BP's Failure to Debias: Underscoring the Importance of Behavioral Corporate Finance*

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Abstract

This paper provides a behavioral analysis of BP, whose capital budgeting decisions in the last decade have resulted in a series of high profile accidents, including the worst environmental disaster in U.S. history. The analysis uses BP as a vehicle to discuss the application of business processes and psychological pitfalls to analyze corporate culture. The paper identifies weaknesses and vulnerabilities in BP's culture, makes comparisons with the corporate financial practices at other firms, and offers suggestions about how BP can engage in debiasing. Notably, the paper also suggests that insufficient knowledge of behavioral decision making resulted in analysts, investors, and regulators attaching insufficient emphasis to the risks in BP's operations. The paper calls for more attention to the psychological aspects of corporate behavior by analysts, regulators, corporate managers, and academics.

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Introduction

In this paper, we apply key concepts from behavioral finance to document how psychological biases and framing effects impacted corporate culture and management decisions at energy firm BP. On April 20, 2010, an accident drilling BP's Macondo well in the Gulf of Mexico produced the worst environmental disaster in U.S. history, an event which dominated the daily news during the spring and summer of 2010. In itself, this event makes the study of BP's decision making of interest, prompting the question of whether the April 20 accident was simply an unfavorable chance event or instead the result of biased decision making.

The discussion of BP's decisions provides a vehicle for discussing more general issues about how corporate managers, analysts, investors, regulators, and academics can apply insights from behavioral corporate finance. In the last decade a literature has emerged documenting the impact of psychological traits such as excessive optimism and overconfidence on the decisions of corporate managers: See Shefrin (2001, 2006, 2008, 2010c), Baker, Ruback, and Wurgler (2007), and Ben-David, Graham, and Harvey (2007).

The degree to which firms deal with vulnerability to psychological pitfalls varies, and in this regard firms occupy a spectrum from low to high. Using a framework developed in Shefrin (2008), our discussion locates BP within this spectrum. The framework identifies process loci for vulnerability to psychological pitfalls, and offers a series of examples of firms that occupy different portions of the spectrum. In applying the pitfall-process framework, we conclude that capital budgeting pitfalls were a major factor in the April 20 accident, and offer suggestions about how BP can use behavioral techniques to debias, improve its decisions going forward, and achieve a stronger corporate culture.

Assessing vulnerability to psychological pitfalls is not just an issue for corporate managers. In respect to BP, investors, analysts, regulators, and the media generally missed the warning signals. Consider a contrast between the characterization of BP by

Shefrin (2008) and the community focusing on corporate social responsibility. Shefrin (2008) profiled BP as an organization possessing many of the psychological weaknesses of high risk firms. He specifically singled out BP because those weaknesses led it to engage in excessive cost cutting and to take excessive risks in respect to the environment, worker safety, national security, and its own profitability. He wrote at the time that BP's rhetoric about social and environmental responsibility was diametrically opposed to its deeds. And he pointed out that these inclinations were imbedded within its corporate culture (Shefrin, 2010b).

Shefrin wrote his analysis of BP in 2007. In contrast, Sverjensky (2010) points out that in the annual ranking of the world's most responsible companies for 2007, both *Fortune* and *AccountAbility* bestowed on BP a top ranking. Statman (2010) points out that just prior to the Gulf disaster, the Dow Jones Sustainability Indexes (DJSI) identified BP as a "Sustainability Leader," writing that "BP is leading its peers in corporate sustainability and is committed to shaping the oil and gas industry in the social and environmental aspects of business."

Both Sverjensky and Statman ask how the financial community's judgments about BP were so mistaken, effectively slamming the barn door after the horse had bolted. In this paper, we provide answers rooted in behavioral corporate finance, identifying psychological phenomena which affected the judgments of the financial community and BP alike. We argue that the financial community exhibited confirmation bias, in that it underweighted publicly available information indicating that BP displayed some of the key features characterizing firms with problematic corporate cultures.

As we complete this article, the estimated cost to BP from the 2010 explosion in the Gulf of Mexico is $40 billion. This figure, along with the events surrounding BP's decisions, vividly illustrates the importance of behavioral corporate finance, and underscores the importance of diagnosing and treating psychological vulnerabilities. The need for diagnosis and treatment comprises the main lesson of the paper. We suggest that this lesson applies across the board, to corporate managers, to security analysts, and to

investors. We also suggest that academics have a special responsibility to incorporate the behavioral dimension into their research, and to teach future managers how to run organizations that are less susceptible to psychological pitfalls.

A word of caution about the devil being in the details: we describe BP's activities in considerable detail. We do so for at least two reasons. The first reason is to convey, as best as we can, the psychological context in which BP made its choices. Some of the underlying issues are subtle, and not always salient in media coverage.[1] The second reason is that we have been unable to detect very few of these details mentioned in analysts' reports, leading us to believe that analysts and investors were either unaware or chose to ignore critical issues associated with BP's risk management practices. The description we provide of decisions and events involving BP underscores what analysts failed to highlight.

The remainder of the paper is organized as follows. Section 1 focuses on events involving BP at Texas City and Alaska, which were documented in Shefrin (2008). Section 2 introduces the pitfall-process behavioral framework and briefly applies it to analyze BP's decisions at Texas City and Alaska. Section 3 describes the events surrounding the explosion of Deepwater Horizon, with a behavioral analysis of BP's standards for risk management. Section 4 deals with the judgments of legislators, analysts, investors, and regulators. Section 5 focuses on steps firms in general and BP in particular can take to improve their cultures to mitigate biases using cognitive repairs. The paper ends with concluding remarks.

1. Major Problems in Texas and Alaska: History

Shefrin (2008) described problematic issues which arose at BP's operations in Texas and Alaska. In this section, we describe conditions and events at those operations[2] which led

[1] In addition, there are issues involving the establishment of legal liability which is yet to be determined, thereby inducing some information spinning by affected parties. We have made a concerted effort to achieve balance in our presentation of the facts.

[2] This section augments the discussion in Shefrin (2008).

him to conclude that the firm's culture left its management prone to excessive cost cutting, and to taking excessive risks in respect to the environment, worker safety, national security, and the company's profitability.

1.1 Texas City

In 2005, the failure of an emergency warning system at a BP refinery in Texas City, Texas caused an explosion that killed fifteen people. The Texas City facility was the second largest refinery in the U.S., but it had been built in 1934, and was poorly maintained.[3] The investigation that followed the 2005 accident, conducted by a panel of independent experts led by former U.S. secretary of state James Baker, found significant process safety issues not only at the Texas City, but also in the other five BP U.S. refineries.[4] In respect to the Texas City accident, the investigating panel found that the explosion occurred when a tower was being filled with liquid hydrocarbons, with nobody noticing that it was being overfilled. The panel noted that workers were discouraged from talking with each other about potential safety issues, and that several workers had been on 12-hour shifts for more than a month (Lyall, 2010).[5]

In evaluating conditions at BP's Texas City facility, the Occupational Safety and Health Administration (OSHA) found more than 300 safety violations,[6] and BP agreed to pay $21 million, the largest fine in OSHA history at the time (Lyall, 2010). In subsequent years, a series of investigations by inspectors from OSHA found more than 700 safety

[3] Two months before the accident, a consulting firm hired to examine conditions at the refinery stated: "We have never seen a site where the notion 'I could die today' was so real" (Rowell, 2010).
[4] In 2002, California officials discovered that BP falsified inspections of fuel tanks at a refinery in the Los Angeles area. They also found that more than 80 percent of the facilities didn't meet the requirements needed to properly maintain storage tanks. BP settled a civil lawsuit brought by the South Coast Air Quality Management District for more than $100 million (Lustgarten, 2010).
[5] Jeanne Pascal, a former EPA attorney who investigated the Texas City explosion, referring to BP, once affirmed: "They are a recurring environmental criminal and they do not follow U.S. health safety and environmental policy". He also added that none of the other big oil companies had an environmental record of violations like the one held by BP (Lustgarten, 2010).
[6] Even if BP owns only six of the 150 refineries in the U.S., 97 percent of the most dangerous violations found by the Occupational Safety and Health Administration (OSHA) were on BP facilities, as reported by the Center for Public Integrity (Morris and Pell, 2010).

violations. In 2009, OSHA proposed to sanction BP with a record fine of $87 million for failing to make safety upgrades at that Texas City refinery.[7] The greatest part of the fine was due to the company failing to respect the previous settlement in full.

1.2 Alaska

In March 2006, corrosion caused a leak in BP's Alaskan oil pipeline, resulting in a 267,000-gallon spill, which was the largest ever on Alaska's North Slope. The spill forced BP to shut down half of its output from its Prudhoe Bay operations. An investigative panel subsequently attributed the incident to the firm's poor maintenance practices.

Pipelines build up sediment through time that can eventually corrode the pipes, causing leaks and spills. Oil companies check pipelines using a technique called "pigging" that involves the injection of a cylindrical droid (the "pig") into the line. Even though BP pledged to improve its safety and maintenance programs, there were complaints by employees claiming that the company was letting equipment and critical safety systems languish at Prudhoe Bay.

As a response, the company hired a panel of independent experts to examine the allegations. In their October 2001 report, the experts found systemic problems in BP's maintenance and inspection programs. According to the report, it seems that BP was trying to sustain profits in the aging drilling field, even though production was declining. To achieve this goal, the only way seemed to be to cut costs, with resulting maintenance backlogs.[8] Notably, the panel's report states that there was "a disconnect between GPB

[7] On August 10, 2010, BP agreed to pay $ 50 million of as part of this fine (that eventually was reduced to $ 80 million). BP, however, did not plead guilty.

[8] The company had not checked pressure valves, emergency safety shutoff valves, automatic emergency shutdown mechanisms, and gas and fire detectors essential to preventing explosions. These key equipments for emergency shutdown were similar to those that could have prevented the fire and the subsequent explosion on the Deepwater Horizon rig in the Gulf of Mexico (Lustgarten, 2010).

(Great Prudhoe Bay) management's stated commitment to safety and the perception of that commitment" (Lustgarten, 2010).

The panel experts claimed that solving these problems was necessary to ensure mechanical integrity and operational efficiency in the long run. They warned the management of the company that those issues could have a potential immediate safety impact or pose an environment threat. Without a systemic effort to address them, single actions could only provide temporary relief, and not be a solution in the long run. Alaska state regulators underscored the experts' findings claiming that BP failed to properly maintain its pipelines.

During 2002, the Alaskan Department of Environmental Conservation had a dispute with BP, and to resolve it, the department asked the oil company to use intelligent pigs[9] to probe its pipelines for leaks, along with a list of other tasks, and to pay a fine of $150,000.

BP responded that it had no evidence to suggest that its pipelines had anything more than minimal sediment buildup, thus asserting there was no need to use intelligent pigs.[10] Five days after receiving this communication, the department withdrew its requirement that BP pig its lines.

In the following two years, Alaska pressured BP comply with state laws and check its pipelines. At the same time, the company received from workers several warning regarding the danger of failing to use intelligent pigs.

Eventually, BP asked another team of outside investigators to check the warnings raised by local workers. The resulting 2004 inquiry found that pipeline corrosion and the age of

[9] Intelligent pigs are droids loaded with sensors used for maintenance tests in the oil industry. A cheaper and more convenient to use alternative is using external devices such as ultrasound that however are not as effective as intelligent pigs.

[10] The use of pigs is standard in the oil industry. For example, the company that operates and maintains Trans Alaska Pipeline System, Alyeska Pipeline Service, checks its pipelines with intelligent pigs every three years, and it also uses cleaning pigs at least twice a month (Shefrin, 2008).

the field endangered operations at Prudhoe Bay. It highlighted health, safety and environment concerns raised by employees who accused BP of allowing "pencil whipping" (falsifying inspection data), and of pressuring workers to skip key diagnostics to cut costs. BP management was cutting maintenance costs with a "run to failure" strategy, meaning that aging equipment was used as long as possible.

BP eventually ran an intelligent pig through its lines in August 2006, only after the March spill, four years after the department asked it to do so, and fourteen years after the last probe, in 1992. The severe pipeline corrosion and leak caused BP to shut down half of its output from Prudhoe Bay.

BP's problems in Alaska continued. In September 2008, a section of a high pressure gas line on the Slope blew apart. A 28-foot-long section of steel flew nearly 1,000 feet through the air before landing on the Alaskan tundra. Had the release caught a spark, the explosion could have been very significant. In 2009, three more accidents occurred on the same system of pipelines and gas compressor stations, including a near explosion that had the potential to destroy the entire facility. See Lustgarten (2010). On May 25, 2010 a power failure led to a leak that overwhelmed a storage tank, resulting in the spillage of 200,000 gallons of oil. See Lyall (2010).

2. Identifying Behavioral Phenomena in Events at Texas City and Alaska

A first step to approaching behavioral issues within organizations is to focus on four specific psychological pitfalls and four specific business processes. For sake of brevity, we refer to this construct as a 4x4 pitfall-process framework.[11]

[11] A more general framework involves more than four pitfalls and more than four processes. We focus on these particular pitfalls and processes because we regard them as the most important, and for reasons of tractability.

Shefrin (2008) applied this framework to analyze the events involving BP at Texas City and Alaska. In this section, we summarize that discussion in order to set the stage for the analysis of BP's decisions in connection with drilling the Macondo well.

2.1 Pitfalls

In the 4x4 framework, the four pitfalls are: excessive optimism, overconfidence, confirmation bias, and aversion to a sure loss.

1. Excessive optimism leads people to look at the world through rose-colored glasses, overweighting the probabilities of favorable events and underweighting the probabilities of unfavorable events.
2. Overconfidence comes in two versions, overconfidence about knowledge and overconfidence about ability. People who are overconfident about their knowledge know less than they think they know, for example about the risks they face. People who are overconfident about their abilities think they are more skilled than they actually are.
3. People who exhibit confirmation bias overweight evidence that confirms their views and underweight evidence that disconfirms their views.
4. Aversion to a sure loss leads people act as if they are risk seeking because they cannot accept a sure loss. In this respect, they choose risk hoping to beat the odds.

2.2 Processes

The four processes are respectively: standards, planning, incentives, and information sharing. These four processes serve as loci for behavioral pitfalls. Although all organizations engage in these processes in some form or fashion, the key issue is the degree to which they do so in an effective and integrative manner. Firms with sound processes

1. establish sensible standards including quality risk management;
2. engage in detailed planning for generating results that are in accordance with established standards, with attention to procedures for identifying and mitigating psychological biases;
3. create incentives that reward performance relative to established standards and plans; and
4. in the course of conducting operations, share information about critical issues among the entire workforce in respect to how outcomes relative to standards and plans.

2.3 Application to BP's Decisions and Judgments

In the 4x4 framework, there are 16 possible combinations of pitfalls and processes. In respect to BP's decisions at Texas City and Alaska, we suggest the following in respect to four of these combinations:

1. *Excessive optimism* caused BP's managers to refrain from establishing clear, measurable *standards* for sediment buildup in its Alaska pipeline.
2. *Overconfidence* led BP's managers to limit *information sharing* about liquid hydrocarbon levels at its Texas City facility.[12]
3. *Confirmation bias* led BP's managers to *plan* for low investment in safety, in the face of the employees' complaints highlighted in 2004.
4. *Aversion to a sure loss* associated with lower production levels in BP's Alaska drilling field led the firm's managers to *plan* for excessive cuts in maintenance expenditures.

[12] Steve Arendt, a safety specialist who assisted the panel appointed by BP to investigate the company's refineries after Texas City explosion, referring to BP's management, affirmed: "They were very arrogant and proud and in denial. It is possible they were fooled by their success" (Rowell, 2010).

It seems that these statements are, if not obvious, then highly plausible. Therefore, we elaborate no further, but consider how the 4x4 framework can help explain the decisions involving Deepwater Horizon and the resulting explosion and oil spill.

3. Decisions Drilling Macondo

In this section we focus on how decisions BP made about digging its Macondo well generated the worst environmental disaster in U.S. history. In doing so, we interweave a narrative of the events with behavioral commentary.

On September 2, 2009, BP announced the discovery of a very large field in the Gulf of Mexico called Tiber, estimated to hold more than 500 million barrels of recoverable oil. That day BP's shares rose by 4.62 percent, indicating the importance investors attached to the announcement. Given declining production in its established fields, such as at Prudhoe Bay, BP's managers may well have concluded that deepwater drilling would drive the firm's future growth. Drilling the smaller Macondo prospect was at the forefront of this strategy. Although Macondo was almost 900 feet deeper than Tiber, it was 13,000 feet below the sea bed, in contrast to 31,000 feet for the larger field (Crooks, 2010).

BP engaged the drilling firm Transocean to drill Macondo in preparation for production. The drilling rig for accomplishing this task was named Deepwater Horizon. On April, 20, 2010 Deepwater Horizon exploded, killing eleven people and causing the worst environmental disaster in U.S. history.

3.1 Pitfalls, Standards, and Planning in the Design Phase

There are many psychological issues associated with the explosion of Deepwater Horizon, and subsequent events. Decisions about design were especially critical. In this regard, consider the following remarks made by Rex Tillerson, CEO of Exxon, in testimony before Congress on June 15, 2010: "It appears clear to me that a number of

design standards that I would consider industry norms were not followed. We would not have drilled the well the way they did." Similar comments were made at the 2010 Aspen Ideas Festival by Joe Leimkuhler and John Hollowell, two drilling specialists at Shell. They too emphasized the importance of standards, along with practices, and procedures. In their presentations, they contrasted the well designs at Shell with the one used to drill Macondo. As we now argue, their comments collectively suggest that BP's standards and planning strongly reflected excessive optimism and overconfidence, consistent with the excessive cost cutting behavior associated with the problems that occurred at Texas City and Alaska.

To begin the argument, consider Figure 1 which illustrates the general situation involving the explosion of Deepwater Horizon. At the top of the figure is an image of Deepwater Horizon, on the surface of the Gulf of Mexico, in this case ablaze. The column descending from Deepwater Horizon is called a riser pipe. It carries a long drill bit which extends to the ocean floor and below. The drill bit burrows a borehole into the rock below the ocean floor to pierce the cavity containing oil and gas trapped some distance below. The objective of the drilling activity is to construct a production well with a series of "pipes" to carry oil and gas from its cavity deep below the ocean to the surface of the ocean, with minimal leakage, in order to be collected. Because the oil and gas are trapped at great pressure below the ocean floor, it is critical that the borehole be appropriately lined with steel casing and cement to prevent leakage.

Figure 1 displays a device called a blowout preventer (BOP) just above the ocean floor, through which the drill bit descends into the sea bed below. In case of an emergency, the blowout preventer is supposed to shear the drill bit in such a way that the BOP blades remain closed, thereby preventing oil and gas from rising towards the ocean surface. In addition to the blowout preventer, BP planned to install two cement plugs to serve as barriers for oil and gas escaping from the portion of the well below the ocean floor. One plug was to be positioned in the borehole at the bottom of the well, just above the oil and gas deposit. The second plug was to be placed just below the ocean floor.

The features just described are common to the well design used by BP and the designs used by other firms such as Shell. However, Shell routinely includes a series of additional barriers in the borehole between the bottom of the well and the ocean floor, to serve as backups in case of leakages in the borehole at intermediate points below the ocean floor. For Shell, the blowout preventer is redundant, what they call a "control" as opposed to a "barrier." For BP, the blowout preventer was intended to serve as a barrier. And in that role, it failed.

The numbered text in Figure 1 traces the sequence which led to the explosion at the ocean surface. In April 2010, BP was on the verge of completing the drilling stage at Macondo. It had put a cement plug in place at the bottom of the well, and was about to put a second cement plug in place just below the ocean floor, along with a "lockdown sleeve." Before it could complete this task, there was a leak of oil and gas in the well below the ocean floor. Escaping gas rose through the riser pipe to the ocean surface and ignited, creating an explosion and fire. Personnel on Deepwater Horizon attempted to activate the blowout preventer (BOP), with the intent of preventing the oil and gas from rising above the BOP. However, the BOP did not function properly, and so oil and gas continued to pour from the well.

Among the most important pieces of safety equipment that BP was criticized for not having in place in Alaska, were gas and fire detection sensors and the emergency shutoff valves that they are supposed to trigger. Similar sensors and the shutoff systems that would have been connected to them were not operating in the engine room of the Deepwater Horizon rig that exploded in the Gulf of Mexico. Backstop mechanism that should have prevented the engines from running wild apparently failed. So did the air intake valves that were supposed to close if gas enters the engine room. The engine room was not equipped with a gas alarm system that could have shut off the power.

The design used by Shell is more expensive, but less risky, than the design BP chose to drill Macondo. Given its risk management practices in Alaska and at Texas City, and the attendant results, we conclude that excessive optimism and overconfidence in BP's

planning and choice of standards were major factors in the explosion of Deepwater Horizon. Reinforcing this contention are the following conclusions from Congress' investigation of the incident:

1. BP chose a risky option in installing the casing the day before the accident.
2. BP did not use enough centralizers to keep the casing in the borehole as it was lowered into the well.[13]
3. BP and its contractors did not run an acoustic test to check that the cement attaching the casing to the rock walls of the borehole had formed a seal to prevent gas from escaping.
4. BP did not pump enough drilling fluid through the well to detect and remove pockets of gas before cementing the well.
5. BP did not properly secure the top of the well with a lockdown sleeve to keep it sealed tightly, so that oil and gas were able to leak out and rise to the rig at the surface.

3.2 Pitfalls and Information Sharing on the Day of the Explosion

Before the second cement plug and lockdown sleeve could be put in place, the well needed to be tested to ensure that the cement and steel locked together, thereby preventing any gas from leaking and causing a fire or explosion. The well could then be abandoned temporarily until BP was ready to begin production.

Normally, such a test would involve the removal of approximately 300 feet of a thick drilling fluid called mud below the blowout preventer, which would then be replaced with seawater. This is because mud is used to prevent gas leaks into the well. Therefore, a test

[13] Centralizers are pieces of metal that maintain a casing centered in the hole. When installing the casing string, BP used approximately six centralizers when its sub-contractor Halliburton had suggested 21. If not enough are used, the casing might get squeezed too hard against one side of the well bore. Then when the cement job is complete, the end result is uneven, and there might be portions where there is almost no cement.

is typically conducted to ensure that the well is fully sealed, before removing too much of the mud.

In terms of the test, BP's managers wanted to remove an unusually large amount of the mud from the well, and then run the test. This would involve a deeper plug than originally envisioned. On April 16, BP requested permission from federal regulators to use a deeper plug, and received approval after 20 minutes.

BP's decision appears to have been unconventional. In July, Ronald Sepulvado, BP's manager in charge of the rig, was asked under oath by the Interior Department-Coast Guard panel if he had ever run a test where so much mud had been removed. His reply: "No, ma'am." When asked if he had ever heard of BP doing so anywhere, his reply was the same: "No, ma'am." Robert Kaluza was BP's day-shift manager on April 20. When interviewed by BP's internal investigators as to the motivation behind removing so much mud, he is reported to have replied: "Don't know why -- maybe trying to save time… At the end of the well sometimes they think about speeding up."

Was the decision by BP about changing the testing procedure driven by aversion to a sure loss in respect to excessive cost cutting? As it happens, the Macondo drilling project was five weeks behind schedule and over budget by $20 million. BP's altered test would help speed a process that was costing an estimated $750,000 a day. This leads us to conclude that BP's managers did indeed exhibit aversion to a sure loss: Instead of accepting the sure loss, they instead chose a testing procedure with a higher risk profile.

Even more interesting are the issues associated with the way that managers at BP and Transocean shared information with each other. Transocean workers and contractors aboard the rig indicated that they were not informed of the change in test procedure until the morning of April 20, at an 11 a.m. meeting. The change caught the Transocean crew off guard. Jimmy Harrell was the most senior Transocean worker on Deepwater Horizon that day. Harrell voiced objections to removing so much mud. Kaluza responded: "This is how it's going to be," and Harrell agreed, albeit reluctantly. Harrell's attorney Pat

Fanning is quoted as saying: "It was BP's well, they were paying for it. BP gave the marching orders."

Groupthink is a form of collective confirmation bias, and reflects inadequate airing of the pros and cons of competing alternatives, often because the group leader discourages devil's advocacy. It is in this sense that groupthink operated on Deepwater Horizon the day of the explosion. However, as we now argue, as the day progressed confirmation bias was particularly pronounced.

For the next few hours, Transocean workers removed mud from the well, and by 5 p.m. had commenced the pressure test. It was at this stage that confirmation bias loomed large. The test results were unusual, and Transocean workers struggled to interpret the readings. Pressure built up unexpectedly with no clear reason as to why. Despite his earlier resistance, Harrell judged the issue to be non-problematic. He had a valve at the top of the blowout preventer tightened, which seemed to address the issue. However, other Transocean workers were not persuaded that the problems had been resolved. For example, Wyman Wheeler, who supervised the drilling crew for twelve hours per day, was not convinced that all was in order. Yet, when Wheeler's shift ended at 6 p.m. his replacement, Jason Anderson, assured both his Transocean co-workers (and for that matter his BP colleagues) that the pressure readings were normal. Anderson suggested an alternative hypothesis called "U-tubing" for the observed readings.[14]

BP managers also disagreed with each other. Donald Vidrine was the BP manager due to relieve Kaluza at 6 p.m. Despite having made the argument for removing so much mud, Kaluza was uncomfortable with the results of the test, and Vidrine was especially concerned about a surge of gas. For that reason, Vidrine decided to order a second test, somewhat different from the first. The results of the second test were especially perplexing. Gauges on the main pipe indicated nonzero pressure, which signaled a problem, although a smaller tube leading up from the well showed no pressure, a sign

[14] "U-tubing" refers to cases where the downward pressure from mud (heavy drilling fluid) located between the drill pipe and the well walls surrounding it pushes seawater back up the drill pipe.

that the well was stable. Notably, the two pipes were connected and should have featured the same pressure. Vidrine consulted with a BP superior, Mark Hafle in Houston, who assured Vidrine that had there been a kick in the well, it would have already been detected.

The decision backdrop pertaining to the test, what behaviorists describe as base rate information, featured a well with a troubled history. In an email message one BP manager described Macondo as a "nightmare well." At various times, the drill got stuck. At other times, the well "kicked," meaning gas shot back through the mud, sometimes at an alarming rate. A Transocean employee interviewed on CNN stated: "There was always like an ominous feeling. This well did not want to be drilled. ... It just seemed like we were messing with Mother Nature."

At approximately 7:50 p.m. Vidrine instructed that a call be placed to BP engineers in Houston stating he was satisfied with the test results.[15] His decision was taken against the backdrop of negative base rate information: Hafle's judgment from Houston about there being no gas surge, Anderson's competing U-tubing hypothesis, a crew anxious to move to the next project, and the pressure exerted by dealing with the project being late and over budget. Interestingly, in his 30 years of experience on rigs, Vidrine had never seen a case of U-tubing; he had only heard about it. Our sense is that confirmation bias and aversion to a sure loss exerted strong influences. An alternative view is that the explosion was simply a tail event, and that our sense reflects hindsight bias.

In the two hours between Vidrine's message to Houston and the first explosion, unfavorable signals continued to be generated. For example, electronic data reviewed by investigators after the explosion showed that the net flow of fluid from the well was negative, meaning more fluid was exiting the well than was being pumped in. Perhaps,

[15] Rep. Henry Waxman said the oil company told the Energy and Commerce subcommittee on oversight privately that the well failed the key pressure test. "Yet it appears the companies did not suspend operations, and now 11 workers are dead and the Gulf faces an environmental catastrophe," Waxman said, asking why work wasn't stopped on the well.

the Transocean crew missed the signals because they had become distracted by other tasks. Or they might have seen the signs, but not viewed them as abnormal.

According to Shell engineers Leimkuhler and Hollowell, the April 20 test would have been a point of high risk in the process, as the mud restraining any escaping gas and oil would have been removed, thereby providing a potential escape channel for that gas to make its way to the ocean surface.

Again, the base rate for Macondo was that it was a difficult well. The well design featured fewer barriers than the design used by competitors Shell and Exxon. The project was behind schedule and over budget, and a modified procedure for a critical test was introduced at the last minute. Was April 20 a time for focusing resources on the tasks at hand, or was it a time to introduce distractions?

BP chose the distracting route. Ronald Sepulvado, the BP manager in charge of the rig was on shore that day for a training program with his phone switched off, Transocean's Harrell, and his second-in-command Randy Ezell, had spent much of that day hosting executives visiting the rig. The visiting executives included including BP's Pat O'Bryan, who had recently been appointed vice president for drilling in the Gulf of Mexico. Ironically, the agenda included commending the crew for its safety record and to discuss coming maintenance. Also ironically, O'Bryan was an expert in detecting gas leaks in oil wells.

3.3 Excessive Optimism and Overconfidence in BP's Crisis Management

We now come to issues that received the most media attention, and with which people are most familiar. After the explosion of Deepwater Horizon, and the failure of the BOP to prevent oil and gas from escaping from the well, there were serious concerns about the environmental impact on the Gulf, especially on the fishing industry and on recreational activities on U.S. beaches. BP's CEO at the time was Tony Hayward. He was under

pressure from the U.S. government and the world media. Did his behavior exhibit psychological pitfalls? To answer this question, consider a series of statements Hayward made in May.

On May 14, Hayward told the British newspaper the *Guardian*: "The Gulf of Mexico is a very big ocean. The amount of volume of oil and dispersant we are putting into it is tiny in relation to the total water volume." On May 17, BP inserted a siphon into the ruined riser pipe and began to collect 1,000 barrels of oil per day. This led Hayward to say: "I do feel that we have, for the first time, turned the corner in this challenge." That siphoning effort was later abandoned. On May 18, he told the BBC: "I think the environmental impact of this disaster is likely to have been very, very modest." In our view, these comments all reflect excessive optimism and overconfidence about ability.

Although Hayward's May 14 statement is technically true, it is seriously misleading in so far as impact is concerned. Here is what is technically true. According to government estimates, between April 20 and July 15 when BP placed a temporary cap on the well, approximately 4.9 million barrels (206 million gallons) spilled into the Gulf from Macondo. In contrast, the volume of water in the Gulf of Mexico is approximately 643 quadrillion (6.43×10^{17}) gallons. In addition, government estimates indicated that 74 percent of the oil which leaked subsequently evaporated, broke up, or was skimmed or burned off.

However, the ratio of the spill to the volume of water in the Gulf is misleading as a measure of the damage caused by the spill. BP eventually estimated that the cost of the spill would be $32 billion and set aside $20 billion in reserves.[16] As oil from Macondo washed up on beaches in Louisiana, Mississippi, Alabama and Florida, the spill severely impacted the Gulf Coast economy, and threatened its ecology. Federal and state authorities shut down Gulf fisheries. The Federal government instituted a temporary federal ban on deepwater drilling, thereby idling oil workers. Scientists warned that the Gulf wetlands, which are pivotal in its ecology, were at high risk. In addition, as of

[16] Analyst reports suggest these amounts might overstate the value of the damage.

September, the amount of spilled oil which has not disappeared remains controversial. A team of researchers from the University of Georgia announced that they had identified a two-inch thick oily layer coating the ocean floor at locations stretching up to 80 miles from the Macondo wellhead, which they believe stems from the BP spill.

Throughout much of the cleanup effort, statements from BP executives reflected excessive optimism and overconfidence. For example, on June 8, BP Chief Operating Officer Doug Suttles stated that the spill "should be down to a relative trickle by Monday or Tuesday" (Sappenfield, 2010). In a major effort at the end of May, called "Top Kill," BP sought to plug ("kill") the well from the ocean floor (the "top"). "Before 'top kill' started, the company's executives were genuinely optimistic that it might work." Hayward said that "top kill" had a 60 – 70 percent chance of stopping the oil flow. Top kill failed (Crooks, 2010).

Excessive optimism and overconfidence were persistent features of BP's public announcements. In the first weeks following the Deepwater Horizon explosion, BP estimated a spill of 1,000 barrels of oil a day. Soon after, they raised their forecast to 5,000 barrels daily. In the second week of June, independent experts suggested that a more precise estimate could be between 35,000 and 60,000 barrels a day.

The excessive optimism of BP's management was also related to the real dimension of what they were facing in the Gulf. They deeply underestimated the size of the oil spill flow rate from the well, and then did not try to adjust it.[17]

As for overconfidence, in seeking permits to drill in the Gulf, BP claimed it could handle a leak of 250,000 barrels of oil per day. "Those claims were later shown to be ludicrously overconfident" (Crooks, 2010).

[17] In doing so, they displayed "anchoring bias" that leads people to remain mentally anchored to a specific reference point, and not adjust sufficiently. Anchoring is related to conservatism and it induces to poor planning, and thus to insufficient response in case of problems. BP's executives remained anchored to their initial estimates, and didn't want to adjust them subsequently, underestimating the real size of the problem.

4. Missed Signals

A 4x4 analysis of BP's corporate culture, conducted after events at Texas City and Alaska, but before the explosion on Deepwater Horizon, points to excessive cost cutting, weak risk management practices, and high risk exposure. These traits were manifest in BP's decisions about the Macondo well. Many analysts, investors, regulators, and BP's own executives missed the signals. This section discusses the missed signals before April 20 and the conclusions reached thereafter.

4.1 Hayward's Tenure: Cost Cutting, Safety, and Culture

BP's value destructive excessive cost cutting and excessive risk taking were traits that deepened, if not emerged, under the leadership of John Browne who was CEO from 1995 to 2007. As the discussion in section 2 pointed out, BP management not only took risks with safety by neglecting aging equipment, but pressured or harassed employees to refrain from reporting problems, and to cut short or delay inspections in order to reduce production costs. In this regard, the report on the Texas City disaster led by former U.S. secretary of state James Baker, stated: "BP has not provided effective process safety leadership and has not adequately established process safety as a core value."

In the wake of accidents at its operations in Texas City and Alaska, Tony Hayward replaced Browne as CEO, with the charge of improving safety at BP. When he was appointed in 2007, Hayward sought to reduce the complexity of the company. He restructured divisions and cut administration and support functions.[18] In this regard, he set up a new risk management system to standardize safety practices and to prevent other accidents from occurring.

[18] Under Browne, BP made significant investments in renewable energy. However, Hayward reduced those investments.

Hayward appears to have believed that safety at BP was trending upward, and that the explosion on Deepwater Horizon was effectively an outlier. In a memorandum to employees just after the explosion, Hayward stated: "This accident has been a terrible exception to that trend and we must learn the lessons from it. But at the same time, it does not invalidate all the hard work you have put in to improve our safety standards around the world. Safety is our first priority. It will remain so" (Lustgarten, 2010).

Although safety might have been first priority at BP in Hayward's mind, the record shows that as of June 2010, BP had 760 OSHA fines for "egregious, wilful" safety violations. By way of contrast, Exxon Mobil had just one violation (Sverjensky, 2010). Anecdotally, Lustgarten (2010) describes an incident in 2008, a time during Hayward's tenure as CEO, in which BP failed to deliver final "as built" design drawings to crews operating deepwater rigs in the Gulf. These drawings are considered an essential safety component because they not only provide the basis for establishing that equipment operates properly, but also serve as instruction manuals in case of emergencies. Lustgarten point outs that an independent contractor met with resistance when he raised the issue of the drawings with BP engineers and management, who he suggests were seeking ways to reduce costs by several million dollars. The contractor subsequently lost his contract.

In May, Congressional hearings into the explosion of Deepwater Horizon led Bart Stupak, chair of the oversight and investigation committee to point out that BP's corporate culture was characterized by excessive cost cutting and excessive risk taking. He stated: "I am concerned that the corporate culture from BP CEO Tony Hayward down to chairman and president of BP America Lamar McKay, and chief operating officer Doug Suttles and possibly down to the leadership on exploration rigs, reflects a willingness to cut costs and take greater risks."

Stupak's statement provides support for Shefrin's 2008 assessment of BP. Further support for this characterization of BP comes from personnel who worked on Deepwater

Horizon. Those personnel stated that BP repeatedly cut corners[19] and persevered despite warnings about safety. One worker pointed to a dichotomy in respect to safety. He stated that one day he was scolded for standing on a bucket on the rig. Yet the next day, a crane violated safety policies by operating in the face of high winds (Bronstein and Drash, 2010).

Accounts of the sort just described led to an interesting observation by David Michaels, assistant secretary of labor for occupational safety and health. He stated: "The way safety is measured is generally around worker injuries and days away from work, and that measure of safety is irrelevant when you are looking at the likelihood that a facility like an oil refinery could explode. This is comparable to saying that an airline is safe because the pilots and mechanics haven't been injured."

4.2 Analysts: Availability Bias and Confirmation Bias

Analyst coverage of BP is illuminating. We examined reports between October 2006 and September 2010 to assess analysts' perceptions and recommendations, with special emphasis on 130 reports from 27 brokerage firms during the period August, 4, 2009 to September, 17, 2010. See Table 1 for a summary of reports issued between April 20 and September 10, 2010. After reviewing the reports, we move onto our general conclusion that analysts lacked a framework for assessing risk management practices and corporate culture at BP, leading them to issue excessively optimistic recommendations reflecting availability bias and confirmation bias.

One of the strongest results in the literature on financial analysts is that analysts' recommendations tend to be biased upward. This feature has been often been explained by potential conflict of interests faced by analysts. In this regard, analysts working for financial intermediaries with actual or potential business relationships with the companies

[19] As a matter of fact, in February 2009, Hayward told reporters: "The mantra in BP today is 'Every dollar counts'" (Crooks, 2010). In 2009, BP implemented a $4bn cost reduction. While production increased by only 4%, the unit production costs reduced by 12% (BP, 2009, p. 84).

being covered have an incentive to issue positive recommendations in order to encourage business dealings between their employer and the covered companies. Positive recommendations issued by analysts may also attract new businesses for their employer. Evidence shows that stocks positively recommended by affiliated analysts tend to perform worst than the ones recommended by independent analysts (Michaely and Womack, 1999; Barber, Lehavy and Trueman, 2007). As a general matter, independent analysts' recommendations display less upwared bias (Malmendier and Shanthikumar, 2007).

Apart from potential conflict of interests, we suggest that behavioral biases played a major role in analysts' recommendations on BP's stock. Figure 2 illustrates the time series for analysts' recommendations between August 4, 2009 and September 17, 2010. We use a traditional[20] five-point scale to code recommendations, where

- 5 denotes buy and strong buy recommendations
- 4 denotes add, overweight, outperform and accumulate recommendations
- 3 denotes hold, perform, or neutral recommendations
- 2 denotes reduce, underweight, and underperform recommendations
- 1 denotes sell or strong sell recommendations

Notice from Figure 2 that there are no negative recommendations during the period. Indeed, there are no negative recommendations after April, 20 2010, the date of the Deepwater Horizon explosion. Even more interesting is the fact that the number of reports featuring ranks 3 or 4 recommendations declines after the accident. To highlight this point, we graph a second degree polynomial trendline to display the upward trending pattern in analysts' recommendations over the period.

Effectively, Figure 2 indicates that the degree of herding in analysts' recommendations for BP stock increased after the April 20 explosion. Kim and Zapatero (2009) propose a

[20] Commercial databases commonly use a reverse scale where 1 denotes a strong buy whereas 5 a strong sell recommendation. However, we find it more intuitive to use a 5 for strong buy, so that an upgrade, for example, is represented by an increase in rating score.

theory suggesting that the star-system leads analysts' recommendations to display less herding in lower volatility stocks than in higher volatility stocks. Their theory also leads to the prediction that an increase in the volatility of a particular stock will cause an increase in herding for that stock. In this regard, Fodor and Stowe (2010) report that option market implied volatility (IV) for BP stock indeed increased after April 28, from below 0.38 to an average level of 0.65.[21]

Notably, analysts did reduce their target prices following the explosion of Deepwater Horizon. See Figure 3, which shows a positive trend until April 20, and then a decline, albeit with a lag. After June 1 2010, almost all reports feature target prices in the range £4 to £6.[22]

Figure 4 displays time series for both target prices and market prices. We add two trendlines (polynomial, second order) to highlight the trends. Notice that the two trendlines feature similar patterns. However, the trendline of target prices (solid line) is always above the trendline for market prices (dashed line). Interestingly, the gap between the two seems to widen over time, perhaps because of the greater uncertainty and consequent difficulty in forecasting after the accident.

In any event, after April 20, the combination of declining target prices in conjunction with more favorable recommendations suggests that analysts viewed the decline in BP's market price in response to the explosion of Deepwater Horizon to have been an overreaction. In this regard, consider Figure 5, which displays the percentage premium calculated as the difference between the target price and the current market price over the current market price and multiplied by 100. This premium is often use by analysts to calculate the future percentage upside or downside potential of the stock. Brokers usually have premium cut-offs which they use in issuing their final recommendations.

[21] See figure 4 in Fodor and Stowe (2010).
[22] Two notable exceptions are represented by the reports by ING dated June, 22 and August, 23, with target prices maintained at £7.12. However, as the analyst (Jason Kenney) highlights, these target prices should be considered on a 1-3 years horizon. Therefore, we do not include them in our analysis, since they cannot be compared with other target prices with a 12-months horizon.

Notice that the trend for premium is upward sloping, similar to the one for recommendations. We note that after April 20 no premium is negative, and that premia seem to be more dispersed, reflecting the greater uncertainty analysts faced after the accident.

To gain more insight into analysts' thinking, both before and after the explosion of Deepwater Horizon, consider some content from a sample of reports. On April 20, 2010 security analyst Dougie Youngson at Arbuthnot Banking Group Plc, London, initiated the coverage of BP with a buy recommendation. In justifying his recommendation, he stated that BP's strategy and cost reductions were yielding the expected results. In respect to competitors, he claimed: "Safe, reliable and compliant operations remain the first priority… With its new strategy, board and aggressive cost cutting programme, we feel BP is much better-positioned relative to most of its peers in 2010 … When comparing BP's progress in strategy development and cost cutting with Shell, we believe it is much more advanced in both areas. Consequently, in our view BP has a significant competitive advantage over its adversary" (Youngson, 2010, p. 1).

Notably, Youngson's report identifies key issues: safety, cost cutting, and profitability. However, in our view his analysis failed to assess these correctly. For example, he appears to have downplayed if not ignored the accidents that continued to occur in Alaska in 2008 and 2009, and the fact that in March 2010, OSHA proposed $3 million more in penalties after finding 62 violations at BP's Ohio refinery. In addition, Youngson's comparison of BP to Shell is striking, given the difference in choice of well design, as discussed in section 3.2.

Youngson's report on BP is fairly typical of analysts' assessments. We examined 33 reports that were issued after April 20, 10 of which by UBS. In the report of April 28, UBS's analysts clearly underestimated the effects of the accident, stating "[…] we think these costs are more likely to be in the hundreds of millions rather than billions and hence, ultimately, unlikely to be material to the long-term investment case." They were recommending purchasing BP stock, setting a target price of £7.25. Between April 20 and

May 10, BP lost 17 percent of its value, corresponding to $32bn of market capitalization. In UBS analysts' view the decline corresponded to "a substantially exaggerated reaction although less so in the context of weak markets."

On May, 25, UBS analysts eventually reduced the target price to £6.30, and to £5.80 on June, 1, but always maintained the buy recommendation. Interestingly, in the latter report, they state "Our forecasts, which look at recurring net income and exclude specials (we assume the costs of the spill are 'special') […]". On June 7, the analysts calculate in a very detailed way the potential costs of the spill. However, they keep the buy recommendation, and the previous target price. In the reports of June 11 and 17 they stated that the market reaction was mainly driven by political factors. Interestingly, they maintained the buy recommendation and did not change their target price, both of which remained more or less stable through the UBS report of September 9, 2010.

By and large, analysts' reports prior to the explosion of Deepwater Horizon emphasized costs and risks in the Gulf of Mexico which were associated with weather and price swings, rather than oil spills and related operational accidents. These reports strongly emphasize potential performance related to cost-cutting. In 2009, BP exceeded analysts' expectations thanks to its aggressive cost-cutting policy. For example, in the report by Unicredit dated December, 17 2009, analysts claim that BP has a good operational momentum because of its "first-mover advantage in cost cutting."

Interestingly, reports that provide a comparison with competitors often (though not always) feature a recommendation of hold. For example, the report issued by Collins Stewart on February, 2 2010 states: "BP's shares outperformed their major peers substantially in the past year, driven by sharply improving performance, cost reduction and volume growth. We think the shares will struggle to outperform from here, given the outlook for slightly lower volumes in 2010, and a slower pace of cost reduction. We continue to recommend a switch into Royal Dutch Shell (Buy, TP 2150p/sh) where we see significant cost reduction potential, a major turnaround in free cash flow on a 2- year view and much better valuation upside (35% upside to SoP vs 16% for BP)."

Another example is a Morgan Stanley Europe research report on BP, dated March 11, 2010, and the last before April 20, assigns an Overweight/Buy recommendation to BP stock. In justifying the recommendation, the report states: "management focus on costs and execution over the last 18 months is undiminished." A notable exception is Datamonitor, whose report dated April 7, 2010 includes a SWOT analysis in which one of the weaknesses described pertains to the Texas City accident and associated OSHA violations. In concluding the discussion on this point, the Datamonitor report states: "Such events causing environmental damage could result in heavy financial penalties for the company, eroding its profits. In addition, such law suits could also tarnish its brand image."

What, if any, psychological pitfalls were at work in explaining why most analysts missed the signals? In our view, availability bias and confirmation bias loom large. Analysts focus heavily on earnings trajectories and company narratives, as these are readily available and salient. It is well known in the behavioral finance literature that security analysts tend to rely on management's stories. See Montier (2005).

An illustrative example can be found in a report by Raymond James, issued August 27, 2009 by analyst Pavel Molchanov. He discusses the incidents at both Texas City and Prudhoe Bay, beginning with Texas City, stating: "Still, early signs are encouraging. BP's companywide "recordable injury frequency" in 2008 was below the level of 2005 and less than half the level of 2000 although it must also be pointed out that the Texas City refinery itself had another fatal accident in 2008. Perhaps most importantly, senior management's increased emphasis on developing a safety culture appears clear. In its annual strategy presentation in March 2009, BP stated: 'Safe, compliant and reliable operations: our No. 1 priority.' As with refinery safety, it is difficult to definitively gauge the level of BP's progress in this regard. What is visible is that the company's number of oil spills (above one Bbl) has continually declined over the past decade, and in 2008 it was more than 10% lower than in 2006."

In conference calls with analysts, BP repeatedly stressed its focus on safety. In its 2009 Annual Report and Accounts, the following passage appears: "Competition puts pressure on product prices, affects oil products marketing and requires continuous management focus on reducing unit costs and improving efficiency." (BP, 2009, p. 18) Following the release of the Baker report in January 2007, analysts accepted at face value the newly appointed CEO Tony Hayward's assertions about accepting and implementing all the report's recommendations. In line with confirmation bias, they appear to have underweighted subsequent information about OSHA violations.

Subsequent to April 20 some analysts adjusted their perspective, especially about the importance of corporate culture. Morgan Stanley Europe's July 28 report states: "Investors will need more clarity on the impact of asset sales and further reassurances of a cultural change regarding safety, a process started by Tony Hayward, before BP can regain a multiple in line with its industry peers." Similarly, the July 29 report by Oppenheimer states: "CEO Change. Although we believe Bob Dudley is the right person to replace Tony Hayward as CEO, we think BP is in serious need of an extreme makeover to change its culture and the way it conducts business. In order to achieve that, many key managers may have to be replaced."

MSCI's ESG Research group revised the manner in which it analyzes risk. It now focuses on risks associated with regulatory risk in respect to health and safety, especially in offshore operations. Notably, its framework for analyzing health and safety involves examining management systems, budgets, track records for oil spills and fatality/injury rates. In September, the research group noted that BP had the highest offshore regulatory risk among its peers and was ranked at the bottom for risk management systems in this dimension.

Nevertheless, some analysts appear to have been unconvinced about the centrality of BP's risk management, especially in connection with well design. In a report dated September 9, 2010, UBS analyst Jon Rigby and associate analyst Caroline Hickson made the following comment, based on the release of a BP report released on September 1:

"Report offers some rebuttal to critics – well design not to blame… BP says "multiple" parties and causes involved in Macondo… BP's internal (although independent) report into the Macondo incident (the Bly report) indicates there was no one clear cause or culprit of the disaster… The committee stressed in a conference call that the well design was "robust" and not unusual for the area, and also defended the use of only six centralizers and the limited circulation of the drilling mud. These decisions had all been listed as possible causes of the blowout by the US congress…"

Rigby appears to have based his assessment on BP's report without adjusting for potential self-interest bias on the part of BP, and assessments of competitors such as Shell and Exxon. One possible explanation for doing so is the issue we described earlier, whereby analysts write reports that are excessively favorable in order to curry favor with the companies they follow, in the hope the management of these companies will engage the firms for which they work. This motivation has been suggested in the popular financial press. See Pressman (2010), who discusses this possibility.[23]

4.3 Investors and Regulators: Availability Bias and Confirmation Bias

Turning to investors, an interesting example is offered by the Corporate Responsibility (CR) community that seems not to have understood the incongruity between BP rhetoric and deeds. BP ranked first in the 2007 *Fortune* and *AccountAbility*'s list of world's "Most Accountable Companies", the annual ranking of business responsibility. In 2010 it was named runner-up for the category "Openness and Honesty" in the Corporate Register's CR Reporting Awards (Sverjensky, 2010). Prior to the explosion of Deepwater Horizon, the Dow Jones Sustainability Indexes (DJSI) identified BP as leading its peer companies in corporate sustainability and commitment to shaping the industry in the social and environmental aspects of business (Statman, 2010). Of course, after the explosion, DJSI removed BP from its indexes.

[23] Pressman also discusses alternative behavioral explanations such as groupthink. In addition, he provides examples from several analysts' reports, including those from Credit Suisse, Citigroup, and Morgan Stanley.

In our view, the factors underlying investors' underestimation of BP's risk profile are the same as the factors underlying those of analysts' judgments, namely availability bias and confirmation bias. Moreover, analysts' judgments may well have impacted investors' judgments. Even if based on publicly available data, most investors appear to rely on information provided by companies. This information often only includes companies' commitments, i.e. what they state they plan to do, and are often based only on the CSR reports of those companies. Instead, rankings and indices should be driven by externally verified data coming from a variety of sources (Sverjensky, 2010).

In contrast to analysts and investors, the relationship between firms and regulatory agencies also features several potential agency costs. For example, a supervisory authority may face the conflicting duties of regulating supervised companies and collecting royalties from them. This seems to have been the case of the Minerals Management Service (MMS), which regulated U.S. oil exploration. The federal agency had been criticized since long before the spill for its conflicting duties (CNN Wire Staff, 2010). On May 19, 2010, Interior Secretary Ken Salazar, whose department oversees offshore oil drilling, announced that he was dividing MMS into three divisions. He affirmed: "We inherited here what was a legacy of an agency that essentially was rubber-stamping whatever it was that the oil and gas industry wanted" (CNN Wire Staff, 2010).[24] The new name of the agency "Bureau of Ocean Energy, Management, Regulation and Enforcement" has been chosen to stress the different duties of the distinct divisions.

5. Debiasing Using Cognitive Repairs

As we stressed in the previous section, one of the most important lessons for analysts from the BP-Macondo incident involves the need to assess how a firm's culture impacts its risk profile, and by implication its prospects and value. In our view, analysts need to develop systematic procedures for assessing the extent to which firms are working to

[24] This statement is consistent with both confirmation bias and agency conflicts.

improve their cultures, particularly their susceptibility to psychological pitfalls. On the other side of the coin, one of the most important lessons for firms' management teams is the importance of mitigating their vulnerability to psychological pitfalls, thereby improving their firms' cultures.

In this section we apply the literature on debiasing and cognitive repairs to suggest ways that BP in particular, and other firms in general, can improve corporate culture. The 4x4 pitfalls-process framework described in section 2 provides the structure for our discussion, together with the cognitive repair approach described in Heath, Larrick, and Klayman (1998).

Shefrin (2008) argues that the starting point for instituting organizational debiasing is the recognition that psychologically induced mistakes are akin to addictive diseases. What behaviorally-induced mistakes and addictive behaviors share in common is habituation. We know something about how to treat addictive diseases. We know that twelve-step programs are group programs that have truly helped many people combat their addictions. Indeed, "step one" of twelve is to acknowledge the problem. In the case of psychologically induced mistakes this means acknowledging susceptibility to phenomena such as confirmation bias, excessive optimism, overconfidence, and aversion to a sure loss. Shefrin suggests that successful debiasing often requires group interaction. Heath et al. make a similar point, stating that "many successful repairs will be social because individuals may not recognize the need to repair themselves" (p. 28).

The extent to which BP's management has taken "step one" remains an open question. During appearances before both the U.S. Congress (in May) and the British Parliament's energy panel (in September), Hayward was aggressively questioned about his promise some years ago to focus like a laser on safety. In response, he stated that BP's record was "better than the industry average." In this regard, he went on to say that the blowout preventer on the rig "was fully compliant with the regulatory regime and it should have functioned." When asked about a BP employee having described Macondo as a "nightmare well," Hayward termed the description "unfortunate" and noted that the well

"had been challenging — not unusually so for the Gulf of Mexico. The gulf is a more challenging drilling environment than the rest of the world."

To be sure, Hayward's statements are intentionally crafted with the view of limiting BP's financial liability for the explosion of Deepwater Horizon. The same statement applies to the report BP released on September 1, mentioned above, explaining the multiple causes of the explosion. The BP report describes failures on the part of all parties involved, including contractor Halliburton and rig owner Transocean. Not surprisingly, both Halliburton and Transocean disputed BP's findings: Transocean called them "self-serving" and Halliburton insisted that the source of the problem was BP's well design.

Taken at face value, our view is that Hayward's statements reflect confirmation bias. As the MSCI materials discussed in section 4 indicate, BP's offshore risk management practices lie at the bottom of their peer group. This is the case, even though during 2009, BP's history of spills and fatality/injury rates was better than others. As we discussed in section 3, BP's well design treated the blowout preventer as a barrier, whereas alternative well designs such as those in use at Shell, treat the blowout preventer as a control. In this respect, we believe that Halliburton has a legitimate point. As for the characterization of the "nightmare well" designation as "unfortunate," consider remarks from one of the mechanics who worked on Deepwater Horizon: "I've seen a lot of gas coming up from muds on different wells, and the highest I've ever seen in my 11 years was 1,500 units. And this well gave us 3,000. I've never been on a well with that high of gas coming out of the mud. That was kind of letting me know this well was something to be reckoned with."

As the title of this paper indicates, under Tony Hayward's leadership, BP failed to debias. BP announced that Tony Hayward is to be replaced by his colleague Bob Dudley as CEO. Will Dudley be able to succeed where Hayward failed?

In the context of the 4x4 pitfalls-process framework, consider some cognitive repair techniques aimed at mitigating bias at BP. In the discussion below, we focus on processes

first, identify pitfalls, and then suggest repairs. Notably, the discussion stresses the importance of interaction across processes.

1. Standards: BP appears to have framed the safety issue by using an excessively narrow definition of safety, a point made by Michaels (see section 4.1). The most important cognitive repair here involves reframing the notion of safety much more broadly. In addition, standards for risk management need to be appropriately framed. Gigerenzer et al. (2008) identify a series of framing pitfalls in connection with randomness. They emphasize the use of frequency statements in place of single-event probabilities, absolute risks instead of relative risks, mortality rates instead of survival rates, and natural frequencies instead of conditional probabilities.

2. Planning: BP characterizes the explosion of Deepwater Horizon as a rare bad luck event, stemming from the simultaneous occurrence of a series of unfavorable events. We think it plausible that BP's management exhibited overconfidence in underestimating the probability of a failure, with anchoring and adjustment bias possibly being a contributing factor. Mitigating overconfidence is a challenge, particularly when it comes to overconfidence about knowledge, as measured by the use of stated confidence intervals. See Kaustia and Perttula (2010). Heath et al. discuss routine cognitive repairs that engineers use for addressing overconfidence. They state: "Fortunately, the engineering profession has developed a particular repair, called "safety factors," that mitigate the overconfident reasoning of individual engineers." (p. 4). These repairs involve the use of additional safeguards that would be excessive if not redundant, were engineers well calibrated.

3. Incentives: On the surface, BP's compensation appears to align the interests of managers and shareholders. The firm required employees to take a significant proportion of their compensation in company stock each year and to retain them. Therefore, many BP staff came to be heavily invested in the firm through

employee share ownership plans. Shefrin (2006) argues that incentives alone do not align the interests of managers and shareholders. In particular, biases and framing effects associated with the other three processes standards and planning can undercut theoretically appropriate compensation plans. As was discussed in section 3.2, aversion to a sure loss is particularly dangerous, with its associations to sunk cost fallacy, escalation of commitment, and risk seeking decisions. See March and Shapira (1992). Shefrin (2006) describes several techniques for addressing aversion to a sure loss. One of these was coined "fire yourself" by Intel's former CEO Andrew Grove. He suggested that the best way for an executive to deal with the reluctance to terminate losing projects is to pretend to fire him or herself, and act as he or she would were they to be the replacement, without the associated psychological pitfalls. Technically speaking, Heath et al. suggest that improving incentives is separate from instituting cognitive repairs. Nevertheless, firms like BP need to address how people are rewarded (or penalized) for resisting cost cutting measures they deem to be value destructive. Rewards and penalties can be nonpecuniary (praise and blame) as well as financial.

4. Information sharing: This is a broad category, which involves (1) hypothesis generation, (2) information collection, and (3) the drawing of conclusions.

   An example of a hypothesis in respect to the April 20 test results on Deepwater Horizon is that readings were caused by "U-tubing." Heath et al. suggest that individuals often generate too few hypotheses, as may have been the case with the U-tubing hypothesis. They suggest two particular cognitive repairs for this tendency, known as "the Five Whys" and "single-case bore questions," both of which are procedures for asking questions designed to address overly narrow search.

   In respect to information collection, Heath et al. discuss methods for dealing with availability bias and rare events. They state: "A particularly important form of

missing information is the absence of experience with highly unusual events. Bank examiners rarely see a bank fail, nuclear technicians rarely see a meltdown, airline personnel rarely witness a crash." The analogy of these examples to the explosion of Deepwater Horizon is evident. Heath et al. describe the following cognitive repair. They state: "For example, at the Federal Reserve Bank, which certifies the security of banks, senior bank examiners deliberately recount stories of failed banks to keep junior examiners aware that they should be vigilant. At one bank's commercial lending department, senior credit officers would hold seminars and informal brown-bag lunches to discuss past lending mistakes, particularly in areas characterized by unusual or rare events (e.g., "problems with highly leveraged companies, real estate, environmental liability on contaminated property") (p. 14).

As for drawing conclusions, a major challenge for a firm with BP's culture is to mitigate confirmation bias. Heath et al. suggest that doing so typically requires a formalized structure for devil's advocacy. In contrast, BP's culture tends to feature great resistance to the presentation of opposing views. Heath et al. provide an interesting example: "Disney regularly holds "Gong Shows" where personnel (including department secretaries) can pitch ideas to a group of senior executives… The senior executives are careful to give exceptionally frank feedback at the end of the session, highlighting both good and bad aspects of the presentations" (p. 19).

A general repair firms can use in respect to sharing information involves the choice of sayings and slogans. Hayward's slogan "Every dollar counts" conveys a powerful message. However, it needs to be counterbalanced by some other slogan that relates to safety, defined sufficiently broadly. Heath et al. discuss another useful saying "There are no bad people, only bad systems," which is motivated by the military's saying "There are no bad troops, only bad officers." The former saying is intended to help mitigate fundamental attribution error, the tendency to attribute outcomes primarily to people instead of to situations. Heath et al. remind

us of the claim in Deming (1982) that situations, rather than people, are primary in 94 percent of cases.

Firms with healthy corporate cultures build cognitive repairs into their processes, and integrate those processes. They establish standards consistent with value creation. They engage in planning to establish detailed strategies for achieving those standards. They put incentives in place to reward the entire workforce for achieving standards. And in the course of conducting operations, they share critical information about how actual performance compares to standards and plans, with the purpose of adapting to conditions as necessary.

Shefrin (2008) describes several firms who he suggests have developed healthy corporate cultures in that they have institutionalized cognitive repairs into the processes in order to mitigate psychological pitfalls. Examples include Ford Motor Company, Southwest Airlines, and Whole Foods.[25] We suggest that if Dudley is to succeed where Hayward failed, he would do well to investigate the best practices of these firms.

In particular, Dudley could learn important lessons from Ford's CEO Alan Mulally. When Mulally was appointed in September 2006 for his experience in corporate repair at Boeing, the company was in distress. He very quickly discovered that information sharing at Ford was poor. To turn things around, he established regular weekly meeting with executives. The meetings are meant to share information and to make executives focus on the firm's standards and business plan. To mitigate aversion to a sure loss (or escalation of commitment), Mulally used praise to induce executives to share negative information with each other. He also instituted techniques to help his managers avoid groupthink. Mulally's approach began to yield positive effects in mid-2007. The company eventually returned to profitability in the second half of 2009 after four years of losses. In 2010 the company earned more than it had in any full year since 1999, when it reported income of $7.24 billion. Ford reported a 70 percent increase in third-quarter

[25] An effective leader can change its company's culture, and its performance with it. SRC, a privately held firm, provides an illuminating example not only of how a leader can institutionalize well structured processes. Its CEO, Jack Stack, is recognized for having pioneered open book management.

earnings, driven by higher sales of vehicles in its core North American market. It reduced its debt and was planning for future investments.

Among the big three U.S. auto makers, Ford is the only one that did not declare bankruptcy during the global financial crisis, and on July 23, 2010, it reported the best quarterly results in the previous six years. Interestingly, Ford adapted to the 18-month recession in the period December 2007 - June 2009 by cutting production. In contrast, GM did not, instead choosing to maintain production rates. We hypothesize that because of poor processes and culture, confirmation bias and aversion to a sure loss both contributed to GM's value destructive decision. On the other hand, Ford had instituted sound processes, and managed to mitigate these pitfalls.

When Tony Hayward became CEO, BP would have done well to have done something similar to Alan Mulally's debiasing efforts; but he did not. Analysts, investors, and regulators would have done well to monitor BP's efforts at debiasing using a pitfalls-process framework; but they did not. We suggest that Bob Dudley needs to initiate sensible debiasing procedures at BP; we hope he does so. We suggest that analysts, investors, and regulators need to monitor BP's efforts at debiasing in a systematic fashion; we hope they do so.

6. Conclusion: Lessons For Academics and Everyone Else

The explosion of Deepwater Horizon is an event offering many lessons. The first lesson is that psychologically induced mistakes can be very expensive. The current estimate attached to BP's liability for the explosion of Deepwater Horizon is $40 billion. Indeed, as we complete this article, the U.S. government has joined 80 other litigants in suing BP for damages.

The second lesson is that BP is not an isolated case. Shefrin (2010c) argues that psychological pitfalls at financial firms were also the root cause of the global financial crisis that erupted in 2008. Indeed, a side-by-side comparison of this paper with Shefrin

(2010c) reveals that the same psychological issues plaguing these financial firms also plagued BP. In this regard, see also Walter (2010).

The third lesson is that BP's corporate culture supported if not encouraged its high risk profile. In this regard, panel appointed by the U.S. government to investigate the explosion of Deepwater Horizon concludes that the main issue was a "failure of management" especially at BP with inadequate policies for managing risk and sharing information. As a result, decisions intended to save time and increase efficiency created a higher risk exposure.

The fourth lesson, which follows immediately from the third, is that the weaknesses in BP's risk management culture were already apparent in 2007, after the accidents which occurred at BP's facilities in Texas and Alaska. Moreover, events after 2008 only served to reinforce this assessment. Yet, analysts, investors, and regulators all missed the signals, and underestimated operational risk at BP.

The fifth lesson is that there is a strong need for a better conceptual framework to judge the quality of corporate culture and risk management before disaster strikes. In this regard, we contend that a useful way of characterizing a firm's culture is in terms of a process-pitfall framework. Corporate financial judgments pertaining to decisions about capital budgeting, capital structure, valuation, agency contracts, and mergers and acquisition fit naturally into this framework.

The process-pitfall framework provides a convenient way both to diagnose biases in a firm's culture, and to use cognitive repairs to address those biases. At the same time, debiasing is difficult. Nevertheless, what BP must do to heal its problematic corporate culture is an important issue for the future. This statement applies well beyond BP to other firms with problematic corporate cultures, to the analysts covering those firms, and to regulators and supervisory authorities overseeing these firms.

The sixth and final lesson is that academics need to ramp up the emphasis they attach to the behavioral dimension of corporate finance, both in the classroom and in their research. Admittedly, behavioral corporate finance is still relatively novel, even within academia, although behavioral concepts are slowly making their way into traditional textbooks and into research agendas. However, the rate of diffusion is slow. We suggest that ignorance about behavioral corporate finance allowed publicly available information about BP's high risk operations to go unnoticed by analysts, investors, and regulators.

We already teach elements of the four processes in traditional corporate finance courses. When we teach our students the principles of valuation and financial ratios, we are teaching them about standards. When we teach them pro forma forecasting techniques, we are teaching them about planning. When we teach them about agency theory, we are teaching them about incentives. And when we teach them about financial reporting and the preparation of incremental cash flow forecasts in respect to capital budgeting, we are teaching them about sharing information.

What traditional corporate finance courses tend to ignore is how to integrate the four processes together in a way that recognizes and mitigates managers' vulnerability to psychological pitfalls. One conclusion we draw from BP's recent history, and for that matter the choices made by financial firms, is that there should be a sense of urgency about integrating behavioral concepts into traditional courses in corporate finance. Otherwise, we remain as vulnerable as ever to future environmental disasters, financial crises, and severe economic downturns.

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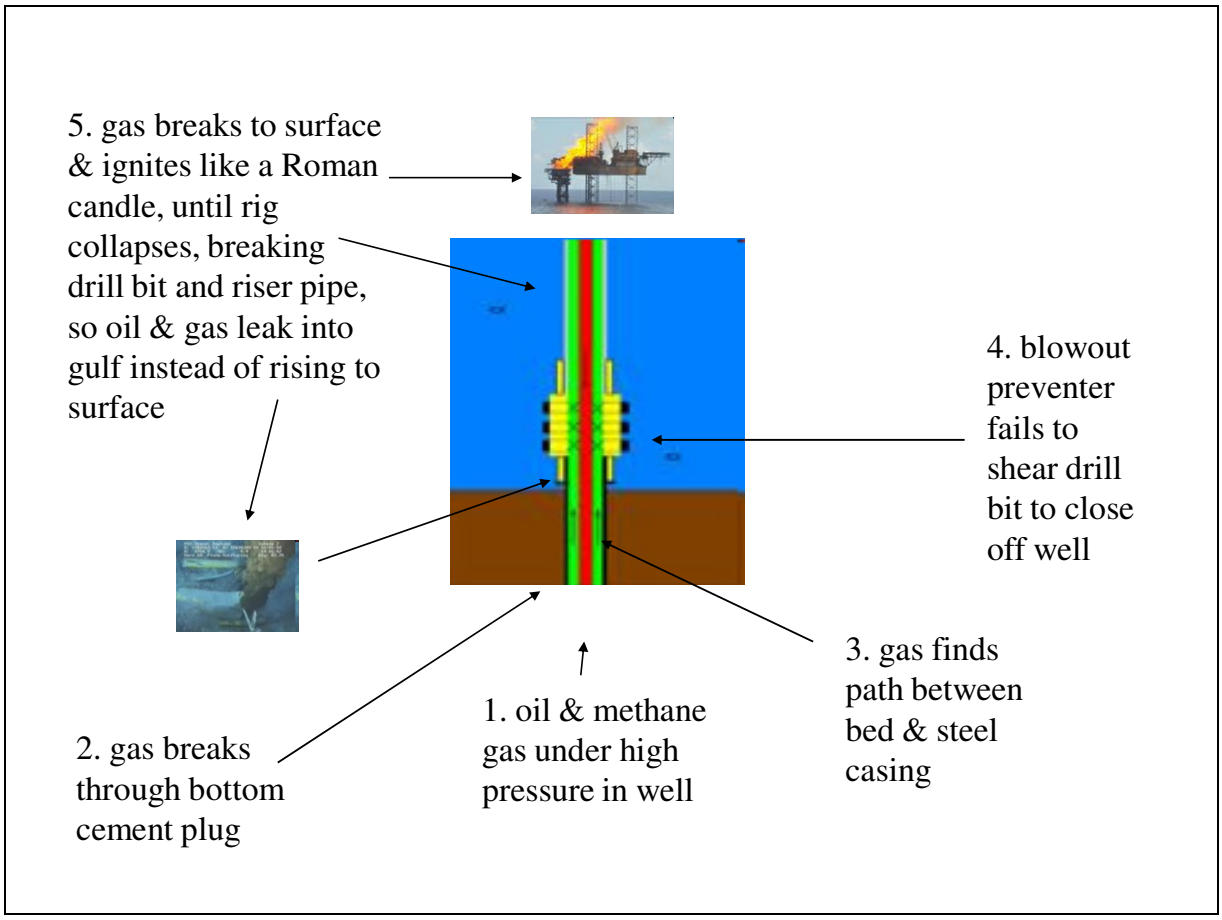

Figure 1. Event Sequence in the Explosion of Deepwater Horizon

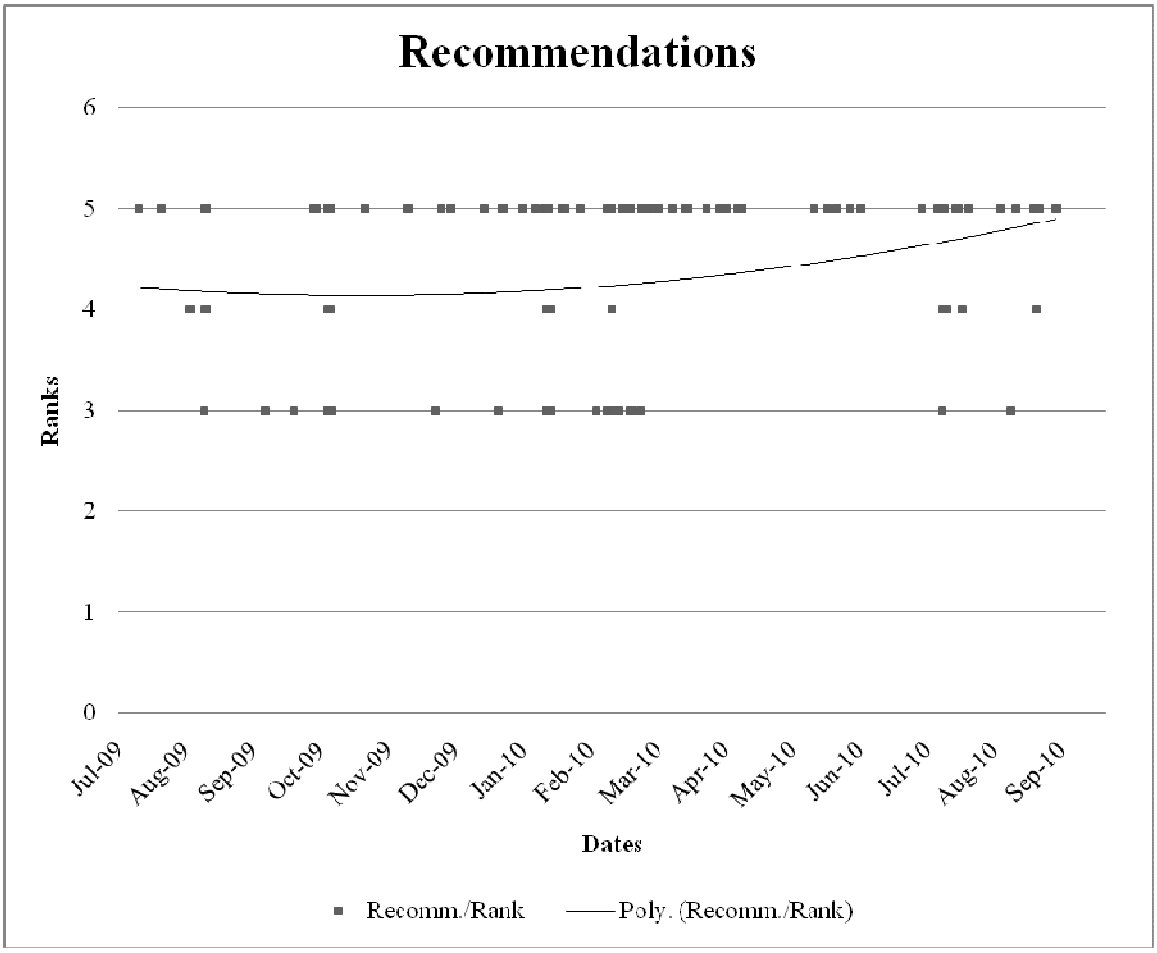

Figure 2. Analysts' Recommendations: Ranks (Buy=5, Add=4, Hold=3)

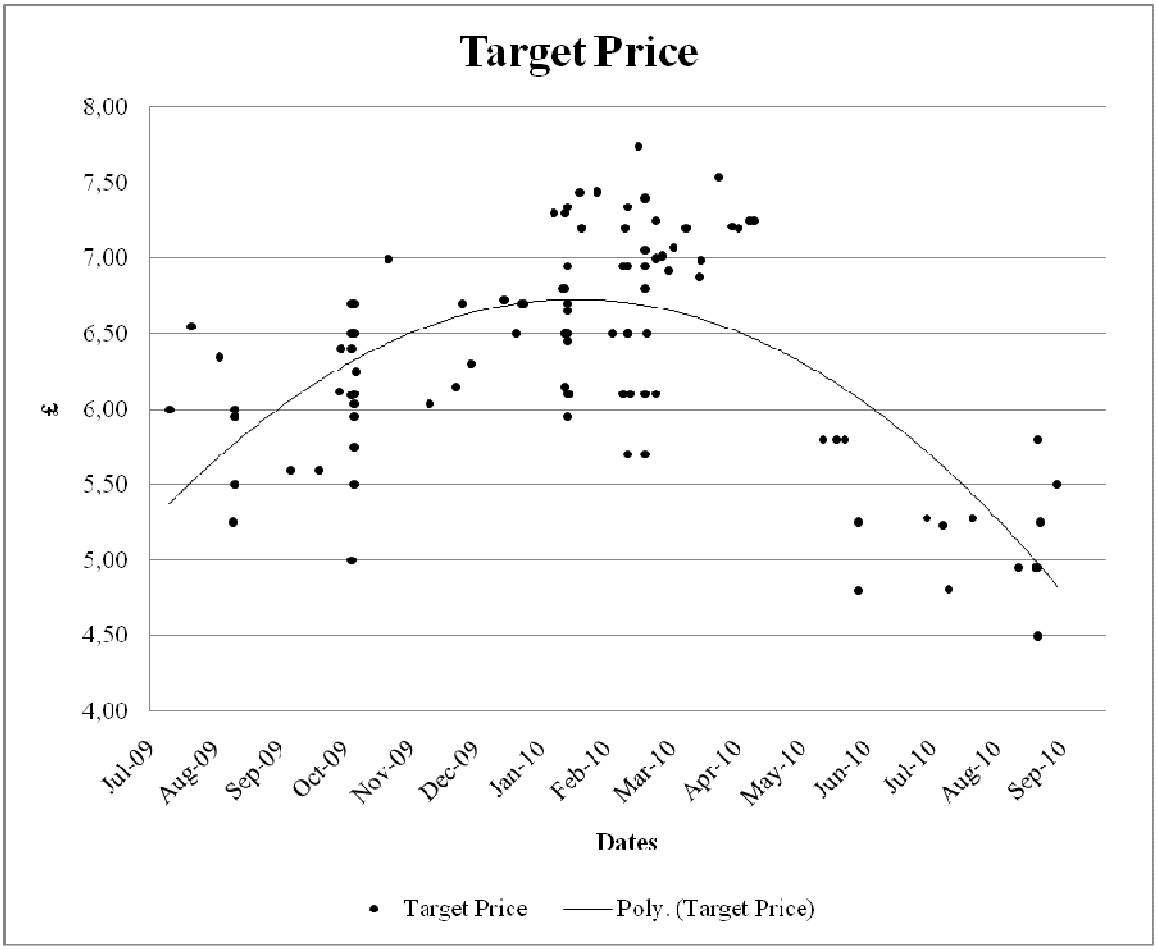

Figure 3. Analysts' Target Prices in Sterling Pounds (£)

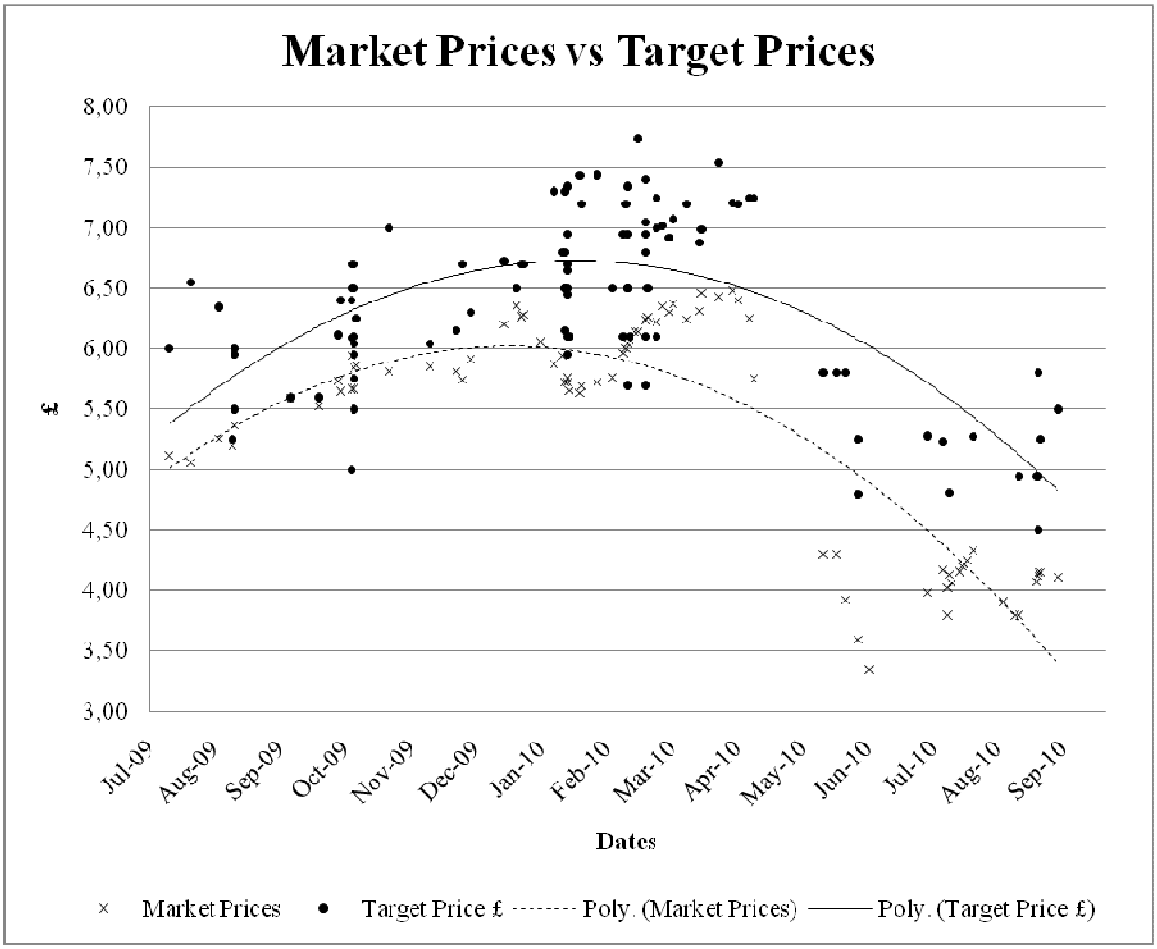

Figure 4. Market Prices *versus* Target Prices in Sterling Pounds (£)

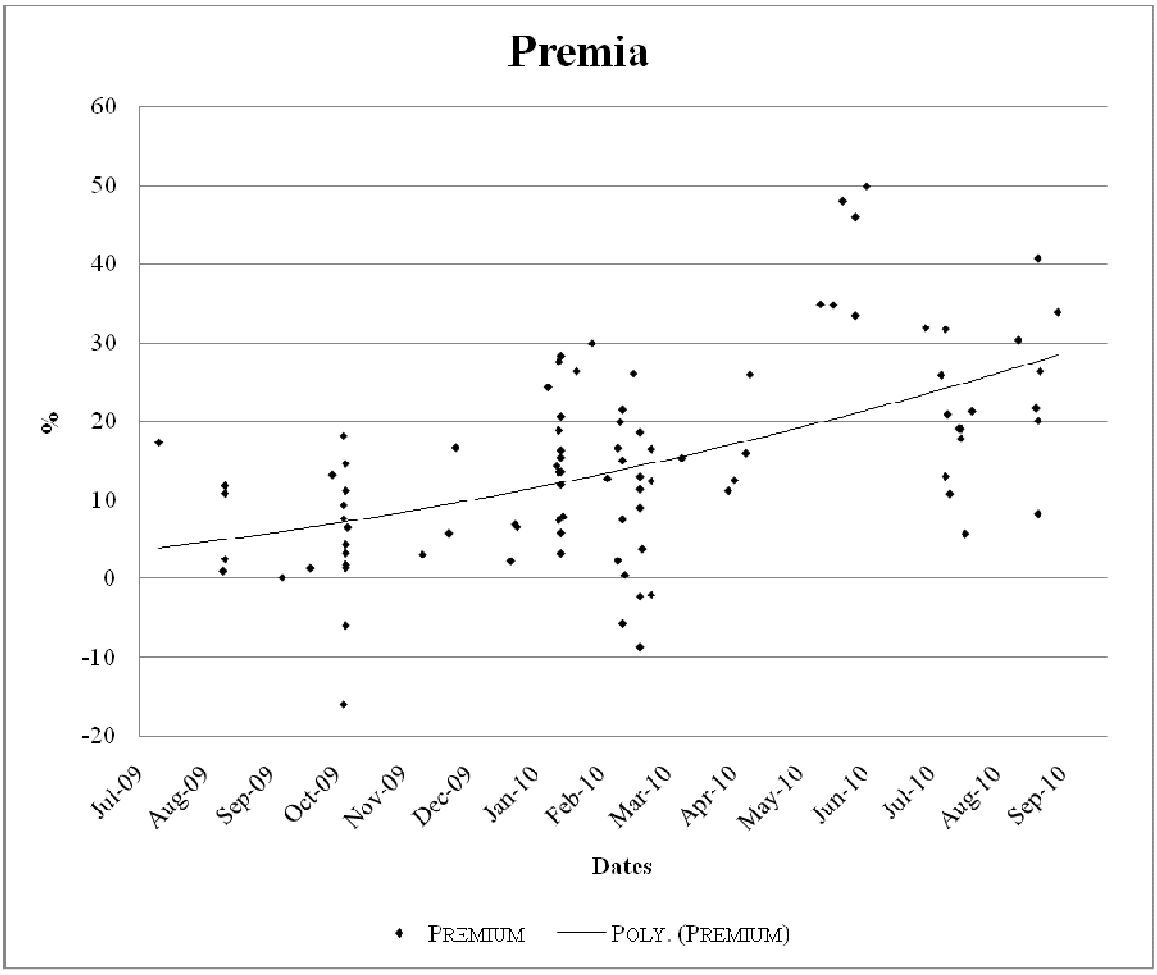

Figure 5. Target Price Premium over Current Market Price (in %)

Table 1. Summary of Analyst Reports Between April 20 – September 10, 2010

Date	Broker	Previous Recomm.	Current Recomm.	Rec. Change	Recomm. /Rank	Target Price	Market Prices	Premium
20-Apr-10	Arbuthnot	No	Buy	Initiation	5	7.21	6.48	11.23
23-Apr-10	Deutsche Bank	Buy	Buy	No	5	7.20	6.40	12.55
28-Apr-10	UBS	Buy	Buy	No	5	7.25	6.25	16.00
30-Apr-10	UBS	Buy	Buy	No	5	7.25	5.76	25.98
01-Jun-10	UBS	Buy	Buy	No	5	5.80	4.30	34.88
07-Jun-10	UBS	Buy	Buy	No	5	5.80	4.30	34.79
11-Jun-10	UBS	Buy	Buy	No	5	5.80	3.92	48.00
17-Jun-10	UBS	Buy	Buy	No	5	5.25	3.60	45.95
17-Jun-10	Deutsche Bank	Buy	Buy	No	5	4.80	3.60	33.44
22-Jun-10	Kepler	Buy	Buy	No	5		3.34	49.91
22-Jun-10	ING	Buy	Buy	No	5		3.34	
19-Jul-10	UBS	Buy	Buy	No	5	5.28	3.98	31.90
26-Jul-10	UBS	Buy	Buy	No	5	5.23	4.17	25.91
28-Jul-10	ARGUS	Buy	Hold	Down	3		3.80	
28-Jul-10	RBS	Hold	Buy	Up	5		4.02	13.08
28-Jul-10	Macquarie	Hold	Add	Up	4		4.02	31.72
29-Jul-10	HSBC	Hold	Buy	Up	5		4.13	20.93
29-Jul-10	OPPENHEIMER	Hold	Add	Up	4	4.81	4.13	
30-Jul-10	Cheuvreux	Add	Add	No	4		4.06	10.85
03-Aug-10	SOCIETE GENERALE	Hold	Buy	Up	5		4.16	19.09
04-Aug-10	J.P. Morgan	Buy	Buy	No	5		4.20	19.05
04-Aug-10	SOCIETE GENERALE	Buy	Buy	No	5		4.20	17.86
06-Aug-10	Cheuvreux	Add	Add	No	4		4.25	5.80
09-Aug-10	UBS	Buy	Buy	No	5	5.28	4.33	21.32
23-Aug-10	ING	Buy	Buy	No	5		3.91	
28-Aug-10	ARGUS	Hold	Hold	No	3		3.80	
30-Aug-10	SOCIETE GENERALE	Buy	Buy	No	5	4.95	3.80	30.38
07-Sep-10	SOCIETE GENERALE	Buy	Buy	No	5	4.95	4.07	21.68
08-Sep-10	Cheuvreux	Add	Add	No	4	4.50	4.15	8.32
08-Sep-10	J.P. Morgan	Buy	Buy	No	5		4.12	
08-Sep-10	DnB NOR	Buy	Buy	No	5	5.80	4.12	40.73
08-Sep-10	SOCIETE GENERALE	Buy	Buy	No	5	4.95	4.12	20.10
09-Sep-10	UBS	Buy	Buy	No	5	5.25	4.15	26.37
17-Sep-10	DnB NOR	Buy	Buy	No	5	5.50	4.11	33.86