ENTERPRISE AND POLITICAL RISK MANAGEMENT IN COMPLEX SYSTEMS

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The oil and gas industry, indeed, the entire value chain of the energy industry, is no stranger to political risk. What the historian Niall Ferguson claims about "modern economic life" in general can be applied with equal force to the energy industry: taken globally, its modern structure is largely the result of political

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events.[1] With respect to political risk, if one considers the industry's long history, it becomes apparent that the energy sector experienced political risk before it possessed the analytical tools to factor such risk into project, let alone portfolio, economics.

Today, there exists a variety of approaches and consulting services for incorporating the impact of political risk at least at the level of project economics.[2] To be sure, there appears to be no single, standardized approach, but there are options available for companies and investors who are unwilling to ignore political risk simply because its assessment is challenging.

Despite apparent progress in attempts to assess political risk, we maintain that more needs to be done. Specifically, in this paper and with a focus on foreign direct investment, we argue, first, that the assessment of political risk for any given project, while essential, must include the possibility of correlations across countries that might otherwise appear unrelated. Stated differently, however profitable a project in a given country might be, it nonetheless may be susceptible to adverse events geographically far afield from and possibly irrelevant to the project's home. Our second argument is that the assessment of political risk should be based on a statistical approach capable of characterizing extreme events. We show how one such approach, quantile regression, can be used for that purpose.

Before proceeding, it is worth noting that both points above, while related, are analytically distinguishable. In what follows we construe the former as dealing with the determination of project-specific political risk, and the latter as dealing with value-at-risk as applied to the totality of an enterprise.

Dominoes in the Rough

At its most basic level, assessing political risk is a two-step process that invariably relies on subjective probabilities and conventionally assumes the "country" (or countries in the case of cross-border projects), is the appropriate unit of analysis. We provide a simplified description of each step below.

In the first step, the relative country risk is determined. The assessment of a nation's political risk can include attempts to gauge its propensity for inter- and intra-state conflict, the stability of the regime, the efficiency of its political institutions, its overall policy framework, its willingness to honor contractual arrangements: all and other "factors" or "areas" can be identified in such an assessment. Needless to say, in any given country it is the probability of adverse risk events stemming from one of the factors that affects a country's perceived level of risk relative to other nations—at the level of country risk.

The second and often more difficult step is to assess what impact, if any, the country-level risk factors have on any given project. For example, a company might be considering an investment in a nation where the regime is stable and the

institutions are efficient, but its tax policy shifts in response to domestic pressures. The company might believe there is an 80-percent probability that the regime will alter its tax policy, but only a 20-percent cumulative probability that its project's expected net present value (NPV) will be affected, thus resulting in a 16-percent chance that the tax rate will be altered over the life of the project. Even if the company is confident that 84 percent of the time its project's fiscal terms remain intact, it is still imperative to estimate how the terms might be changed in 16 percent of the "worlds" in which it presumably will be required to increase its tax payments. Will the company pay 10 percent, 20 percent, or more in taxes?

Although it can be difficult, the assessment described above is not intractable. Admittedly, when the stakes are high, it can be unsettling for foreign direct investors to rely, as they almost certainly will, on subjective probabilities. But relying on subjective probabilities is not unique to political risk assessments. More problematic is the *question of whether the assessment is complete.*

As we have seen, an important facet of a political risk assessment is the ability to identify and then attach a probability to those events that might impair a project's expected value. It is important to remember that the objective of the analysis is *not* ***the anticipation of*** *the event per se, but the impact on value*—the dependent variable. The difficulty is that, while adverse events may well impair a project's value, it also is possible that values can be impaired in the absence of adverse, country-specific events.

There are at least two ways this can happen. First, the risk events may not be independent, that is, adverse events themselves may be correlated across countries. If so, a "country-specific" approach will fail to capture the non-independence of risk events. Unfortunately, as yet we lack the data necessary to determine, with the possible exception of nationalization, the degree to which adverse events resulting in value impairments are correlated across comparable projects in multiple countries.

Second, "values" themselves may not be independent across countries. Analysts have looked at this possibility, not from a project-specific standpoint but from the perspective of global financial markets. Perhaps not surprisingly, the data appear to support increasing correlation across global markets over time.

To assess the extent of the correlation with relatively recent data, we analyzed Morgan Stanley Capital International (MSCI) data covering the years January 1996 through December 2007.[3] We placed the countries contained in the MSCI into one of six categories: (a) Latin America emerging (Argentina, Brazil, Chile, Mexico, Columbia, Peru); (b) Europe emerging (Greece, Portugal, Poland, The Czech Republic, Hungary, Russia); (c) Europe developed (United Kingdom, Germany, France, Italy, Austria, Belgium, Denmark, Finland, Netherlands, Ireland, Norway, Spain, Sweden, Switzerland); (d) Asia/Africa emerging (Indonesia, Jordan, Korea, Malaysia, Philippines, Taiwan, Thailand, Turkey, China, South Africa, India, Israel, Pakistan, Egypt); (e) North America developed (United States

and Canada); and (f) Oceania/Asia developed (Australia, New Zealand, Hong Kong, Singapore, Japan).

Figures 1, 2, and 3 illustrate a convergence of the above six market groups over time and use the "Europe emerging," "Latin America emerging," and "Asia emerging," respectively, as the base group with which correlations are computed. As each figure shows, the overall trend is toward higher correlations across the set of six categories. Significantly, the correlation between emerging market sectors approaches 0.8.

What does this mean for the political risk posed to foreign direct investments? Two points merit emphasis. First, diversifying political risk obviously becomes difficult if correlations across countries are relatively high. It follows that foreign direct and other investors should be loathe to assume that portfolios are diversified simply because they consist of holdings that are geographically dispersed.

Second, as noted earlier, what typically matters in project economics are events presumably specific to the project, not stock market values. Nevertheless, to the

Figure 1
CONVERGENCE OF MARKETS: CORRELATION OF PERCENT RETURNS OVER TIME, EMERGING EUROPEAN COUNTRIES (EU-E) AS BASE GROUP, JANUARY 1996 THROUGH DECEMBER 2007
(base group = 1)

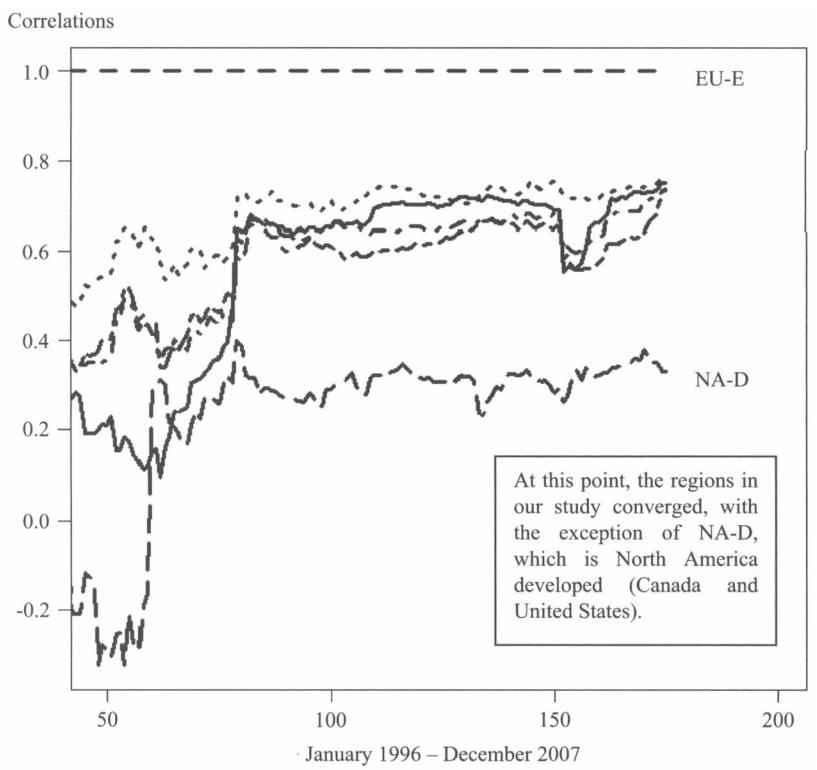
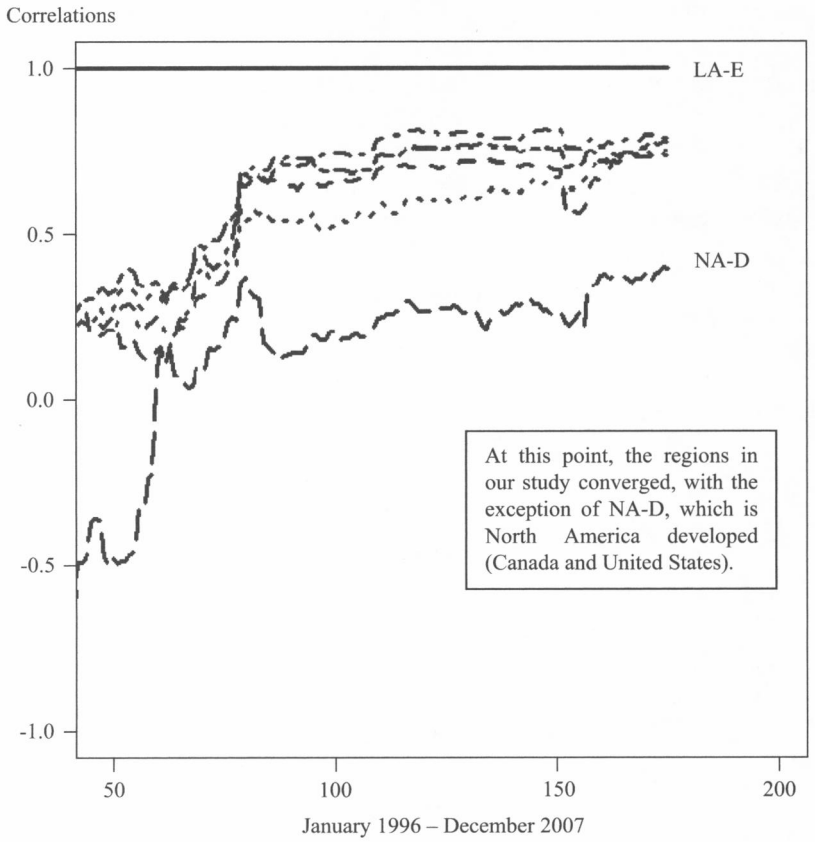


Figure 2
CONVERGENCE OF MARKETS: CORRELATION OF PERCENT RETURNS OVER TIME, EMERGING LATIN AMERICAN COUNTRIES (LA-E) AS BASE GROUP, JANUARY 1996 THROUGH DECEMBER 2007
(base group = 1)

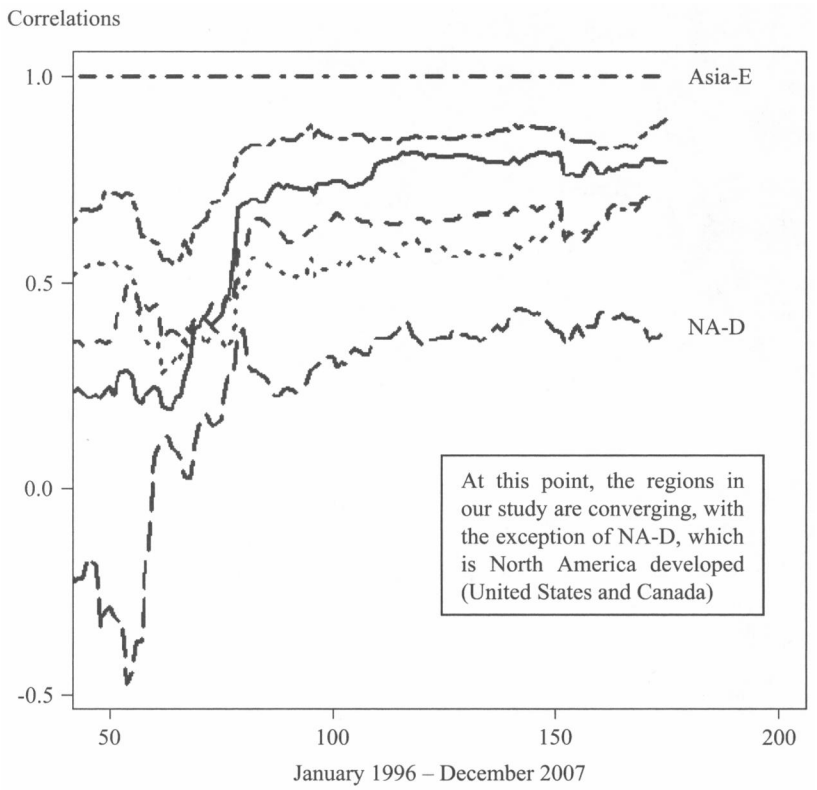


extent that market values are not independent but globally correlated, any given project, as part of a larger corporate portfolio, may have its value impaired for reasons unrelated to its actual and/or expected performance.

A Tail of Two Distributions

Beyond specific projects, how does one determine the impact of political risk on the totality of the enterprise? One way to answer this question is to determine the impact of political risk on the overall value at risk (VAR) of the enterprise risk portfolio.[4]

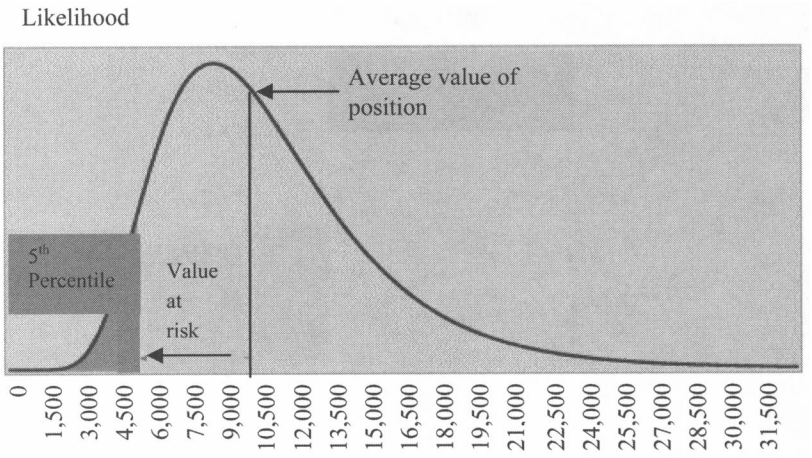
Figure 3
CONVERGENCE OF MARKETS: CORRELATION OF PERCENT RETURNS OVER TIME, EMERGING ASIAN COUNTRIES (ASIA-E) AS BASE GROUP, JANUARY 1996 THROUGH DECEMBER 2007
(base group = 1)



There are, perhaps understandably, a variety of approaches employed for determining the VAR of an enterprise. Whatever the approach used, the ultimate objective is to determine the loss (or gain) in value at a given confidence level over a specified period of time. Typically, the focus is on the downside risk from so-called extreme events. For example, at a 95-percent confidence interval, VAR should "tell" a stock market investor that there is only a 5-percent chance that a loss of a certain dollar amount *will be exceeded* during a day's trading.

A typical approach for determining value-at-risk is to rely on ordinary least-squares (OLS) regression estimates. OLS regression provides an estimate of the conditional mean of a distribution as a function of explanatory variables. The VAR is then computed by examining the behavior of the distribution at one, two, or more standard deviations away from this mean (see figure 4). Two standard deviations correspond to the 95-percent confidence level.

Figure 4
UNDERSTANDING VALUE AT RISK
(in thousand dollars)



One problem with OLS is that it may fail to characterize the behavior of independent variables at the relative extremes of a distribution. In attempts to identify VAR, where much of the focus is on the value at stake in extraordinary conditions, this problem can be profound. With respect to political risk, the OLS shortcoming could produce an assessment that fails to depict the behavior of political risk factors at the extreme tails of a distribution.

An alternative regression technique, quantile regression, is growing in popularity.[5] Quantile regression captures the non-linear relationships between variables and thereby provides a better characterization of the influence of independent variables, particularly at the extreme ends of a distribution and that, to reiterate, is exactly where precision is needed when the aim is to determine value-at-risk.[6] Quantile regression accomplishes this characterization by modeling the conditional quantiles or percentiles as a function of the explanatory variables rather than relying on the conditional mean model of OLS. The basic premise behind quantile regression is that the explanatory variables impact the distribution of returns differently and in a non-linear fashion, depending on the quantile of the return distribution that is of interest. Quantile regression techniques produce the same results as OLS *if, as OLS assumes, the impact of the explanatory variables is consistent across the distribution of the value of the investment.*

To assess the relative ability of quantile regression and OLS regression to account for the behavior of political risk factors at the extremes, we constructed three types of portfolios: enterprise portfolios, developed country portfolios, and emerging country portfolios. Each set covered the years 1994 to 2006 and

combined the MSCI data described earlier with the political risk rankings from the *International Country Risk Guide* (ICRG) of the consulting service, PRS.[7] In what follows we will describe the ICRG and then the approach we used to test the relative sensitivity of OLS vs. quantile regression.

The ICRG: The ICRG has continuously provided risk assessments of individual countries for a significant period of time and is one of the standard sources for such information in the published literature. In the ICRG assessment of any country, political risk is the weighted sum of twelve components. The components and the weights are displayed in table 1.

Constructing Portfolios: As noted previously, we constructed three types of portfolios: developed, emerging, and enterprise. The first two, as their names connote, consisted of MSCI holdings in developed or emerging countries. What we are calling the enterprise portfolio is more of a blend of holdings. Our aim is, at least roughly, to reflect the behavior of a firm based in a developed country but seeking to expand its investments in emerging markets.

To construct our "enterprise" portfolios, we started from the premise that *the initial portfolio* would consist of a blend of MSCI holdings obtained 70 percent from the home country (where the "home" country is a developed nation), 20 percent from other developed, and 10 percent from emerging. We further assumed that this portfolio would be adjusted on an annual basis, as a foreign direct investor might allocate capital expenditures during an annual budget review process.

Table 1
GEOPOLITICAL RISK VARIABLES

Sequence	Political Risk Components	Points (max)
A	Government stability	12
B	Socioeconomic conditions	12
C	Investment profile	12
D	Internal conflict	12
E	External conflict	12
F	Corruption	6
G	Military in politics	6
H	Religion in politics	6
I	Law and order	6
J	Ethnic tensions	6
K	Democratic accountability	6
L	Bureaucracy quality	4
Total		100

Source: PRS Group, Inc., *International Country Risk Guide,* available at www.prsgroup.com.

During this adjustment three decisions are available. Specifically, using a probabilistic decision-rule-based approach for any portfolio, a decision would be made (1) *not* to diversify the initial holding or (2) to diversify the initial holdings. If the option selected is to diversify (2 above), then probability-based outcomes would be used to determine whether further diversification would be made in "developed" or "emerging" markets. For each year, we simulated 5,000 portfolios for each of the three types, or 60,000 for each of the 12 years (1996-2007) for a total of 180,000 simulated portfolios. A flowchart of our simulation is provided in figure 5.

Figure 6 shows the distribution of simulated returns for each of the three types of portfolios. Perhaps not surprisingly, of the three portfolios the "emerging" portfolio showed the highest volatility while, relative to the emerging portfolio, the enterprise and developed portfolios exhibited lower and comparable volatility levels.

Volatility and Political Risk: One component of the ICRG provides an example of the problem of relying on OLS as opposed to quantile regression estimates. In the ICRG ratings, the risk component—"investment profile"—is given a weight of 12 points and itself consists of three subcomponents: contract viability/expropriation, profits repatriation, and payment delays, each of which is worth four points. The higher the score, the stronger the country's investment profile.

Table 2 displays the VAR associated with varying scores on an investment profile, that is, from countries receiving a rank of four to those receiving a 12,

Figure 5
DESIGN PROCESS FOR SIMULATING ENTERPRISE PORTFOLIOS
SIMULATION SCHEMATIC

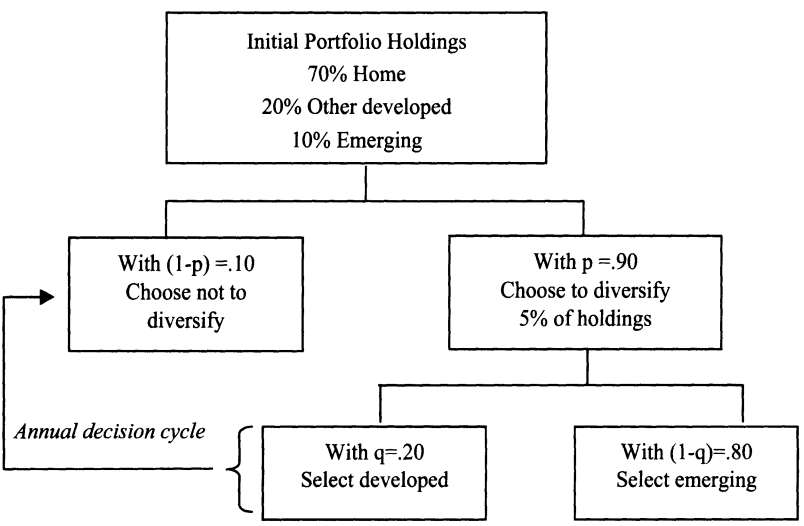
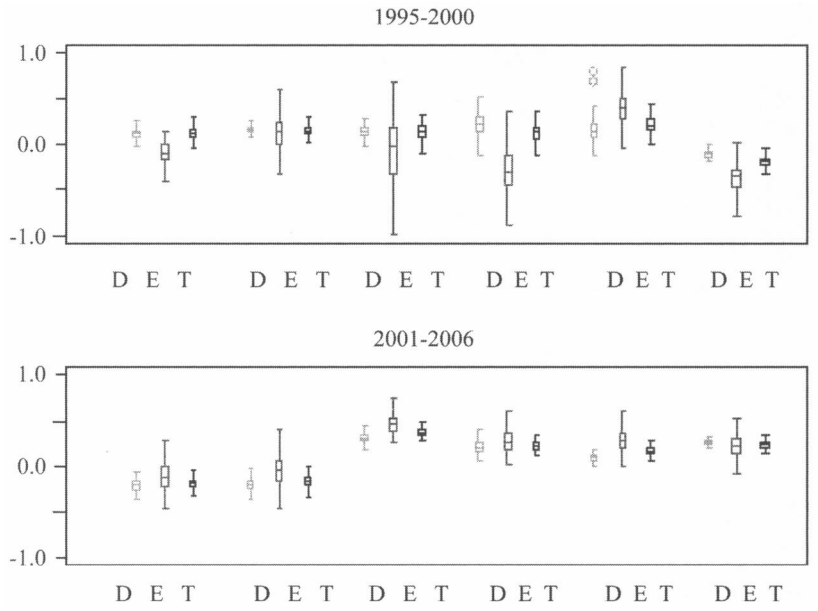


Figure 6
BOX PLOTS DEPICTING THE DISTRIBUTION OF SIMULATED PORTFOLIOS: DEVELOPED (D), EMERGING (E), AND ENTERPRISE (T), 1995-2000 AND 2001-2006



where the VAR is obtained using either OLS or quantile regression. As the table shows, with a $1-million dollar investment in a country scoring a four on the investment profile (the lowest score possible), an investor has a 5-percent chance of losing $417,000 when the VAR is obtained using quantile regression. Using the more conventional OLS regression, that loss would be estimated at $271,000, a 154-percent *undervaluation* of the risk. On the other hand, the "upside" available in the remaining 5 percent of the distribution is somewhat higher when derived from quantile regression than from OLS regression.

At the other end of the "investment profile," with countries scoring a 12, quantile regression estimates a smaller downside risk at the 95th percentile (-$143,287 vs. -$325,132), but a relatively smaller upside gain beyond that ($73,123 vs. $270,374).

Differences between OLS and quantile regression, as noted earlier, are not an artifact of the techniques. Rather, the differences stem from the fact that the distribution of explanatory variables in the data we examined is not consistent with the underlying assumptions required by the OLS approach, specifically the assumption that the political risk variables behave consistently across the distribution of the investment.

Table 2
VALUE AT RISK (VAR) COMPARISONS COMPUTED WITH "TRADITIONAL" ORDINARY LEAST SQUARES (OLS) AND THE RECOMMENDED QUANTILE REGRESSION METHOD (CORRECT VAR) BASED ON $1 MILLION INVESTMENT UNIT

		Loss		Gain	
	Score	**Correct VAR**	**OLS**	**Correct VAR**	**OLS**
Poor investment profile	4	-$417,011	-$271,602	$474,418	$323,904
	5	-$382,795	-$278,293	$424,256	$317,213
↓	6	-$348,580	-$284,985	$374,094	$310,522
	7	-$314,364	-$291,676	$323,932	$303,830
	8	-$280,149	-$298,367	$273,770	$297,139
	9	-$245,933	-$305,059	$223,608	$290,448
Strong investment profile	10	-$211,718	-$311,750	$173,447	$283,756
	11	-$177,502	-$318,441	$123,285	$277,065
	12	-$143,287	-$325,132	$73,123	$270,374

Concluding Observations

In remarks before The Economic Club of New York, Timothy F. Geithner, President and Chief Executive Officer of the Federal Reserve Bank of New York, provided both an explanation as to why, at least since the summer of 2007, the global financial system has been so fragile and a set of recommendations to reduce the vulnerability of the system. Not surprisingly, Mr. Geithner's explanation of why markets have exhibited such fragility involves a range of factors, some of which, like the creation of low-quality mortgage securities, may be unique to this particular crisis. He further described a fundamental problem hampering risk management and oversight generally:

> Risk management and oversight now focuses too much on the idiosyncratic risk that affects an individual firm and too little on the systematic issues that could affect market liquidity as a whole. To put it somewhat differently, the conventional risk-management framework today focuses too much on the threat to a firm from its own mistakes and too little on the potential for mistakes to be correlated across firms. It is too confident [to assume] that a firm can adjust to protect itself from its own mistakes without adding to downward pressure on markets and takes too little account of the risk of a flight to safety—a broad-based, marketwide rush for the exits. . . .[8]

The problem is not unique to financial markets. Foreign direct investors in the energy industry and the service companies that support them can feel the effects of the correlations "across firms" described by Mr. Geithner. Consistent with that view, we provided, in the first part of this paper, support for the contention that, in the assessment of political risk at the project level, it is important to consider the possibility that factors outside of and unrelated to the economics of the project

itself may adversely, albeit indirectly, affect the value of the project. This possibility stems from the increasing correlation across markets over time.

If diversifying political risk is an elusive quest in highly correlated markets, then it becomes even more important to understand the value at risk in a portfolio. This is particularly the case when so-called extreme events take place. As a general observation, we note that, just as there are people who win the lottery, so too in the financial arena: extreme events happen, even to smart people. Long-Term Capital Management, despite the sophistication of its management, discovered that the tails of the distribution of their complex portfolio were "fatter" than they had expected.[9]

Ordinary least squares has served as the standard approach for determining value at risk. Yet at the extremes, OLS has shortcomings. OLS assumes that variables, far removed from the mean of the distribution, nonetheless exhibit behavior conditional on that mean. The quantile regression technique employed in our analysis does not rely on that restriction; rather, it allows for the very real possibility that variables may exhibit non-linear behavior that varies depending upon the quantile being examined. In one of our examples above, reliance on OLS undervalued by 154 percent the potential loss to an investor at the 95th percentile level.

Perhaps it is worth repeating that quantile regression is not designed or biased to provide a higher VAR at extreme ends of the distribution than OLS. Recall that quantile regression showed a higher upside at the 95 percentile level in one of our examples. Moreover, if the variables at the extremes of a distribution behave as assumed by the OLS technique, then quantile regression will estimate a VAR identical to that estimated by OLS. What our analysis showed was that the variables at the extreme of a distribution do not always behave in a manner consistent with the assumptions of OLS. Quantile regression can capture that difference.

We readily acknowledge that additional research needs to be done to probe further the inter-country correlations we observe in the MSCI data. Although global markets as represented in the MSCI data have exhibited higher positive correlations over time, we have not sought to determine how well energy companies and energy service companies as a subset of the MSCI correlate with the MSCI itself across the range of categories we described. For example, if investors become convinced that the current price environment is likely to persist (setting aside for now the definition of "persists"), it may well be the case that companies in the energy sector could exhibit inverse correlations with the index overall, though positive correlations among themselves. It is perhaps too soon to explore that possibility, but it would certainly seem to warrant analysis in the future.

As stated at the outset, political risk is nothing new to the energy industry. However, it has evolved over time. Tightly connected global markets make it difficult for a company to appear hedged against downside, "above ground" (political) risk, or uniquely positioned to seize political opportunities. Just as

political risk has evolved, so too have the tools available to assess it. The assessment of political risk remains a difficult and dynamic task for the energy industry. Yet it is far too important to neglect and far too important to tackle with any but the best analytical tools available.

NOTES

[1]Niall Ferguson, *The Cash Nexus: Money and Power in the Modern World*, 1700 – 2000 (New York: Random House,) p. 13.

[2]Companies and services working in the political risk area include: The Economist Intelligence Unit's (EIU's) country risk services; Marsh, part of the Marsh & McLennan Companies (NYSE: MMC); Global Insight, particularly its country intelligence products; IHS (NYSE: IHS); and the alliance of PricewaterhouseCoopers and the Eurasia Group.

[3]Morgan Stanley Capital International (MSCI), available at ur,nscu,cin/releasedetail. cfm?ReleaseID=319300. Note that events may alter the ownership status, structure,or other characteristics of the MSCI after the time this was written (November 2008).

[4]Barbel Finkenstadt and Holger Rootzen, *Extreme Values in Finance, Telecommunications and the Environment* (Boca Raton, Florida: Chapman & Hall/CRC, 2004), p. 6.

[5]Roger Koenker, *Quantile Regression*, Econometric Society Monographs (New York: Cambridge University Press, 2005) and Raul A. Barreto and Anthony W. Hughes, "Under Performers and Over Achievers: A Quantile Regression Analysis of Growth," *Economic Record*, March 2004, pp. 17-35.

[6]Ruey Tsay, *Analysis of Financial Time Series* (Hoboken, New Jersey: Wiley Interscience, 2005), chapter 7.

[7]*International Country Risk Guide* is a product of the PRS Group, Inc., which has been rating countries since 1980. The PRS web site is www.prs.com.

[8]Timothy F. Geithner, available at www.ny.frb.org/newsevents/speeches/2008/tfg080609.

[9]Roger Lowenstein, *When Genius Failed: The Rise and Fall of Long-Term Capital Management* (New York: Basic Books, 2001) pp. 173 and 188.