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Case study

Predictive modeling with Bloomberg's Supply Chain data.

Quantifying indirect exposure to Volkswagen's "Dieselgate".

Bloomberg

Volkswagen

Bloomberg clients can build sophisticated models by combining data sets to address many potential use cases. In this case study, we explore using Bloomberg's Supply Chain data in conjunction with other Bloomberg data sets to build a quantitative model to predict price changes following economically significant news.

Our test subject: Volkswagen AG suppliers, whose stock prices declined significantly in 2015 after the German car manufacturer admitted that it had cheated on emissions tests conducted by the U.S. Environmental Protection Agency (EPA).

In this article, we will build a relatively simple model to analyze the interplay of news, supplier relationships and fundamental data in the wake of Volkswagen's emissions revelations. We will then compare it to a model that predicts prices without supply chain data to determine whether incorporating Bloomberg's Supply Chain data improves our ability to quantify the exposure faced by investors in Volkswagen's suppliers.

The Volkswagen emissions scandal

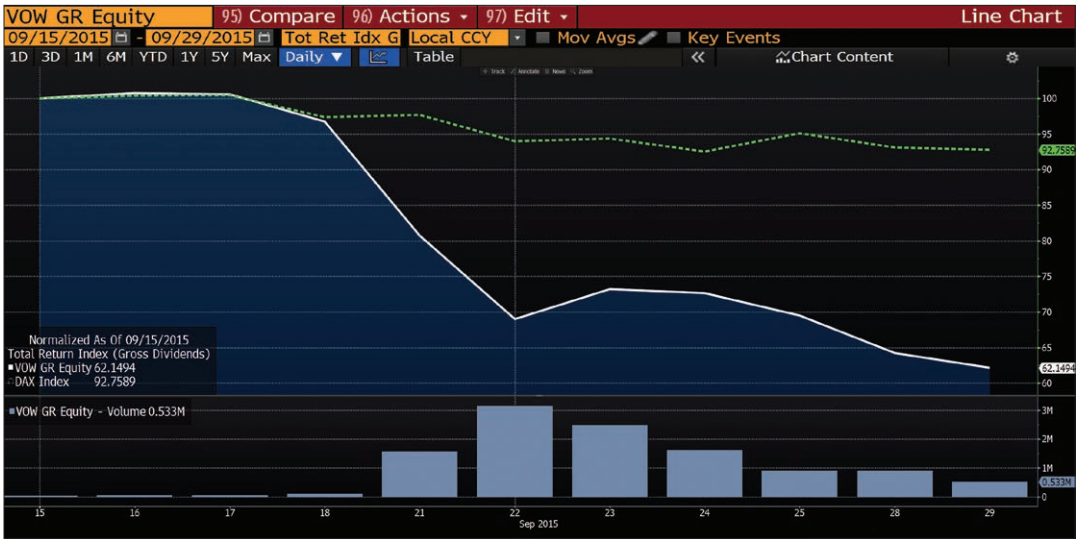
In September 2015, the EPA ordered Volkswagen to recall about 500,000 vehicles, accusing the company of cheating on government emissions tests and violating the Clean Air Act. The agency had discovered that the diesel engines of Volkswagen cars sold in the U.S. had been fitted with software that would reduce emissions when they detected engine testing. On the road, the vehicles often exceeded pollution levels allowed under the Clean Air Act. Volkswagen officials confessed that about 11 million cars worldwide contained these "defeat devices."

In the wake of "Dieselgate," markets needed time to process and price the full impact of these revelations on Volkswagen and on Volkswagen's key suppliers. However, Volkswagen's stock immediately suffered, dropping nearly 40% over a 14-day period and underperforming its index by more than 30%.

Volkswagen underperformance after "Dieselgate"

Many investors were concerned about their indirect exposure via holdings in Volkswagen's suppliers. Some of these investors were interested in treating this exposure as a risk and potentially hedging it. Other investors were interested in treating this exposure as an opportunity that they could use to generate investment returns.

We can use Bloomberg's Supply Chain data to help quantify the exposure that investors in Volkswagen's suppliers faced as a result of the Dieselgate news.



Volkswagen total return vs. DAX Index, normalized

Setting up the analysis

1. Selecting our universe

The first and most fundamental decision we need to make is selecting which Volkswagen suppliers we want to analyze. To make our analysis quantitative, we must be able to quantify the exposure of these companies to Volkswagen. Fortunately, we can use Bloomberg's Supply Chain historical data, specifically the %Revenue field, to achieve both of these goals.

We decide to use the percentage of a company's revenue that comes from Volkswagen as a heuristic for that company's exposure to Volkswagen. In addition, we choose to analyze suppliers with the largest percentage of revenues coming from Volkswagen in late 2015 that also have clean and complete data. We select all of Volkswagen's American and European suppliers that derived at least 10% of their revenue from Volkswagen at the time of the diesel emissions revelations, omitting those companies with missing or incomplete data.

2. Defining risk sensitivity

We now have a list of suppliers that are expected to be most sensitive to news regarding Volkswagen. It's also necessary to measure the riskiness of the companies themselves — not just in relation to Volkswagen, but as independent variables. It's reasonable to believe that a company with strong economic fundamentals is inherently more resilient to shocks emanating from its large customers than one with weak economic fundamentals. Conversely, a company with weak fundamentals should be more sensitive to shocks than one with strong fundamentals. Furthermore, we can expect strong economic fundamentals to be linked to strong financial metrics and ratios. Therefore, we will use Bloomberg's Fundamentals data set to get the DuPont Analysis ratios for our chosen set of Volkswagen supplier companies. We will use those ratios as proxies for the inherent economic resilience of the companies.

We will also include the companies' one-year default probabilities immediately before the diesel emissions revelations. This data is available from Bloomberg's Default Risk data set. This is an additional risk metric that takes into account everything from a company's capital structure to its liquidity needs and cash flow positions. By incorporating both Default Risk and DuPont ratios into our models, we can be reasonably certain that our models reflect the financial health of Volkswagen's suppliers at the time of the diesel emissions news.

3. Measuring the impact of the news

At this point we are almost ready to begin analysis, but we still do not have the "so what" variable that we are trying to describe or predict. We start with an intuitive hypothesis that the more strongly a supplier company depended on Volkswagen, the worse its stock should have performed in the wake of the diesel emissions news (accounting for the fundamental economic strength of the company). Therefore, we can simply use the change in a supplier's stock price as our target variable. Specifically, we can use the return in the supplier's stock over the two weeks from September 15, 2015 (the day before the news came out) to September 29, 2015 (by which time the scope of the problem had become more fully apparent). Leveraging Bloomberg's Calculation Services over the Data License platform, special override fields can provide a custom total return over this period for each of the chosen companies.

We can use Bloomberg's Supply Chain data to help quantify the exposure that investors in Volkswagen's suppliers faced as a result of the Dieselgate news.

Putting it all together

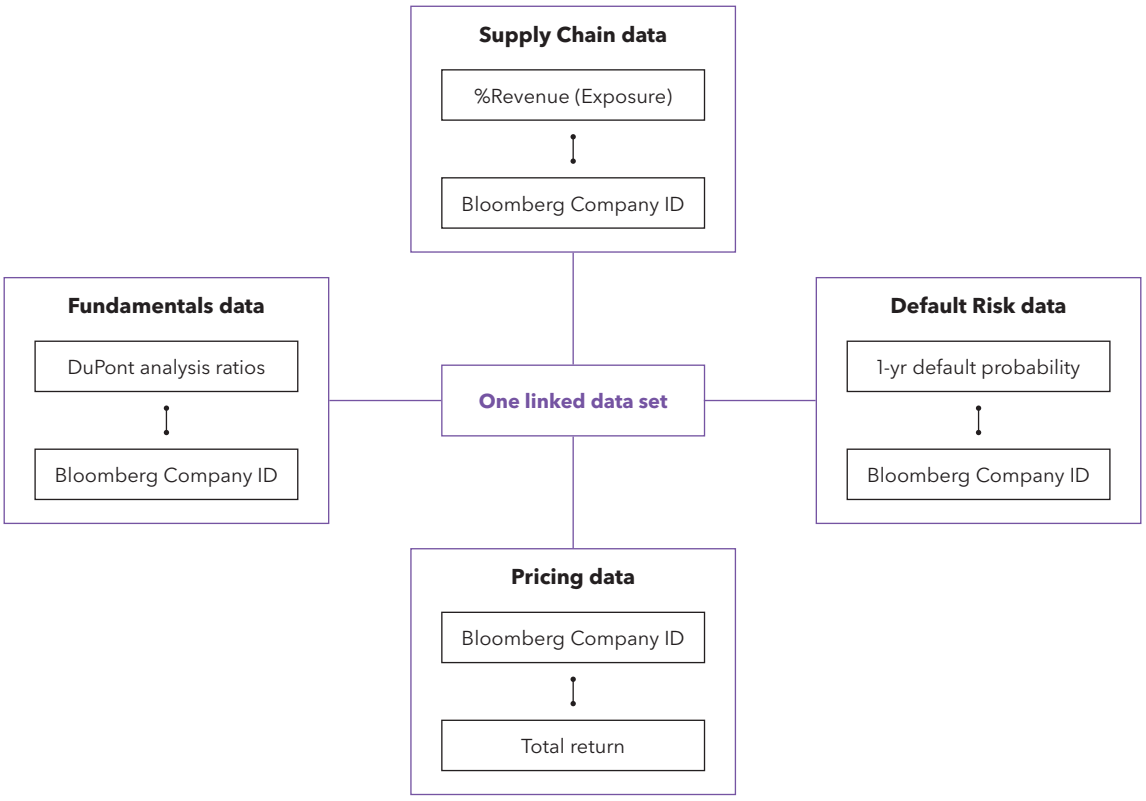
Now that we have all of the required data, we need to combine it into one data set. Bloomberg's One Data concept really shines here: Combining all our data into one table using Bloomberg Company Identifiers is straightforward as these entity-level IDs are consistent across all Bloomberg data sets.

Table 1: Our Volkswagen suppliers data set

Data Source	From Supply Chain			From Fundamentals					From Default Risk	From Pricing Data
Data Field	Supplier Company	Bloomberg ID	Exposure	Leverage Ratio	Asset Turnover	Operating Margin	Interest Burden	Tax Burden	Default Risk	Total Return
Bloomberg Field Mnemonic	LONG_COMP_NAME	ID_BB_COMPANY	RELATIONSHIP_PERCENT	YOY_ASSET_TO_EQUITY_RATIO	ASSET_TURNOVER	OPER_MARGIN	INT_BURDEN	TAX_BURDEN	BB_1YR_DEFAULT_PROB	CUST_TRR_RETURN_HOLDING_PER
SHW AG		25535337	45.31%	2.19	2.11	4.65%	94.10%	67.28%	4.70bp	–20.56%
Motherson Sumi Systems LTD		182691	44.00%	5.24	2.11	5.83%	89.91%	54.12%	1.72bp	–17.26%
Polytec Holding AG		9304601	36.90%	3.07	1.38	6.00%	85.87%	66.81%	4.80bp	–11.83%
Grammer AG		187549	23.23%	3.78	1.56	2.73%	91.90%	66.08%	60.27bp	–16.51%
Perceptron Inc		106239	23.00%	1.42	0.85	100.00%	100.00%	55.21%	0.78bp	–23.08%
Semcon AB		221309	20.03%	2.14	1.22	3.64%	94.36%	140.27%	24.98bp	–5.40%
Faurecia SA		115349	19.00%	4.58	1.99	3.97%	74.96%	63.30%	5.26bp	–15.91%
Valeo SA		115556	18.44%	3.45	1.36	6.68%	90.53%	92.78%	2.35bp	–2.89%
Burelle SA		117317	17.75%	5.03	1.25	7.61%	88.31%	44.09%	9.37bp	–8.68%
BorgWarner Inc		119697	17.00%	2.24	1.00	12.30%	93.88%	72.37%	0.23bp	–7.08%
Cie Plastic Omnium SA		115294	17.00%	3.31	1.30	7.61%	88.71%	87.89%	2.58bp	–10.75%
Tower International Inc		18192960	15.00%	9.89	1.51	4.76%	72.10%	113.36%	17.80bp	–8.53%
Gentex Corp		104206	14.00%	1.27	0.74	30.32%	99.06%	68.70%	0.00bp	–6.66%
Magna International		109806	12.05%	2.14	1.70	8.43%	97.86%	69.86%	0.24bp	–6.99%
Harman Intl Industries Inc		100708	11.00%	2.40	1.23	7.51%	96.52%	95.86%	38.76bp	–8.51%
Modine Manufacturing Co		105425	10.85%	2.51	1.52	3.54%	77.88%	73.40%	9.96bp	–5.08%
Kuka AG		117654	10.75%	3.47	1.36	4.56%	92.97%	63.58%	1.06bp	–9.31%
CIE Automotive SA		153235	10.70%	5.67	0.81	9.12%	77.74%	76.75%	4.25bp	–12.12%
ElringKlinger AG		153784	10.40%	2.12	0.91	9.36%	91.24%	70.41%	2.24bp	–21.52%

By incorporating both Default Risk and DuPont ratios into our models, we can be reasonably be certain that our models reflect the financial health of Volkswagen's suppliers at the time of the diesel emissions news.

One linked data set



Combining data is simple using Bloomberg Company Identifiers

Running the analysis

We use standard analytical concepts to measure the impact of supply chain data. First, we perform a linear regression to predict total return using the Fundamentals and Default Risk data as independent variables. Then, we perform the same linear regression, but add the Exposure field that we derived from Bloomberg's Supply Chain data as an additional independent variable. Finally, we compare the performance of the two models (with and without the Supply Chain field) to quantify the impact of incorporating supply chain information into a simple model based on Fundamentals and Default Risk data.

When comparing the performance of the two models, we do not look solely at standard measures of regression performance (R2 and root mean squared error), but also account for the explanatory cost of adding an extra variable by computing the Akaike Information Criterion and the Adjusted R2. The last two metrics are more robust ways of determining whether an additional variable really contributes new information to a model or whether it increases raw performance because of an overfitting effect. (It is out of scope to give the full mathematical definitions of all of these metrics, but they are in standard use.)

The results

Our analysis shows that using Bloomberg Supply Chain data improves our model's predictive power.

Table 2 below demonstrates this in two distinct ways. First, looking at R2 and RMSE, we see the model that incorporated Supply Chain's Exposure data had better "goodness-of-fit" performance than the model without it. Therefore, adding the Supply Chain data made the model more accurate. Second, looking at Adjusted R2 and AIC, the model that used Supply Chain's Exposure data again performed better. These are not goodness-of-fit metrics, rather they are metrics for model selection that take into account the trade-off between goodness of fit and simplicity. Since these metrics also show an improvement, our model with Supply Chain data is not only more accurate, it is better informed.

Table 2: Supply Chain data improves performance

Model type	R^2	RMSE	Adjusted R^2	AIC
Without Exposure	0.4186	4.4314%	0.1280	41.02
With Exposure	0.5019	4.1017%	0.1849	40.08

Now let's see if the impact of the Exposure variable is not just significant at the model level, but also leads to large changes in predicted returns based on Exposure.

Digging into the regression coefficients in Table 3 below, we see that the effect of the Exposure variable is indeed large. The regression coefficient is approximately -0.2. Thus, if a hypothetical supplier company's exposure to Volkswagen were 5 percentage points higher, its stock would have had a return more than 1 full percentage point lower over the two-week period following the diesel emissions news – all else being equal.

These results demonstrate that Bloomberg Supply Chain data provides a way to quantitatively link companies according to the importance of their relationships and to improve data-driven models. These results also provide evidence that supplier relationships can have a large impact on investment performance.

Note that since the analysis was only done on suppliers that were known to have a large exposure to Volkswagen (more than 10% of their revenue), we are actually undervaluing the importance of supply chains. There is a whole universe of companies with no exposure to Volkswagen whatsoever, thus it would be meaningless to apply our linear model to them since the diesel emissions news would not affect them. A diligent data analyst's next step would be to model this nonlinearity in the importance of supply chain exposure by using more sophisticated analytical techniques or nonlinear combinations of variables.

Table 3: Regression coefficients for model with Exposure data

Intercept	Exposure	Leverage ratio	Asset turnover	Operating margin	Interest burden	Tax burden	Default risk
−0.256	−0.219	0.002	−0.005	−0.119	0.156	0.089	−8.236

Investment implications

Our analysis offers several investment implications. First, since the risk of investing in one of Volkswagen's suppliers was quantifiable based on Bloomberg's Supply Chain data, clients who had been using this data set and who were invested in Volkswagen's suppliers might have been able to use this quantified exposure to construct a hedge, thus saving money. Second, clients interested in generating alpha could have used the quantified supply chain exposure to correlate price moves with supplier exposure and build a trading strategy around statistical arbitrage. Finally, sell-side data clients could have offered hedging services to clients based on their quantifiable exposure to VW and its suppliers.

Conclusion

A client replicating this analysis – by using supply chain data and the first two weeks of suppliers' returns after market-moving news breaks – could prepare themselves for the subsequent months and years of additional related revelations and legal actions. Whether a client's goal is to hedge risk or to generate returns, Bloomberg's Supply Chain data can add valuable insights to the mosaic of information feeding investment decisions.

Learn more

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