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Understanding Drivers of Credit Risk: Differences and Similarities of the Credit Risk Assessment of a Non-Financial Corporation, via a Probability of Default and a Scoring Model

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Introduction

Since the introduction of Altman's Z-score for US corporations in 1968,[1] there has been a proliferation of statistical models that combine financial ratios, socio and macroeconomic factors with advanced mathematical techniques to estimate the credit-worthiness of publicly listed or privately held companies in a simplified, quick, automated and scalable way.

Fundamentals-based credit risk models usually come in two flavours, depending on the asset class they aim to cover: Probability of Default (PD) models are trained and calibrated on default flags, that are abundant for small and medium enterprises; scoring models exploit the ranking power of an established credit rating agency, to estimate the credit score of low-default asset classes, such as high-revenue corporations or insurance companies.

At S&P Global Market Intelligence we offer both types of statistical models: PD Model Fundamentals and CreditModel™: PD Model Fundamentals is a Probability of Default model that covers publicly listed and privately owned corporations and banks, with no revenue and asset size limitation.

CreditModel is a scoring model trained on the S&P Global Ratings, covering publicly listed and privately owned corporations, banks and insurance companies, with more than $25M in total revenue and $100M in total assets respectively.[2]

CreditModel and PD Model Fundamentals overlap in their coverage of medium and large corporations with more than $25M in revenue (banks over $100M in assets), and in certain instances can (and will) provide divergent credit risk assessments on the same company, with a difference at times of several credit score notches.

This should be no surprise, given that we are comparing the assessment from two different families of models (PD models vs scoring models), that were trained on different datasets (default flags vs S&P Global Ratings level), and are characterized by a different analytical "DNA" (the risk assessment is medium-term risk for PD models, with a stability of circa 1 year time horizon, and long-term for scoring models trained on ratings, with a stability of 3-5 years for investment grade scores and 2 to 3 years for non-investment grade scores).

[1] Altman, Edward I. (September 1968). "Financial Ratios, Discriminant Analysis and the Prediction of Corporate Bankruptcy". Journal of Finance: 189-209.
[2] S&P Global Ratings does not contribute to or participate in the creation of credit scores generated by S&P Global Market Intelligence. Lowercase nomenclature is used to differentiate S&P Global Market Intelligence PD credit model scores from the credit ratings issued by S&P Global Ratings.

In the next sections, we will perform an in-depth analysis on the weak credit scores output by CreditModel and PD Model Fundamentals for non-financial Corporations in North-America:

- for all models, the main drivers of a weak credit score refer to the size, the profitability and the leverage/flexibility risk dimensions, but the actual ratios included in each model depend on the availability/coverage and their predictive power;
- outputs from different models are aligned within one notch in the majority of cases, when the financial statement contains "weaknesses across the board"; marked divergences can be seen in limited instances, whenever a company financial statement presents a mixed profile, with some "strong" and some "weak" items.

Drivers of differences between CreditModel and PD Model Fundamentals credit risk assessment

S&P Global Market Intelligence's Credit Analytics suite provides access to CreditModel and PD Model Fundamentals, analytics, pre-calculated scores[4], benchmarks combined with workflow tools and integrated with S&P Capital IQ Platform data.

As part of this suite, the Absolute Contribution is a powerful tool to conduct an empirical analysis of these differences:

1. What are the company's financial traits that commonly result in a weak credit risk assessment by PD Model Fundamentals or by CreditModel?
2. How often and by how much does the credit assessment diverge for PD Model Fundamentals and CreditModel when looking at the same company?
3. What are the drivers of the differences?
4. Is one model more suitable than the other to assess credit risk?

Common financial traits of distressed companies, using different statistical models

Using the S&P Capital IQ Platform screening tools, it is possible to quickly extract all non-financial corporations that have a pre-calculated output from either CreditModel (CM) or PD Model Fundamentals (PDFN), in the last 13+ years.[3] For sake of simplicity and to improve comparability, this analysis focuses on companies domiciled in North America (United States and Canada only), and excludes the Airlines industry, that is treated as a separate sub-model in CM due to its "global operations".

[3] Credit Analytics pre-scored database in Capital IQ Platform includes PD values and credit scores from more than 640K companies, calculated with our suite of statistical models (depending on availability of inputs). Figures as of October 2016.

CreditModel analysis

Table 1 shows summary statistics of the distribution of actual values and absolute contributions of each model input, for companies that have a CreditModel score "worse than b-" between 2006 and 2016. Within this time period there are 2635 observations in the Credit Analytics pre-scored database.

Table 1: Summary statistics of companies with CreditModel score worse that b- (2.6k observation)

	Actual Value				Absolute Contribution		
CreditModel Input	***25th%***	***Median***	***75th%***	***CreditModel Input***	***25th%***	***Median***	***75th%***
Debt / (Debt + Equity)	0.5	1.0	1.7	**Debt / (Debt + Equity)**	0%	6%	**19%**
Return on Capital	-0.4	-0.1	0.0	**Return on Capital**	0%	0%	**11%**
EBIT Interest Coverage	-7.2	-1.4	0.3	EBIT Interest Coverage	0%	1%	7%
Operating Income (bef.D&A) / Revenues	-0.1	0.0	0.1	**Operating Income (bef.D&A) / Revenues**	5%	**11%**	**22%**
Free Operating Cash Flow / Debt	-0.6	-0.2	0.0	**Free Operating Cash Flow / Debt**	0%	6%	**10%**
FFO Interest Coverage	-3.9	-0.5	0.7	FFO Interest Coverage	0%	2%	9%
Gearing Ratio	-1.9	0.0	0.5	Gearing Ratio	0%	0%	1%
Acid- Test Ratio	0.5	0.8	1.3	Acid- Test Ratio	1%	4%	8%
Asset Turnover	0.6	1.1	1.8	Asset Turnover	0%	1%	3%
Total Assets	40.3	102.9	276.6	**Total Assets**	**23%**	**37%**	**48%**

Source: S&P Global Market Intelligence as of October 31st, 2016.
Note: since these statistics are calculated independently, the Absolute Contribution values do not necessarily correspond to the contributions of actual values at the same percentiles. Moreover, the medians of the absolute contributions do not necessarily add up to 100%; the absolute contributions are meant to add up to 100% only at the individual observation level.

At a first glance, the companies that receive a CreditModel score 'worse than b-' tend to have (Table 1, left panel):

- Debt/(Debt+Equity)>1 in 50% of the cases, driven by negative equity (total assets lower than total liabilities);
- Negative Return on capital, EBIT interest coverage, Operating Income Before D&A / Revenues, Free Operating Cash Flow / Debt, FFO interest coverage in at least 50% of the cases;
- Low gearing ratio, low acid test ratio;
- Relatively low total assets.

These conclusions do not change materially if we analyze the data by year, consistent with the fact that the model weights certain drivers more heavily.

To quickly identify the main drivers of such low credit scores, Absolute Contribution can be used (Table 1, right panel). By simply highlighting in red all cases where the absolute contribution is higher than 10%, it is easy to find the following:

Table 2: Main Drivers of worse than "b-" scores in CreditModel 2.6, for Corporate Companies in North America

Main Driver of worse than "b-" CM score	Implications
Low Total Assets (<$100m) in majority of cases	Small and medium size companies are less robust, and prone to higher default rates
Low or Negative Operating Income Before D&A (EBITDA) / Revenues in more than 50% of the cases	Companies with negative Operating Income before D&A leading to negative operating metrics reflecting the limited ability of a company to repay debt
Debt / (Debt + Equity) > 1 in 50% of the cases	Companies with negative equity (ie, total assets lower than total liabilities), leading to "over-leveraged" risk.
Negative Return on capital and Free Operating Cash Flow / Debt	Companies with low profitability and liquidity, again unable to repay debt.

Source: S&P Global Market Intelligence, as of October 31st 2016.

The statistical dominance of Total Assets, EBITDA / Revenues and Debt / (Debt + Equity) shall not come as a surprise. CreditModel is a statistical model that was trained on S&P Global Ratings and uses socio-economic factors and company financials to generate a credit score that statistically matches S&P Global Ratings. Looking at the whole universe of North American companies rated by S&P Global Ratings, between 2006 and 2016, only circa 1% has Total Assets < $100m.[4] Even if we widen the group, and look at the North American companies with Total Assets < $300m, there is not a single case rated "better than B-" by S&P Global Ratings with negative EBITDA/Revenues; in fact, between 2006 and 2016, there are only 5 cases with Total Assets < $300m and EBITDA/Revenues<0, and all got a "B- or worse" rating.[5] Finally, 86% of the (38) cases with Total Assets < $300m and Debt / (Debt + Equity)>1 (ie, negative Equity) have a rating of "B- or worse".[6] Thus, CreditModel is consistent with the empirical observations from S&P Global Ratings' rated universe.

PD Model Fundamentals analysis

Table 3 and 4 show summary statistics of the distribution of actual values and absolute contributions of each model input, for companies that have a PD Model Fundamental mapped score "worse than b-" between 2006 and 2016. Within this time period there are 60K observations for private and 5K for public companies in the Credit Analytics pre-scored database, divided across the three core industry clusters.

[4] Source: S&P Capital IQ Platform, as of October 11th 2016.
[5] Source: ibid.
[6] Source: ibid.

Table 3: Summary statistics of private companies with PD Model Fundamentals mapped score lower than b- as of October 31st, 2016 – 60k observations

	Actual Value								
	Manufacturing (Cluster 1)			Infrastructure (Cluster 2)			Services (Cluster 3)		
PDFN Private Input	**25th%**	**Median**	**75th%**	**25th%**	**Median**	**75th%**	**25th%**	**Median**	**75th%**
Cash / Total Assets	0.0	0.1	0.2	0.0	0.1	0.2	0.0	0.1	0.3
Current Liabilities / Net Worth	0.3	1.1	3.6	0.2	0.7	3.6	0.2	0.7	6.6
PPE / Total Assets	0.0	0.1	0.2	0.1	0.3	0.6	0.0	0.2	0.5
Net Income / Total Liabilities	-0.2	0.0	0.0	-0.5	-0.1	0.0	-0.7	-0.2	-0.1
Net Income / Total Revenue	0.0	0.0	0.0	-0.2	0.0	0.0	-0.2	-0.1	0.0
Return on Net Capital Proxy	-1.0	-1.0	0.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0
Total Equity / Total Assets	0.2	0.4	0.7	0.2	0.5	0.8	0.1	0.5	0.8
Total Revenue	0.0	4.7	11.1	0.2	4.4	12.1	2.1	6.4	14.7
CIRS	moderately high risk	moderately high risk	high risk	moderately high risk	moderately high risk	moderately high risk	moderately high risk	moderately high risk	moderately high risk
CRS	aaa	aaa	aaa	aaa	aaa	aaa	aaa	aaa	aaa
CPI	1.5	2.9	3.4	1.5	2.9	3.4	1.5	2.9	3.2

	Absolute Contribution								
	Manufacturing (Cluster 1)			Infrastructure (Cluster 2)			Services (Cluster 3)		
PDFN Private Input	**25th%**	**Median**	**75th%**	**25th%**	**Median**	**75th%**	**25th%**	**Median**	**75th%**
Cash / Total Assets	4%	5%	6%	3%	4%	5%	3%	4%	5%
Current Liabilities / Net Worth	10%	**12%**	**13%**	8%	**11%**	**13%**	**11%**	**13%**	**15%**
PPE / Total Assets	8%	**12%**	**14%**	6%	**11%**	**12%**	9%	**11%**	**12%**
Net Income / Total Liabilities	6%	7%	**10%**	6%	9%	**10%**	**11%**	**13%**	**14%**
Net Income / Total Revenue	**19%**	**20%**	**24%**	**18%**	**20%**	**23%**	**17%**	**18%**	**20%**
Return on Net Capital Proxy	6%	8%	9%	**12%**	**13%**	**14%**	**10%**	**11%**	**11%**
Total Equity / Total Assets	4%	4%	6%	3%	4%	5%	4%	4%	5%
Total Revenue	**19%**	**21%**	**25%**	**19%**	**21%**	**24%**	**17%**	**18%**	**21%**
CIRS	5%	8%	**11%**	4%	8%	10%	4%	8%	9%
CRS	0%	0%	0%	0%	0%	0%	0%	0%	0%
CPI	0%	1%	2%	0%	1%	2%	0%	1%	1%

Source: S&P Global Market Intelligence. Analysis is divided for the three core PDFN industry clusters.
Note: since these statistics are calculated independently, the Absolute Contribution values do not necessarily correspond to the contributions of actual values at the same percentiles. Moreover, the medians of the absolute contributions do not necessarily add up to 100%; the absolute contributions are meant to add up to 100% only at the individual observation level.

Table 4: Summary statistics of Public companies with PD Model Fundamentals mapped score lower than b- as of October 31st, 2016 – 5k observations

	Actual Value								
	Manufacturing (Cluster 1)			Infrastructure (Cluster 2)			Services (Cluster 3)		
PDFN Public Input	**25th%**	**Median**	**75th%**	**25th%**	**Median**	**75th%**	**25th%**	**Median**	**75th%**
Cash / Total Assets	0.0	0.1	0.2	0.0	0.1	0.2	0.1	0.2	0.3
Current Liabilities / Net Worth	0.8	3.5	8.9	0.2	0.6	4.2	0.5	1.5	8.9
Debt / (Debt + Equity)	0.3	0.7	1.7	0.1	0.3	0.8	0.1	0.4	1.2
EBIT Interest Coverage	-19.3	-6.1	-1.9	-41.4	-10.4	-3.1	-42.3	-9.1	-2.1
EBIT / Revenues	-0.9	-0.2	-0.1	-3.9	-1.2	-0.4	-0.8	-0.2	-0.1
PPE / Total Assets	0.1	0.2	0.4	0.5	0.7	0.9	0.0	0.1	0.2
Retained Earnings / Total Assets	-5.6	-1.9	-0.6	-2.4	-1.0	-0.4	-6.0	-2.3	-0.9
Return on Net Capital	-3.0	-3.0	-3.0	-3.0	-3.0	-3.0	-3.0	-3.0	-3.0
Sales Growth	-24.4	-8.4	6.8	-34.6	-1.6	19.9	-18.5	-2.3	15.8
Total Assets	4.2	17.7	65.7	7.8	23.4	66.5	6.6	23.7	67.2
Total Equity	-3.3	1.7	11.8	1.0	7.5	25.0	-1.1	4.2	19.8
EBIT / Total Assets	-0.7	-0.2	-0.1	N/A	N/A	N/A	N/A	N/A	N/A
Cash Flow from Operations / Net Income	N/A	N/A	N/A	-11.9	-11.9	-0.4	N/A	N/A	N/A
FFO Interest Coverage	N/A	N/A	N/A	N/A	N/A	N/A	0.0	0.0	0.0
CIRS	intermediate risk	intermediate risk	moderately high risk	moderately high risk	moderately high risk	moderately high risk	moderately high risk	moderately high risk	moderately high risk
CRS	aaa	aaa	aaa	Aaa	aaa	aaa	aaa	aaa	aaa
CPI	1.5	2.9	3.2	1.2	2.0	2.9	1.5	2.9	3.2

	Absolute Contribution								
	Manufacturing (Cluster 1)			Infrastructure (Cluster 2)			Services (Cluster 3)		
PDFN Public Input	**25th%**	**Median**	**75th%**	**25th%**	**Median**	**75th%**	**25th%**	**Median**	**75th%**
Cash / Total Assets	1%	1%	2%	1%	1%	2%	5%	6%	8%
Current Liabilities / Net Worth	3%	4%	5%	2%	3%	5%	7%	7%	8%
Debt / (Debt + Equity)	0%	0%	5%	0%	0%	0%	0%	0%	2%
EBIT Interest Coverage	5%	5%	6%	6%	6%	7%	6%	7%	8%
EBIT / Revenues	**17%**	**18%**	**19%**	**18%**	**18%**	**19%**	**17%**	**18%**	**19%**
PPE / Total Assets	7%	8%	10%	**10%**	**11%**	**12%**	6%	7%	8%
Retained Earnings / Total Assets	8%	**12%**	**13%**	**15%**	**15%**	**16%**	**13%**	**15%**	**16%**
Return on Net Capital	5%	5%	6%	5%	5%	5%	5%	5%	5%
Sales Growth	6%	8%	8%	4%	6%	8%	5%	7%	8%
Total Assets	0%	0%	0%	0%	0%	0%	0%	0%	0%
Total Equity	**21%**	**21%**	**22%**	**21%**	**21%**	**22%**	**21%**	**21%**	**22%**
EBIT / Total Assets	9%	10%	**10%**	N/A	N/A	N/A	N/A	N/A	N/A
Cash Flow from Operations / Net Income	N/A	N/A	N/A	4%	5%	7%	N/A	N/A	N/A
FFO Interest Coverage	N/A	N/A	N/A	N/A	N/A	N/A	0%	0%	0%
CIRS	4%	4%	6%	4%	6%	6%	5%	6%	6%
CRS	0%	0%	0%	0%	0%	0%	0%	0%	0%
CPI	0%	1%	1%	0%	0%	1%	0%	1%	1%

Source: S&P Global Market Intelligence. Note: since these statistics are calculated independently, the Absolute Contribution values do not necessarily correspond to the actual values at the same percentiles.

Private Companies

Private companies with a weak PDFN score tend to operate in high risk / moderately high risk industries, as can be seen by inspecting the Corporate Industry Risk Score (CIRS).

By highlighting in red all cases where the absolute contribution exceeds 10%, it is possible to immediately identify the major drivers of such poor scores, across all clusters; from top to bottom contribution:

Table 5: Main Drivers of worse than "b-" scores in PD Model Fundamentals – Private Corporates, for Corporate Companies in North America

Main Driver of PDFN "worse than b-" score (Private Companies)	Implications
Very low Total Revenues (<$25m), in all cases	Small and medium size companies are less robust, and prone to higher default rates.
Zero or negative Net Income / Revenues, in more than 75% of the cases	Low profitability suggests the company may not be able to repay its debt.
High Current Liabilities / Net Worth, low Net Income / Total Liabilities, low Return on Net Capital proxy and poor PPE / Total Assets, in many cases	High short-term liabilities that may need to be serviced quickly, poor "operating efficiency" that suggests the company cannot service its debt quickly, and low tangible fixed assets suggesting the company cannot recur to "emergency reserves".

Source: S&P Global Market Intelligence, as of October 31st 2016.

As expected, Country Risk Score (CRS) has tiny or no contribution at all, being already equal to its best possible value (aaa), for the North American companies;[7] Consumer Price Index growth (CPI) contribution fluctuates, but it does not play a major role, since it is related to two strong economies (United States and Canada). Corporate Industry Risk Score tends to play a somewhat limited role, given that most companies come from the "moderately high risk industry" sectors.

Public Companies

The factors dominating the absolute contribution, from top to bottom are:

Table 6: Main Drivers of worse than "b-" scores in PD Model Fundamentals – Public Corporates, for Corporate Companies in North America

Main Driver of PDFN "worse than b-" score (Public Companies)	Implications
Relatively low Total Equity (<$25m) in all cases	Small and medium size companies are less robust, and prone to higher default rates.
Negative EBIT/Revenues, in more than 75% of the cases	Low profitability suggests the company may not be able to repay its debt.
Negative Retained Earnings / Total Assets	Low reserves do not help servicing debt in an emergency.
Negative EBIT / Total Assets, and to a lesser extent	Again, low efficiency/profitability suggests the company is not operated at its best.
PPE/ Total Assets[8]	Tangible Fixed Assets may not be easy to convert into cash to service debt.

Source: S&P Global Market Intelligence, as of October 31st 2016.

Exactly like in the case of the private companies, Country Risk Score has tiny or no contribution at all, as expected, being already equal to its best possible value (aaa), for the North American companies; Consumer Price Index growth contribution

[7] One would expect this to have a larger impact in emerging markets.
[8] PPE / Total Assets has a positive impact for private companies or public real estate investment trusts, and a negative impact for public companies (excluding real estate investment trusts).

fluctuates, but it does not play a major role; also Corporate Industry Risk tends to play a somewhat limited role.[9]

Please, refer to the appendix for summary statistics on the contribution of model inputs for companies with a "worse than b-" score, operating outside North America (Tables 13 and 14).

Convergence / Divergence of company scores generated by CreditModel and PD Model Fundamentals

Leveraging the information provided by the absolute contribution, it is possible to identify the main drivers of weak credit risk assessment under each family of models. For example, for non-financial corporate companies domiciled in North America, the 3 major common drivers of a score "worse than b-" are:

Table 7: Drivers of weak credit assessment for North America non-financial Corporate Companies

Model	Drivers for North American non-financial Corporate Companies		
CreditModel 2.6 Corporates	**Total Assets** (Size)	**EBITDA / Revenues** (Profitability)	**Debt / Capital** (Leverage)
PD Model Fundamentals – Public Corporates	**Total Equity** (Size)	**EBIT / Revenues** (Profitability)	**Retained Earnings / Total Assets** (Flexibility)
PD Model Fundamentals – Private Corporates	**Total Revenues** (Size)	**Net Income / Revenues** (Profitability)	**Current Liabilities / Net Worth** (Short-term Leverage)

Source: S&P Global Market Intelligence. As of October, 31st 2016.

While size, profitability and financial leverage/flexibility are the main drivers in all instances, there are subtle differences that play an important role in driving model outputs, and sometimes lead to marked differences between the models, as discussed below.

The following analysis focuses on the common sub-set of North American companies that are scored by both models between 2006 and 2016, and have a score "worse than b-" in CreditModel (2527 cases) or in PD Model Fundamentals (3804 cases). Table 8 shows model agreement in the two cases.

Table 8: Agreement between CM and PDFN credit assessment

CM/PDFN agreement for companies with CM score worse than b- (2527 companies)			
Exact match	**+/- 1 notch**	**+/- 2 notches**	**+/- 3 notches**
27%	70%	91%	96%

PDFN/CM agreement for companies with PDFN score worse than b- (3804 companies)			
Exact Match	**+/- 1 notch**	**+/- 2 notches**	**+/- 3 notches**
15%	50%	80%	93%

Source: S&P Global Market Intelligence,as of October 1st 2016.

[9] We stress here, once again, that all the results of this analysis apply to the group of companies in the Credit Analytics prescored database, domiciled in NA, and with a score worse than "b-". Variations in the results will be obtained for companies in other countries, where for example the Country Risk Score will be worse than "aaa", and thus will certainly contribute more to the weak scores / high PD values generated by the model. Please, refer to the Appendix for other regions.

Both models produce outputs within 1 notch from each other in the majority of the cases analyzed. Overall, there are less than 4% (7%) of the cases where PDFN (CM) assigns a score differing by more than 3 notches from the "worse than b-" score of CM (PDFN).

The broad agreement between the two models despite the different financial inputs and training reflects the analytical strength of both approaches to assess credit risk and identify weak companies.

At the same time, the different approaches and financial inputs might determine different assessments for companies with financial profiles that present both strong and weak drivers in the same statement.

Looking in more detail at the cases where model disagreements are sizable:

- There are only 34 cases (0.89% of observations) for which PDFN assigns a "worse than b-" score and CM assigns a better score, by 6 or more notches;
- Conversely, there are only 19 cases (0.75% of observations) for which CM assigns a "worse than b-" score and PDFN assigns a better credit score, by 6 or more notches, i.e. nearby or right within the investment grade region.[10]

Tables 9 and 10 in the Appendix show summary statistics of the financial inputs used in each model, both in terms of actual values and absolute contributions.

By inspecting Table 9 in the Appendix, it is now evident why CM assigns a much better score than PDFN. Do you recall in the previous analysis the drivers of the 'worse than b-' score in CreditModel? Let us list them in Table 11, below, for convenience:[11]

Table 11: Companies with PDFN 'worse than b-' and CM 5+ notches better – 34 observations

Drivers of CM score 'worse than b-'	Company financials
Total Assets (lower than $300m)	Total Assets is well above $500m
Operating Income Before D&A (EBITDA) / Revenues (negative)	EBITDA / Revenues is positive
Debt / (Debt + Equity) (high)	Debt/(Debt + Equity) is well below 1
Return on capital (negative)	Return on Net Capital is positive
Free Operating Cash Flow / Debt (negative)	Free Operating Cash Flow / Debt is positive

Source: S&P Global Market Intelligence, as of October 31st 2016.

Improvements in size, leverage and profitability variables cause CreditModel to generate much better scores, up to a+. This is also reflected in the absolute contributions of some of these key drivers which have decreased significantly vs. the levels for poorly scored companies, as highlighted in green in Table 9 in the Appendix. For example, the absolute contribution of Operating Income (bef. D&A) /

[10] The assigned score is never above "a+", in this dataset.
[11] Based on the absolute contribution.

Revenues has decreased to 0% from 11%, as it has improved to a positive value from a negative value.

Note that there are some exceptions, driven by the redistribution of the absolute contribution weights that need to add up to 100% on each observation. For example, Total Assets has increased (improved) on median, but its absolute contribution has also risen to 48% from 37% because it is now a constraining factor given the relative improvement of the rest of the ratios.

For PDFN, similar considerations apply (see Table 10, in the Appendix). The major drivers of the 'worse than b-' score now get much better actual values, as summarized in Table 12, below.

Table 12: Companies with CM 'worse than b-' and PD FN (Public or Private) 5+ notches higher – 19 observations

Drivers of PDFN score 'worse than b-'	Company financials
Total Revenues (lower than $20m)	Total Revenues is above $70m
Net Income / Total Revenues (negative)	Net Income / Total Revenues is positive
Current Liabilities /Net Worth (well above 1)	Current Liabilities /Net Worth well below 1
Total Equity (below $25m or negative)	Total Equity is above $100m
EBIT / Revenues (negative)	EBIT / Revenues (positive)
Retained Earnings / Total Assets (low or negative)	Retained Earnings / Total Assets is positive

Source: S&P Global Market Intelligence, as of October 31st 2016.

Again, it is important to stress that it is not necessary for an input to have absolute contribution equal to zero, in order to generate an excellent credit score, because overall absolute contributions need to add to 100% for each observation. Indeed, looking at the absolute contributions of the drivers listed above, it is evident that only EBIT/Revenues has a lower absolute contribution; the remaining ones show a higher absolute contribution, meaning that any further and significant score improvement can be achieved only by improving the other drivers.

A holistic approach to measuring credit risk

While both CreditModel and PD Model Fundamentals are very strong tools to perform credit risk assessments,[12] each individual model tends to focus on a selection of financial items that is optimized for the training and model objectives (statistically match an S&P Rating vs. calculate a probability of default).

In order to mitigate the necessary assumptions applied by any given statistical model, it is recommended to combine multiple analytics that measure credit risk from different angles of the financial statement.

[12] See for example S&P Global Market Intelligence's "PD Model Fundamentals Public Corporates – Detangling Financial Risk From Business Risk in a Probability of Default Model (August 2016)", or "CreditModel 2.6 Corporates – A Global Scoring Model Specializing in the Analysis of Unrated Firms and Low Default Sectors (August 2016)".

- When both models generate a weak score, this implies that the company has weak financials "across the board", and thus it is definitely risky to venture into business with it.
- When model outputs diverge, it is useful to remember that CreditModel was trained on S&P Global Ratings, and as such its scores retain similar dynamics, being stable and providing a long-term view of credit risk; conversely, PD Model Fundamentals was trained on default flags: its PD values and mapped scores are more dynamic, thus providing a more responsive view to changing company financials.[13]
- In case of marked divergences, it may be worth complementing the analysis with additional information available on S&P Global Market Intelligence's Capital IQ Platform, checking company financials in more detail, reviewing news and key developments, looking at complementary market signals such as PD Model Market Signals (where available), considering the debt structure and the maturity schedule of all liabilities, performing a peer comparison analysis via Credit Health Panel and keeping in mind the time horizon of the intended business deal.

[13] This is also reflected in the choice of the financials. For example, in PDFN Private short-term Liabilities are included in one of the inputs.

About S&P Global Market Intelligence

At S&P Global Market Intelligence, we know that not all information is important—some of it is vital. Accurate, deep and insightful. We integrate financial and industry data, research and news into tools that help track performance, generate alpha, identify investment ideas, understand competitive and industry dynamics, perform valuation and assess credit risk. Investment professionals, government agencies, corporations and universities globally can gain the intelligence essential to making business and financial decisions with conviction.

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APPENDIX

Table 9: Companies with PDFN implied score 'worse than b-' and CM scores of 5+ notches better

	Actual Value				Absolute Contribution		
CreditModel ™ Input	***25th%***	***Median***	***75th%***	***CreditModel ™Input***	***25th%***	***Median***	***75th%***
Debt / (Debt + Equity)	0.2	0.4	0.7	**Debt / (Debt + Equity)**	**0%**	**0%**	**1%**
Return on capital	0.1	0.1	0.2	**Return on capital**	**0%**	**0%**	**3%**
EBIT interest coverage	1.6	3.1	16.7	**EBIT interest coverage**	0%	3%	**20%**
Operating Income (bef.D&A) / Revenues	0.1	0.3	0.5	**Operating Income (bef.D&A) / Revenues**	**0%**	**0%**	**5%**
Free operating cash flow / Debt	0.0	0.2	1.5	**Free operating cash flow / Debt**	**0%**	**0%**	**1%**
FFO Interest Coverage	2.1	5.1	20.2	**FFO Interest Coverage**	0%	1%	**15%**
Gearing Ratio	0.1	0.4	2.0	**Gearing Ratio**	0%	2%	**17%**
Acid- Test Ratio	1.0	1.3	2.1	Acid- Test Ratio	0%	0%	0%
Asset Turnover	0.3	0.4	1.2	Asset Turnover	3%	7%	**19%**
Total Assets	522.4	797.3	3678.1	**Total Assets**	**12%**	**48%**	**68%**

Source: S&P Global Market Intelligence, as of October 31st 2016.

Table 10: Companies with CM score 'worse than b-' and PDFN implied scores of 5+ notches better[14]

	Actual Value				Absolute Contribution		
PDFN Private Input	**25th %**	**Median**	**75th%**	**PDFN Private Input**	**25th %**	**Median**	**75th %**
Cash / Total Assets	0.0	0.1	0.2	Cash / Total Assets	5%	6%	7%
Current Liabilities / Net Worth	0.5	2.1	108.4	**Current Liabilities / Net Worth**	**12%**	**14%**	**16%**
PPE / Total Assets	0.2	0.4	0.6	PPE / Total Assets	9%	**10%**	**13%**
Net Income / Total Liabilities	0.1	0.4	0.7	Net Income / Total Liabilities	5%	6%	9%
Net Income / Total Revenue	0.2	0.3	0.5	**Net Income / Total Revenue**	**15%**	**18%**	**20%**
Return on Net Capital Proxy	0.1	0.4	1.1	Return on Net Capital Proxy	6%	8%	9%
Total Equity / Total Assets	-0.7	0.1	0.3	Total Equity / Total Assets	6%	7%	**11%**
Total Revenue	71.3	154.7	327.2	**Total Revenue**	**19%**	**21%**	**21%**

[14] We report summary statistics for PDFN in aggregate this time, without splitting by industry cluster, since the previous analysis showed very strong similarities across industry clusters. We do not report the actual and contribution values for CRS, Corporate Industry Risk Scores, and the CPI growth, since these maintain similar values as before.

	Actual Value		
PDFN Public Input	**25th%**	**Median**	**75th%**
Cash / Total Assets	0.2	0.2	0.2
Current Liabilities / Net Worth	0.1	0.1	0.2
Debt / (Debt + Equity)	0.0	0.0	0.0
EBIT Interest Coverage	148.4	150.3	152.2
EBIT / Revenues	0.1	0.2	0.2
PPE / Total Assets	0.6	0.6	0.7
Retained Earnings / Total Assets	-0.1	0.0	0.1
Return on Net Capital	0.1	0.1	0.1
Sales Growth	92.5	103.2	113.9
Total Assets	134.5	141.1	147.6
Total Equity	111.2	120.6	129.9
EBIT / Total Assets	N/A	N/A	N/A
Cash Flow from Operations / Net Income	2.0	2.1	2.3

	Absolute Contribution		
PDFN Public Input	**25th%**	**Median**	**75th%**
Cash / Total Assets	2%	3%	3%
Current Liabilities / Net Worth	2%	3%	3%
Debt / (Debt + Equity)	0%	0%	0%
EBIT Interest Coverage	2%	2%	2%
EBIT / Revenues	**15%**	**15%**	**16%**
PPE / Total Assets	**11%**	**12%**	**12%**
Retained Earnings / Total Assets	**17%**	**17%**	**18%**
Return on Net Capital	4%	4%	4%
Sales Growth	3%	3%	4%
Total Assets	0%	0%	0%
Total Equity	**22%**	**22%**	**22%**
EBIT / Total Assets	N/A	N/A	N/A
Cash Flow from Operations / Net Income	**12%**	**12%**	**12%**

Source: S&P Global Market Intelligence, as of October, 31st 2016.

Table 13: Absolute contributions of CM inputs, for companies that get assigned a 'worse than b-' score, in regions outside North America. [15]

	Absolute Contribution		
Emerging Markets	**25th%**	**Median**	**75th%**
Debt / (Debt + Equity)	1%	2%	4%
Return on capital	2%	7%	8%
Asset Turnover	0%	0%	0%
Total Assets	**37%**	**40%**	**42%**
EBIT interest coverage	9%	**11%**	**12%**
Total Equity	0%	0%	0%
Cash/Total Debt	1%	1%	2%
Current Ratio	6%	**10%**	**14%**
EBITDA interest coverage	**11%**	**14%**	**17%**
Sales Growth	**11%**	**14%**	**15%**
Country Risk Score	2%	3%	5%

	Absolute Contribution		
Pacific and Asian Mature	**25th%**	**Median**	**75th%**
Debt / (Debt + Equity)	0%	0%	4%
Return on capital	0%	1%	8%
Asset Turnover	0%	1%	3%
Total Assets	**32%**	**45%**	**59%**
EBIT interest coverage	0%	1%	**15%**
Operating Income (bef.D&A) / Revenues	7%	**10%**	**21%**
Free operating cash flow / Debt	0%	3%	8%
Gearing Ratio	0%	0%	2%
Acid- Test Ratio	1%	5%	9%
FFO Interest Coverage	0%	1%	7%

[15] The statistics are extracted from more than 2000 observations (2013-2015), for the CreditModel standalone score. In some instances, the absolute contribution appears to be zero; in reality, it is usually very small and simply reflects the dominance of the other factors that play a major role in driving the score down to 'worse than b-'.

DRIVERS OF MODEL OUTPUTS AND DIFFERENCES

	Absolute Contribution		
Airlines	**25th %**	**Median**	**75th%**
Debt / (Debt + Equity)	0%	0%	1%
Return on capital	0%	0%	0%
Asset Turnover	0%	0%	0%
Total Assets	**20%**	**25%**	**28%**
EBIT interest coverage	0%	0%	2%
Free operating cash flow / Debt	0%	0%	0%
Cash flow from oper. Interest coverage	**40%**	**44%**	**49%**
Operating Income (after D&A) / Revenues	**26%**	**29%**	**31%**

	Absolute Contribution		
Europe	**25th%**	**Median**	**75th%**
Debt / (Debt + Equity)	0%	0%	0%
Return on capital	0%	1%	3%
Asset Turnover	0%	1%	4%
Total Assets	**55%**	**62%**	**71%**
Operating Income (bef.D&A) / Revenues	**11%**	**15%**	**18%**
Free operating cash flow / Debt	0%	0%	0%
Cash flow from oper. Interest coverage	**11%**	**16%**	**20%**
Gearing Ratio	0%	0%	1%

	Absolute Contribution		
Japan	**25th %**	**Median**	**75th%**
Debt / (Debt + Equity)	**46%**	**52%**	**64%**
Return on capital	0%	0%	0%
Operating Income (bef.D&A) / Revenues	0%	1%	4%
Total Equity	**36%**	**44%**	**50%**
FFO / Debt	0%	0%	0%

Source: S&P Global Market Intelligence, as of October, 31st 2016.

Table 14: Absolute contribution of PDFN inputs, for companies that get assigned a 'worse than b-' score, in regions outside North America.[16]

	Absolute Contribution								
	Manufacturing (Cluster 1)			Infrastructure (Cluster 2)			Services (Cluster 3)		
PDFN Private Input	**25th%**	**Median**	**75th%**	**25th%**	**Median**	**75th%**	**25th%**	**Median**	**75th%**
Cash / Total Assets	4%	5%	6%	3%	4%	5%	3%	4%	5%
Current Liabilities / Net Worth	**11%**	**12%**	**14%**	**11%**	**12%**	**13%**	**13%**	**14%**	**15%**
PPE / Total Assets	**12%**	**13%**	**14%**	**10%**	**12%**	**13%**	9%	**11%**	**12%**
Net Income / Total Liabilities	6%	6%	9%	5%	6%	9%	9%	**10%**	**13%**
Net Income / Total Revenue	**18%**	**19%**	**21%**	**17%**	**19%**	**20%**	**16%**	**18%**	**19%**
Return on Net Capital Proxy	4%	5%	8%	**10%**	**12%**	**12%**	9%	**10%**	**11%**
Total Equity / Total Assets	4%	5%	6%	4%	5%	5%	4%	5%	5%
Total Revenue	**19%**	**19%**	**22%**	**18%**	**19%**	**21%**	**17%**	**18%**	**20%**
CIRS	6%	9%	10%	5%	9%	9%	4%	8%	9%
CRS	0%	2%	4%	0%	1%	4%	0%	0%	2%
CPI	1%	2%	3%	0%	2%	3%	0%	1%	2%

[16] The statistics are extracted from more than 51,000 observations (2015), for the PDFN standalone score. In some instances, the absolute contribution appears to be zero; this happens only for the variables that are activated beyond specific thresholds only, acting as penalization factors (eg: Debt/ (Debt + Equity), that starts penalizing a company in PDFN only for values beyond 1.0).

	Absolute Contribution								
	Manufacturing (Cluster 1)			Infrastructure (Cluster 2)			Services (Cluster 3)		
PDFN Public Input	**25th %**	**Median**	**75th %**	**25th %**	**Median**	**75th %**	**25th %**	**Median**	**75th %**
Cash / Total Assets	2%	3%	5%	2%	3%	4%	5%	7%	8%
Current Liabilities / Net Worth	2%	2%	3%	2%	3%	4%	4%	6%	7%
Debt / (Debt + Equity)	0%	0%	0%	0%	0%	0%	0%	0%	0%
EBIT Interest Coverage	**12%**	**14%**	**14%**	5%	6%	6%	7%	9%	**10%**
EBIT / Revenues	**15%**	**17%**	**18%**	**15%**	**17%**	**18%**	**15%**	**16%**	**17%**
PPE / Total Assets	7%	8%	9%	7%	8%	9%	5%	6%	8%
Retained Earnings / Total Assets	4%	5%	7%	**14%**	**16%**	**17%**	**11%**	**13%**	**14%**
Return on Net Capital	5%	5%	6%	6%	6%	7%	8%	10%	**11%**
Sales Growth	5%	6%	7%	4%	6%	7%	4%	6%	7%
Total Assets	N/A	N/A	N/A	0%	0%	0%	N/A	N/A	N/A
Total Equity	**19%**	**21%**	**22%**	**19%**	**20%**	**22%**	**18%**	**19%**	**21%**
Cash Flow from Operations / Net Income	N/A	N/A	N/A	1%	3%	4%	N/A	N/A	N/A
FFO Interest Coverage	N/A	N/A	N/A	N/A	N/A	N/A	0%	0%	0%
Cash Interest Coverage	7%	9%	**10%**	N/A	N/A	N/A	N/A	N/A	N/A
CIRS	3%	3%	5%	3%	4%	5%	4%	5%	5%
CRS	2%	7%	8%	1%	6%	7%	1%	3%	6%
CPI	0%	1%	2%	0%	1%	2%	0%	1%	2%

Source: S&P Global Market Intelligence, as of October, 31st 2016.