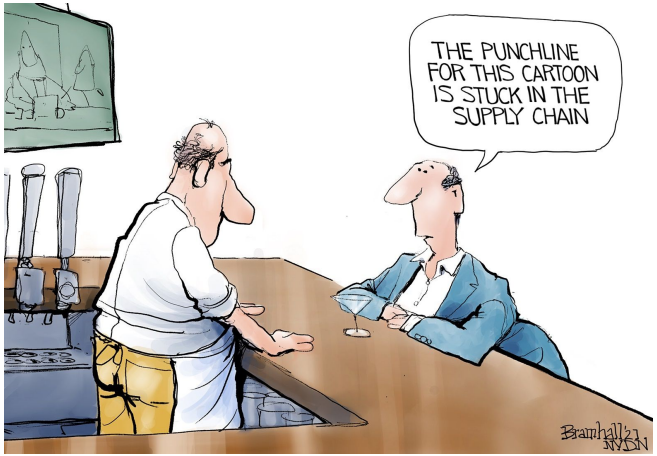
Impact of Environmental and Supply Chain Metrics on Company Financials

TEAM 6



Questrom School of Business, Boston University
MSBA Presentation

BOSTON UNIVERSITY

Motivation:

In today's rapidly evolving business landscape, the integration of environmental sustainability in corporate strategy is not just a moral imperative but a foundational component of enduring financial success.

Our comprehensive dataset provides a unique opportunity to explore the multifaceted relationships between environmental practices and financial outcomes across diverse industries and geographies.

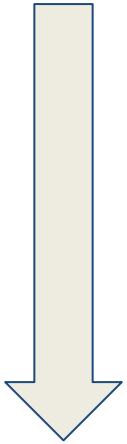
Goals for this Dataset

Product Safety and Quality Factors

Recycling and Waste Management

Inventories of raw materials and Emissions, Pollution Prevention

Consumers



Companies/ firms

About the Dataset

The dataset contains data for 77,313 entries across 49 columns, primarily related to companies and their environmental and financial metrics.

MSCI : https://drive.google.com/drive/folders/1bHeKVn-scXI6HmgJNZ59MjKVjjuVRPZc
Finance : https://drive.google.com/drive/folders/1GXkMHmEPLMhxkeJeHpmVYNCclfAzj6O8

Summary of key aspects of the dataset:

Identification and General Information:

- Company Name: Name of the company.
- country: Country where the company is located.
- year: Year of the data entry.

Environmental Performance Metrics:

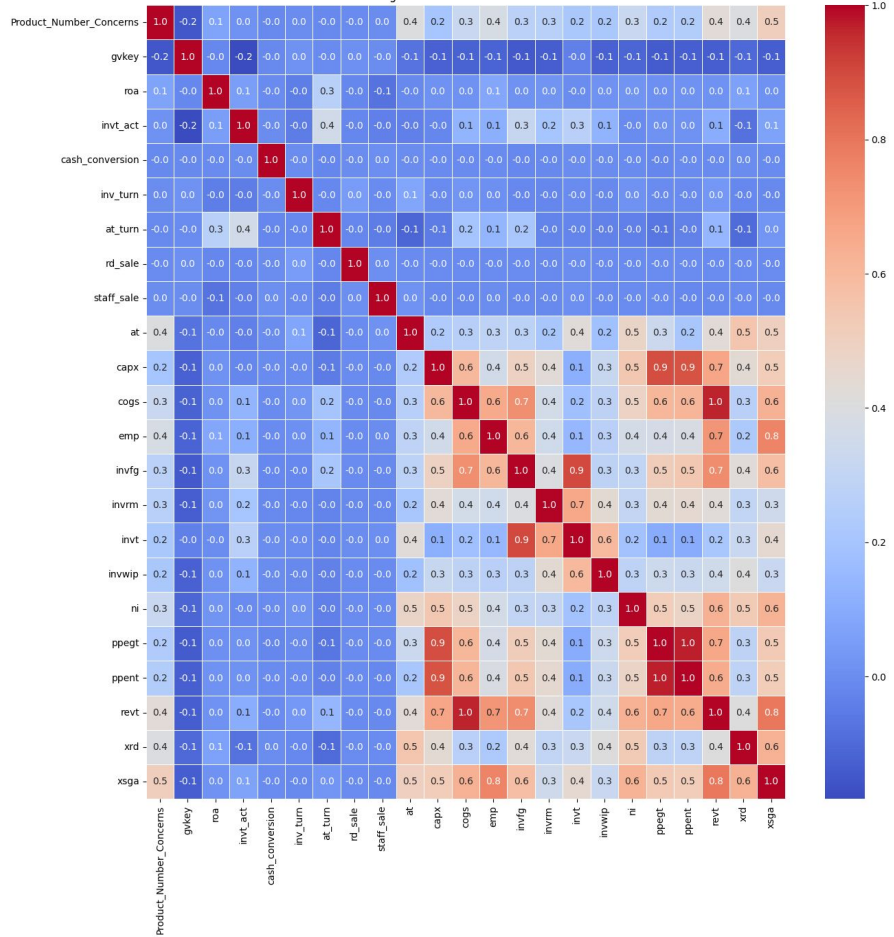
- Supply_Chain_Policies
- Hazardous_Waste
- Regulatory_Problems
- Pollution_Prevention
- Recycling

Financial and Operational Metrics:

- roa (Return on Assets)
- invt_act (Inventory Activity)
- inv_turn (Inventory Turnover)
- at_turn (Asset Turnover)

Needed a lot of data cleaning!

Figure 1.2 : Correlation Matrix



Understanding the Correlation Matrix:

The correlation matrix provided encompasses all numerical columns within the dataset. Notably, it highlights significant collinearity among specific financial variables:

- Total Revenue (revt) and Selling, General, and Administrative Expense (xsga)
- Capital Expenditures (capx), Property, Plant, and Equipment - Total Gross (ppegt), and Property, Plant, and Equipment - Total Net (ppent)
- Inventories - Total (invt) and Inventories Finished Goods (invfg)

Awareness of these interrelationships prompts a cautious approach when incorporating these variables into regression analyses, ensuring accurate and reliable model outcomes.

REGRESSION ANALYSIS

Return on Assets Considering Product Safety and Quality Factors

OLS Regression Results

Dep. Variable:	roa	R-squared:	0.002
Model:	OLS	Adj. R-squared:	0.002
Method:	Least Squares	F-statistic:	14.09
Date:	Thu, 02 May 2024	Prob (F-statistic):	1.74e-11
Time:	13:59:26	Log-Likelihood:	-32059.
No. Observations:	28721	AIC:	6.413e+04
Df Residuals:	28716	BIC:	6.417e+04
Df Model:	4		
Covariance Type:	nonrobust		

	coef	std err	t	P>|t|	[0.025	0.975]
Intercept	0.1489	0.197	0.754	0.451	-0.238	0.536
C(Product_Safety)[T.0]	-0.0733	0.198	-0.371	0.711	-0.460	0.314
C(Product_Safety)[T.1]	0.0127	0.199	0.064	0.949	-0.376	0.402
C(Product_Safety)[T.2]	8.684e-18	1.06e-18	8.180	0.000	6.6e-18	1.08e-17
C(Quality)[T.0]	-0.0080	0.009	-0.884	0.377	-0.026	0.010
C(Quality)[T.1]	-0.1163	0.018	-6.527	0.000	-0.151	-0.081

Omnibus:	128070.929	Durbin-Watson:	1.925
Prob(Omnibus):	0.000	Jarque-Bera (JB):	654066353813.118
Skew:	-145.516	Prob(JB):	0.00
Kurtosis:	23379.694	Cond. No.	3.01e+18

Product Safety: This indicator gauges product and service quality/safety controversies, encompassing issues like

1. Food safety,
2. Media controversies
3. Recalls
4. Service disruptions
5. Chemical concerns.

Quality : This indicator assesses companies' handling of major product quality concerns and potential recalls.

Result : Asset turnover inclusion reveals significance for companies with low product safety concerns, highlighting the need for a nuanced understanding of their impact on ROA.

Return on Assets Considering Product Safety and Quality Factors with Controls

OLS Regression Results

Dep. Variable:	roa	R-squared:	0.075
Model:	OLS	Adj. R-squared:	0.074
Method:	Least Squares	F-statistic:	458.5
Date:	Thu, 02 May 2024	Prob (F-statistic):	0.00
Time:	13:59:26	Log-Likelihood:	5825.4
No. Observations:	28441	AIC:	-1.164e+04
Df Residuals:	28435	BIC:	-1.159e+04
Df Model:	5		
Covariance Type:	nonrobust		

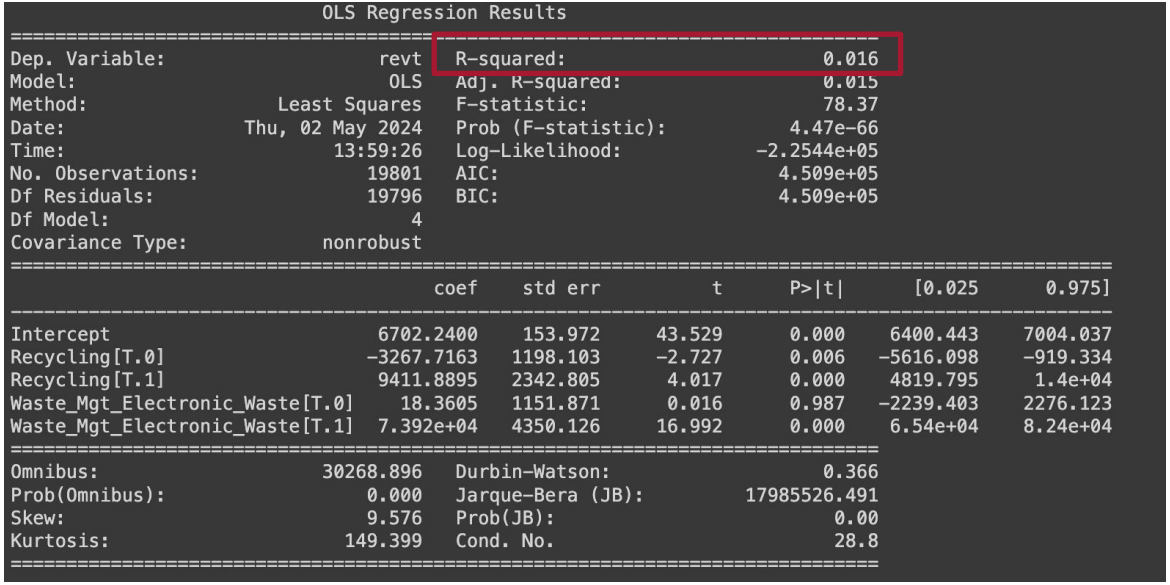
	coef	std err	t	P>|t|	[0.025	0.975]
Intercept	0.1561	0.055	2.853	0.004	0.049	0.263
Product_Safety[T.0]	-0.1213	0.055	-2.218	0.027	-0.229	-0.014
Product_Safety[T.1]	-0.0638	0.055	-1.161	0.246	-0.172	0.044
Product_Safety[T.2]	-1.147e-17	9.34e-19	-12.282	0.000	-1.33e-17	-9.64e-18
Quality[T.0]	-0.0206	0.002	-8.428	0.000	-0.025	-0.016
Quality[T.1]	-0.0389	0.005	-8.022	0.000	-0.048	-0.029
at_turn	0.0689	0.002	45.871	0.000	0.066	0.072

Omnibus:	46931.086	Durbin-Watson:	1.128
Prob(Omnibus):	0.000	Jarque-Bera (JB):	107187233.505
Skew:	-10.633	Prob(JB):	0.00
Kurtosis:	302.997	Cond. No.	5.89e+16

Result :

1. More Robust
2. Increase in R2
3. Introducing a significant variable (at_turn) as a control.

Total Revenue with Recycling and Waste Management



OLS Regression Results

Dep. Variable:	revt	R-squared:	0.016
Model:	OLS	Adj. R-squared:	0.015
Method:	Least Squares	F-statistic:	78.37
Date:	Thu, 02 May 2024	Prob (F-statistic):	4.47e-66
Time:	13:59:26	Log-Likelihood:	-2.2544e+05
No. Observations:	19801	AIC:	4.509e+05
Df Residuals:	19796	BIC:	4.509e+05
Df Model:	4		
Covariance Type:	nonrobust		

	coef	std err	t	P>|t|	[0.025	0.975]
Intercept	6702.2400	153.972	43.529	0.000	6400.443	7004.037
Recycling[T.0]	-3267.7163	1198.103	-2.727	0.006	-5616.098	-919.334
Recycling[T.1]	9411.8895	2342.805	4.017	0.000	4819.795	1.4e+04
Waste_Mgt_Electronic_Waste[T.0]	18.3605	1151.871	0.016	0.987	-2239.403	2276.123
Waste_Mgt_Electronic_Waste[T.1]	7.392e+04	4350.126	16.992	0.000	6.54e+04	8.24e+04

Omnibus:	30268.896	Durbin-Watson:	0.366
Prob(Omnibus):	0.000	Jarque-Bera (JB):	17985526.491
Skew:	9.576	Prob(JB):	0.00
Kurtosis:	149.399	Cond. No.	28.8

Result : Proactive environmental management, particularly in recycling and e-waste, correlates with higher revenues, alongside the significant role of cost of goods sold as a revenue control variable.

Recycling:

This indicator assesses how companies manage the risk of market loss or increased compliance costs due to packaging regulations.

Electronic Waste:

This indicator evaluates regulatory risks related to electronic waste recycling for companies. It considers exposure to regulations, recycling targets, and implementation of recovery programs.

Total Revenue with Recycling and Waste Management with controls

OLS Regression Results

Dep. Variable:	revt	R-squared:	0.926
Model:	OLS	Adj. R-squared:	0.926
Method:	Least Squares	F-statistic:	4.169e+04
Date:	Thu, 02 May 2024	Prob (F-statistic):	0.00
Time:	13:59:26	Log-Likelihood:	-1.6854e+05
No. Observations:	16641	AIC:	3.371e+05
Df Residuals:	16635	BIC:	3.371e+05
Df Model:	5		
Covariance Type:	nonrobust		

	coef	std err	t	P>|t|	[0.025	0.975]
Intercept	1054.4268	49.642	21.241	0.000	957.124	1151.730
Recycling[T.0]	-560.6428	347.817	-1.612	0.107	-1242.401	121.115
Recycling[T.1]	3593.5414	670.790	5.357	0.000	2278.721	4908.362
Waste_Mgt_Electronic_Waste[T.0]	641.9769	333.278	1.926	0.054	-11.284	1295.238
Waste_Mgt_Electronic_Waste[T.1]	1.355e+04	1244.626	10.890	0.000	1.11e+04	1.6e+04
cogs	1.2953	0.003	452.380	0.000	1.290	1.301

Omnibus:	20627.425	Durbin-Watson:	0.444
Prob(Omnibus):	0.000	Jarque-Bera (JB):	4892301.911
Skew:	6.594	Prob(JB):	0.00
Kurtosis:	85.957	Cond. No.	4.54e+05

Notes:
[1] Standard Errors assume that the covariance matrix of the errors is correctly specified.
[2] The condition number is large, 4.54e+05. This might indicate that there are strong multicollinearity or other numerical problems.

COGS significantly impacts revenue, highlighting its role as a **control variable** in understanding the impact of recycling and e-waste management on revenue.

Raw Material with Emissions, Pollution Prevention and Recycling

OLS Regression Results

Dep. Variable:	invrm	R-squared:	0.111
Model:	OLS	Adj. R-squared:	0.111
Method:	Least Squares	F-statistic:	330.7
Date:	Thu, 02 May 2024	Prob (F-statistic):	0.00
Time:	13:59:27	Log-Likelihood:	-1.1109e+05
No. Observations:	15849	AIC:	2.222e+05
Df Residuals:	15842	BIC:	2.222e+05
Df Model:	6		
Covariance Type:	nonrobust		

	coef	std err	t	P>|t|	[0.025	0.975]
Intercept	9.6378	6.593	1.462	0.144	-3.284	22.560
Substantial_Emissions[T.0]	50.4889	5.772	8.748	0.000	39.176	61.802
Substantial_Emissions[T.1]	450.1829	15.657	28.753	0.000	419.494	480.872
Pollution_Prevention[T.0]	16.9513	4.865	3.484	0.000	7.415	26.487
Pollution_Prevention[T.1]	312.0692	13.038	23.935	0.000	286.513	337.625
Recycling[T.0]	47.4783	9.683	4.903	0.000	28.498	66.458
Recycling[T.1]	463.8135	27.323	16.975	0.000	410.257	517.370

Omnibus:	21992.456	Durbin-Watson:	0.395
Prob(Omnibus):	0.000	Jarque-Bera (JB):	6872585.277
Skew:	8.108	Prob(JB):	0.00
Kurtosis:	103.718	Cond. No.	19.2

Substantial Emission : This indicator assesses controversies related to a company's non-GHG emissions, including spills, standard emissions, and hydraulic fracturing.

Pollution Prevention : This indicator evaluates companies' risk management of pollution and toxic emissions, favoring those with clear strategies and reduction programs.

Raw Material with Emissions, Pollution Prevention and Recycling with controls

OLS Regression Results

Dep. Variable:	invrm	R-squared:	0.464
Model:	OLS	Adj. R-squared:	0.464
Method:	Least Squares	F-statistic:	1960.
Date:	Thu, 02 May 2024	Prob (F-statistic):	0.00
Time:	13:59:27	Log-Likelihood:	-1.0707e+05
No. Observations:	15847	AIC:	2.141e+05
Df Residuals:	15839	BIC:	2.142e+05
Df Model:	7		
Covariance Type:	nonrobust		

	coef	std err	t	P>|t|	[0.025	0.975]
Intercept	-4.1489	5.122	-0.810	0.418	-14.188	5.890
Substantial_Emissions[T.0]	20.5758	4.492	4.581	0.000	11.772	29.380
Substantial_Emissions[T.1]	239.1231	12.333	19.389	0.000	214.949	263.297
Pollution_Prevention[T.0]	8.8971	3.780	2.354	0.019	1.489	16.305
Pollution_Prevention[T.1]	111.4987	10.314	10.810	0.000	91.282	131.715
Recycling[T.0]	16.9913	7.526	2.258	0.024	2.240	31.742
Recycling[T.1]	354.7166	21.245	16.696	0.000	313.073	396.360
invt	0.1502	0.001	102.128	0.000	0.147	0.153

Omnibus:	13665.171	Durbin-Watson:	0.315
Prob(Omnibus):	0.000	Jarque-Bera (JB):	4396944.251
Skew:	3.264	Prob(JB):	0.00
Kurtosis:	84.342	Cond. No.	1.58e+04

1. **Supply Chain Uncertainty and Risk Management**: Environmental controversies create supply chain doubts, leading to higher raw material stockpiles.
2. **Regulatory Compliance**: Stricter regulations compel companies to keep larger raw material inventories to meet compliance requirements.
3. **Reputation Management:** Companies build trust by sourcing eco-friendly materials, necessitating increased raw material stockpiles.

News Articles

ies Cut Orders, Build Up Inventory as Supply Disruptions Continue

Share

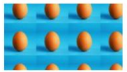
plates, its biggest revenue generator.

A metric ton of aluminum cost about $1,000 more in late February than in May 2021, resulting in a roughly $100 million hit to the company's balance sheet, he said. The price per metric ton topped $3,400 by Feb. 28, compared with just over $2,400 on May 28, 2021, according to data provider FactSet Inc.

Kodak now holds around six months of inventory, compared with three months before the supply-chain challenges began, Mr. Bullwinkle said. During the first quarter, the company reported $247 million in net inventory, up more than 12% from the prior-year period. Kodak's revenue during that same period was $290 million, which is up over 9% compared with the prior-year period.

3. She Was Convicted of Making a Bank Her Personal ATM—and Sentenced to Death

4. BlackRock's Plan for Your Retirement: A 401(k) With a Monthly Check



5. Fed Says Inflation Progress Has Stalled, Extends Wait-and-See Rate Stance

Retailers Are Pulling More Inventory into the U.S. Earlier This Year Amid Supply Chain Uncertainties

American importers are pulling more inventory in the U.S. this year due to increased supply chain uncertainties. The **COVID-related lockdowns** in China—specifically at the ports of Shenzhen and Shanghai—are increasing anxiety in American shippers that the lifting of regulations will result in a flood of cargo to the west.

downsides.

For manufacturers, there is concern that the shifting economic environment might lead to unwanted high inventories. While carrying more inventory helps soften the impact of supply disruptions, high inventories bring costs of their own. Storing extra inventories can be costly—firms need warehouse space, as well as the transport and labor to move their excess goods. Once stored, firms may need to lower prices in the future to offload excess goods.

The ISM New Orders Index contracted in July for a second month in a row. Still, long lead times for key products remain an issue, meaning that manufacturers, like retailers, remain in the uneasy position of worrying about inventories both above and below desired levels.

Importers increase inventories after the pandemic

We first show that before the pandemic, relative to firms that purchase inputs only domestically, importing firms tend to have higher inventory ratios (inventories over sales) and stocks in materials and supplies, work-in-process (intermediate goods), and finished goods, even controlling for firm size. While this relationship has been documented by Alessandria et al. (2010) for Chilean firms, we show that it is also present for Japanese manufacturing firms.

Understanding the Analysis through Dashboards

Tableau Link

News Articles

boost a company's worth when it is situated in a location with better government relations, less dependency on natural resources, and stronger enforcement. The analysis concludes that there is no conflict between the "pursuit of profit" and the "benefit to society" under command-and-control environmental management. Therefore, governments should advise and support businesses in the areas of the environment, society, and governance; enhance the quality of information disclosed; create differentiated enforcement standards to ensure equity in the costs of environmental regulatory compliance for businesses; and

https://www.bakerinstitute.org/research/closing-loop-worlds-fastest-growing-waste-stream-electronics

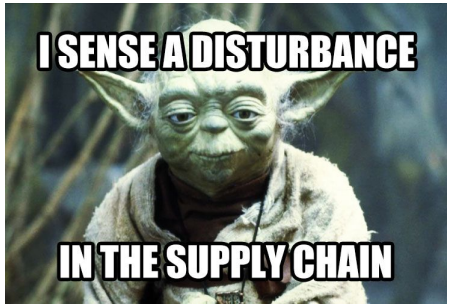
side recycling. Here we show that when recycling commodity markets were most lucrative in 2011, net US recycling costs were as little as US$3 per household annually, and when markets reached a minimum (in 2018–2020), the annual recycling-programme costs ranged from US$34 to US$42 per household. This investment offsets the greenhouse gas emissions from

Key Takeaways

1. **Quality and Financial Impact:** Companies abiding by product quality measures often tend to enjoy higher ROA gradually.

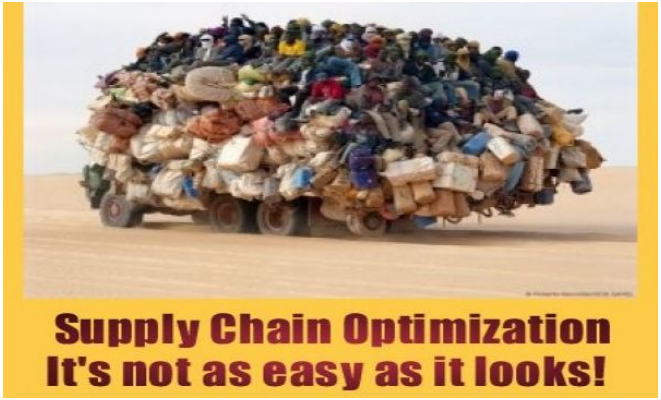
2. **Financial Benefits of Environmental Sustainability:** Initiatives like recycling and eco-friendly packaging correlate with higher revenues, emphasizing the financial advantages of environmental responsibility.

3. **Environmental Controversies and Inventory Management:** Companies facing environmental controversies tend to maintain larger raw material inventories, possibly due to supply chain uncertainties and regulatory compliance, underscoring the need for integrating environmental considerations into inventory management strategies.



Challenges

1. **Majority of Missing Values:** Incomplete data, impacting the robustness of statistical models and analyses.
2. Making Sense of **Statistical Significance** in the Maze of Multicollinearity Challenges
3. **Data set constraints:** Our scope and depth of the analysis



Business Aspect

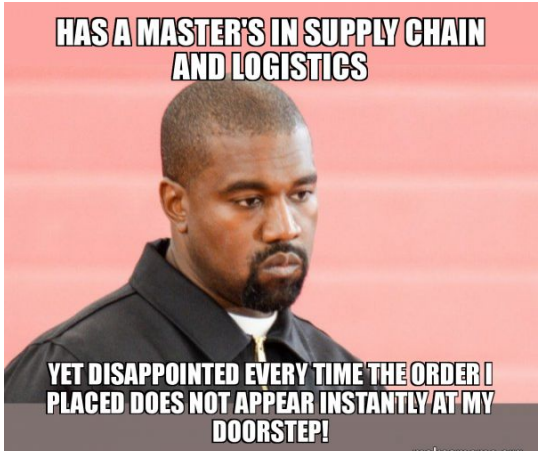
- **Regulatory Compliance and Risk Management:** With increasing global attention on climate change and environmental degradation, companies face heightened regulatory pressures. Understanding how environmental policies impact financial metrics can guide strategies that preemptively manage these risks.

- **Consumer and Investor Preferences:** Modern consumers and investors are progressively prioritizing sustainability. Companies leading in environmental stewardship are likely to attract more investments and loyal customers, directly impacting their financial health.

- **Operational Efficiencies:** Effective management of resources, including waste reduction and energy efficiency, often leads to cost savings and improved asset utilization, as evidenced by metrics such as asset turnover and inventory levels in our dataset.

Not all rules are meant to be broken!!!

Thank you!


HAS A MASTER'S IN SUPPLY CHAIN AND LOGISTICS
YET DISAPPOINTED EVERY TIME THE ORDER I PLACED DOES NOT APPEAR INSTANTLY AT MY DOORSTEP!