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George Serafeim, Katie Trinh*

Impact-Weighted Accounts Project Research Report

Abstract

We apply the product impact measurement framework of the Impact-Weighted Accounts Initiative (IWAI) in two competitor companies within the telecommunications industry. We design a monetization methodology that allows us to calculate monetary impact estimates of network efficiency, rural service provision, and connectivity, among other factors. Our results indicate substantial differences in the impact that competitors have through their products. These differences demonstrate how impact reflects corporate strategy and informs decision-making on industry-specific areas, including service provision geographies.

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1. Introduction

Although significant progress has been made in the environmental and social metrics disclosed by companies and prescribed by reporting standards, these mostly pertain to a company's operations and are still not embedded in financial statements. In contrast to employment or environmental impacts from operations, product impacts, which refer to the impacts that occur from usage of a product once a company has transferred control of the good or service, tend to be highly idiosyncratic limiting the ability to generalize and scale such measurements. As such, for companies that do measure 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.

We have put forth a framework in which product impacts can be measured and monetized in a systematic and repeatable methodology across industries and have provided a sample application to the automobile manufacturing industry to address these issues.[1] Within any industry, the framework can be applied using a set of standard principles, industry assumptions and public data to estimate product impacts across the following seven dimensions.

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

In this paper we apply the framework to two competitor companies in the telecommunications industry. We then discuss potential data points and data sources for

[1] George Serafeim and Katie Trinh. "A Framework for Product Impact-Weighted Accounts", Harvard Business School. Accessed July 6, 2020.

monetization and detail the decisions behind assumptions made. Finally, we provide examples of insights specific to the telecommunications industry that can be derived from impact-weighted financial accounts and their analysis. The application of the product impact framework to the telecommunications industry demonstrates feasibility and actionability, while also providing guidance on the nuances and decision-making of applying the framework to other similar industries. The impacts derived demonstrate the potential for product impact measurement to inform strategic decision-making. 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. Application of the product impact framework

We apply the product impact framework of the Impact-Weighted Accounts Initiative within the telecommunications industry to ensure the framework is feasible, scalable, and comparable in the space. Through a deep-dive of two competitor companies, we provide a cohesive example that examines the impacts of telecommunications companies across the seven product impact dimensions of the framework to uncover nuances of the framework application in estimating actual monetary values. The companies will be referred to as Companies A and B given the purpose of this exercise is to examine feasibility and is not to assess the performance of individual companies. We do note that the data is from two of the largest telecommunications firms globally.

2.1 Data collection process

This application is based on publicly available data from company disclosures and industry-wide assumptions informed by regulatory bodies and established research firms. These examples make use of existing data and metrics with the goal of incorporating publicly available data.

Self-disclosed company datapoints reflect information found in the company's disclosures from 2018 such as the Form 10-K or annual sustainability reports which often disclose Sustainability Accounting Standards Board (SASB) and Global Reporting Initiative (GRI) metrics. Industry-wide assumptions on industry ARPU, value of rural connectivity, average broadband speed available and associated activities enabled, and cost and value associated with e-waste also come from the CTIA Wireless Association, the United States Telecom Association, the World Bank, the Federal Communications Commission, the Bureau of Labor Statistics, and various economic and academic studies. Given the methodology determines monetary impacts, the industry wide assumptions inevitably rely on some market-determined price and valuations.

3. Telecommunications application of the product impact framework

3.1 Overall impacts estimated

TABLE 1

Product Impacts of Company A and B

					Dimensions of Customer Usage									
					Reach		Access		Quality			Optionality	Env Use	End of Life
Company	Revenue	Relevant Impact Revenue	Positive Product Impact	Negative Product Impact	Quantity		Affordability	Underserved	Health & Safety	Effectiveness	Need	Monopoloy	Emissions	Recyclability
A	$171bn	$102bn	$9.2bn	-$12.7bn	Wireless customers Broadband connection	171m 14m	$439m	$4,980m	-	-$8,622m	$3,752m	-$2,097m	-$422m	-$1,555m
B	$131bn	$117bn	$13.9bn	-$5.3bn	Wireless customers Broadband connection	118m 7m	-	$558m	-	$8,990m	$2,584m	-$1,848m	-$484m	-$1,281m

* Total positive and negative product impact may differ from the sum of product impact within each dimension given effectiveness is composed of impacts positive and negative in magnitude.

For the telecommunications industry, the access dimension captures affordability of wireless and internet provision and service provision to rural, emerging market, and other underserved populations. The effectiveness dimension captures network efficiency and the need dimension captures connectivity benefits from internet and wireless access. The optionality dimension captures price rents from monopoly exposure. The environmental usage dimension captures emissions from product use and the recyclability dimension captures the cost and value associated with e-waste generation and recycling. There is no health and safety impact given the telecommunications industry does not have clear, demonstrable issues associated with customer health and safety. The following sections dive into the details, assumptions, and decisions behind these estimated impacts.

3.2 Reach

TABLE 2

Customers of Company A and B

Data			
		A	**B**
10K	Wireless customers	171,327,000	117,999,000
10K	Broadband connections	14,409,000	6,961,000

The goal of the reach dimension is to identify the number of individuals served by the company. For applicability and comparability, we limit this example to examining the impact of traditional and pure telecommunications services. While some telecommunication companies have additional business lines around media, content creation, and content distribution, we exclude these business lines from this example given the product is inherently different from telecommunications. These firms could estimate their overall product impact by separately estimating their product impact from communications as outlined in this paper and their product impact from content creation and distribution. Within the communications businesses, both telecommunications companies disclose the number of wireless customers they serve and the number of broadband connections they maintain.

3.3 Access – Affordability

3.3.A Affordability in telecommunications

The goal of the affordability dimension is to identify the positive impact of more affordable product or service provision. Affordability in the telecommunications industry aims to capture the impact of providing wireless and internet services more affordably than others in the industry. This can be measured with estimates of monthly service fees.

3.3.B Pricing data

To estimate the affordability of wireless and internet services, we examine industry price averages and look for the corresponding company-specific metric. For industry price averages, the

CTIA Wireless Association provides monthly average revenue per unit (ARPU)[2] and the United States Telecom Association provide estimates of average broadband pricing using the Federal Communications Commission Urban Rate Survey.[3]

For the company-specific costs and fees, we looked to the company's Form 10-K and marketing materials to identify the appropriate corresponding data. In marketing materials and financial disclosures, both Company A and Company B disclose their wireless and broadband ARPU.

TABLE 3

Affordability of Company A and B

Data			
Company datapoints		**A**	**B**
10-K	Wireless ARPU	$49.73	$42.03
10-K	Broadband ARPU	$49.83	$96.43
Industry assumptions			
CTIA	Industry wireless ARPU	$37.85	
US Telcom	Industry broadband ARPU	$52.37	

Estimation		
	A	**B**
(Industry wireless ARPU	$37.85	
	-	
Firm wireless ARPU)	$49.73	$42.03
	=	
Savings enabled	$0.00	$0.00
	x	
Wireless customers	171m	118m
	=	
Wireless affordability	-	-
(Industry broadband ARPU	$52.37	
	-	
Firm broadband ARPU)	$49.83	$96.43
	=	
Monthly savings enabled	$2.54	$0.00
	x	
Wireless customers	14m	7m
	x	
Annualization	12	
	=	
Broadband affordability	**$439m**	-
Affordability impact	**$439m**	-

3.3.C The impact estimate

To estimate the wireless and broadband service affordability, we take the monthly cost differential between the industry average ARPU and company average ARPU for services as shown in Table 3 with a floor at zero. We calculate the overall affordability impact by multiplying

[2] "CTIA Annualized Wireless Industry Survey Results". *CTIA Wireless Association.* Accessed December 2020.
[3] Arthur Menko. "2020 Broadband Pricing Index". *US Telecom Association.* Accessed December 2020.

the number of customers experiencing the more affordable pricing and annualizing. Given data availability, this example estimates the affordability impact at the overall company average level. A company with internal data could estimate a more granular affordability impact by applying the same methodology at the product or market level.

3.4 Access – Underserved

TABLE 4

Underserved Customers of Company A and B

Data			
Company datapoints		**A**	**B**
Firm PR	Rural homes connected	660,000	0
10-K	Emerging market customers	12,264,000	0
10-K	Pre-paid customers	17,000,000	4,646,000
News	Pre-paid cost-savings	$7.73	$10.00
Industry assumptions			
Microsoft	Value of rural connectivity	$2,100	
WB	Value of relevant emerging mkt	$164.48	-

Estimation		
	A	**B**
Rural homes connected	660,000	0
	x	
Value of rural connectivity	$2,100	
	=	
Rural impact	**$1,386m**	**-**
Emerging market customers	12m	-
	x	
Value of connectivity	$164	-
	=	
Emerging market impact	**$2,017m**	**-**
	-	
Pre-paid customers	17.0m	4.6m
	x	
Pre-paid cost savings	$7.73	$10.00
	x	
Annualization	12	
	=	
Pre-paid impact	**$1,577m**	**$558m**
Underserved impact	**$4,980m**	**$558m**

3.4.A The underserved customer

The goal of the underserved dimension is to identify the impact associated with provision of service to underserved customers. In the telecommunications space, we estimate the underserved impact by identifying customers in rural geographies or emerging markets and lower-income customers.

3.4.B Price or cost savings data

To identify customers in rural geographies or emerging markets, we use company self-reporting on the number of customers or households with broadband connectivity in a rural geography and the number of customers with wireless connectivity in emerging markets. Company A provides the estimated number of households connected in a rural region as defined by the FCC along with the number of wireless customers served in Mexico. Company B does not provide an estimate of households or customers connected in a rural region and solely operates in the United States. The value of rural household connectivity is estimated by Microsoft.[4] The value of emerging markets connectivity is estimated from the GDP and population of the relevant emerging market given the World Bank estimates a 10% increase in connectivity penetration is associated with a 0.17% increase in GDP.[5] Given the current literature relies on GDP to estimate the value of connectivity in emerging markets, we use the available GDP-based estimate as a proxy for more direct measures of productivity and other benefits from connectivity in emerging markets. As more direct estimates become available, those could more accurately capture the underserved impact to emerging markets.

To identify lower-income customers, we identify pre-paid customers as a proxy for lower-income customers given pre-payment tends to be associated with cost-savings compared to post-paid services. Both companies disclose the number of pre-paid customers. To estimate the cost savings associated with pre-payment, we take the difference between pre-paid and post-paid ARPU for Company A. For Company B, we rely on secondary marketing materials to estimate the average cost-savings for pre-payment.

3.4.C The impact estimate

We multiply the number of households connected in rural regions by the value of rural connectivity to estimate the underserved impact within rural populations. Similarly, we multiply the number of wireless customers connected in emerging markets by the per person value of connectivity in emerging markets to estimate the underserved impact within emerging markets. Lastly, we multiply the number of pre-paid customers by the monthly cost-savings from pre-payment and annualize to estimate the underserved impact to pre-paid customers. We then sum the underserved impact to these three populations to estimate the overall underserved impact.

3.5 Quality – Health and Safety

The health and safety dimension aims to capture instances where a customer's health, safety has been affected, or privacy has been breached. For a telecommunications company, a

[4] "An Update on Connecting Rural America". The 2018 Microsoft Airband Initiative. Accessed December 2020.
[5] Tim Kelly and Carlo Maria Rossotto. "Broadband Strategies Handbook." *The World Bank*. Accessed December 2020.

health and safety impact could be estimated by identifying instances of breaches to customer data or privacy. We note that government or law-enforcement mandated disclosures are not considered to be breaches of customer data or privacy in this example, assuming that such mandated disclosures are consistent with the laws of the country. As such, Companies A and B have not faced any data security or privacy breaches and do not have a health and safety impact.

3.6 Quality – Effectiveness

TABLE 5

Effectiveness Impact of Company A and B

Data			
Company datapoints		**A**	**B**
Firm PR	High-speed internet offered	50.25	486.46
10-K	High-speed customers	13,729,000	6,100,000
Firm PR	Low-speed internet offered	2.88	6.08
10-K	Low-speed customers	20,000	861,000
Firm PR	Wireless speed	21.10	101.80
Industry assumptions			
FCC	Median internet speed	72.00	
FCC	Cut-off speed for internet work-use	50.00	
OOKLA	Average wireless download speed	27.33	
Assumed	Maximum speed increase with value realized	150%	
BLS	Annual seconds on internet for work	2,779,110	
BLS	Annual seconds on internet for leisure	2,266,650	
eMarketer	Annual seconds on wireless internet for multi	470,850	
World Bank	Global hourly wage	$4.24	
Pharmaco	Global hourly value of leisure	$1.11	

Estimation		
	A	**B**
(High-speed internet speed	50.25	486.46
Activity affected by speed	*(Leisure)*	*(Leisure)*
	-	
Median internet speed)	72.00	
	=	
Speed differential (up to max)	-21.75	36.00
	x	
Leisure seconds on internet	2,266,650	
	=	
Missing or gained megabytes	-49m	82m
	÷	
Median internet speed	72.00	
	=	
Equivalent hours lost / gained	-190.2	314.8
	x	
High-speed internet customers	14m	6m
	=	
Total hours lost / gained	-2,611m	1,920m
	x	
Value of hourly leisure	$1.11	
	=	
High-speed effiency impact	**-$2,902m**	**$2,134m**
Effectiveness impact	**-$8,622m**	**$8,990m**

3.6.A Telecommunications effectiveness

In the effectiveness dimension, we aim to capture whether the product or service is effective at meeting customer expectations. For telecommunications, this includes aspects of efficient and reliable service provision. Given public data availability, we examine network speed to estimate the effectiveness impact of efficient service provision. A company with internal data on interruption frequency and duration can also estimate the effectiveness impact of reliable service provision.

3.6.B Data on network speeds, activities enabled, and associated time spent

Company data on network speed is self-disclosed in network performance marketing materials. Both Company A and B provide download speed in Mbps for their internet offerings by speed tier. Given public data availability does not identify customers by speed tier, we calculate an average company speed for each internet offering. As discussed in section 3.6.A, we do not estimate the effectiveness impact of network reliability given public data availability. We note however that as companies do begin to report reliability data per SASB metric TC-TL-550a.1 which covers system interruption frequency and duration, the impact from network reliability would be included within the effectiveness impact.

The industry average broadband[6] and wireless network speed[7] is provided at the country level by the Federal Communications Commission and Ookla, an internet testing and analysis data provider. In this example, we apply a country-level benchmark given available data granularity. A company with more granular internal data can apply a benchmark of the average speed available to a customer at a more specific geography level. We note that in geographies with only one service provider, the industry average speed available would match the company average speed available, resulting in no effectiveness impact within that specific geography. This is consistent with the incentive alignment principle[8], as the impact estimate should not discourage companies from providing service below the national average speed in rural areas that would otherwise be unserved.

We also examine the internet speed required for different activities and the associated average time spent, given variation in internet speed enables different activities rather than the speed of a single activity. The FCC broadband speed guide[9] outlines the broadband speed required for various general usage, video, conferencing and gaming related activities. We group the activities into work and leisure use to identify 50 Mbps as the speed required for work-related activities. We use the American Time Use Survey[10] from the Bureau of Labor Statistics to estimate the associated time spent online for work and leisure, allocating 50% of the time in the work and

[6] "Eighth Measuring Broadband America Fixed Broadband Report". *Federal Communications Commission Office of Engineering and Technology.* Published December 2018. Accessed December 2020.
[7] "Mobile Speedtest Data Report 2018 United States". *Ookla.* Published July 2018. Accessed December 2020.
[8] George Serafeim and Katie Trinh. "A Framework for Product Impact-Weighted Accounts", Harvard Business School. Accessed July 6, 2020.
[9] "Broadband Speed Guide". *Federal Communications Commission Consumer and Governmental Affairs Bureau.* Published February 2020. Accessed December 2020.
[10] "American Time Use Survey – 2019 Results". *Bureau of Labor Statistics*. Published June 2020. Accessed December 2020.

work-related activities, educational activities, and telephone calls, mail, and e-mail categories as internet-enabled work use and the time in the socializing and communicating and watching television categories as internet-enabled leisure use. For wireless use, we refer to industry reported estimates of time spent on mobile devices.[11] Since several wireless activities, such as texting and social media, are enabled at much lower speeds than the industry average, we reference the FCC speed guide to identify leisure activities that would be affected by higher wireless speed availability. We identify multi-media use as an activity that would be affected and refer to the Comscore Mobile App Report[12] to estimate time allocated for multi-media use.

For estimates on the value of work and leisure, we apply a global hourly wage estimate from the World Bank as discussed in the product framework application to automobile manufacturers[13] and calculate the hourly value of leisure based on literature that suggests leisure is valued at approximately 26% of paid work[14].

3.6.C The impact estimate

We identify the relevant activity affected by the company offered internet speed. In the example provided in Table 5, both companies offer an internet speed above the speed required for work use. This indicates that the activity impacted will be leisure. We calculate the difference between the company and industry speed to identify the difference in download speed compared to the industry. To estimate the experienced data gains or losses per customer, we multiply the speed differential by the seconds spent on the relevant activity, in this case, leisure. We then estimate the time gained or lost due to internet speed by dividing the data gains or losses by the industry average speed. To estimate the overall effectiveness impact from the higher-speed internet provided, we multiply the time gained or lost per customer by the number of customers on higher-speed internet and the hourly value of leisure. We repeat this methodology, as detailed in the Appendix, to calculate the effectiveness impact of the lower-speed internet offering and wireless and note that the lower-speed internet offering for both companies affects work rather than leisure use.

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[11] Yoram Wurmser. "Mobile Time Spent 2018". *eMarketer.* Published June 2018. Accessed December 2020.
[12] "The 2017 U.S. Mobile App Report". *Comscore White Paper.* Published August 2017. Accessed December 2020.
[13] George Serafeim and Katie Trinh. "A Framework for Product Impact-Weighted Accounts", Harvard Business School. Accessed July 6, 2020.
[14] Verbooy K, et al. "Time Is Money: Investigating the Value of Leisure Time and Unpaid Work." *PharmacoEcon Outcomes News* 808. Published July 2018. Accessed December 2020.

3.7 Quality – Basic Need

TABLE 6

Basic Need Impact of Company A and B

Data				Estimation		
Company datapoints		**A**	**B**		**A**	**B**
10-K	Wireless customers	171,327,000	117,999,000	Minimum unique customers	171,327,000	117,999,000
					x	
Industry assumptions				Averted connectivity loss	$21.90	
Deloitte	Loss from lack of connectivity	$21.90			=	
				Basic need impact	**$3,752m**	**$2,584m**

3.7.A Basic needs met by telecommunications

The basic need dimension aims to capture the impact created from a company by providing a service or product that meets a basic need. In the case of telecommunications, provision of broadband and wireless meets a basic need of connectivity. Examining the price elasticity of broadband cements this designation as the long-run price elasticity is in the inelastic range.[15]

3.7.B Value of connectivity data

To estimate the value of connectivity, we examine the economic losses associated with an internet outage as estimated by Deloitte.[16] Deloitte estimates an internet outage affecting 10 million individuals in a country with low internet connectivity would cost $0.6 million daily. This is equivalent with a $219 million loss annually that implies the per person loss associated with lack of internet connectivity annually is $21.90. To identify the number of individuals reached by Company A and B, we refer to figures self-reported by the companies as shown in section 3.2.

3.7.C The impact estimate

To estimate the basic need impact from provision of internet services, we multiply the number of individuals connected by Company A and B by the averted economic loss associated with lack of connectivity. For conservatism, we estimate the number of individuals reached assuming complete overlap of wireless and broadband customers. A company estimating their own basic need impact could apply the number of unique customers connected.

[15] Richard Cadman and Chris Dineen. "Price and Income Elasticity of Demand for Broadband Subscriptions: A Cross-Sectional Model of OECD Countries". *Telenor ASA.* Published 2009. Accessed January 2021.
[16] "The economic impact of disruptions to Internet connectivity". *Deloitte LLP.* Published October 2016. Accessed December 2020.

3.8 Optionality

TABLE 7

Optionality Impact of Company A and B

Data			
Company datapoints		**A**	**B**
JD Power	Customer satisfaction	81.1%	82.2%
10-K	Total service subscriptions	185,736,000	124,960,000
10-K	Avg monthly service price	$49.78	$69.23
Industry assumptions			
Roos. Inst.	Monopoly price premium	10%	

Estimation		
	A	**B**
Customers dissatisfied (%)	18.9%	17.8%
	x	
Total service subscriptions	185,736,000	124,960,000
	=	
Customer monopoly exposure	35,104,104	22,242,880
	x	
Monthly service price	$49.78	$69.23
	x	
Monopoly price premium	10%	
	x	
Annualization	12	
	=	
Optionality impact	**-$2,097m**	**-$1,848m**

3.8.A Optionality in telecommunications

The optionality dimension aims to capture the impact from consumers lacking freedom of choice when making a purchase, which we determine by examining whether the industry is monopolistic, whether the product or service is addictive, and whether there have been any information failures. In the case of telecommunications, consumers lack freedom of choice given the industry's monopolistic nature, as evidenced by the industry's HHI of 2,800.[17] The optimality impact estimates the losses consumers face from anti-competitive price rents and reduced quality as a result of the monopolistic industry.

3.7.B Monopolistic pricing and exposure data

We identify the impact of the telecommunications monopolistic nature on pricing as a 10% price premium as estimated by the Roosevelt Institute.[18] Given we cannot directly identify customer exposure to monopolistic effects, we apply customer dissatisfaction as a proxy for monopoly exposure with satisfaction data from J.D. Power.[19] To identify the total service

[17] Gene Kimmelman and Mark Cooper. "A Communications Oligopoly on Steroids." *Washington Center for Equitable Growth.* Published July 2017. Accessed December 2020.

[18] Mark Cooper. "Overcharged and Underserved: How a Tight Oligopoly on Steroids Undermines Competition and Harms Consumers in Digital Communications Markets". *Roosevelt Institute Working Paper.* Published December 2016. Accessed December 2020.

[19] "Social Media Emerges as Wireless Customer Service Channel of Choice, J.D. Power Finds" *J.D. Power.* Published January 2018. Accessed December 2020.

subscriptions of Company A and B, we refer to figures self-reported by the companies as shown in section 3.2.

3.7.C The impact estimate

To estimate customer monopoly exposure, we multiply the number of service subscriptions of Company A and B by customer dissatisfaction. We multiply the service subscriptions with dissatisfied customers by the price premium of the average monthly service fee and annualize to estimate the overall optionality impact.

3.9 Environmental Usage

TABLE 8

Environmental Usage Impact of Company A and B

Data			
Company datapoints		**A**	**B**
CSR	Emissions from use of product	3,705,329	4,241,232
Industry assumptions			
IWAI	Cost per metric ton of carbon	$114	

Estimation		
	A	**B**
Emissions from usage	3,705,329	4,241,232
	x	
Cost per ton of carbon	$114	
	=	
Emissions impact	**-$422m**	**-$484m**

3.9.A Environmental usage in telecommunications

The environmental usage dimension aims to capture any environmental emissions, pollutants, or efficiencies produced from use of the product. For telecommunications, we estimate the impact from the emissions generated by customer usage of the service. For example, the emissions associated with the electricity used to power a router for internet services would be included within the environmental usage dimension. However, we exclude the impact from the emissions associated with powering a cellular tower as those impacts are fully captured by the environmental framework of the Impact-Weighted Accounts given these impacts are operational.[20] We note that this example excludes efficiencies gained from Internet of things (IoT) innovations. As this technology becomes more widely adopted, the environmental usage impact of IoT can be estimated as companies will have better internal information and public data disclosures.

[20] 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. Published March 2020.

3.9.B Environmental usage data

We identify a company's emissions from product use in their corporate sustainability reporting. While Company A's Scope 3 disclosures report the emissions associated with product use, Company B's Scope 3 disclosures are limited to employee travel. We therefore estimate Company B's emissions associated with product use by assuming the ratio of emissions to relevant impact revenue for Company A is representative for Company B. The cost associated with a metric ton of carbon is estimated in the environmental framework of the Impact-Weighted Accounts.[21]

3.9.C The impact estimate

We estimate a company's environmental usage impact by multiplying the emissions from usage by the cost of emissions.

3.10 End of Life Recyclability Impact

TABLE 9

End of Life Impact of Company A and B

Data			
Company datapoints		**A**	**B**
Estimated	Tons of e-waste generated	3,688,639	3,082,833
CSR	Tons of e-waste recycled	4,876	21,067
Industry assumptions			
Journal	Cost associated with ton of e-waste	$423	
UN	Value of recycled e-waste (ton)	$1,072	

Estimation		
	A	**B**
(Tons of e-waste generated	3,688,639	3,082,833
	x	
Cost associated with e-waste)	-$423	
	=	
E-waste generation impact	-$1,560m	-$1,304m
	+	
(Tons of e-waste recycled	4,876	21,067
	x	
Cost associated with e-waste)	$1,072	
	=	
E-waste recycled impact	$5m	$23m
	=	
End of life impact	**-$1,555m**	**-$1,281m**

3.10.A End of life impact in telecommunications

The end of life dimension aims to measure the averted and created emissions from the end of life treatment of the product. For telecommunications, the end of life dimension captures the impacts e-waste generated and recycled. As the industry continues to adopt end of life and other

[21] 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. Published March 2020.

recyclability innovations, we would expect disclosure and reporting on these innovations to improve, enabling more comprehensive impact estimates.

3.10.B Waste generation and recyclability data

We estimate the volume of e-waste generated and recycled given sustainability and financial disclosures. For Companies A and B, we estimate the volume of e-waste generated from the number of broadband and wireless connections as discussed in section 3.2 and an assumed volume for a broadband and mobile device. We estimate the volume of e-waste recycled for Company A from the reported number of recycled devices and the same assumed volume for a broadband and mobile device. Company B discloses the volume of recycled e-waste directly in their sustainability report. Given public data availability, we apply the e-waste volume as disclosed by Company B and note that this volume may be overstated given firms tend to include operational e-waste in their disclosures. The cost associated with a ton of e-waste is estimated in environmental science literature[22] and the value associated with a ton of recycled e-waste is estimated by the United Nations.[23]

3.9.C The impact estimate

We estimate a company's end of life recyclability impact from waste generation by multiplying the volume of e-waste generated by the cost of e-waste generated. We estimate a company's end of life recyclability impact from waste recycled by multiplying the volume of e-waste recycled by the value of recycled e-waste.

4. Discussion

This application of the product framework to telecommunications not only indicates feasibility of estimating monetary product impacts within this industry, but also demonstrates the potential value of impact-weighted financial statement analysis.

The product impact dimensions reflect the nature of the telecommunications industry. Effectiveness is a significant driver of product impact, and a dimension on which companies

[22] Brett H. Robinson. "E-waste: An assessment of global production and environmental impacts". *Science of the Total Environment,* 408 (2) pp. 183-191. Published December 2009. Accessed December 2020.
[23] Vanessa Forti, Cornelis Peter Baldé, Ruediger Kuehr, and Garam Bel. "The Global E-waste Monitor 2020". *United Nations University.* Published 2020. Accessed December 2020.

demonstrate significant variation. The optionality and basic need dimensions reflect the costs associated with the monopolistic nature of the industry and the value created from providing connectivity. The underserved dimension demonstrates the potential untapped value to customers and service providers from rural and emerging market service provision.

Another potential analysis could compare the product impacts of different companies. Within a single industry, one can identify differences in how the two companies approach different product attributes. For example, our analysis suggests that Company A is less effective than Company B given they operate with lower efficiency. However, Company A provides services to more underserved communities compared to Company B. Analyzing each dimension allows for a deeper understanding of the product impact performance of each company relative to competitors and the broader industry.

Finally, the impact-weighted financial statement analysis indicates which dimensions are most material to product impact creation. In telecommunications, the impact is driven mostly effectiveness, underserved, basic need, and optionality. However, most of the variance in company performance on product impact in telecommunications is most dependent on provision of service to the underserved and system efficiency.

4.1 Application of impact-weighted financial statement analysis

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

The dataset consists of product impact estimates across 4 years, 2015 to 2018, of 12 global publicly traded telecommunications companies that are listed or cross-listed in the US with over $2 billion in revenue to ensure data availability and comparability. The product estimates are calculated by applying the industry-wide assumptions to the respective company-specific data points as demonstrated with Companies A and B. While most industry assumptions used for monetizing product impact are constant throughout the industry across geography, we note that the average affordability and effectiveness benchmarks of average revenue per user and average wireless and broadband speed are based off US averages and we assume these are reasonably representative of the averages in the other geographies included in our dataset, Canada, Japan, Germany, Spain, France, United Kingdom, Australia, Singapore, Switzerland and Norway. For comparability across firms of different size, we examine the product estimates scaled by EBITDA and revenue.

For reach, we estimate the number of wireless customers and internet connections from company annual reports. Similarly, for the affordability dimension, we collect company-specific data on wireless and internet average revenue per user from company annual reports and other financial disclosures. This company-specific data is also referred to for the optionality dimension.

For the underserved dimension, we estimate company-specific data on the number of rural households, emerging market customers, and wireless pre-paid customers connected from company annual reports and corporate responsibility disclosures. To estimate the relevant GDP and population for the emerging markets represented, we take the total sum of the relevant emerging market GDP and emerging market population for each company.

For the effectiveness dimension, wireless and broadband speeds come from company annual reports when available. We note that the decision to report on speed and the granularity of such reporting varies between companies. We thus also refer to secondary sources including press releases, news media, and third-party speed test data.[24] We examine the resulting effectiveness estimates to ensure the two source types do not lead to skewed estimates. Based on the distribution of effectiveness estimates by both source types, we believe these secondary sources provide a reasonable and conservative estimate compared to self-reporting. However, as speed reporting data becomes more consistent, we expect future dataset construction to rely on a single data source type.

For the environmental usage dimension, emissions from product use comes from company annual reports and corporate sustainability reporting where available. For firms that do not report their emissions from product use, we apply imputed emissions given the number of wireless customers and broadband customers as discussed in section 3.9.

For the end-of-life dimension, the volume of e-waste generated is estimated through the number of wireless and broadband connections which comes from company annual reports. The volume of recycled e-waste from product use comes directly from corporate sustainability

[24] Examples of secondary sources include "Speedtest Ookla Insights" which aggregates consumer-initiated test data from over 30 billion users, "Opensignal Market Insights" which provides independent insights on mobile connectivity globally, and industry news media such as "Fierce Wireless" which provides breaking news and expert analysis of trends shaping wireless communications.

reporting where available. For most firms, this is estimated through the number of devices collected or taken back for recycling which comes from company corporate sustainability reporting as discussed in section 3.10.B.

Table 10

Product Impact of Telecommunications Companies

	Impact Scaled by EBITDA			**Impact Scaled by Revenue**		
Impact	N	Average	SD	N	Average	SD
Affordability Impact	48	8.88%	0.18	48	2.99%	0.06
Underserved Impact	48	48.37%	0.77	48	15.22%	0.23
Effectiveness Impact	43	-25.00%	1.08	43	-7.14%	0.34
Optionality Impact	48	-7.76%	0.05	48	-2.55%	0.02
Environmental Use Impact	48	-1.85%	0.02	48	-0.59%	0.01
End-of-Life Impact	48	-0.38%	0.01	48	-0.12%	0.00
Overall Product Impact	43	21.44%	1.57	43	7.46%	0.49

Table 10 shows the summary statistics for all the impact variables. Examining the average impact scaled by EBITDA and revenue indicates that underserved and effectiveness are significant drivers of the overall product impact. Both dimensions are also characterized by larger standard deviations when scaled by EBITDA and revenue, indicating the variance in product impact is influenced by strategic decisions and variance around wireless and internet speed offerings, pre-paid service offerings, and provision of service to emerging and rural markets.

Figure 2

Distribution of Overall Product Impact Estimates Scaled by EBITDA

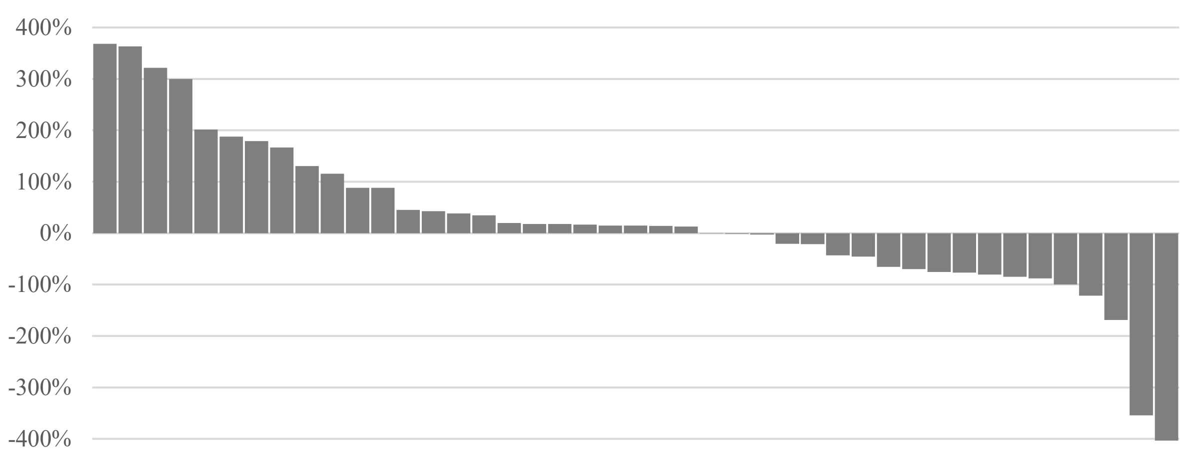


Figure 2 shows the distribution of total product impact scaled by EBITDA in the sample showing significant variation. The distribution exhibits a positive median and a slight positive skew. In firm-years where we do observe negative product impact, this is due to slower service offerings and optionality issues.

4.2 Hypotheses explaining product impact estimates

There are four hypotheses that can explain the product impact we are observing within the telecommunications industry. The first hypothesis is the *baseline case* in which the product impact estimated is consistent with and captures the impact of the industry. The second hypothesis is the *scope bias case* in which some impacts created by the telecommunications industry have not yet been estimated and included in the total product impact. The third hypothesis is the *measurement bias case* in which the benefits or costs are rightly scoped but incorrectly estimated. Finally, the fourth hypothesis is *sample selection bias* in which the companies selected in our sample are unrepresentative of the full industry.

We minimize issues of *scope bias* by estimating the impact of identified product impact issues raised in the financial and sustainability disclosures by telecommunications firms. However, we note there may exist impacts which have not yet been estimated due to current data availability and quality on other aspects of service provision, such as service interruptions. To minimize *measurement bias,* we use commonly accepted industry research and guidance to estimate benefits and costs. We note that simplifying the pricing and service speed benchmarks to a single representative geography may influence our access and effectiveness impacts. For example, we may overestimate affordability impact in regions with lower priced offerings. Finally, we minimize *sample selection bias* by including firms across different geographies that serve regions with differing infrastructure levels.

4.3 Discussion of insights enabled by impact-weighted financial statement analysis

Figure 3

2015 Overall Product Impact Estimates

(Scaled by EBITDA)

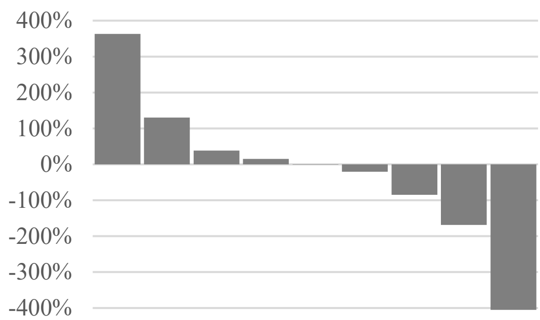
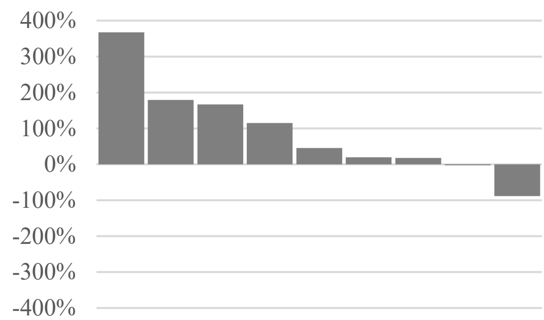


Figure 4

2018 Overall Product Impact Estimates

(Scaled by EBITDA)



Comparing the distribution of overall product impact estimates in 2015 and 2018 indicates improvement in overall product impact performance for nearly all firms observed. While the distribution of product impact in 2015 is balanced between positive and negative impact, the distribution of product impact in 2018 demonstrates both a positive median and skewness. While many firms display negative product impact in 2015, the majority of firms display positive product impact in 2018. The product impact leaders remain generally consistent between 2015 and 2018. Telefonica and Singtel lead product impact across 2015 and 2018 and Telenor and Verizon consistently perform above average in all firm year observations. Lastly, Deutsche Telekom and BT Group demonstrate improvement in product impact over the observed years, with their faster service speed moving them from below average performance to being industry leaders in 2018.

Figure 5

Affordability Impact Estimates

(Across All Years, Scaled by EBITDA)

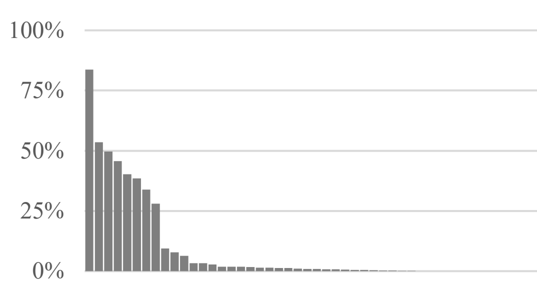


Figure 6

Underserved Impact Estimates

(Across All Years, Scaled by EBITDA)

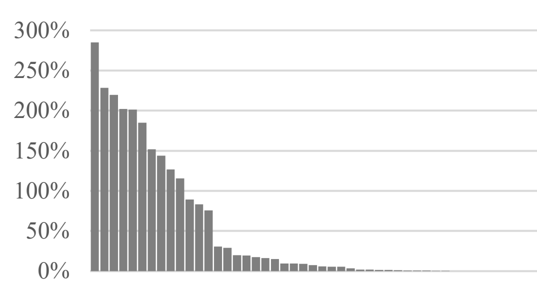


Figure 7

Effectiveness Impact Estimates

(Across All Years, Scaled by EBITDA)

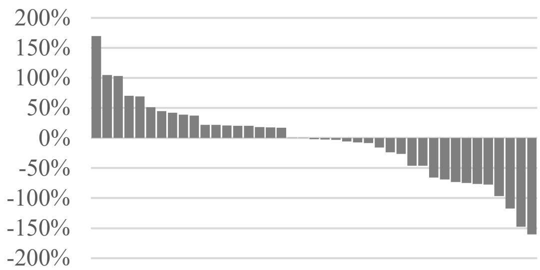


Figure 8

Optionality Impact Estimates

(Across All Years, Scaled by EBITDA)

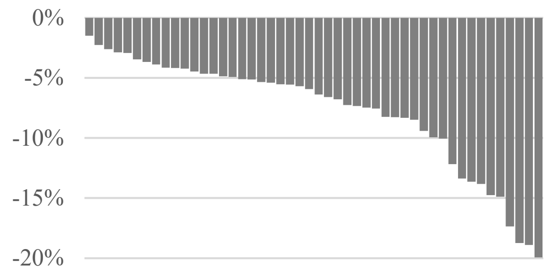


Figure 9

Environmental Use Impact Estimates

(Across All Years, Scaled by EBITDA)

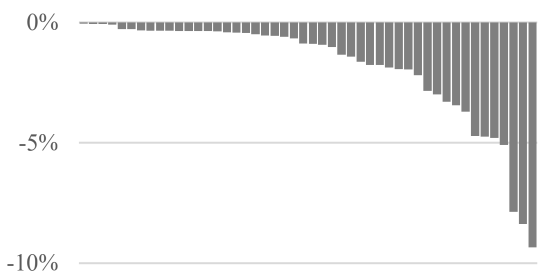


Figure 10

End-of-Life Impact Estimates

(Across All Years, Scaled by EBITDA)

The magnitude and distribution of the affordability indicates that while most firms in our sample provide slightly more affordable services than the industry average, there exists a group of three firms that provide a more premium offering and have no affordability impact, and two firms that provide a budget offering and thus lead on affordability impact.

The magnitude and distribution of the underserved dimension suggests that service provision to the underserved is a driver of product impact for firms with meaningful efforts to provide telecommunications services to the underserved. This dimension contributes to the variation in overall product impact as firms either do or do not reach a large underserved population, indicated by the discontinuity in the distribution. While Telefonica and Singtel lead this dimension given the number of customers they reach in emerging markets, many firms reach few to no underserved customers.

The magnitude and distribution of the effectiveness dimension indicates that effectiveness is also a key driver of the observed variation in product impact across all firms in the dataset. Aside from BT Group and Deutsche Telekom that demonstrate significant improvement in effectiveness, the remainder of the firms are rather consistent in their effectiveness impact across all four years.

The magnitude and distribution of the optionality dimension indicates that while all firms have an optionality impact given the monopolistic nature of the industry, the variation in customer service and pricing is reflected in the variation of optionality impact.

Finally, the magnitude of the environmental usage and end-of-life dimensions suggests these two dimensions are not key drivers of product impact in this industry.

Examining the relationship between product impact performance across different dimensions, we identify trade-offs in different operating and strategic decisions. Examining affordability impact alongside effectiveness impact, we determine that the budget offering strategy could be, but is not necessarily, associated with slower speed offerings. We also determine that firms with more affordable budget offerings tend to also reach more underserved customers. Lastly, we examine the optionality impact in conjunction with affordability impact to determine whether more affordable firms have fewer optionality issues. We note that one of the budget offering firms leading affordability impact is a laggard in optionality impact for most years given low customer satisfaction. This firm extracts rent not through high pricing, but through a higher number of customers experiencing the negative effects of monopoly exposure. For most firms, the optionality dimension is an untapped opportunity to improve on product impact by reducing customer exposure to monopolistic effects. Ultimately, firms that deliver positive product impact manage to deliver at or above average service speeds, with the firms leading on product impact also delivering a more affordable offering and reaching underserved customers. However, firms that deliver positive affordability and underserved impact do not necessarily deliver positive product impact. Ultimately, for many firms, the affordability, underserved, and effectiveness dimensions are an untapped opportunity to deliver more positive product impact.

5. Conclusion

Although interest in ESG measurement continues to grow significantly, 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. The creation of a product impact framework 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, we examine applications of the framework to company pairs across each GICS sector. In this working paper, we provide a sample application to the telecommunications industry. We use publicly disclosed data and industry-wide assumptions to derive monetary estimates of a product's reach, accessibility, quality, optionality, environmental use emissions and end of life recyclability. While publicly disclosed data can provide meaningful insights, use of internal company data can further enable precision and support internal decision-making. This example also highlights the need for ongoing discussion and refinement of industry-accepted assumptions as contemporary literature leads to changing guidance over time.

This paper is one within the series of applications of the framework across each GICS sector, covering telecommunications in the communications services sector. Ultimately, the aspiration is to develop and provide a framework that enables more informed decisions which account for the many impacts created by products.

A. Appendix

Data			
Company datapoints		**A**	**B**
Firm PR	High-speed internet offered	50.25	486.46
10-K	High-speed customers	13,729,000	6,100,000
Firm PR	Low-speed internet offered	2.88	6.08
10-K	Low-speed customers	20,000	861,000
Firm PR	Wireless speed	21.10	101.80
Industry assumptions			
FCC	Median internet speed	72.00	
FCC	Cut-off speed for internet work-use	50.00	
OOKLA	Average wireless download speed	27.33	
Assumed	Maximum speed increase with value realized	150%	
BLS	Annual seconds on internet for work	2,779,110	
BLS	Annual seconds on internet for leisure	2,266,650	
eMarketer	Annual seconds on wireless internet for multi	470,850	
World Bank	Global hourly wage	$4.24	
Pharmaco	Global hourly value of leisure	$1.11	

Estimation		
	A	**B**
(Low-speed internet speed	2.88	6.08
Activity affected by speed	*(Work)*	*(Work)*
	-	
Work internet speed)	50.00	
	=	
Speed differential (up to max)	-47.12	-43.92
	x	
Work seconds on internet	2,779,110	
	=	
Missing or gained megabytes	-131m	-122m
	÷	
Median internet speed	72.00	
	=	
Equivalent hours lost / gained	-505.3	-470.9
	x	
Low-speed internet customers	20,000	861,000
	=	
Total hours lost / gained	-10m	-405m
	x	
Value of hourly leisure	$4.24	
	=	
Low-speed effiency impact	**-$43m**	**-$1,720m**
Wireless speed	21.10	101.80
	-	
Median internet speed)	27.33	
	=	
Speed differential (up to max)	-6.23	13.67
	x	
Work seconds on internet	470,850	
	=	
Missing or gained megabytes	-3m	6m
	÷	
Median internet speed	27.33	
	=	
Equivalent hours lost / gained	-29.8	65.4
	x	
Wireless customers	171m	118m
	=	
Total hours lost / gained	-5,108m	7,717m
	x	
Value of hourly leisure	$1.11	
	=	
Wireless effiency impact	**-$5,677m**	**$8,576m**

Note: We assume rural areas are served by a single telecommunications company and exclude rural customers from the low-speed internet customers in the above calculation as discussed in section 3.6.B. For geographies in which a service provider is the sole-service provider, there is no benchmark for comparison as the average industry speed and company speed are the same.