**Introduction**

ESG ratings play a critical role in evaluating corporate sustainability efforts. However, discrepancies between disclosures and actual performance, known as ESG Decoupling, raise concerns about rating credibility. The study investigates the extent of Decoupling across different Chinese regions and examines whether certain areas exhibit greater divergence. Additionally, the research explores how the media portrays companies with significant Decoupling. By combining three datasets - Bloomberg ESG scores, Independent ESG performance ratings, and News Sentiment analysis, the study aims to quantify ESG Decoupling, uncover regional patterns, and assess the media's role in shaping ESG reputations.

**Literature Review**

*News Sentiment Analysis and ESG Reputation*

The interplay between News Sentiment and ESG reputation has garnered significant academic attention. Studies have demonstrated that media coverage depending on the company size can materially influence a company's ESG perception and financial performance (Bose, 2020). Research indicates that positive ESG news sentiment can enhance consumer perception and company standing for green business practices (Lee, Shin, & Kim, 2023). Conversely, negative ESG-related social media activity can be linked to declines in shareholder value, hinting at the financial implications of negative reputations (Mansouri, 2016). These findings showcase the critical role media sentiment has in creating the brand narrative for the consumer.
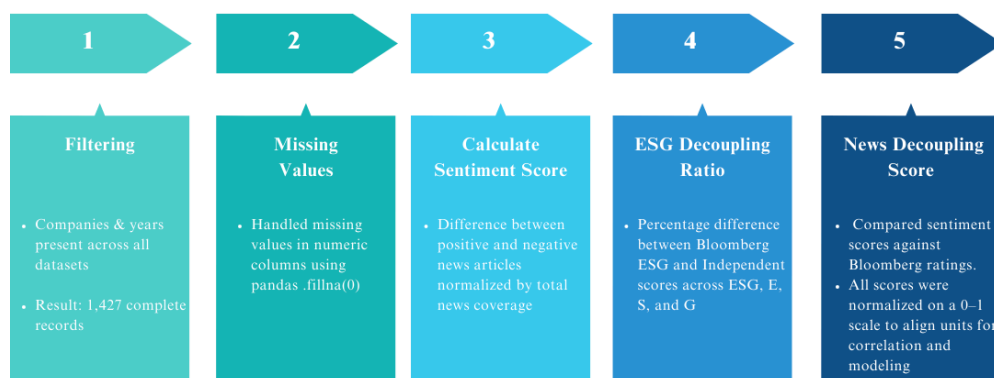
*Industry-Specific ESG Challenges and Geographic Considerations*

ESG challenges lack uniformity across industries and regions. The MSCI ESG Industry Materiality Map illustrates that key ESG issues and their impacts vary significantly by industry, reflecting diverse operational and environmental contexts. For example, the fashion industry faces heightened challenges from regulatory and environmental impacts associated with textile production; with the relaxation of environmental regulations can exacerbate these challenges, leading to increased pollution and undermining sustainability goals. Geographically, firms' ESG performance is influenced by their businesses and regional diversification. These industry and regional disparities necessitate tailored ESG strategies that account for specific challenges and regulatory environments. Existing literature emphasizes the impact of news sentiment on ESG reputation, the necessity for industry, and region-specific ESG strategies, and the efficacy of predictive modeling techniques in ESG analysis. These insights provide the foundational framework for the following study.

**Data and Methodology**

The study integrates three key datasets: Bloomberg ESG scores, Independent ESG performance ratings, and a News Sentiment dataset. The Bloomberg ESG and Independent dataset provides annual scores for each company, including sub-scores of ESG, Environmental (E), Social (S), and Governance (G). The news sentiment dataset quantifies the number of positive, neutral, and negative news articles mentioning each company annually. The Data preprocessing steps are shown in Exhibit 1.

**Exhibit 1: Data Preprocessing**



| 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|
| **Filtering** | **Missing Values** | **Calculate Sentiment Score** | **ESG Decoupling Ratio** | **News Decoupling Score** |
| • Companies & years present across all datasets<br>• Result: 1,427 complete records | • Handled missing values in numeric columns using pandas .fillna(0) | • Difference between positive and negative news articles normalized by total news coverage | • Percentage difference between Bloomberg ESG and Independent scores across ESG, E, S, and G | • Compared sentiment scores against Bloomberg ratings.<br>• All scores were normalized on a 0–1 scale to align units for correlation and modeling |

**Predictive Modeling Approach**

The predictive modeling framework was developed to quantify Decoupling using a combination of firm-level characteristics, industry classifications, and sentiment indicators. The primary prediction target was the Total Decoupling score, a weighted composite metric combining the divergence between Bloomberg and Independent ratings (70% weight) and the disconnect between Bloomberg scores and News Sentiment (30% weight, scaled to amplify impact).

Three regression models were evaluated: Linear Regression, Random Forest Regressor, and XGBoost Regressor. Predictor variables included year, sentiment score, regional dummies (East, Mid, West), binary flags for high-tech and polluting industries, and one-hot encoded industry classifications. The models created a prediction divergence between Bloomberg and Independent ratings.

Among the models, XGBoost delivered the strongest performance, achieving an R² of 0.59 and an RMSE of 6.46. In comparison, Linear Regression and Random Forest models produced R² scores of 0.49 and 0.53. Feature importance analysis from the XGBoost model identified year, the polluting industry, and specific industry sectors (e.g., metal, insurance, real estate) as the most influential predictors. These findings suggest that decoupling is shaped more by shifts and detailed industry-level characteristics than by broader labels or media narratives alone.

*Time-Series Forecasting of ESG Performance*

To explore predictive analysis through time series forecasting, we selected Shenzhen Energy as a case study. An ARIMA model was developed using the company's historical ESG scores to forecast future performance. The model's accuracy was evaluated using standard metrics including RMSE, MAE, and MAPE, see Table 1 for full results. Based on the trained model, Shenzhen Energy's ESG score is predicted to reach 54.71 in 2025 and 56.61 in 2026, reflecting a continued upward trend in its ESG performance.

| Evaluation Metrics | Value |
|---|---|
| RMSE | 3.178 |
| MAE | 2.349 |
| MAPE | 7.968 |

**Table 1 Performance of the ARIMA model**

**Results and Discussion**

**Exhibit 2: Top 15 Industries by ESG Decoupling**
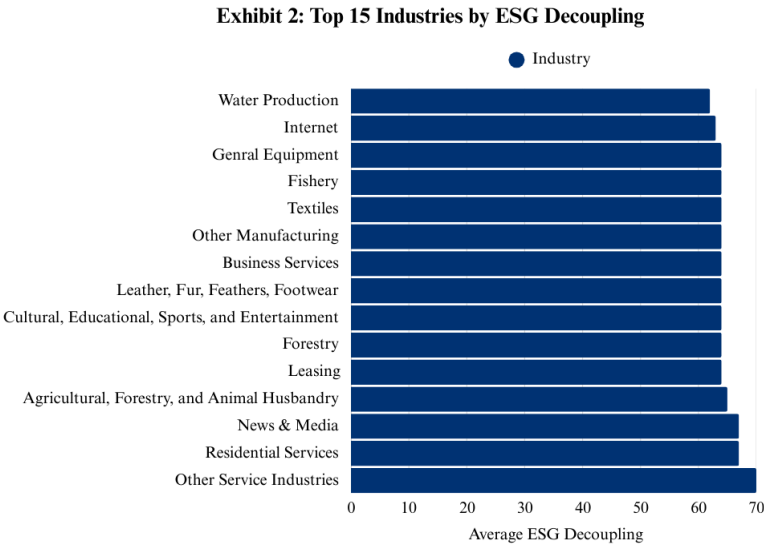


*ESG Decoupling Trends*

The analysis confirms a widespread divergence between Bloomberg and those from an Independent rating provider, reinforcing the presence of Decoupling. On average, the absolute percentage difference between the two scores is 60.72%, indicating substantial disagreement. A Pearson correlation, as seen in Exhibit 7, of -.874 between the Bloomberg and Independent overall, indicates a strong likelihood of decoupling when Bloomberg scores are low.

Industry-level analysis revealed that the top 15 industries by average Decoupling consistently exhibited high divergence, with mean decoupling values ranging between 64.2% and 70.3%, suggesting that rating inconsistencies are not isolated to specific sectors but are across many industries, as shown in Exhibit 2. The most extreme cases of decoupling were often driven by company-specific factors rather than industry alone, with firms such as Jishi Media reaching average decoupling scores as high as 87.0%, as seen in Exhibit 6. Component-level examination showed that Environmental (E) and Social (S) scores had the highest levels of decoupling, often exceeding 90% in certain industries, while Governance (G) scores exhibited notably lower divergence, typically around 17–29%. These findings highlight that while disagreement is widespread, it is especially pronounced in how environmental and social performance are assessed by different rating systems.

*News Sentiment vs. ESG Ratings*

The analysis revealed weak correlations between news sentiment and ESG ratings. Specifically, the correlation with Bloomberg scores was 0.104, while the correlation with Independent scores was slightly higher at 0.176. These low values indicate that media sentiment is largely disconnected from formal assessments, with limited alignment between news perception and reported performance. The Scatter plots and K-Means clustering (k=4) shown in Exhibit 3, further illustrated this disconnect. Most companies fell into clusters where low-to-mid scores coexisted with positive news sentiment, highlighting a common pattern of decoupling. The most frequent category, "Low ESG & Positive News," appeared in over 10,000 company-year observations. On average, the news-ESG disconnect score was 0.319, quantifying a moderate but widespread gap between sentiment and scores. Companies may maintain favorable ratings despite receiving negative press, or conversely, benefit from positive media coverage while scoring poorly in formal evaluations.

**Exhibit 3: News Sentiment vs ESG Ratings**
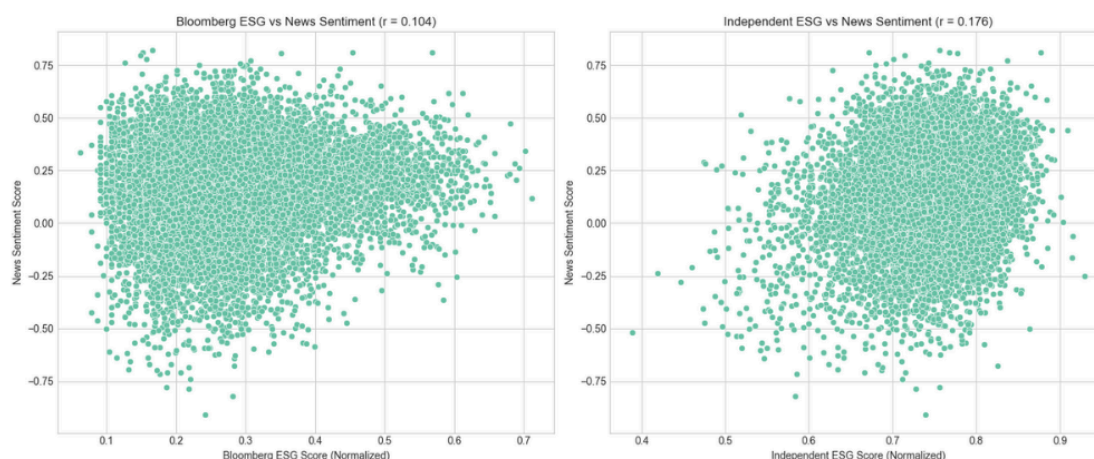


*Industry and Regional Impact*

Regression analysis showed minimal variation in total Decoupling across broad industry categories. The average decoupling score for polluting industries was 49.33, high-tech industries averaged 48.59, and companies flagged as both high-tech and polluting had the lowest average decoupling at 48.06, which suggests that broad classifications alone are not strong predictors of divergence.The differences across industry types were marginal, all clustering closely around 48–49%, indicating that decoupling is prevalent across the board.

*Regional Decoupling*

The Eastern regions have the two highest regional decoupling with The Jilin Province at 66.225 and the Fujian Province at 65.283, suggesting location-based differences in reporting or enforcement, as seen in Jilin Province, which is home to the company with the single highest decoupling score—Jishi Media—at 87.03. As a

hub of China's traditional heavy industries, including manufacturing, paper production, and gas processing, Jilin

**Exhibit 4: ESG Decoupling by Region**
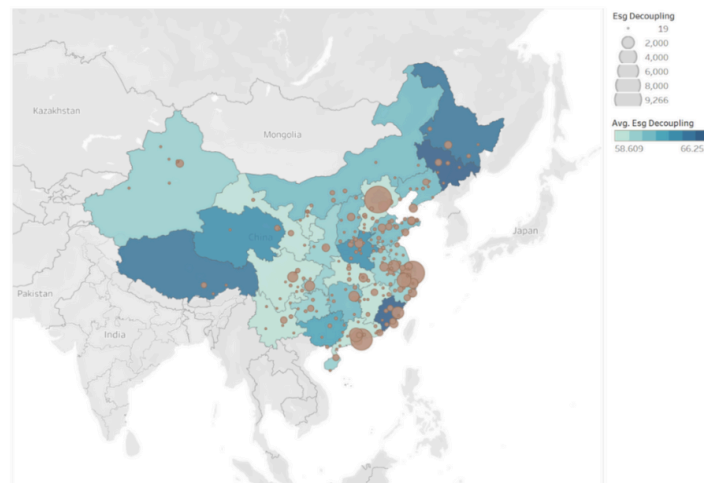


Providence's industrial base is characterized by high pollution levels and energy consumption. The Fujian Province is one of the largest exporters in all of China, and its strong industrial base—particularly in electronics, machinery, and textiles—positions it as a key player in global supply chains, potentially increasing the pressure to maintain favorable ESG disclosures amid intense international scrutiny (OEC, 2024). While the Jilin and Fujian Provinces hold the highest average ESG decoupling score—driven in part by outliers such as Jishi Media, the broader trend reveals that the average decoupling scores across the East, Mid, and West regions are nearly identical, clustering around 49%. These findings suggest that regional differences are minimal, and firm-specific and industry-level factors play a more prominent role in driving Decoupling than geographic location alone (Huang, W., & Zhang, M. 2022).

*Future Research*

Future research can extend this framework by implementing anomaly detection techniques such as Isolation Forest and Local Outlier Factor (LOF) to identify companies potentially at risk of misrepresentation. Additionally, incorporating time-series forecasting models like ARIMA and LSTM neural networks could support dynamic monitoring of ESG performance over time, offering early indicators of potential greenwashing behaviors. The suggested predictive framework presents a scalable approach for enhancing ESG credibility assessments across a range of industries and regions.

**Conclusion and Future Work**

The results of this study confirm that Decoupling in China is both measurable and significant, while certain provinces, such as Jilin and Fujian, displayed the highest average decoupling scores, partially driven by outlier firms, average decoupling across major regions (East, Mid, West) remains relatively uniform, hovering around 49%. Broad regional factors may have limited influence compared to firm-level and industry-specific dynamics.

Specific sectors such as Real Estate and Retail showed slightly elevated levels across regions, indicating that decoupling may be more closely tied to detailed industry characteristics than broad classifications like "polluting" or "high-tech." Sentiment analysis revealed a weak correlation between media coverage and scores, with companies frequently receiving positive sentiment despite low ratings, and vice versa. The disconnect showcases the limited influence of public narratives on formal assessments and raises questions about the reliability of these scores in reflecting real-world performance.

Overall, the findings highlight the complexity of maintaining consistent and credible scoring systems. Despite growing calls for transparency and accountability, ESG ratings remain largely detached from media sentiment and often vary significantly between providers. These results emphasize the need for multi-source evaluation and continuous methodological refinement to ensure ESG metrics serve as valid and comparable global benchmarks for sustainability.

# References

Bose, S. (2020). *Evolution of ESG reporting frameworks*. The ESG Exchange. https://theesgexchange.org/wp-content/uploads/2023/03/Evolution-of-ESG-Reporting-Frameworks.pdf

Chen, J., Wang, Y., Du, W., & Wang, Z. (2024). ESG-based sentiment prediction model using BERT: Extracting and analyzing investment-related news. *Financial Innovation*, 10(1). https://link.springer.com/article/10.1007/s41471-024-00185-3

Datta, P. (2019, November 22). *Fraud detection: Isolation forests & LOF explained*. Medium. https://medium.com/@pinakdatta/fraud-detection-isolation-forests-lof-explained-228828bd496b

Huang, W., & Zhang, M. (2022). Disparities in ESG reporting by emerging Chinese enterprises: Evidence from a global financial center. *Sustainability Accounting, Management and Policy Journal*, *13*(2), 453–477. https://doi.org/10.1108/SAMPJ-08-2021-0323

Guo, Y., Liu, X., & Guo, Y. (2024). The impact of social media ESG sentiment on shareholder value: Evidence from Twitter data. *Journal of Behavioral and Experimental Finance*, 40, 101128. https://www.sciencedirect.com/science/article/abs/pii/S154461232301084X?utm_source=chatgpt.com

Majumder, A., Sinha, A., & Mukherjee, S. (2019). Outlier detection using isolation forest and local outlier factor. *ResearchGate*. https://www.researchgate.net/publication/337204025_Outlier_detection_using_isolation_forest_and_local_outlier_factor

Mansouri, N. (2016). *A Three-Dimensional Model for Corporate Sustainability*. Routledge.

MSCI. (n.d.). *ESG Industry Materiality Map*. MSCI ESG Research LLC. https://www.msci.com/our-solutions/esg-investing/esg-industry-materiality-map?utm_source=chatgpt.com

Lee, K., Shin, D., & Kim, K. (2023). *The effect of corporate ESG management on brand image, brand attitude, and brand loyalty: Focusing on the mediating role of perceived value*. Sustainability, 15(8), 6795. https://doi.org/10.3390/su15086795

Sun, T., Wang, W., & Chen, S. (2024). The effect of news-based ESG sentiment on stock price crash risk. *The North American Journal of Economics and Finance*, 71, 101857. https://www.sciencedirect.com/science/article/abs/pii/S105752192300162X?utm_source=chatgpt.com

Tang, M., Liu, Y., Wang, R., & Li, D. (2023). How does ESG performance of multinational enterprises impact their financial performance? The mediating role of business and regional diversification. *Journal of Business Research*, 169, 114163. https://www.sciencedirect.com/science/article/pii/S0148296323007518?utm_source=chatgpt.com

Vogue Business. (2020, July 15). *How EPA deregulation could undermine fashion's sustainability goals*. Vogue Business. https://www.voguebusiness.com/story/sustainability/how-epa-deregulation-could-undermine-fashions-sustainability-goals?utm_source=chatgpt.com

Wang, Z., Zhao, J., Zhang, Q., & Wang, S. (2024). Can ESG sentiment improve corporate energy innovation? The role of alleviating financing constraints. *Sustainable Development*, 32(1), 303–316. https://onlinelibrary.wiley.com/doi/10.1002/sd.3399?af=R&utm_source=chatgpt.com

**Exhibit 6: The Distribution of ESG Decoupling Scores**
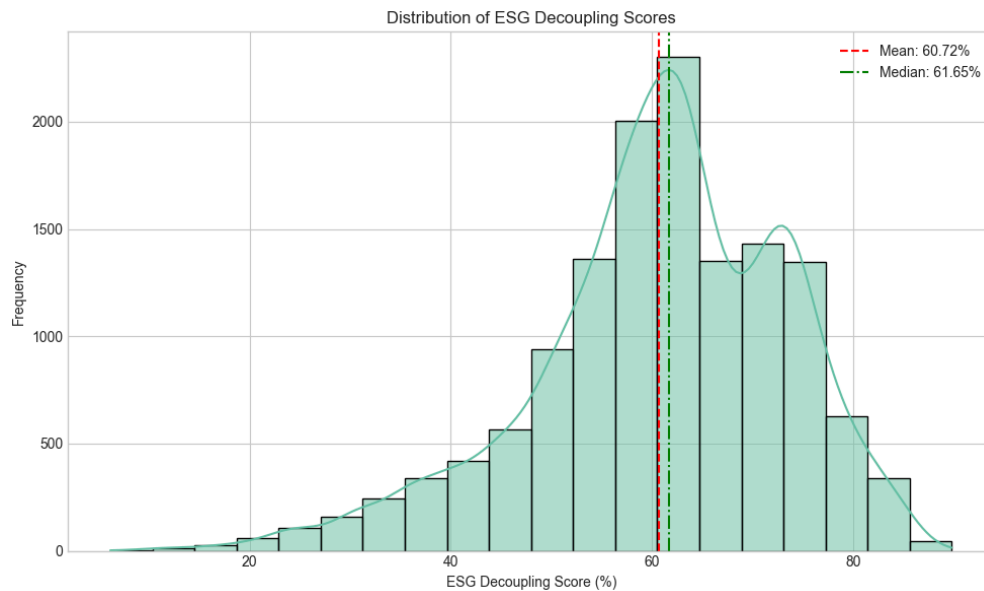


Distribution of ESG Decoupling Scores

Exhibit 6 presents the distribution of ESG Decoupling Scores across the dataset. The histogram illustrates a slightly right-skewed distribution, with the majority of companies clustered around 60% decoupling, meaning decoupling score is 60.72%, while the median is slightly higher at 61.65%, indicating that a significant portion of companies experiences moderate levels of divergence between Bloomberg scores and Independent ratings. The presence of a long tail toward higher decoupling scores suggests that a subset of companies may be particularly prone to misalignment.

**Exhibit 7: Bloomberg ESG scores versus Independent Ratings**



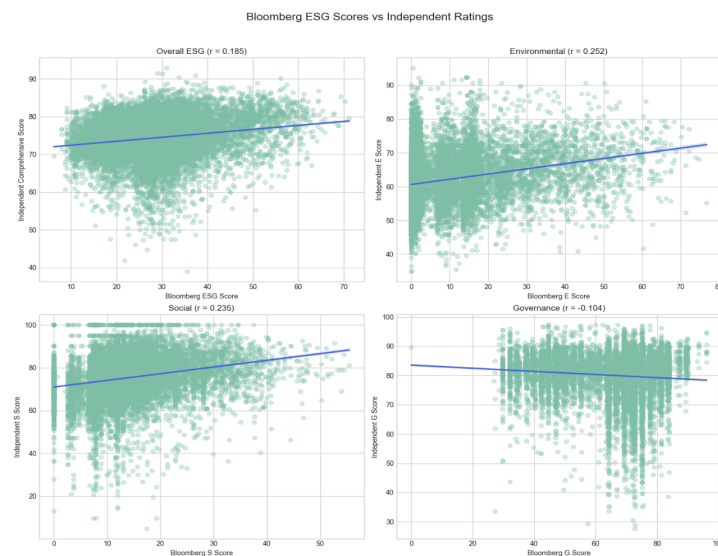Bloomberg ESG Scores vs Independent Ratings

Exhibit 7 illustrates the relationship between Bloomberg scores and Independent ratings across four dimensions: overall ESG, Environmental (E), Social (S), and Governance (G). Each subplot presents a scatter plot with a fitted regression line and Pearson correlation coefficient. The top-left panel shows a weak positive correlation (r = 0.185) between Bloomberg's overall ESG scores and independent comprehensive ratings, suggesting limited alignment between the two scoring systems. The top-right panel highlights the Environmental component (r = 0.252), where Bloomberg E scores exhibit a slightly stronger, yet still modest, correlation with independent E ratings. The bottom-left panel shows a similar trend in the Social dimension (r = 0.235), indicating a mild positive relationship. However, the bottom-right panel reveals a negative correlation (r = -0.104) in the Governance dimension, implying that higher Bloomberg G scores are actually associated with lower independent G scores. The inconsistency across dimensions reinforces concerns about ESG Decoupling and suggests that Bloomberg's disclosed ESG scores may not reliably reflect independently assessed performance, particularly in governance-related criteria.

**Exhibit 8: Companies by News Sentiment and ESG Rating Relationship**



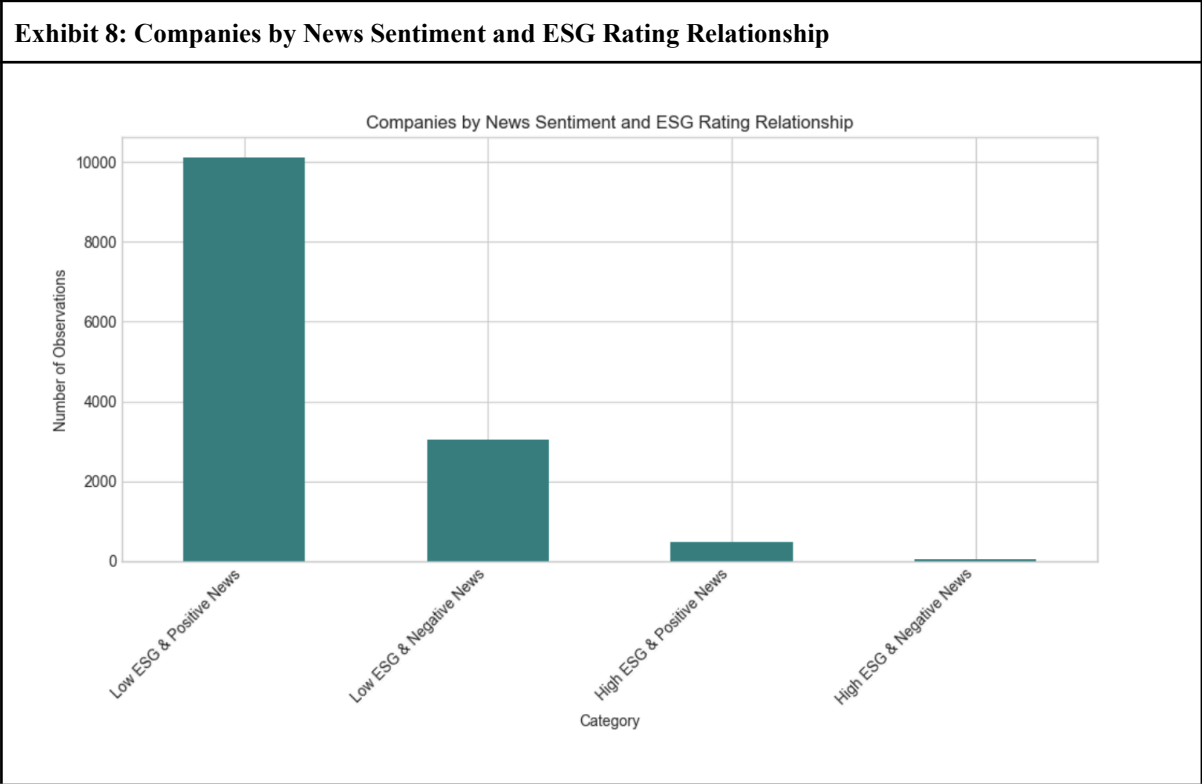Companies by News Sentiment and ESG Rating Relationship

Exhibit 8 displays the distribution of companies by the relationship between their ESG scores and associated news sentiment. Companies were categorized into four groups: Low ESG & Positive News, Low ESG & Negative News, High ESG & Positive News, and High ESG & Negative News. The majority of observations fall into the Low ESG & Positive News category, indicating that many companies with weak ESG performance still receive favorable media coverage. Supporting the idea of a decoupling between public perception and ESG ratings, potentially due to reputation management or media bias. The second largest group, Low ESG & Negative News, reinforces this gap, showing that some poorly rated firms also face reputational challenges. Notably, the High ESG & Negative News group is the smallest, with very few companies receiving high ESG scores while attracting negative press, suggesting that ESG scores are largely unaffected by media sentiment, and that public criticism does not necessarily impact ESG disclosures or ratings.

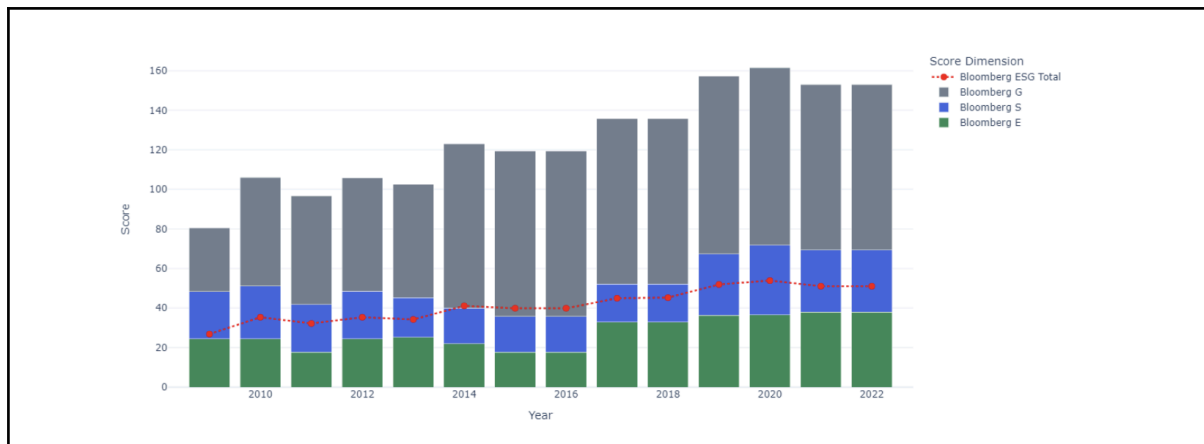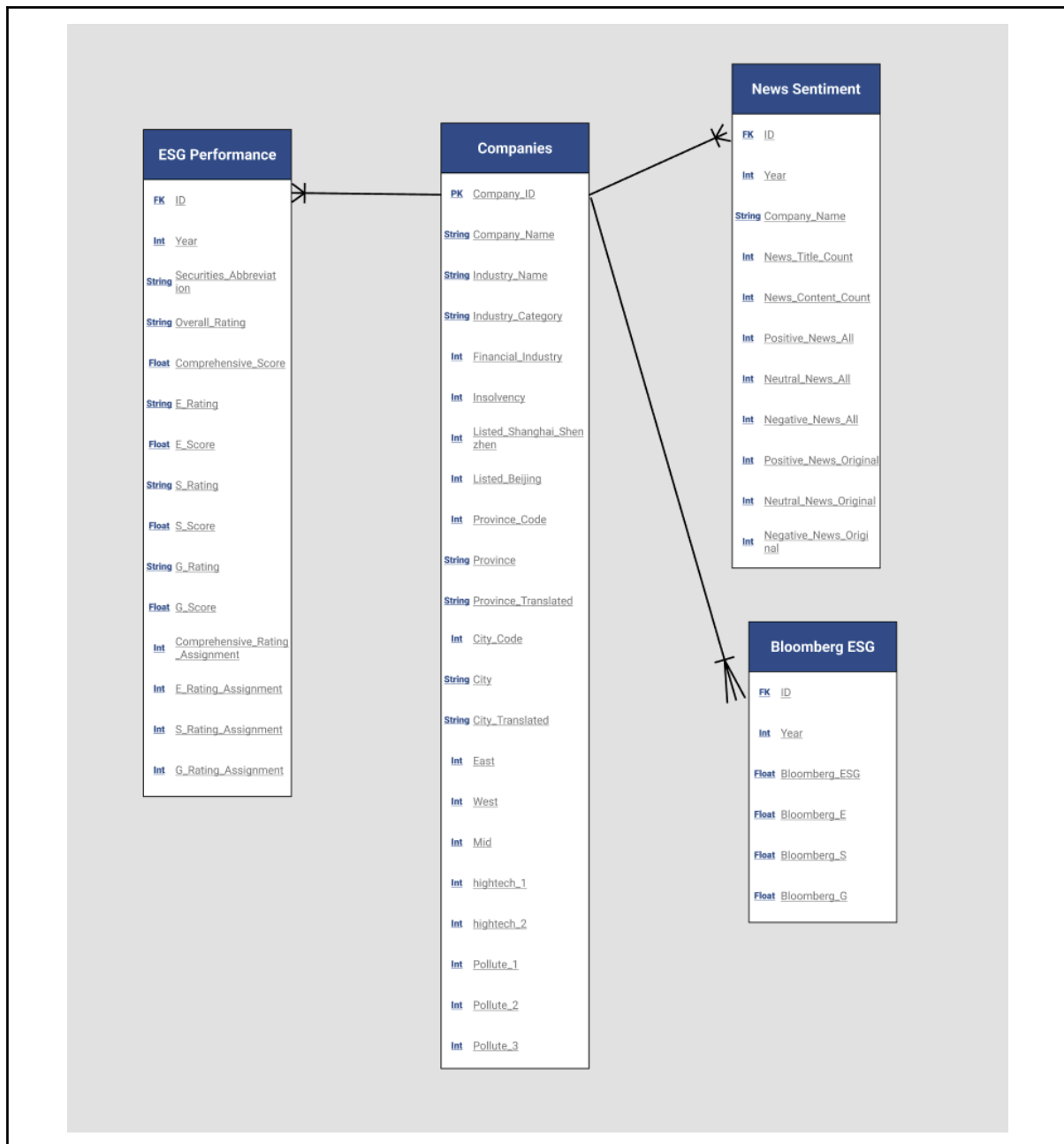**Exhibit 9: Bloomberg ESG Scores over Time**

Exhibit 9 shows Bloomberg scores over time, displayed as a stacked bar chart broken down by Environmental (E), Social (S), and Governance (G) components. A red dotted line tracks the total score progression. Bloomberg scores show a clear upward trend across the years, with particularly strong growth in the Governance (G) component. The total score rose steadily from 2009, peaking around 2020 before stabilizing. This trend highlights Bloomberg's increasing ESG assessment for the company, primarily driven by improvements in governance scores.

**Exhibit 10: Independent ESG Scores over Time**
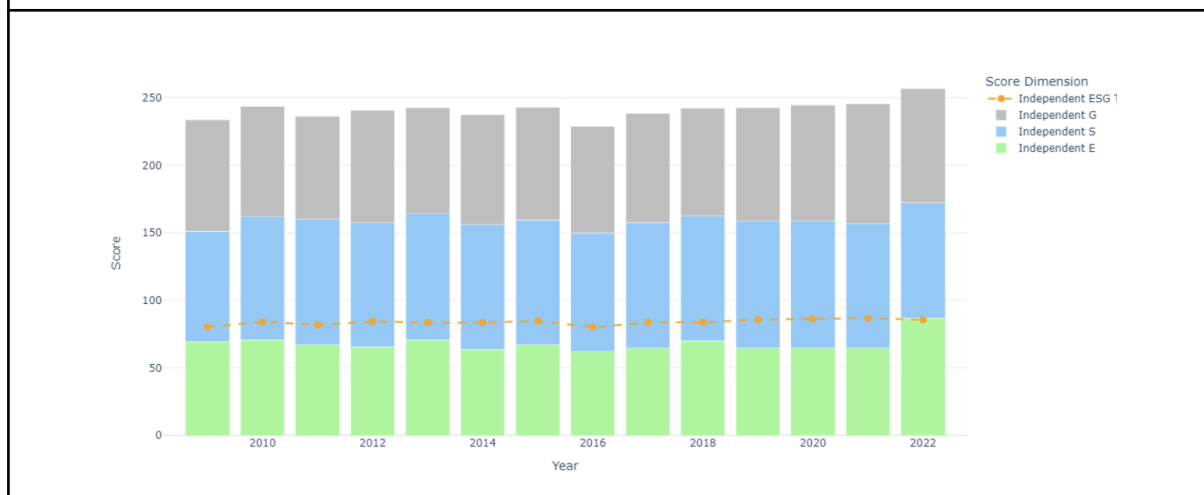


In contrast, Exhibit 10 shows the Independent ratings over the same period, also visualized as a stacked bar chart with Environmental, Social, and Governance breakdowns. The Independent total score, tracked by an orange dotted line, remains relatively stable throughout the years, showing only minor fluctuations. Unlike Bloomberg, Independent ratings do not reflect a significant upward trajectory, particularly in the Governance dimension. The divergence between the steadily rising Bloomberg and the flat Independent score over time visually captures the decoupling effect, where third-party evaluators maintain a consistent view of ESG performance while Bloomberg ratings indicate substantial improvement.

**Exhibit 11: Entity Relationship Diagram**

**ESG Performance**

| | |
|---|---|
| **FK** | ID |
| **Int** | Year |
| **String** | Securities_Abbreviation |
| **String** | Overall_Rating |
| **Float** | Comprehensive_Score |
| **String** | E_Rating |
| **Float** | E_Score |
| **String** | S_Rating |
| **Float** | S_Score |
| **String** | G_Rating |
| **Float** | G_Score |
| **Int** | Comprehensive_Rating_Assignment |
| **Int** | E_Rating_Assignment |
| **Int** | S_Rating_Assignment |
| **Int** | G_Rating_Assignment |

**Companies**

| | |
|---|---|
| **PK** | Company_ID |
| **String** | Company_Name |
| **String** | Industry_Name |
| **String** | Industry_Category |
| **Int** | Financial_Industry |
| **Int** | Insolvency |
| **Int** | Listed_Shanghai_Shenzhen |
| **Int** | Listed_Beijing |
| **Int** | Province_Code |
| **String** | Province |
| **String** | Province_Translated |
| **Int** | City_Code |
| **String** | City |
| **String** | City_Translated |
| **Int** | East |
| **Int** | West |
| **Int** | Mid |
| **Int** | hightech_1 |
| **Int** | hightech_2 |
| **Int** | Pollute_1 |
| **Int** | Pollute_2 |
| **Int** | Pollute_3 |

**News Sentiment**

| | |
|---|---|
| **FK** | ID |
| **Int** | Year |
| **String** | Company_Name |
| **Int** | News_Title_Count |
| **Int** | News_Content_Count |
| **Int** | Positive_News_All |
| **Int** | Neutral_News_All |
| **Int** | Negative_News_All |
| **Int** | Positive_News_Original |
| **Int** | Neutral_News_Original |
| **Int** | Negative_News_Original |

**Bloomberg ESG**

| | |
|---|---|
| **FK** | ID |
| **Int** | Year |
| **Float** | Bloomberg_ESG |
| **Float** | Bloomberg_E |
| **Float** | Bloomberg_S |
| **Float** | Bloomberg_G |

The entity relationship diagram (ERD) in Exhibit 11 outlines the database structure used for analyzing ESG decoupling and sentiment alignment in this study. The central Companies table serves as the primary reference point, uniquely identified by Company_ID, and contains attributes related to company name, industry classification, financial status, geographic location, and pollution or high-tech industry indicators.

The ESG Performance table is linked to the Companies table via Company_ID and stores independent ESG ratings, including the overall rating, individual Environmental (E), Social (S), and Governance (G) scores, and comprehensive scores. Additional fields capture rating assignment levels across the three ESG dimensions.

The Bloomberg ESG table, also connected by Company_ID, contains Bloomberg-provided scores for total ESG as well as each E, S, and G component, offering a standardized source for comparison against independent ratings.

The News Sentiment table links company-level information with sentiment metrics based on media coverage. It includes counts of positive, neutral, and negative news articles—both overall and from original sources—alongside yearly news volume indicators.

**Exhibit 12: Shenzhen Energy ESG Score & Predicted ESG Score**



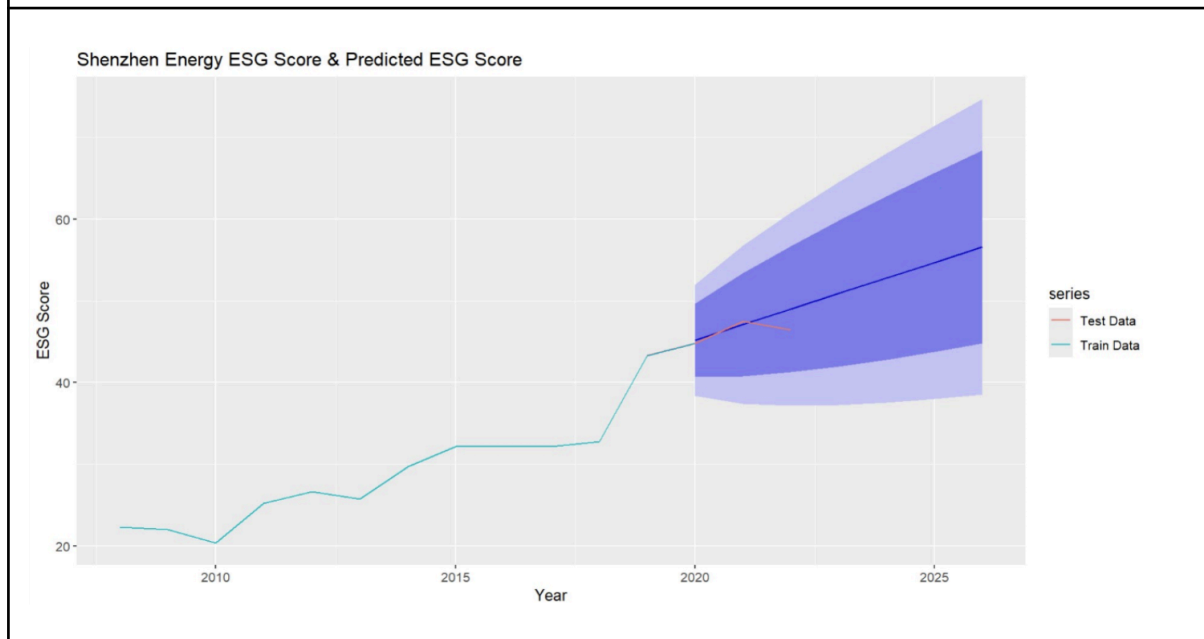Shenzhen Energy ESG Score & Predicted ESG Score

Exhibit 12 displays the historical and forecasted ESG scores for Shenzhen Energy, generated using a time-series model. The light blue line represents actual ESG scores from the training data, illustrating a steady upward trend from approximately 2007 to 2020. The red line shows the test data, observed scores not used during model training, providing a basis for evaluating the model's predictive accuracy. The dark blue line projects ESG performance into the future, while the shaded blue areas represent the model's confidence intervals, with wider bands indicating increasing uncertainty over time. The model anticipates a continued rise in ESG scores, though with notable variance in the forecast beyond 2023. The visual supports the feasibility of ESG performance forecasting and reflects how companies like Shenzhen Energy are projected to improve or maintain disclosure trends based on historical momentum.

**Exhibit 13: Regression analysis of linear regression model**

```
Coefficients:
              Estimate Std. Error t value Pr(>|t|)
(Intercept) -0.8139441  0.0272021 -29.922  < 2e-16 ***
BloombergE   0.3450665  0.0006274 550.032  < 2e-16 ***
BloombergS   0.2834957  0.0009600 295.300  < 2e-16 ***
BloombergG   0.3542043  0.0004351 814.088  < 2e-16 ***
STPT1       -0.0176800  0.0390395  -0.453    0.651
Insolvency1  0.0045238  0.0954422   0.047    0.962
HighTech_11 -0.0803310  0.0141970  -5.658 1.56e-08 ***
HighTech_21  0.0172226  0.0147856   1.165    0.244
Pollute_11  -0.0062305  0.0207590  -0.300    0.764
Pollute_21   0.0117376  0.0273656   0.429    0.668
Pollute_31  -0.0156767  0.0295693  -0.530    0.596
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 0.6978 on 15602 degrees of freedom
  (225 observations deleted due to missingness)
Multiple R-squared:  0.9952,    Adjusted R-squared:  0.9952
F-statistic: 3.204e+05 on 10 and 15602 DF,  p-value: < 2.2e-16
```

Exhibit 13 displays the result of regression analysis. The VIF for all the variables in the linear regression model is less than 10 so there is no collinearity problem in the linear regression model. The regression analysis shows that Environmental score, Social score, Governance score and Indicator that whether the company belongs to high-tech industry type 1 are significant factors that influence the overall ESG score when the significant level is 0.001. We can conclude that high tech factors are significant factors that influence the ESG performance.