sustainable Investment Alliance, "2016 Global Sustainable Investment Review" (PDF File), downloaded from GSI-Alliance Website on July 9, 2019.

[3] George Serafeim, T. Robert Zochowski, Jen Downing. "Impact-Weighted Financial Accounts: The Missing Piece for an Impact Economy", Harvard Business School. Accessed December 16, 2019.

such operational impacts and more disclosure now exists around them, the progress on measuring the far-ranging impacts that products have on consumers and society has been less impressive.

Product impact refers to impact that occurs once a company has transferred control of goods or services, which is consistent with traditional accounting recognition of a sale. Measurement efforts for product impact are still coarse, relegated to broad categorizations such as businesses with large negative externalities, traditionally tobacco and more recently coal, versus all else. However, in reality, different products can have fundamentally different impacts due to their effectiveness and affordability among other factors.

Moreover, while significant progress has been made in the development of environmental and social metrics, these are not embedded in a financial statements' framework enabling managers and investors to understand trade-offs and relative performance evaluation that considers impact along with risk and return. Monetization based on available data translates impact into a language that is familiar to decision-makers. For this to happen impacts need to be measured and monetized based on available data. Creating impact-weighted financial accounts is a scalable solution for the incorporation of impact in business decision-making.

For companies that do measure their product impact, impact evaluation is highly specific, limiting comparability and scalability. Moreover, the number of companies that have managed to measure product impact in monetary terms is even more limited. Of the 56 companies that have experimented with monetary impact valuation, only twenty percent estimate product impact.[4] NS Rail applies a monetary value to the mobility trains provide, whereas Safaricom measures the value of secure financial connectivity created by M-Pesa. As demonstrated, the dimensions on which these companies measure product impact are highly specific to individual products. Therein lies the difficulty with measuring product impact: such impacts, in contrast to employment or environmental impacts from operations, tend to be highly idiosyncratic limiting the ability to generalize and scale such measurements.

A framework in which product impacts can be measured and monetized is needed. First, creating a framework to measure the impacts of products introduces a systematic and repeatable methodology that can capture product impacts across industries. This allows for transparency, comparability, and scalability of product impacts. Second, a framework enables more nuanced

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[4] George Serafeim, T. Robert Zochowski, Jen Downing. "Impact-Weighted Financial Accounts: The Missing Piece for an Impact Economy", Harvard Business School. Accessed December 16, 2019.

measurement of product impact. Rather than categorizing certain products, such as cigarettes or coal, as unequivocally negative, a framework allows measurement of the level of positive or negative impact that all types of products can create, including many that have large negative externalities but are not traditionally classified as 'sin' businesses (e.g. high trans-fat or sodium food). Measuring positive impacts allows for differentiation across products and companies and derivation of a more balanced assessment of a company's impact. Finally, the introduction of a product framework encourages a holistic approach of measuring and reflecting impact in financial statements by broadening the scope of impacts beyond operations. Instead of relying on customer willingness to pay or demand to measure product impact, a framework expands measurement to impacts that may not be felt by customers until years later or may not be borne by customers directly, as in the case of environmental damage. An exhaustive system for measuring impact is critical to promote and manage the development of products with better total stakeholder value. Ultimately, the aspiration is to provide investors and managers with the ability to make more informed decisions that account for the impact of a company's product using impact-weighted financial statement analysis.

In this paper we provide a framework for systematic measurement of product impact and the rationale for each of its elements. Moreover, we apply the framework in the context of two competitor companies to show the feasibility of measuring product impact and actionability of the framework. Finally, we provide examples of information that can be derived from impact-weighted financial accounts through analysis of product impact estimates for 18 global corporations across 4 years. We see our results as a first step, rather than a definitive answer, towards more systematic measurement of product impact in monetary terms that can then be reflected in financial statements with the purpose of creating impact-weighed financial accounts.

2. Current efforts to measure product impact

There has been a significant level of experimentation in the market attempting to measure product impact. These efforts have moved the field forward and allowed for a more sophisticated treatment of product impact. In examining the different methodologies used to measure product impact by organizations such as companies, investors, reporting standards, and data providers, a few patterns arise. The metrics often are input or process oriented and are highly specific to single products, investments, or industries. Where monetary impacts are estimated, there is a lack of

transparency around the specific assumptions used to monetize outcomes. In addition, the current state of product impact measurement has comparability and accountability limitations. Below, the current measurement efforts of different companies, investors, reporting standards, and data providers is examined.

2.1. Companies

Companies have made significant progress in identifying a consistent methodology with which to measure product impact. For example, the Handbook for Product Social Impact has created a consensus-based methodology to inform companies on how they can assess the impacts of products.[5] Given the highly idiosyncratic nature of product impacts, a consistent methodology can still produce a wide range of reported impacts that vary between companies. Even within a single company with a range of different products, there is no consistent set of metrics used to estimate product impacts. Yet, companies can compare their products to alternatives in the market when identifying the impact their product generates. These product impact comparisons indicate a feasibility for using similar metrics to compare the product impact of two different products and suggests there is some set of relevant metrics across products that should be identified and standardized.

TABLE 1

Sample of Companies Measuring Product Impact

Company	Example products	Measurement	Example metrics or impacts
ABN·AMRO	Fee and interest-based payment and account services, mortgages, corporate loans and advice[6]	Monetary ranges	Client value of money storage and management, value of time, data and privacy breaches, decrease in cash related crime, financial distress due to repayment difficulties of loans[7]
AkzoNobel	Decorative paints, automotive and specialty coatings, industrial coatings,	Descriptive and numeric and descriptive	Revenue from products with sustainability benefits that outperform the market, standard of reducing hazardous substances and volatile organic compounds in products, percent of timely deliveries[8]

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[5] Goedkoop, M.J. Indrane, D.; de Beer, I.M.; Product Social Impact Assessment Handbook - 2018, Amersfoort, September 1st, 2018.
[6] ABN AMRO Group N.V., "Impact Report 2018", page 18. Accessed September 11, 2019.
[7] ABN AMRO Group N.V., "Impact Report 2018", page 23. Accessed September 11, 2019.
[8] AkzoNobel, "AkzoNobel Report 2018", pages 155 – 157. Accessed September 16, 2019.

BASF We create chemistry	Petrochemicals, nutrition and care chemicals, coatings, crop care[9]	Monetary	Reduction of fat in the liver from product consumption, percent improvement in crop yield, customer emissions from the use of end products
NOVARTIS	Pharmaceutical drugs, oncology drugs	Numeric	Number of patients reached, health gains per patient year in Quality-adjusted life years [10]
NS	Rail transportation	Monetary and numeric	Percent customer satisfaction, percent punctuality, seat availability, monetary values for mobility created and journey time[11]
Safaricom	Mobile services and mobile payments	Monetary	Increase in personal savings due to theft reduction, increase in personal savings due to convenience and reduced transaction costs[12]
vodafone	Mobile services, Internet of Things connectivity, cloud services, carrier services[13]	Monetary	End of life waste production, avoided emissions through reduced commuting and office utilities, improved modem efficiency[14]
VOLVO	Vehicles, excavators, trucks, haulers, wheel loaders	Numeric	Emission levels, external sound levels, recyclability[15]
YorkshireWater	Water utility services	Monetary	Water quality compliance, water supply interruptions, customer service satisfaction, customer bills[16]

2.2. Investors

As more investment managers incorporate ESG issues into their decision-making, a few of them have made either their methodology or examples of metrics used publicly available. Similar to companies that report their product impact, investors rely on metrics that are specific to each investment. Interestingly, all four investment firms that have made some progress towards measuring product impact are investing in private markets, having relatively concentrated portfolios in a small number of investee organizations. This reflects the difficulty in producing product impact measurements for thousands of organizations that would be required for investors holding broadly diversified portfolios in public markets. Ultimately, given the nature of investment decisions, these methodologies tend to produce a prospective estimation of potential financial, social, and environmental gains, rather than an estimate of the impacts that have occurred.

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[9] BASF, "BASF 2018 Report", pages 68 – 106. Accessed September 10, 2019.

[10] A.H. Seddik, J. Branner, R. Helmy, D.A. Ostwald, S. Haut, *The Social Impact of Novartis Products: Two Case Studies from South Africa and Kenya.* Basel/Berlin/Darmstadt, August 2018.

[11] NS, "NS Annual Report 2018", pages 7 and 127. Accessed September 13, 2019.

[12] KPMG International Cooperative, "KPMG True Value Case Study Safaricom Limited". Accessed September 17, 2019.

[13] Vodafone Group Plc, "Annual Report 2019", page 6. Accessed September 17, 2019.

[14] Vodafone Netherlands, "Environmental Profit and Loss Methodology and Results 2014/15". Accessed September 17, 2019.

[15] Volvo Construction Equipment, "Environmental Declaration Volvo Articulated Haulers". Accessed September 12, 2019.

[16] Yorkshire Water, "Our Annual Performance Report 2018/2019." Published July 2019. Accessed September 16, 2019.

TABLE 2

Sample of Investors Measuring Product Impact

Company	Public information	Measurement	Sample case or methodology	Sample product metrics
BainCapital	Case study examples	Numeric	Skills-focused education company	Number of programs completed, number of sponsored students, percent of learners reporting pay increase, percent of learners reporting career improvement, net promoter score[17]
THE CARLYLE GROUP	Case study examples	Numeric	Manufacturer of powertrain components	Number of electric vehicle patents filed, percent reduction in efficiency losses, miles traveled on a single charge[18]
KKR	Case study examples	Numeric	Medical transportation company	Communities served, vehicles in fleet, frequency of critical interventions, patients transported, natural disasters responses[19]
RISE	Methodology	Monetary	Impact multiple of money on online alcohol abuse course	Students (scale), reduction in alcohol incidents following course completion (desired social outcome), value of fatality reduction (economic value of social outcome), probability of impact (risk adjustment), probability of ongoing value creation (terminal value calculation)[20]

2.3. Reporting standards

Given the interest in ESG data, many global reporting frameworks have begun to help companies with measurement and reporting of sustainability information. Two of the global leading standard setters, the Sustainable Accounting Standards Board (SASB) and the Global Reporting Initiative (GRI), have identified hundreds of sustainability metrics. One key difference between SASB and GRI is that the SASB standards are industry-specific. SASB's identification of industry-specific metrics translates to the larger number of identified product related outcomes and impacts. This reflects the idiosyncratic nature of product impact. Given that product impacts differ significantly across industries, one would need an industry lens to capture product outcome metrics.

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[17] Bain Capital Double Impact, "Year in Review." Published May 2019. Accessed September 18, 2019.
[18] The Carlyle Group, "Corporate Sustainability Report 2019." Accessed September 18, 2019.
[19] KKR, "2018 ESG, Impact, and Citizenship Report." Accessed September 18, 2019.
[20] Chris Addy, Maya Chorengel, Mariah Collins, and Michael Etzel, "Calculating the Value of Impact Investing". *Harvard Business Review* January-February 2019 Issue pp. 102 – 109.

TABLE 3

Sample of Reporting Standards and Product Metrics

Standard	Industry Metrics	Number of Industries	Measurement	Input or Outputs	Outcomes or Impacts
GRI	N	-	Descriptive and numeric	4	2
SASB	Y	47	Descriptive, monetary, and numeric	70	117

2.4. Data providers

With standard-setting efforts for ESG disclosure underway, complementary efforts to provide ESG data are also ongoing. For two of the main data providers sharing ESG data, neither provides impact or monetary metrics. For example, one product metric Bloomberg examines in the telecom space is the number of phones recycled rather than the monetary value of the emissions saved from recycling. Similarly, Thomson Reuters has a metric on product recalls rather than the monetary value from injuries or illnesses associated with the recall. Although product recall count provides color to the health and safety of a company's products, monetary figures associated with the recall provide a metric that can be seamlessly integrated into financial statements and decision-making.

TABLE 4

Sample of Data Providers and Product Metrics

Standard	Industry Metrics	Number of Industries	Measurement	Input or Outputs	Outcomes or Impacts
Bloomberg	Y	3	Numeric	33	4
THOMSON REUTERS	N	-	Numeric and rating	25	18

While highly idiosyncratic, the metrics of these reporting standards and data providers seem to have recurring themes. For example, although the underlying metrics themselves may vary, most of these organizations make some effort to capture the accessibility or recyclability of a product. In summarizing these recurrent themes of measurement, it appears some common ones

include access, environment, health and safety, information, quality, and satisfaction. The metrics from reporting standards and data providers are distributed across the product impact categories with a focus on environmental, health and safety, and access related impacts.

TABLE 5

Number of Product Metrics by Theme

Product impact theme	Number of metrics
Access	49
Environment	108
Health and safety	87
Information	17
Quality	3
Satisfaction	9

3. Product impact framework design methodology

A framework for measuring product impacts should build on existing measurement efforts and leverage public data. The framework should also be applicable to any industry or product to allow for comparability and scalability. Finally, the framework should aim to adhere to certain guiding principles.

3.1. Framework design principles

In designing a standard product impact measurement framework, the five preliminary design principles for creating a methodology for impact-weighted accounts were applied.[21] The scope of source of impact and scope of stakeholders focuses the design to simple but important metrics from a small set of directly impacted stakeholders to test implementation. Specificity as a design principle ensures clear direction when choosing metrics for measurement. Monetization of impact metrics enables that all metrics are expressed in currency terms. Finally, a broad scope of value ensures all material impacts of a firm are captured.

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[21] George Serafeim, T. Robert Zochowski, Jen Downing. "Impact-Weighted Financial Accounts: The Missing Piece for an Impact Economy", Harvard Business School. Accessed December 16, 2019.

From these preliminary principles, an additional five product-specific guiding principles were identified when testing the framework against various industries. *Consistency* ensures the framework has constant units, scale, and approach. *Incentive alignment* encourages consideration of the behavior that is incentivized by the framework to ensure it is aligned with positive social and environmental impact. *Best-in-class* benchmarking protects the impact of a product or industry from moving towards an unwanted average. *Conservatism* bases the framework in feasible assumptions and comparisons. Finally, the scope of impacts considered is limited to *first-order* effects from general usage of the product or service. We recognize this excludes impacts to both broader stakeholders in the value chain and higher-order impacts to the direct stakeholder, but make this limitation to allow for clear delineation and attribution.

3.2. Building the framework

To identify the relevant dimensions of product impact, a thought experiment was conducted in which the product impact of two products with identical features and qualities are compared. All else equal, the product with greater reach would have greater impact. Therefore, *reach* must be a dimension of product impact, composed of a product's quantity and duration. In reality, products do not have identical features and therefore, greater reach does not mean greater impact. Holding reach constant in simplified examples allows identification of the other dimensions of product impact.

To identify these other dimensions of product impact, additional thought experiments can be conducted to explore the elements of a customer's interaction with a product. Consider the impact of designer handbags and water where both products have the same reach. Water would be viewed as more impactful because of the inherent goodness of the product. While water is a basic need that provides sanitation and prevents dehydration, a designer handbag is a luxury item with lower inherent utility. This example illustrates that *quality* is a dimension of a product's impact. To specify, quality as a dimension of impact therefore captures the extent to which a product provides a basic need of inherent goodness and the effectiveness of a product which can be measured by customer satisfaction, rather than the level of craftsmanship or leather that might be used in a designer bag.

Next, consider the impact of a generic and prescription drug where both products have the same reach and quality, but the generic has a lower price. The lower priced generic would be

viewed as more impactful since its pricing makes it more accessible to consumers. Therefore, another dimension of a product's customer usage impact is access.

Holding price, reach, and quality constant, consider the example of cigarettes. Cigarettes have accessible pricing (especially in the absence of taxes), broad reach, and high customer satisfaction but are generally accepted as a product that is unequivocally bad. Regardless of the negative impacts of cigarettes, the product maintains broad reach due its addictive nature. Therefore, a dimension that product impact should capture is consumer *optionality* (i.e. if the consumer has the freedom to make choices). In cases of addictive products or monopolies this optionality is limited. Together, access, quality, and optionality compose of the customer usage dimensions.

Finally, consider various products that produce energy, such as coal and solar. If the two products had the same price, reach, quality, and optionality, solar energy would have greater positive impact than coal because solar energy produces fewer emissions than coal when used. A product's environmental impact through usage *efficiency* and end of life *recyclability* is a dimension of capturing a product's overall impacts.

Looking at existing disclosure data, reach (quantity and duration), the customer usage dimensions (quality, access, and optionality), environmental usage, and end of life impacts of products are comprehensive of the categories that appear in existing measurement efforts. Pricing and underserved impacts are components to access. Health and safety, data privacy, and innovation are some of the attributes of a product's quality. Information is one of the components within optionality. Finally, emissions, energy and recyclability contribute to a product's environmental impact.

4. Diving deeper into the product impact framework

The dimensions of product impacts can be aggregated into a cohesive framework for use across products and industries.

FIGURE 1

Product Impact Framework Dimensions

Reach		Dimensions of Customer Usage			Env Use	End of Life
Quantity	Duration	Access	Quality	Optionality	Pollutants & efficiency	Recyclability
The magnitude of individuals reached	Length of time the product can be used, particularly for durables	Accessibility of product through pricing and efforts to provide for the underserved	Quality of product through health, safety, effectiveness, and inherent need or goodness	Ability to choose an alternative product with full information and free will	All pollutants and efficiencies enabled through customer usage	Projected product volume recycled at end of product life

Reach

Reach examines how many individuals are reached by the product and the length of time for which the product can be used. Some sample metrics that can be used to estimate a product's reach are sales volume or number of customers. Duration can be estimated with metrics such as average or expected product life. For example, the quantity component of reach for a pharmaceutical company where a discrete number of customers might be unavailable can be estimated through sales data by pharmaceutical drug divided by dose pricing and doses in a treatment to identify the number of individuals treated. For the duration component of reach, most pharmaceutical drugs will have a duration of 0 with implants having a duration equivalent to average product life.

Access

Access is how available a product is to consumers. This can be measured through product pricing and efforts to make the product available for underserved populations. Sample metrics that can be used to estimate affordability include the difference between a product's price and average pricing in the market. For example, a consumer-packaged goods company could compare the price per calorie of their own products to the average price per calorie of all alternatives in the relevant product categories as identified by a standard research or reporting firm such as Nielsen. Products that are priced below the relevant benchmark are deemed affordable and have a positive impact. Products that are priced above the relevant benchmark and luxury products are not deemed affordable and therefore do not have an affordability impact. The accessibility of a product to the general population can be estimated through affordability.

For particularly vulnerable populations, access to various products often allows for the realization of large, critical impacts at a scale far beyond that of the general population. Given the significance and importance of these impacts, product impacts to the underserved are estimated separately in addition to general access. For a product to qualify as accessible to the underserved, the product must address a UN Sustainable Development Goal in a market that would usually not have access to the product. For example, cigarettes do not address a sustainable development goal but are sold in developing markets. They would not be viewed as products that address an underserved population even though they are serving a developing market because they make no contributions to development. On the other hand, a pharmaceutical company could estimate the

13

averted medical and mortality costs and productivity gains of providing qualified drugs to underserved markets.

Quality

Quality of a product can be measured by the health and safety, effectiveness, and inherent goodness of the product. The health and safety of a product examines whether the product performs to expected health, safety and privacy standards. For a packaged food product, its health and safety would not be captured by how healthy the food product is, but by the costs associated with food-borne illnesses from product recalls. Other metrics that can capture the health and safety of a product include controversies or data leaks associated with the product.

The effectiveness of a product is whether the product works as it should. For packaged food products, effectiveness would be where the nutritional value of the product is captured. For example, the whole grains, fiber, added sugar, sodium, and trans-fat content of a product can be translated to costs associated with changes in risk of coronary heart disease or diabetes. Where effectiveness cannot be readily observed, customer satisfaction can be used as a proxy measure.

Lastly, the necessity dimension of the product examines whether the product provides some basic need to the population. Elasticity can be used to identify products that are basic needs. Some other relevant metrics for estimating how the product addresses a basic need include global economic losses avoided through the product. For example, the basic need component of a utilities company providing water would be captured through the averted economic losses from sanitation. Similarly, the basic need component of certain food products would be the averted economic losses of starvation.

Optionality

Optionality of a product is the extent to which consumers have free will and full information in their purchasing choices. The optionality in product choice is composed by information availability, monopolistic nature of the industry, and decision altering characteristics. Under information availability, sample metrics would include labeling and marketing controversies. For example, a water utilities company could use warning letters and fines around improper marketing to estimate the costs of inaccurate information to consumers.

To identify products in an industry with monopolistic behavior, the Herfindahl-Hirschman Index (HHI) or four-firm concentration ration (CR4) can be used. Monopolistic industries such as the pharmaceutical industry can estimate extractive rents to consumers by using the excess of costs associated with marketing to research and development.

For decision altering products, sample metrics include how addictive a product is. A tobacco company could estimate the productivity and treatment costs associated with addiction itself.

Environmental use

Environmental impacts from product usage include emissions and other pollutants to the environment and efficiencies enabled through product use. Some sample metrics that capture the efficiency of a product are carbon or particulate emissions from use or energy required from use. A consumer-packaged goods company could identify the carbon cost of emissions that would be used for cooking and storage of the product.

End of life recyclability

End of life environmental impacts are based on the end of life treatment of the product. Sample metrics could include volume or percentage recyclability and recoverability. A pharmaceutical company could identify the associated carbon costs with the end of life treatment of products sold.

5. Application of the product impact framework

Thus far, the product impact framework has been applied to company pairs within a number of different industries across different sectors. These applications ensure the framework is feasible, scalable, and comparable across different sectors. These applications also uncover nuances within the dimensions of the framework and demonstrate how actual monetary values can be estimated within each dimension.

We will first review a deep-dive of two competitor companies within a single industry, automobile manufacturing, to provide a cohesive example that examines the impacts of automobiles across all the product impact dimensions. We focus our impact estimates on those of passenger fleet vehicles. The companies will be referred to as Company A and B given the purpose

of this exercise is to examine feasibility and is not to assess the performance of individual companies. However, we note that all the data are actual data from two of the largest automobile manufacturers in the world.

5.1. Data collection process

The examples below are based on publicly disclosed data and industry-wide assumptions. Company datapoints reflect information found in the most recent annual financial statements such as the company's Form 10-K and annual sustainability reports which often disclose SASB and GRI metrics. These examples make use of existing data and metrics from the perspective of incorporating publicly available data rather than judgement of materiality. Industry-wide assumptions come from government agencies such as the US Department of Transportation or the Food and Drug Administration. Given the methodology determines monetary impacts, the industry wide assumptions inevitably rely on some market-determined price and valuations.

6. Automobile manufacturing application of the product impact framework

6.1. Overall impacts estimated

TABLE 6

Product Impacts of Company A and B

| Company | Revenue | Positive Product Impact | Negative Product Impact | Reach | | Dimensions of Customer Usage | | | Env Use | End of Life |
				Quantity	Duration	Access	Quality	Optionality	Emissions	Recyclability
A	$160bn	$6,710m	-$3,342m	5,982,000 vehicles sold	14.72 years	$353m	$4,806m	-	-$3,161m	$1,369m
B	$147bn	$10,242m	-$3,910m	8,384,000 vehicles sold	14.26 years	$1,085m	$7,745m	-	-$3,569m	$1,072m

Total positive and negative product impact differ from sum of dimension-level impacts provided given the access, quality, and recyclability dimensions aggregate positive and negative impacts. Variances from totals below due to rounding.

6.2. Reach

TABLE 7

Product Sales and Duration of Company A and B

Data				Estimation			
SASB Disclosure		**A**	**B**			**A**	**B**
TR-AU-000.A	Number of vehicles manufactured	6,000,000	8,459,236	Forbes	Maximum mileage	198,409	192,169
						÷	
TR-AU-000.B	Number of vehicles sold	5,982,000	8,384,000	FHWA	Average annual mileage[23]	13,476	
						=	
Secondary Data		**A**	**B**		**Average product life**	**14.72**	**14.26**
Forbes	Maximum[22] mileage	198,409	192,169				

To estimate the relevant quantity and duration for reach, a combination of publicly disclosed data and secondary assumptions were used. The maximum mileage of the manufacturer's vehicle and average annual mileage in the United States are used to estimate average product life. Although annual mileage is specific to the United States, this does not indicate that the framework itself is only applicable in the United States. Instead, this is indicative of how an estimate can be influenced by data availability. If a company were to apply this framework, internal data on product life could be applied instead of calculating duration from a localized assumption. Furthermore, these estimates can be rooted in other underlying data points, such as powertrain warranties for average product life. It is possible that as companies apply and refine their estimates, different underlying measures may prevail.

The importance of accounting for average product life is highlighted with durable products. The impact of a vehicle on the consumer is not limited to point of sale, but throughout its useful life. For example, a vehicle has affordability and efficiency impacts throughout use and maintenance and environmental impact at end of life. Therefore, average product life is needed to determine how long and when to recognize usage and end of life impacts.

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[22] Henry, Jim. "Toyota Leads Top 10 Longest Lasting Brands". Forbes Media LLC. Accessed October 23, 2019.
[23] Office of Highway Policy Information. "Average Annual Miles per Driver per Age Group". US Department of Transportation Federal Highway Administration. Accessed October 23, 2019.

6.3. Access - affordability

TABLE 8

Affordability of Vehicles Sold by Company A and B

Data

SASB Disclosure		A	B
TR-AU-410a.1	Sales-weighted avg passenger fleet fuel economy (mpg)	28.90	23.00
Secondary Data		**A**	**B**
Kelley Blue Book	Average cost of company vehicle	$42,234	$41,621
Repair Pal	Average annual maintenance cost for company vehicle	$775	$649
Industry assumptions			
Kelley Blue Book	Avg. cost of non-luxury vehicle	$33,642	
	Avg. cost of luxury vehicle	$67,649	
EPA	Average fuel economy	39.4	
AAA	Average annual maintenance cost	$792	
Applied industry assumptions for operating cost			
Blue Book	(Industry non-luxury vehicle[24]	$33,642	
	÷		
BTS	Industry car product life[25])	11.60	
	Industry vehicle price	$2,900	
	+		
FWHA	(Average miles driven	13,476	
	÷		
EPA	Industry mileage in MPGe[26])	39.4	
	x		
EPA	Price of gallon of fuel[27]	$2.64	
	Industry fuel cost	$903	
	+		
AAA	Industry maintenance[28]	$792	
Industry annual operating cost		**$4,595**	

Estimation

		A	B
Blue Book	(Avg cost of company vehicle	$42,234	$41,621
	÷		
	Avg product life of company vehicle)	14.72	14.26
	=		
	Avg annual vehicle price	$2,869	$2,919
	+		
FWHA	(Average miles driven	13,476	
	÷		
SASB	Vehicle mileage)	28.9	23
	=		
	Avg fuel cost	$1,231	$1,547
	+		
Repair Pal	(Avg maintenance for company vehicle	$775	$649
	=		
	Vehicle annual operating cost	**$4,875**	**$5,115**

		A	B
	Industry annual operating cost	$4,595	
	-		
	Vehicle annual operating cost	$4,875	$5,115
	x		
SASB	Vehicles sold	5,982,000	8,384,000
Affordability impact		-	-

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[24] Kelley Blue Book. "Average New-Car Prices Up 2 Percent Year-Over-Year for April 2019". *PR Newswire*. Published May 2019.

[25] Bureau of Transportation Statistics. "Average Age of Automobiles and Trucks in Operation in the United States". US Department of Transportation. Accessed October 23, 2019.

[26] Office of Energy Efficiency & Renewable Energy. "Most Efficient Cars by EPA Size Class". US Department of Energy.

[27] US Energy Information Administration. "Gasoline and Fuel Update". Accessed October 23, 2019.

[28] AAA Automobile. "What Does it Cost to Own and Operate a Car". *AAA*. Accessed October 2020.

The affordability dimension accounts for the impact created by a company through provision of a more affordable product. Given vehicle ownership costs go beyond the initial sale price, the affordability of a vehicle should consider the complete price for ownership. Therefore, the estimated affordability impact compares the annual cost for operating a vehicle to an average in the market. This consists of annualized sale price, fuel costs, and maintenance costs. An important nuance to note around affordability and luxury products is that less affordable and luxury vehicles do not have an affordability impact. While provision of a more affordable product creates positive impacts, a consumer's decision to purchase a more expensive or luxury vehicle and a vehicle manufacturer's luxury pricing strategy does not have any inherent negative impact or any additional positive impact to affordability. Therefore, the affordability impact of luxury vehicles or any vehicle more expensive than the industry benchmark is floored at zero.

Estimating industry operating cost

The data section of Table 8 provides the assumptions and methodology applied to estimate the annual industry average cost to own and operate a non-luxury vehicle. To estimate the annualized sale price, the appropriate vehicle price benchmark needs to be selected. We use the non-luxury industry average price as the relevant benchmark given the overall industry average would include more expensive luxury vehicles. The sales price is divided by the average product life to estimate an annualized sales price difference that should be recognized until end of product life. The average product life is a key factor in determining affordability because even though a certain car might have a very low sales price, it could also have an extremely short product life and require more frequent car purchases. Furthermore, this recognition timing matches the common mode of payment for vehicles through long-term leases.

To estimate the cost of fuel, the average annual mileage driven is divided by the industry average fuel economy and multiplied by fuel price. An important nuance to note is the benchmark selected for fuel economy is limited to vehicles rather than other modes of transportation given the first-order principle to ensure there is not an intractable comparison. In practice, a manufacturer with more detailed fuel economy data could make the comparison by car type rather than across car type.

The estimated industry average annual vehicle price and fuel cost are summed with the industry average maintenance cost to estimate the annual cost of operating a vehicle.

Estimating the affordability impact

The affordability impact is estimated by comparing the annual industry cost to operate a vehicle to the cost for the company. Since Company A and B have a higher operating cost than the industry average, their affordability impact is floored at zero. Even with manufacturer data, these estimates are reliant on industry-wide assumptions around fuel price and average miles driven in a year. Industry input is therefore crucial in refining these assumptions to improve accuracy and ensure alignment over time.

6.4. Access - underserved

TABLE 9

Underserved Access to Vehicles Sold by Company A and B

Data				Estimation			
Secondary Data		**A**	**B**			**A**	**B**
Statista	% sales to developing countries	26%	57%	UN	Addresses SDG	1	
						x	
				ANTP	(Avg travel time with car	.42 hours	
						-	
				ANTP	Avg travel time without car)	.63 hours	
						x	
				World Bank	Average global net national income (per capita)[29]	$8,826	
						÷	
					Annual working hours	2,080	
						x	
				Statista	Percent of sales to developing countries	26%	57%
						x	
				SASB	Vehicles sold	5,982,000	8,384,000
					Underserved impact	**$353m**	**$1,086m**

Sales of vehicles in underserved markets qualify as providing a positive impact to the underserved since vehicles address the ninth sustainable development goal on industry, innovation,

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[29] The World Bank Data. "Adjusted net national income per capita (current US$). Accessed November 11, 2019.

and infrastructure. In this example, sales to underserved markets is approximated by the percentage of sales to a developing country. A manufacturer with more detailed data could apply a more nuanced approach to identifying sales that qualify as underserved.

The impact of these sales can be estimated using industry assumptions on time savings when relying on private vehicles for transportation compared to other modes of transportation. These time savings can be estimated for a local population or with a global constant. For illustrative purposes, this example relies on a global time savings constant. Again, this constant could be refined through industry debate and recommendations.

To identify the monetary value of these time savings, the average global hourly wage is applied. A global wage is preferred to a local wage to ensure perverse incentives are not created for manufacturers to avoid countries with the lowest wages, and likely the most underserved. Although the monetary value of time saved could have also been estimated using willingness to pay for time, global wage is preferred given the willingness to pay for time varies by congestion (free flow, slowed down, stop and start) and timeliness (early arrival, minimized lateness, reduced mean travel time)[30]. As with the affordability impact, the underserved impact can be recognized until end of product life.

[30]Zheng Li, David A. Hensher, John M. Rose. "Willingness to pay for travel time reliability in passenger transport: A review and some new empirical evidence". *Transportation Research* Volume 46, Issue 3, May 2010. Accessed October 23, 2019.

6.5. *Quality – health and safety*

TABLE 10

Safety Impact of Vehicles Sold by Company A and B

Data				Estimation			
SASB Disclosure	**A**	**B**				**A**	**B**
TR-AU-250a.1	Percentage of vehicle models rated by NCAP programs with an overall 5-star safety rating, by region - US	59%	73%	AAA	Crash / 100 million miles	519	
					÷		
				FWHA	Average miles driven	13,476	
					x		
TR-AU-250a.3	Number of vehicles recalled	5,940,000	4,230,000	Statista	% of 5-star safety cars	59%	73%
					x		
				NCBI	% of reduction in crashes[31]	14%	
					x		
				SASB	Vehicles sold	5,982,000	8,384,000
					x		
				Tavss	Average cost of crash[32]	$69,100	
				Safety impact		**$2,387m**	**$4,141m**

		A	**B**
SASB	Recalled vehicles	5,940,000	4,230,000
	÷		
BTS	Number of vehicles in US[33]	272.4m	
	x		
NHTSA	# vehicle caused crashes[34]	44,000	
	x		
Tavss	Average cost of crash	$69,100	
Recall impact		**-$66.2m**	**-$47.2m**

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[31] Metzger KB, Gruschow S, Durbin DR, Curry AE. "Association between NCAP Ratings and Real-World Rear Seat Occupant Risk of Injury". *Traffic Injury Prevention 2015.* Accessed October 23, 2019.

[32] Tavvs Fletcher. "The Price Paid for Automobile Accidents and Injuries". Accessed October 23, 2019.

[33] Bureau of Transportation Statistics. "Number of US Aircraft, Vehicles, Vessels, and Other Conveyances. Accessed October 23, 2019.

[34] National Highway Traffic Safety Administration. "Critical Reasons for Crashes Investigated in the National Motor Vehicle Crash Causation Survey". *Traffic Safety Facts.* Accessed October 23, 2019.

Safety impact

The safety of a vehicle is estimated using the US-based NCAP rating program. This safety rating is associated with a reduction rate in injury for frontal crashes. The monetary value of the reduced injuries attributable to the manufacturer can be estimated with average costs associated with a crash. For illustrative purposes, this example applies a US safety rating to all vehicles sold. A manufacturer would be able to apply this methodology on data that is disaggregated to use safety ratings from different geographies. Furthermore, this estimate is reliant on industry ratings and assumptions that can be continually adjusted as new safety and injury information becomes available. For example, the injury reduction assumption applied is limited to frontal crashes. Yet, there is a known association between safety ratings and reduced injury for two additional crash types. Industry debate can identify an estimate that can be generalized to all crashes. Finally, as the industry innovates and more data is available, it is possible that the safety impact will transition from capturing only crash performance to also include preventative measures such as driver assistance technology.

Recall impact

The recall impact is based on manufacturer disclosed data on recall car volume and public reports of vehicle caused crash rates. The attribution of these recalled cars to the pool of crashes can be approximated by applying the percentage of cars on the road that are recalled by the manufacturer. This estimate implicitly assumes that only recalled cars are capable of a vehicle caused crash and that all recalled cars can produce a crash given the time frame required to fix a recalled car. For a manufacturer with data on the rate at which their recalled cars are fixed, the attribution percentage can be lowered by using the number of unfixed recalled cars remaining on the road rather than the total number of recalled cars. Given ongoing changes and advances in the industry, it is possible to imagine a future in which extended warranties can also factor into the health and safety impacts.

6.6. Quality - effectiveness

TABLE 11

Customer Satisfaction Impact of Company A and B

Data				Estimation			
Secondary Data		A	B			A	B
ASCI	Customer satisfaction rate	80%	80%	ASCI	Satisfaction rate	79.5%	80%
						-	
				ASCI	Average satisfaction rate[35]	79%	
						x	
				Carfax	% loss in car value (initial year)[36]	20%	
						x	
				Blue Book	Avg cost of company vehicle	$42,234	$41,621
						x	
				SASB	Vehicles sold	5,982,000	8,384,000
					Satisfaction impact	**$253m**	**$523m**

Since the effectiveness of a vehicle is not directly measurable, it is approximated through customer satisfaction rate. The value associated with customer satisfaction is estimated by applying the loss in car value after ownership in the initial year. This implicitly assumes that a customer can realize their dissatisfaction in the initial year of ownership and has the optionality to change to another vehicle. Given the assumption is tied to the initial year of ownership, the satisfaction impact should be recognized only in year of sale. The customer satisfaction and car value loss assumptions are again, based on industry estimates that can be refined with additional information. Furthermore, as new technology is introduced, it is possible that effectiveness can be more directly measured in this industry. For example, one could imagine a future in which vehicles influence congestion, reduce commute time or avert accidents differently by make and model through recorded innovations such as driver assisted technology. These innovations would then reflect differences in the ability for different vehicles to effectively transport the user.

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[35] American Customer Satisfaction Index. "ACSI Automobile Report 2018 – 2019". Accessed October 23, 2019.
[36] Carfax. "Car Depreciation: How Much Value Will a New Car Lose?". Accessed October 23, 2019.

6.7. *Quality – necessity*

TABLE 12

Basic Needs Met by Company A and B

<table>
<tr><td colspan="2">Data</td><td colspan="4">Estimation</td></tr>
<tr><td colspan="2">Secondary Data</td><td></td><td></td><td>A</td><td>B</td></tr>
<tr><td>Harvard</td><td>Long-run price elasticity of vehicle</td><td>1.2</td><td>Necessity (elasticity < 1)</td><td colspan="2" align="center">1</td></tr>
<tr><td>Harvard</td><td>Price elasticity of vehicle (rural)[37]</td><td>0.2</td><td></td><td colspan="2" align="center">÷</td></tr>
<tr><td></td><td></td><td></td><td>Illustrative</td><td>Percent of rural sales</td><td>50%</td><td>50%</td></tr>
<tr><td></td><td></td><td></td><td></td><td colspan="2" align="center">X</td></tr>
<tr><td></td><td></td><td></td><td>Average daily commute[38]</td><td colspan="2" align="center">.45 hours</td></tr>
<tr><td></td><td></td><td></td><td></td><td colspan="2" align="center">X</td></tr>
<tr><td></td><td></td><td></td><td>Commute days</td><td colspan="2" align="center">260</td></tr>
<tr><td></td><td></td><td></td><td></td><td colspan="2" align="center">X</td></tr>
<tr><td></td><td></td><td></td><td>Ho, Chinh</td><td>WTP for mobility as a service[39]</td><td colspan="2" align="center">$6.40</td></tr>
<tr><td></td><td></td><td></td><td>SASB</td><td>Vehicles sold</td><td>5,982,000</td><td>8,384,000</td></tr>
<tr><td></td><td></td><td></td><td></td><td>Necessity impact</td><td>$2,231m</td><td>$3,127m</td></tr>
</table>

The final component to quality examines whether a vehicle meets a basic need. The elasticity of a vehicle demonstrates that vehicles are a basic need in rural areas. This makes logical sense as urban areas have alternative modes of transportation and vehicles could contribute to congestion. For illustrative purposes since detailed sales data is not available by geography, this example simply assumes that 50% of sales are rural. To estimate the impact created by rural vehicle provision, the time spent commuting annually is valued with willingness to pay for mobility. Given the impact is realized in all years of ownership, the necessity impact can be recognized throughout the expected product life. In practice, the manufacturer could apply the actual percentage of non-urban sales and industry input could identify precise estimates on the value of mobility.

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[37] Patrick L. Anderson, Richard D. McLellan, Joseph P. Overton, Dr. Gary L. Wolfram. "Price Elasticity of Demand". Accessed October 23, 2019.

[38] Sinclair, Liz. "Commute Times in Every State, Ranked." Accessed October 23, 2019.

[39] Chinh Ho, David Hensher, Corinne Mulley, Yale Wong. "Potential uptake and willingness-to-pay for Mobility as a Service (MaaS): A stated choice study". *Transportation Research,* volume 117, pages 302-318. Accessed October 23, 2019.

6.8. Optionality

TABLE 13

Optionality Impact for Company A and B

Data		Estimation	
Secondary Data		Monopoly (HHI > 1500)	0
HHI for vehicle manufacturers[40]	650	**Optionality impact**	**-**

For the monopolistic component of optionality, the vehicle manufacturing industry is not a monopoly. Therefore, no impact related to monopolistic behavior exists to be estimated. Similarly, vehicles do not have decision-altering capabilities. Finally, neither company has reported marketing or information penalties for the year of 2018.

6.9. Environmental use

TABLE 14

Costs of Emissions Produced by Vehicles Sold by Company A and B

Data				Monetization			
SASB Disclosure		**A**	**B**			**A**	**B**
TR-AU-410a.1	Sales-weighted average passenger fleet fuel economy, by region - tail pipe emissions per vehicle (grams / mile)	312	251.41	SASB	Emissions (grams / mile)	312	251.41
						x	
				FWHA	Average miles driven	13,476	
						÷	
					Grams per ton	907,184	
						x	
				EPS	Social cost of carbon[41]	$114	
						X	
				SASB	Vehicles sold	5,982,000	8,384,000
					Emissions impact	**-$3,160m**	**-$3,569m**

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[40] Korus, Sam. "The Automotive Industry is on the Threshold of Massive Consolidation". *Ark Invest*. Accessed October 23, 2019.
[41] Assuming a 3% discount rate. Source: David Freiberg, DG Park, George Serafeim, and T. Robert Zochowski. "Corporate Environmental Impact: Measurement, Data and Information." Harvard Business School Working Paper, No. 20-098, March 2020.

To estimate the costs associated with disclosed tail-pipe emissions per mile, assumptions need to be made around customer usage of the vehicle which can be captured through average annual mileage and the carbon cost associated with the emissions. The carbon cost applied assumes 3% discounting of costs over time and is expected to be continually refined to reflect the latest data. Similarly, the average annual mileage should also be refined as new information is available. This example demonstrates the monetization of the carbon emissions impact associated with a single year of vehicle use and should be recognized for the entirety of expected product life. Although this example focuses on carbon given the data provided by SASB and the Environmental Protection Agency, it is possible to apply this methodology to other non-carbon emissions and pollutants with the respective social cost. This is particularly relevant for companies and regulatory tests where non-carbon emissions are disclosed, such as the Worldwide Harmonised Light Vehicle Test Procedure conducted by the European Automobile Manufacturers Association.

6.10. End of life recyclability

TABLE 15

Recyclability and Recoverability Vehicles Sold by Company A and B

Data				Monetization			
SASB Disclosure		**A**	**B**			**A**	**B**
TR-AU-440b.3	Average recyclability of vehicles sold	85%	85%	ANL	Cars recycled in operating markets	79.15%	57.5%
						x	
	Average recoverability of vehicles sold	95%	95%	SASB	Recyclability	85%	85%
						x	
					Curb weight (pounds)	4,506	4,071
						x	
					Value per pound[42]	$0.08	
						x	
				SASB	Vehicles sold	5,982,000	8,384,000
					Recycling impact	**$1,450m**	**$1,334m**
						A	**B**

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[42] B.J. Jody and E.J. Daniels. "End-of-Life Vehicle Recycling: The State of the Art of Resource Recovery from Shredder Residue." Energy Systems Division, Argonne National Library. Accessed October 23, 2019.

		A	B
ANL	Cars recycled in operating markets	79.15%	57.5%
		x	
SASB	Recoverability delta	15%	15%
		x	
SASB	Recoverability rate	95%	95%
		x	
	Curb weight (pounds)	4,506	4,071
		x	
	Value per pound[43]	$0.01	
		x	
SASB	Vehicles sold	5,982,000	8,384,000
	Recovered impact	**$33m**	**$31m**

		A	B
ANL	(Cars recycled in operating markets	79.15%	57.5%
		x	
SASB	Waste from recycling	0.75%	0.75%
		x	
	Curb weight)	4,506	4,071
		+	
	Cars not recycled	20.85%	42.5%
		x	
SASB	Vehicles sold	5,982,000	8,384,000
		x	
	Cost per pound of waste[44]	$0.02	
	Waste impact	**-$115m**	**-$293m**

As is standard in the automobile manufacturing industry, both companies disclose the recyclability and recoverability of vehicles sold. For illustrative purposes, average curb weight is estimated from industry aggregate assumptions. In practice, a manufacturer could use actual curb weight of sales. The assumptions around recycling rates and associated value of recycled,

[43] B.J. Jody and E.J. Daniels. "End-of-Life Vehicle Recycling: The State of the Art of Resource Recovery from Shredder Residue." Energy Systems Division, Argonne National Library. Accessed October 23, 2019.

[44] B.J. Jody and E.J. Daniels. "End-of-Life Vehicle Recycling: The State of the Art of Resource Recovery from Shredder Residue." Energy Systems Division, Argonne National Library. Accessed October 23, 2019.

recovered or wasted volume can be refined with additional information. Given the recycling and recovering occurs at the end of product life, the associated impacts should be recognized at the expected end of product life. As with previous dimensions, innovation and increasing data disclosure is expected to influence how recyclability is monetized. For example, as electric vehicles are beginning to reach their end-of-life, companies are starting to invest in battery collection and recycling, efforts that could make sense to include in monetization as they become more widespread.

7. Value of impact-weighted financial statement analysis

This application of the product framework to the competing automobile manufacturers not only indicates feasibility of estimating monetary product impacts, but also demonstrates the potential value of impact-weighted financial statement analysis. As indicated in the application, one potential analysis enabled is a comparability of the product impacts of different companies. Within a single industry, one can identify differences in how the two companies approach different product attributes such as vehicle emissions or vehicle safety. For example, our analysis suggests that while one company has relatively better performance on the access dimension the other company outperforms on quality. Analyzing each dimension allows for a deeper understanding of the business strategies employed by each company. The company that outperforms on recyclability is better positioned to compete in the circular economy while the company that provides more access to products through lower maintenance costs and lower fuel expenses is better positioned to compete in underserved markets.

Beyond identifying differences in approach, impact-weighted financial statement analysis can also help investors identify companies that are well-positioned to create additional impact in dimensions of interest. For example, although both Company A and Company B create vehicles with the same recyclability and recoverability rates, the prevalence of recycling in the markets in which both companies differ. Company A operates in markets where more cars are recycled. Therefore, even if both companies were to make the same improvement to their vehicle's recyclability and recoverability, Company A is better positioned to create positive end of life recyclability impacts in the future. As financial statement analysis today enables business insights beyond the reported values, one can expect that impact-weighted financial statement analysis should also drive insights beyond the numeric impact estimated.

7.1. Application of impact-weighted financial statement analysis

To provide a comprehensive example of the information enabled by impact-weighted financial statement analysis, we generated product impact estimates for other companies within the automobile manufacturing industry. These estimates allow us to identify competitive dimensions of product impact within automobile manufacturing, company strategy and product impact performance over time, and overall industry leaders and laggards.

The dataset consists of time-series product impact estimates spanning 4 years, 2015 to 2018, of the 18 leading global automobile manufacturers by revenue that are publicly traded and cross-listed in the US to ensure data availability. Given the industry assumptions used for product impact monetization stay constant within the industry, the product estimates are calculated by applying the industry-wide assumptions to the respective company-specific data points as shown with Companies A and B. For comparability to research that estimates environmental impact from operations[45], we examine the product estimates scaled by EBITDA and revenue.

For the affordability dimension, company-specific data on vehicle price, maintenance cost, and fuel economy data comes from Richmond Global Sciences. For data consistency purposes in estimating duration, we use the same industry average duration of 11.60 years for all companies regardless of maximum mileage. We note this differs from the methodology shown in the example with Companies A and B which estimates duration from maximum mileage. For the affordability benchmarks, we determine luxury vehicles at the brand rather than product level. We note this is a simplification for companies such as Toyota which have luxury and non-luxury vehicle offerings. We designate BMW, Daimler, and Tesla brands as luxury and these three companies therefore do not have vehicle price affordability impact, even though they might offer some non-luxury models in more competitive prices.

For the underserved dimension, we have collected data from public company disclosures on the markets in which they operate and apply the same time savings and global hourly wage as shown in the example with Companies A and B. We note that we apply emerging market sales as a proxy in identifying sales to underserved customers given public data availability does not allow for more granular identification.

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[45] David Freiberg, DG Park, George Serafeim, and T. Robert Zochowski. "Corporate Environmental Impact: Measurement, Data and Information." Harvard Business School Working Paper, No. 20-098, March 2020.

For the health and safety dimension, recall and five-star safety rating data comes from the National Highway Traffic Safety Administration rather than company reporting to ensure consistency of methodology. We apply the same industry assumptions as provided in the example with Companies A and B.

For the basic need dimension, we assume that no sales occur in rural areas for consistent and conservative data collection. Therefore, no automobile manufacturer in our dataset has a basic need impact. We note this assumption differs from the 50% rural sales rate used in the example with Companies A and B which was chosen for the purpose of demonstrating the methodology.

For the environmental usage dimension, emissions data comes from the Environmental Protection Agency rather than company reporting to ensure consistency of methodology. In this dimension, we apply the same industry assumptions as provided in the example with Companies A and B.

For the end of life dimension, recyclability, recoverability, and curb weight data is provided by Richmond Global Sciences. We note that the end of life dimension estimates are based on an assumption that 50% of sold vehicles are recycled and recovered to ensure consistent treatment of companies given the limited information around recycling rates by market and geography.

Table 16 shows summary statistics for all impact variables. The number of observations varies across the variables as for some companies we might be missing information necessary to calculate the impact estimates. Scaling by revenue increases the sample by three observations as for three firm-years EBITDA is negative and therefore excluded from the sample that scales by EBITDA as the scaled estimate would be misleading. Figure 2 shows the distribution of total product impact in the sample showing significant variation. The distribution exhibits a positive mean and a slightly positive skew suggesting that the firms in our sample overall deliver more positive product impact. However, there is a sizeable number of firm-years exhibiting negative total product impact.

TABLE 16

Summary Statistics of Automobile Manufacturer Product Impact

Impact	Impact Scaled by EBITDA			Impact Scaled by Revenue		
	N	Average	SD	N	Average	SD
Affordability Impact	69	18.86%	0.24	72	1.41%	0.02
Underserved Impact	67	3.91%	0.04	70	0.27%	0.00
Health and Safety Impact	59	13.94%	0.11	62	1.15%	0.01
Recall Impact	64	-0.44%	0.01	67	-0.04%	0.00
Safety Rating Impact	59	14.39%	0.11	62	1.18%	0.01
Effectiveness Impact	60	3.12%	0.07	60	0.37%	0.01
Environmental Usage Impact	57	-26.50%	0.15	60	-2.25%	0.01
End of Life Treatment Impact	69	4.82%	0.03	72	0.39%	0.00
Overall Product Impact	51	12.01%	0.26	51	0.81%	0.02

FIGURE 2

Distribution of Overall Product Impact Estimates Scaled by EBITDA

(Across All Firm Year Observations)
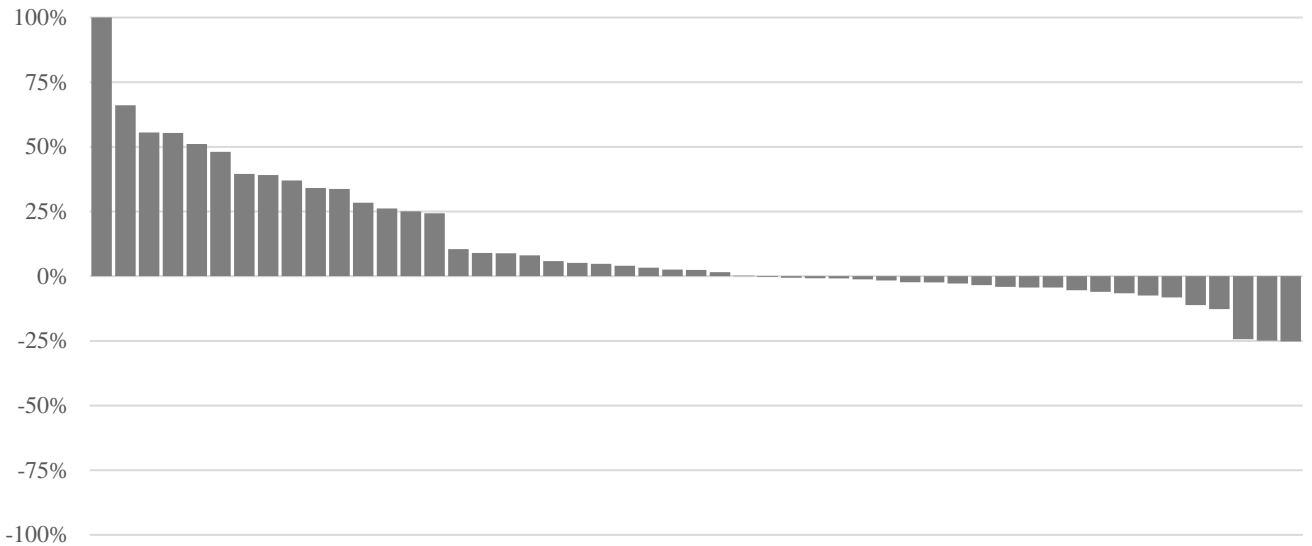
7.2. Discussion of insights enabled by impact-weighted financial statement analysis

The analysis of the product impact dataset consists of two components. We examine the distribution of product impact estimates to identify dimensions of product impact that are most competitive within automobile manufacturing and trends in product impact performance over time. We also examine company-level product impact performance to identify leaders and laggards and trends in company performance.

Figure 3	**Figure 4**
2015 Overall Product Impact Estimates (Scaled by EBITDA)	2018 Overall Product Impact Estimates (Scaled by EBITDA)
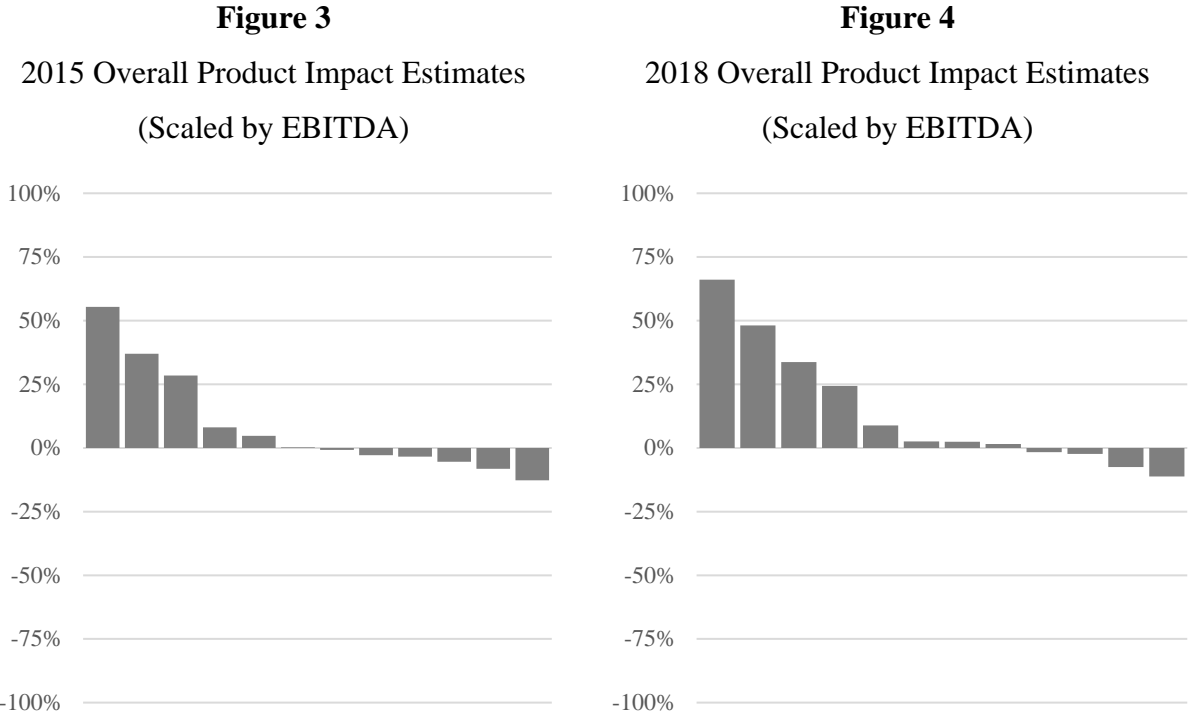
Comparing the distribution of overall product impact estimates in 2015 and 2018 indicates improvement in the overall product impact performance of automobile manufacturers. The maximum product impact performance has increased to over 60% in 2018, and the minimum has decreased. The number of companies with positive product impact has increased from six to eight in 2018.

Figure 5

Affordability Impact Estimates

(Across All Years, Scaled by EBITDA)
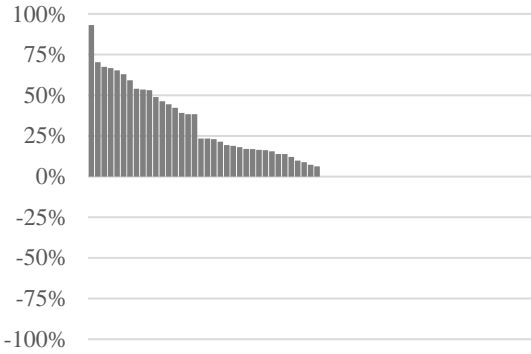
Figure 6

Underserved Impact Estimates

(Across All Years, Scaled by EBITDA)
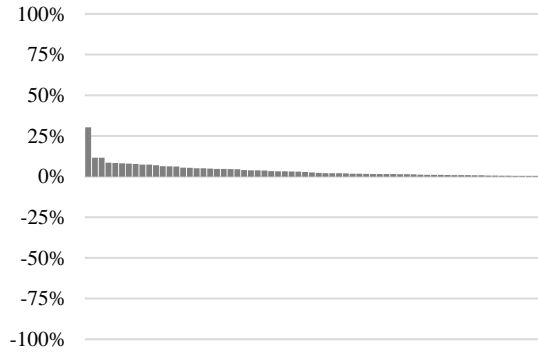
Figure 7

Health and Safety Impact Estimates

(Across All Years, Scaled by EBITDA)
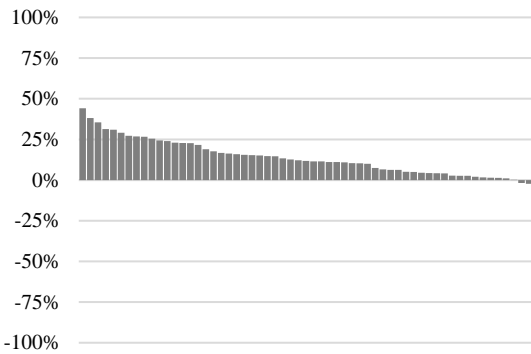
Figure 8

Effectiveness Impact Estimates

(Across All Years, Scaled by EBITDA)
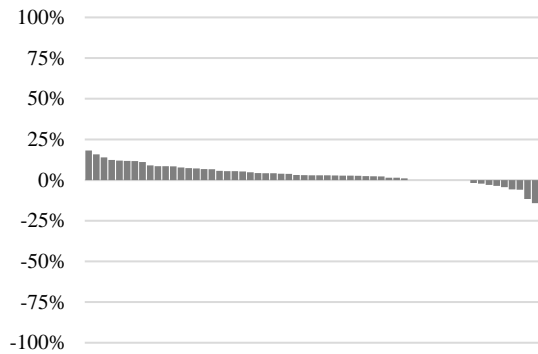
Figure 9

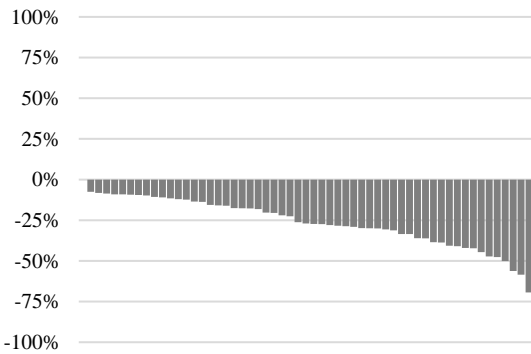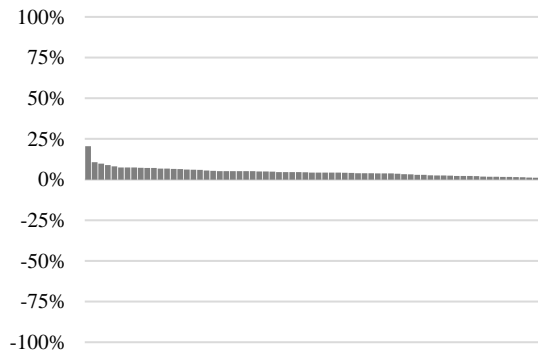Environmental Usage Estimates

(Across All Years, Scaled by EBITDA)

Figure 10

End of Life Impact Estimates

(Across All Years, Scaled by EBITDA)

Comparing the distribution of product impact by dimension across all years provides information on which dimensions are drivers of product impact within automobile manufacturing and how the dimensions influence overall product impact numbers. The magnitude of the affordability and efficiency dimensions suggests that these two dimensions are key drivers of product impact in automobile manufacturing. The variation of affordability and efficiency impacts also highlights that these dimensions are key points of differentiation within this industry. This suggests that the overall cost for operating a vehicle, inclusive of fuel economy, vehicle price, and maintenance costs, as well as tail-pipe emissions are key differentiators in this industry. We note that more granular benchmarking for affordability will likely lead to smaller estimates since the positive impact from providing more affordable products will likely be derived from a more accurately identified low-price benchmark product.

The health and safety and effectiveness impact estimates are of smaller but still meaningful overall magnitude and characterized also by significant variation across companies. The end of life and underserved impact dimensions are characterized by much smaller overall magnitudes and smaller variation. The smaller magnitude of the underserved impact dimension can potentially be explained by lack of granular data on which customers are truly underserved. This indicates that these dimensions have less influence on an automobile manufacturer's product impact performance.

Examining the positioning of the individual companies provides information on industry leaders, laggards, and potentially future performance. The data suggests that Honda, Hyundai, and Kia are product impact industry leaders. Honda and Hyundai have also shown improvement across at least three dimensions. Ford, General Motors, and Daimler have exhibited minimal improvement over time. In contrast, although Fiat is lagging across many dimensions, it has shown improvement across three dimensions.

7.3. *Product impact estimates and financial performance*

An important analysis that impact measurement enables is understanding the relationship between product impact and financial performance. For example, do firms give up profitability to pursue more positive product impact? Or is it the case that pursuing more positive product impact leads to stronger financial performance? We categorize automobile manufacturers as "High-Impact" or "Low-Impact" based on their overall product impact by splitting the sample on the

median value of each year. Whether we scale by EBITDA or revenue, the categorizations remain unchanged. We exclude Mitsubishi, Renault, and Suzuki from this categorization given lack of environmental usage data from these companies positively skews their product impact. We note that given the small sample we do not intend to assess statistical significance but rather to provide a blueprint of how financial analysis could be examined in the presence of more data. Moreover, our analysis presents associations rather than causal links between product impact and financial performance.

We ask three performance-related questions. First, are products with better impact sell more over time thereby high product impact firms exhibiting higher sales growth? Second, are products with better impact enabling a company to exhibit higher profitability ratio in terms of return on assets (ROA)? Third, we decompose ROA to a profitability margin effect, in terms of return on sales (ROS), and an operating efficiency effect, in terms of asset turnover, to understand what might be driving differences in profitability, according to the equation:

$$ROA = ROS \times Asset\ Turnover = \frac{Operating\ Income}{Sales} \times \frac{Sales}{Assets}$$

We first compare year-over-year sales growth of "High-Impact" and "Low-Impact" automobile manufacturers to identify whether firms with higher product impact demonstrate higher sales growth. We calculate the median estimate within each group to avoid outliers from calculating the mean value. In Figure 11, we examine year-over-year sales growth of "High-Impact" and "Low-Impact" automobile manufacturers to determine whether firms with higher product impact demonstrate higher sales growth. We find that the two groups do not display consistently higher or lower sales growth. In Figure 12, we examine return on assets to identify whether firms with higher product impact demonstrate higher profitability. We find that high-impact automobile manufacturers display slightly higher profitability ratios (ROA) in three out of four years with both ratios around 4%.

Figure 11

Year-over-Year Sales Growth for
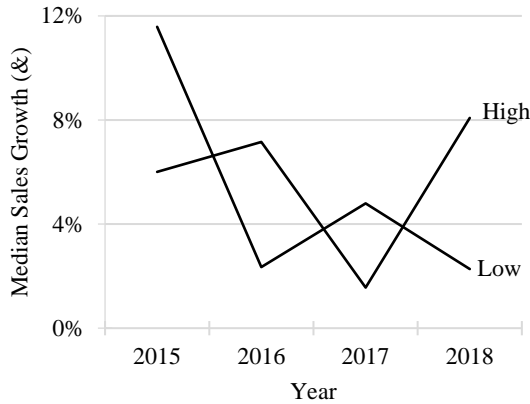
High and Low Product Impact Firms

Figure 12

Return on Assets for

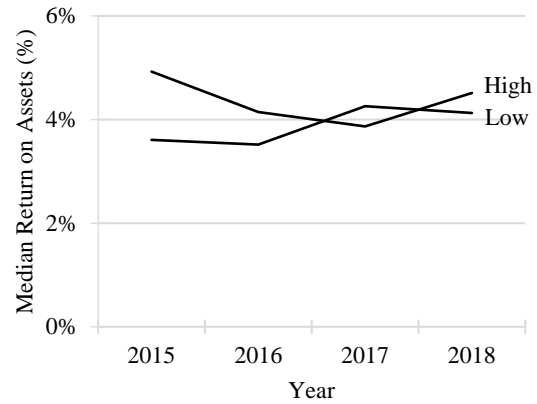High and Low Product Impact Firms

Figure 13

Return on Sales for

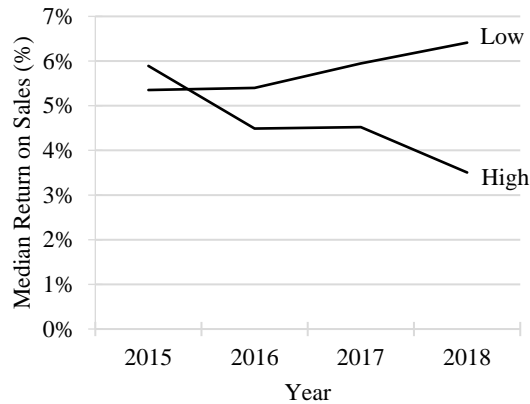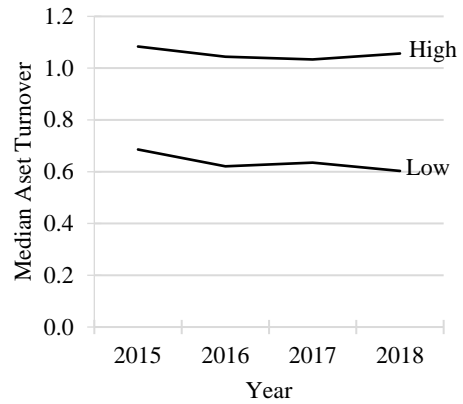High and Low Product Impact Firms

Figure 14

Asset Turnover for

High and Low Product Impact Firms

Next, in Figures 13 and 14, we examine return on sales and asset turnover to determine how profitability margin and operating efficiency drive profitability ratios for "High-Impact" and "Low-Impact" automobile manufacturers. "High-Impact" automobile manufacturers achieve a higher asset turnover ratio. This indicates that operating efficiency drives higher profitability for "High-Impact" firms. Because affordability is a dimension of product impact, "High-Impact" automobile manufacturers have lower vehicle prices which could explain their lower return on sales.

37

In addition to examining the financial performance of "High-Impact" and "Low-Impact" automobile manufacturers, we also examine the change in financial performance of firms that display improvement in product impact from 2015 to 2018. We designate the seven firms with most improvement in overall product impact from 2015 to 2018 as "Improvers" and examine their sales growth, their change in ROA, their change in ROS, and their change in asset turnover.

Figure 15

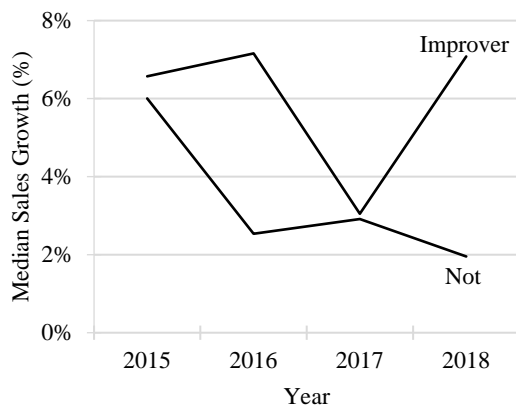Year-over-Year Sales Growth for
Product Impact Improver Firms

Figure 16

Change in Return on Assets for
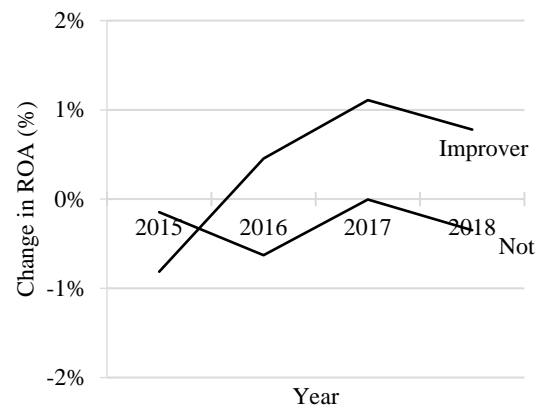Product Impact Improver Firms

Figure 17

Change in Return on Sales for
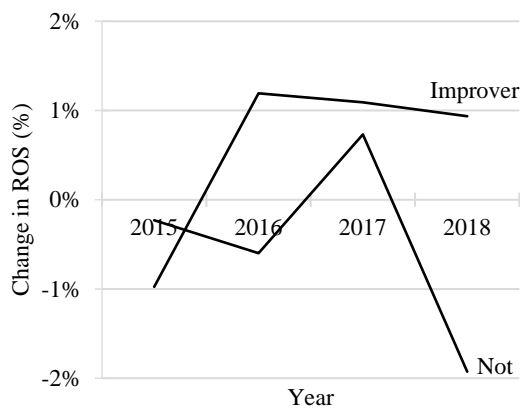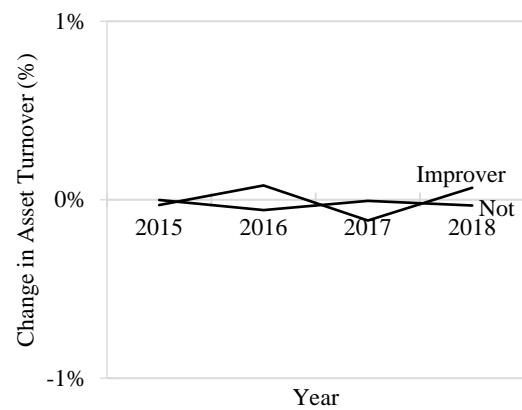Product Impact Improver Firms

Figure 18

Change in Asset Turnover for
Product Impact Improver Firms

In Figure 15, firms that improve their overall product impact from 2015 to 2018 also achieve higher sales growth during that time frame. We also compare the change in profitability of "Improver" firms to firms that do not display improvement in their overall product impact. In Figure 16, "Improver" firms demonstrate improvement in profitability and firms that do not display improvement in overall product impact display lack of improvement in profitability.

Next, we examine the change in return on sales and change in asset turnover for product improver firms. In Figure 17, we find that firms with improved overall product impact display a positive change in return on sales. In Figure 18, we find that firms with improved overall product impact display similar change in asset turnover to firms without improved overall product impact. This indicates that improved profitability margins could be driving the improvement in sales growth.

We recognize that with the available observations of automobile manufacturer product impact, it is difficult to determine clear associations with financial performance. As we expand the product impact framework applications to additional industries, we will continue to examine the relationship between a company's product impact and financial performance.

8. Accounting treatment of product impacts

As these identified product impacts are to be used in decision-making, the accounting treatment of these impacts needs to be considered. These considerations include where to recognize these impacts in financial statements and the timing of recognition.

In determining where to recognize product impacts, it is useful to identify where other product-related line items are recognized. For example, product sales are recognized in the income statement as revenue. Following the treatment of product sales, product impacts could likely be recognized as an adjustment to revenue. A company with overall negative product impacts would find their impact-weighted revenue lower than their financial revenue while a company with overall positive product impact would have a higher impact-weighted revenue than their financial revenue number.

Although product impact is recognized in the income statement there needs to be consideration of potential balance sheet effects. While product impact in this case is not to be recognized as an asset or a liability, the positive or negative effect would flow to other comprehensive income. These impacts are non-cash flow items that can contribute to equity which

is recorded in the balance sheet. Furthermore, it is imperative to note that although product impacts are not recorded in the balance sheet, that is not to say that all other social and environmental impacts should be recorded directly in the income statement. For example, employment-related impacts such as the impact from employee training could be recognized as human capital investments in the balance sheet that are depreciated over time. We explore employment impact and its accounting treatment in a future paper.

As the timing of impact recognition has been discussed above in the example automobile manufacturer application, product impact could be recognized when the actions influencing impact take place. This is preferable to recognizing impact at point of sale since the recognition should not be forward looking. For an automobile manufacturer, the timing of recognition for the dimensions of product impact can vary by when the action occurs. This is highlighted when one examines emissions and recyclability. With emissions, the impact would be recognized for the duration of expected product life since the vehicle is being used throughout product life and the emission particulates are being emitted during that usage. This is preferable to recognizing emissions impact at point of sale since the particulate emissions have not yet been created. On the other hand, their recyclability impact would be recognized at end of product life since that is when the vehicle is being recycled.

9. Conclusion

Although interest in ESG measurement has grown significantly, the focus has largely been around the impacts related to a company's operations rather than those created through product use. Product impact has been difficult to systematically measure given the idiosyncratic nature of the impacts and the tendency to view products in broad categorizations of simply good and bad. This idiosyncrasy is highlighted in the efforts of the few companies, investors, and disclosure frameworks that identify product impact.

The creation of a product impact framework that captures a product's reach, accessibility, quality, optionality, environmental use emissions and end of life recyclability allows for a systematic methodology that can be applied to different companies across a wide range of industries. This enables transparency, comparability, and scalability within product impact

reporting. The identified standard dimensions on which product impact can be measured are rooted in existing measurement efforts, allowing data that is publicly available to be leveraged.

To ensure applicability, determine feasibility, and identify nuances within each dimension of product impact, the framework will be tested on company pairs within each GICS sector. The examples presented in this paper highlight the need for ongoing discussion and refinement of industry-accepted assumptions given new information and changes to industries and technology over time. Input from industry is crucial for the framework to be widely applicable. The example also demonstrates how general estimates of impacts can become more precise when applying internal company data with more granularity within this framework.

The next set of research papers will examine applications of the framework across each GICS sector with the first in the series focused on automobile manufacturers for consumer discretionary, food products for consumer staples, water utilities for utilities, oil and gas for energy and pharmaceuticals for healthcare.

Ultimately, the aspiration is to develop and provide a framework that enables more informed decisions which account for the many impacts created by products.