MOODY'S ANALYTICS

DEFAULT CASE STUDY

Suntech Power Holdings Company Ltd.

Mainland China's First Public Debt Default

Moody's Capital Markets Research, Inc.

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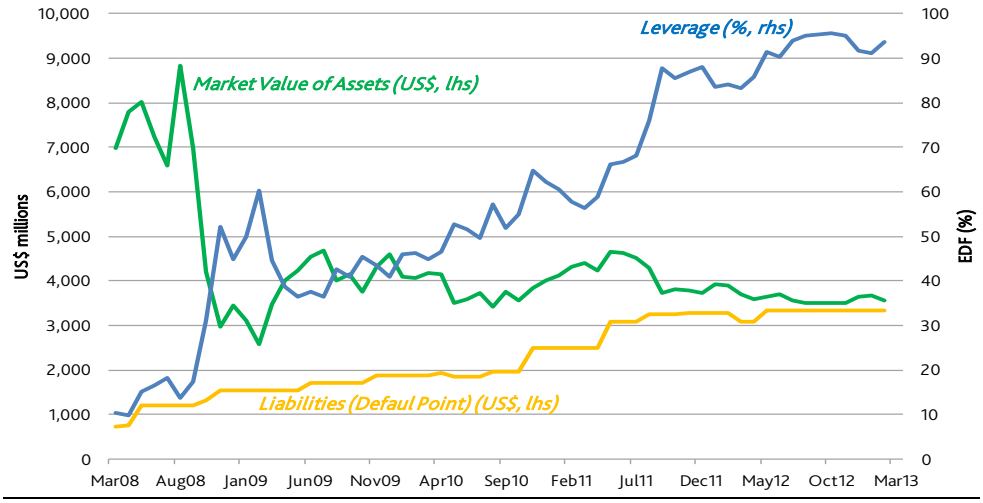
Executive Summary

- Last month, Suntech Power Holdings failed to repay its maturing $541 million bond issue, **becoming mainland China's first public company to default on its debt**. On March 20, eight Chinese banks filed a petition for insolvency and restructuring of the group's operating subsidiary, Suntech Wuxi.
- Moody's Analytics' proprietary credit risk metric for Suntech – known as the EDF™ (Expected Default Frequency) measure – **began to signal a heightened risk of default as early as 2008**. In September 2011, Suntech's EDF measure suggested a 29% likelihood of default within 12 months. By August 2012 – seven months prior to the company's default – the metric rose to 35%.
- Decomposing Suntech's EDF metric, we observe that **the company's default was caused by both deteriorating financial performance and increasing financial risk**. Between 2008 and last month's default, the market value of Suntech's assets fell by 50%, while its liabilities grew by 368%, resulting in a nearly nine-fold increase in leverage. By early 2012, the market value of the company's assets was nearly equivalent to its total liabilities. Through the lens of the EDF metric, Suntech's elevated default risk became increasingly clear.

Figure 1: Suntech's Path to Insolvency - The Convergence of Liabilities and Market Value of Assets



About

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Chinese solar panel companies fall victim to the forces of supply and demand

One of the world's largest manufacturers of solar panels, Suntech Power Holdings Company became mainland China's first public company to default on its bonds after failing to repay a $541 million issue that matured on March 15, 2013. Suntech Wuxi's subsequent bankruptcy filing (on March 18) was an extremely rare event for public companies in China, where the government has typically provided aid to failing companies.[1]

Suntech's bond default and bankruptcy declaration reflected several adverse trends for Chinese solar panel manufacturers that are both national and global in nature. From 2008 to 2012, Chinese state-owned banks provided the equivalent of $18 billion in loans to the industry, which had also been incentivized by local political authorities to raise production. The resulting higher supply combined with tepid demand set off a 75% drop in global solar panel prices. The upshot was heavy losses for panel makers, especially for Chinese companies. Suntech was particularly vulnerable to these developments. Since at least 2008, the company's operating performance had been declining and its financial risk had been rising, with this negative trend accelerating sharply in mid-2011. As the company's cash reserves dwindled, state-owned banks proved reluctant to provide fresh liquidity. Default and bankruptcy were then inevitable.

A number of firm's in Suntech's peer group, as defined by CreditEdge, also have elevated EDFs (Figure 2). Readers should also be aware that Suntech is relatively rare in that its EDF was based on ADRs, as opposed to shares traded on a Chinese exchange. The information content of the inputs into the various firms' EDFs thus differs somewhat.

Figure 2: Suntech's Peer Group

Company Name	EDF Measure		% Change	Total Adjusted Liabilities (CNY Millions)
	Apr-13	Jan-13		Apr-13
LDK Solar Co Ltd	35.00%	34.68%	0.92%	33,426
Renesola LTD-ADR	33.75%	32.02%	5.40%	10,484
Hanwha Solarone Co Ltd-ADR	31.74%	32.85%	-3.38%	6,260
Suntech Power Holdings-ADR	30.83%	35.00%	-11.91%	22,115
Shenzhen Mingwah Aohan High Technology	4.68%	2.95%	58.64%	42.541
Shanghai Chaori Solar Energy Science	2.52%	1.18%	113.56%	5,040.12
Jiangsu Changjiang Electronichs Tech	2.29%	2.49%	-8.03%	4,330.02
Shunfeng Photovoltaic Intl	2.24%	4.55%	-50.77%	2,033.44
Comtec Solar Systems Group Ltd	2.08%	1.19%	74.79%	814.928
Jiangsu Akcome Solar Science & Tech	2.02%	2.32%	-12.93%	2,025.38
Risen Energy Company, Ltd	1.95%	2.28%	-14.47%	2,183.30
Eging Photovoltaic Intl	1.92%	1.48%	29.73%	3,392.47
Shanghai Aerospace Automobile	1.82%	1.57%	15.92%	7,625.24
Tianjin Zhonghuan Semiconductor Co	1.69%	1.50%	12.67%	5,443.22
Ningbo Kangqiang Electronics Co Ltd	1.29%	1.71%	-24.56%	974.308
Tellhow Sci-Tech Company Ltd	1.11%	1.75%	-36.57%	3,236.28
Wuxi Taiji Indust. Company Ltd	0.89%	0.85%	4.71%	3,984.92
Hareon Solar Technology Co Ltd	0.71%	0.50%	42.00%	9,803.59
Advanced Semiconductor Manufacturing	0.64%	0.53%	20.75%	181.589
Semiconductor Manufacturing Intl	0.54%	0.67%	-19.40%	11,210.50

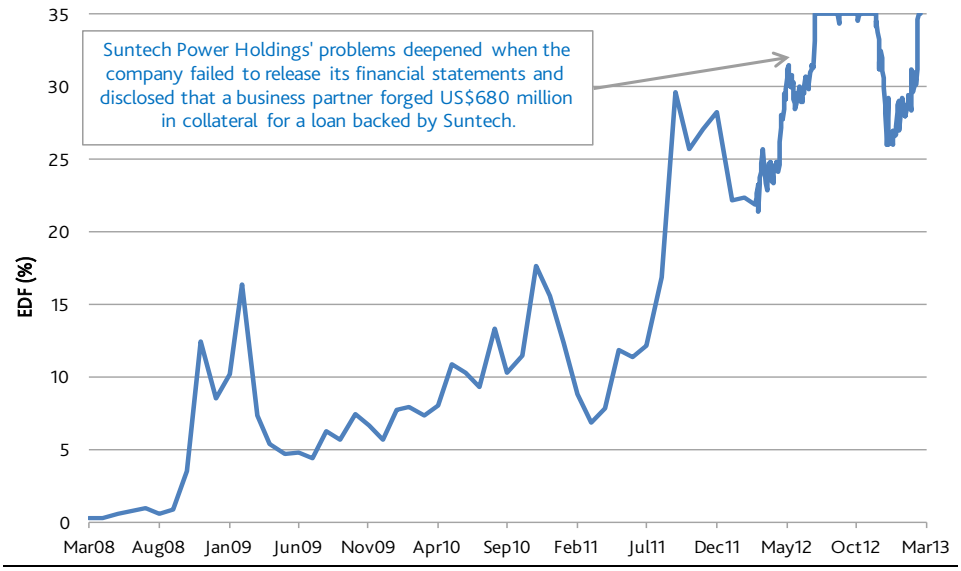
The EDF metric provided good early warning of Suntech's of financial distress

Suntech's bonds were not rated by any of the global or domestic credit rating agencies. Moreover, because the liquidity of its public debt is relatively thin, little information about the company's credit quality could be gleaned from bond market data. As a result, Moody's Analytics' Expected Default Frequency (EDF) model provided a unique tool to assess Suntech's credit risk. Using information from the company's balance sheet together with equity market data, the EDF measure offered an early warning signal of Suntech's financial distress, adding transparency to the relatively opaque Chinese corporate credit market.

[1] In April 2012, Weifang-based Shandong Helon nearly became China's first public default, but was rescued at the eleventh hour by local government authorities. Moody's Analytics' EDF case study for Shadong Helon is available at https://www.moodys.com/researchdocumentcontentpage.aspx?docid=PBC_142523

As shown in Figure 3, Suntech's EDF – which reflects the probability that the company would default on its debt within one year – increased very substantially, from 0.32% at the end of 2007 to 12.51% by the end of 2008. Although the EDF declined to a low of 4.4% in 2009, it never recovered to its pre-2008 levels of less than 1%. In May 2011 the EDF measure began to deteriorate rapidly, jumping from 6.8% to over 29% by September. The firm's problems deepened in July 2012, when it failed to release its financial statements, and disclosed that a business partner had forged $680 million in collateral for a loan backed by it. At that point, the company's EDF had already reached 35%, the upper bound of the EDF scale.

Figure 3: Suntech Power Holdings' EDF Measure

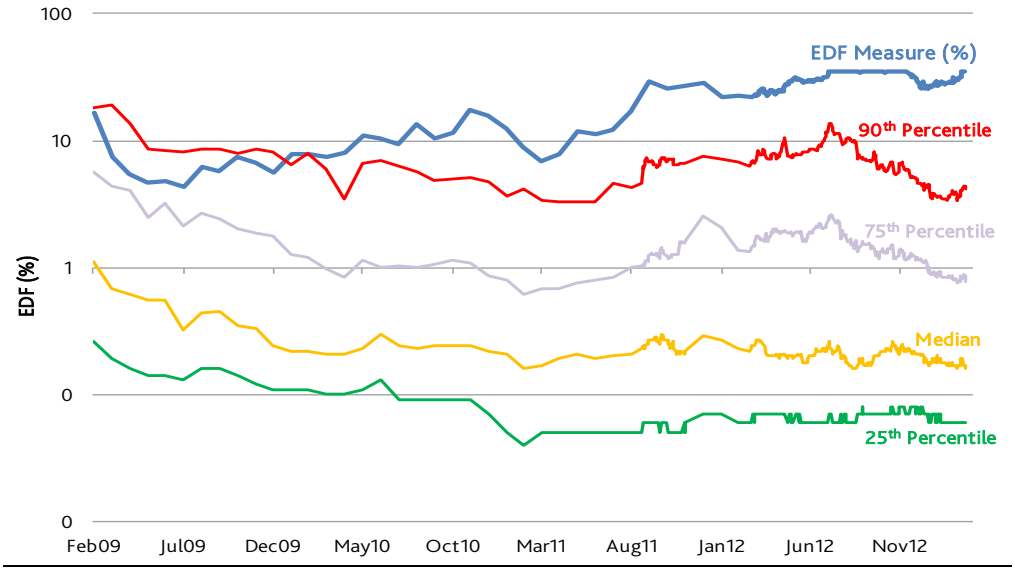


Sharp divergence of Suntech's EDF measure from its peer group levels

It is noteworthy that the sharp rise in Suntech's EDF was not matched by a similar increase in EDFs for its peer group. Figure 4 shows the company's default probability compared to the median, 25th, 75th, and 90th percentile EDFs for the China Electronic Equipment sector. In the two years leading up to last month's default, Suntech's EDF measure increased by almost 255%, from 8.84% to 31.23%. This elevated risk signal for Suntech contrasted sharply with the performance of its peer group, for which the median default probability declined by 20%. More recently, Suntech's EDF measure was nearly 200 times greater than the median EDF measure for the industry. So while the absolute level of Suntech's EDF measure provided clear signals about rising default risk, the company's weakness relative to its industry peers served as an additional red flag.[2]

[2] See Appendix II for a discussion of the use of relative EDF measures.

Figure 4: Suntech Power Holdings' EDF measure vs. EDF Distribution of its Industry Peer Group



Suntech's rising financial risk as the primary cause of distress and default

Although it represents a purely quantitative approach to assessing credit risk, the EDF model incorporates analytical principles familiar to practitioners of fundamental credit analysis. The key difference between the two lies in how they value a firm's assets – the EDF model takes a market value-based approach, while fundamental analysis is book value-based.[3] An important feature of the EDF model is that it offers insight into the drivers of financial distress and default risk. In the paragraphs that follow we use the Suntech case to illustrate this aspect of the EDF model.

We first look at market leverage, which is the ratio of a firm's liabilities – also known as the default point – to the market value of its assets. We derive the latter from the market value of a firm's equity. In this way, market value of assets reflects the forward-looking views of investors regarding the company's ability to generate cash flow in the years to come. It thus differs significantly from backward-looking book value-based measures, which often do not reflect potentially significant changes over time in the assets' cash-generating ability. Readers will recognize that market leverage captures a firm's financial risk, just as traditional leverage ratios do, but it does so on a forward-looking basis since it is derived from the market value of assets.

Figure 1 (on the cover) shows the time series of Suntech's market value of assets, default point, and market leverage. Between 2008 and the time of its default, the company's market leverage increased by 830%. In 2008 alone, Suntech's market leverage rose five-fold, driven primarily by a 57% decline in the market value of its assets. Suntech's asset value drifted further downward over the next eighteen months. In mid-2011, the company's leverage increased sharply as its asset value fell and liabilities rose. All this reflected real world events, including falling solar panel prices, a rapid expansion of natural gas production in the United States (which reduced the cost of electricity generated by conventional means), and limitations on subsidies in the European Union that had encouraged the purchase of solar panels.

The interpretation of these trends as an indicator of rising default risk is intuitive – the company will default when the value of its assets falls below the value of its liabilities.[4] In Suntech's case, the level of the company's market value of assets was very close to its default point a full year prior to default. In short, on a

[3] See Appendix I below for a technical discussion of MA's EDF model.

[4] Indeed, this is a key underpinning of the model. As we explain in Appendix I, a company's EDF is the probability that its market value of assets will fall below its default point in the next 12 months.

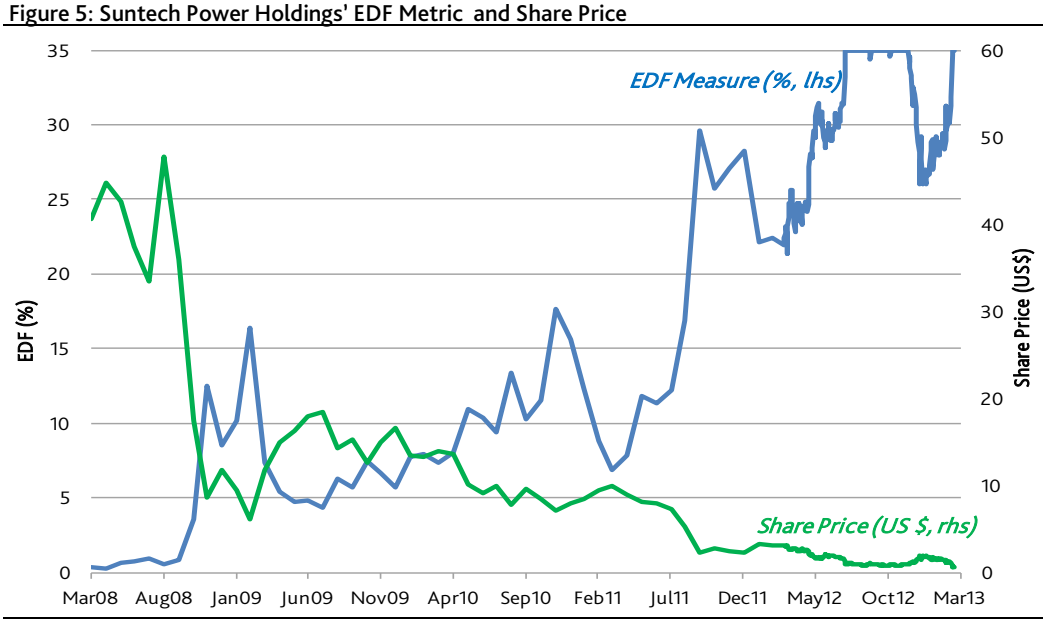
market value basis, the company was very nearly insolvent early 2012, and the associated default risk was reflected clearly in the spike in Suntech's EDF measure at that time.

Divergences between changes in Suntech's EDF and its share price

One of the strengths of Moody's Analytics' EDF model is that it incorporates the forward-looking views of investors through the use of market prices, specifically firms' stock market capitalization. However, the model combines equity market capitalization with other variables to deliver predictive power that market prices alone cannot provide. Market metrics, whether equity prices or credit spreads, reflect multiple sources of risk of which default probability is only one. Arguably, equity holders are highly indifferent to credit risk, at least until default is imminent and equity market value plummets. Consistent with this, Moody's Analytics' research shows that public EDF measures are substantially more predictive of default than equity returns alone.[5]

Figure 5 illustrates this point for Suntech Power Holdings. The graph contains Suntech's EDF and share price over the past three years. As would be expected, changes in share prices and changes in EDFs are inversely correlated. This is because a decline in a company's equity reflects investors' assessment that future earnings will be reduced. As a result, a decline in the market value of assets increases the market leverage ratio. Yet the chart also shows that Suntech's share price and EDF do not convey the same information about its credit risk. Between March 2010 and December 2010, Suntech's share price fell by 42%, and its EDF measure increased by 111%. Between March 2011 and June 2012 the shares declined by a further 82%, while its EDF measure leapt 362%. To a large degree, the different rates of change reflect the rise in the company's default point, as shown in Figure 1, which accelerated the rise in its market leverage ratio.

Figure 5: Suntech Power Holdings' EDF Metric and Share Price



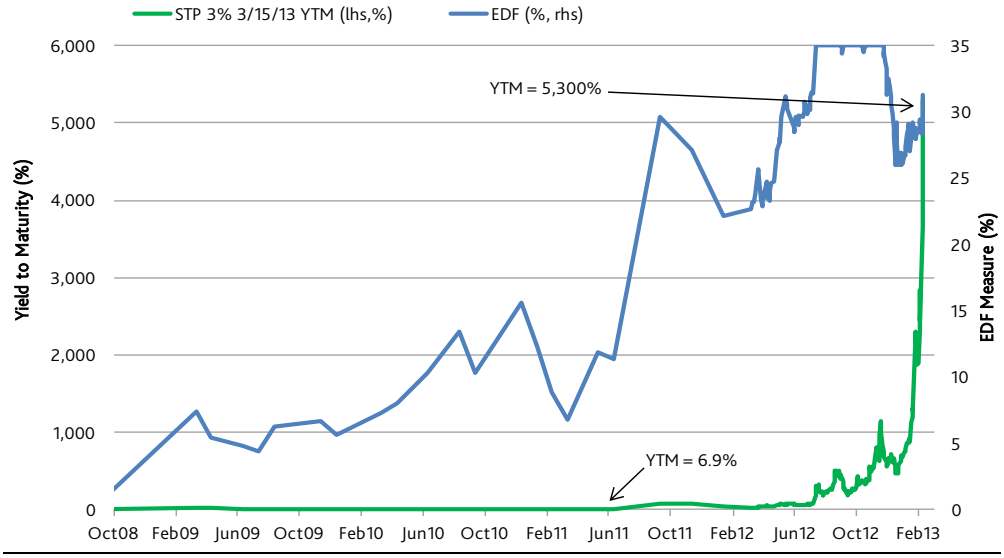
Examining alternative market signals

If equity prices inadequately capture default risk, then perhaps bond prices provide more predictive power. As shown in Figure 6, we see that in the Suntech case the EDF measure furnished an earlier, stronger signal of Suntech's deteriorating credit quality than did prices of the company's bonds. Although default probability is a primary determinant of bond prices, prices for Suntech's debt did not reflect a material risk of default until the second half of 2012.

[5] See Moody's Analytics ViewPoints paper "An Empirical Examination of the Power of Equity Returns vs. EDFs for Corporate Default Prediction," by Zhao Sun, January 2010.

The chart below shows the time series for Suntech's EDF measure and the yield to maturity on its 3% bonds due March 2013. The contrast between the two time series is striking . Several years before last month's default, Suntech's rising EDF measure began to signal a growing likelihood of financial distress, while the bond yield remained virtually unchanged until late last year. What accounts for the delayed response of the bond market? One explanation is that bond investors expected (and/or hoped) that Chinese authorities, consistent with historical precedent, would take steps to prevent Suntech's bankruptcy and bail out creditors. Only as the March 2013 redemption date approached did bondholders begin to lose confidence in this expectation of government intervention, leading to widespread selling and significantly higher yields on the debt. An alternative explanation is simply that the bond market's lower level of liquidity means that its price signal is inferior to that of the equity market. Regardless of the reason, for the superior power of the EDF model – especially as an early warning signal – is clear.

Figure 6: Suntech Power Holdings' EDF Metric and Yield-to-Maturity on its 3% Bonds Due 3/15/2013



Summary

Despite the complexities of the Suntech situation – the rapidly changing economics of the solar technology industry, the company's evolving capital structure, and the unexpected departure of Chinese authorities from historical precedent – Moody's Analytics' EDF model provided a powerful early-warning tool, signaling rising credit risk at the company starting in 2008. The absolute level of Suntech's EDF measure, together with its elevated risk level relative to its industry peers, offered clear indications of the significant financial challenges facing the company..

As illustrated in the Suntech case, MA's public EDF model captures the risks presented by adverse operating trends and high leverage. Suntech's market leverage at default was among the highest of all large South East Asian corporate firms. The increase in leverage was due to both a sharp fall in the market value of Suntech's assets and rapid growth in its liabilities. By capturing these dynamics, MA's public EDF model provides a unique perspective on credit risk and – as shown by the performance of Suntech's EDF metric – offers a highly predictive and powerful measure of default risk.

Appendix I: Moody's Analytics' EDF Model

Moody's Analytics' public firm EDF model belongs to a class of credit risk models referred to as structural or asset value models. The basic assumption of asset value models is that there is a causal, economically motivated reason that default occurs. The central premise of this model is that default is highly likely to occur when the market value of the firm (essentially, the sum of the value of its equity market capitalization and debt) is insufficient to cover liabilities due at some future date – put simply, the model rests on the observation that firms default when they are insolvent. This premise holds because equity holders are residual claimants on the value of the firm. If the market value – i.e., the difference between the value of assets and the firm's liabilities – of the firm is negative, then equity holders can and typically will "put" the residual value of the firm to creditors.

The above economic intuition can be translated into three quantifiable variables: the expected market value of a firm's assets (*A*, measured in logs), the volatility of its assets (denoted by σ), and its default point, *X* (also measured in logs). The default point is derived from a firm's short and long-term liabilities, and reflects the notional debt payment due that would trigger a default. The interaction of the three drivers is encapsulated by the firm's distance-to-default (*DD*) which, under some largely innocuous assumptions, can be expressed as:

$$DD \approx \frac{A - X}{\sigma_A}$$

This simple equation essentially states that a firm's relative credit risk (measured by *DD*) is a function of its financial risk and its business risk, two factors that are core concepts of fundamental credit analysis. The numerator of the above equation measures market leverage – i.e. financial risk. All else equal, higher leverage decreases *DD* and hence increases the probability of default. The denominator of the *DD* equation can be viewed as business risk. Firms in industries with high asset volatility tend to exhibit higher risk of default, all else equal. (In contrast, fundamental credit analysis cannot measure these economic drivers of default risk directly – financial ratios derived from accounting statements used in fundamental analysis are at best viewed as proxies for such economic drivers.) Once we have calculated a firm's *DD*, we can derive its probability of default (its EDF measure) by looking at the historical average default rate consistent with each *DD* level.

Appendix II: Relative EDF Measures Provide Additional Predictive Power

Moody's Analytics' research has shown that firms experience a higher default frequency when they underperform their industry sectors, regardless of the level of their EDF measure. Based on data from 1992 to 2011, we calculated one-year default rates conditioned on a firm's EDF level and on the relative EDF change versus its industry sector. Relative performance is measured by the difference in the change in a firm's EDF measure and the change in its industry median EDF measure. Figure below shows the results. The cells of the table show historical one-year default rates conditioned on EDF level and relative change. For ease of presentation, we bucketed EDF levels and change versus sector into ten equally sized categories (deciles). The cell (5,5) for example, shows firms whose EDF levels were near the median for its sector, and whose change in EDF was keeping track with the median sector change. Cells to the right of the column labeled 5 show default rates for firms whose EDF change is worse relative to its sector. Hence, the trend of Suntech Power Holdings' EDF measure versus its industry group showed the particularly high risk of default for the company.

Average Realized Default Rates by EDF Level and Relative Performance vs. Industry Sector

		EDF Change Relative to Industry Peer Group Change										
		1	2	3	4	5	6	7	8	9	10	ALL
Firm EDF Level	1	0.05%	0.03%	0.02%	0.00%	0.00%	0.01%	0.03%	0.00%	0.00%	0.00%	0.02%
	2	0.10%	0.05%	0.06%	0.06%	0.00%	0.00%	0.02%	0.07%	0.11%	0.27%	0.05%
	3	0.10%	0.06%	0.01%	0.03%	0.01%	0.03%	0.07%	0.06%	0.03%	0.18%	0.05%
	4	0.28%	0.12%	0.17%	0.15%	0.09%	0.10%	0.08%	0.09%	0.17%	0.30%	0.15%
	5	0.32%	0.23%	0.24%	0.32%	0.22%	0.24%	0.21%	0.27%	0.22%	0.46%	0.27%
	6	0.62%	0.44%	0.45%	0.34%	0.44%	0.56%	0.44%	0.72%	0.51%	0.97%	0.55%
	7	0.71%	0.56%	0.66%	0.80%	0.64%	0.72%	0.73%	1.06%	1.18%	1.63%	0.89%
	8	1.01%	1.01%	1.19%	1.25%	1.27%	1.44%	1.58%	1.65%	2.05%	3.10%	1.68%
	9	3.14%	2.22%	4.83%	5.16%	5.25%	4.34%	4.87%	5.75%	6.37%	8.39%	5.60%
	10	6.43%	4.68%	5.76%	7.70%	7.70%	6.96%	7.67%	9.31%	9.99%	13.70%	8.94%
	All	0.66%	0.63%	1.08%	1.73%	1.73%	1.83%	2.24%	2.92%	3.13%	5.96%	2.16%

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