

**Alternative Explanations for Managerial Flexibility:
Economic and Sociological Analyses of Mine Closing Decisions**

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Understanding how managers make decisions and react to external stimuli is an important topic that academics in many disciplines study. Economists tend to build normative models of rational behavior, such as real options models, that represent how value-maximizing agents should optimally choose to exercise the options that business presents. Sociologists tend to build positive models of behavior, characterizing how individuals and organizations are likely to respond to the world around them. Far too often, these single-disciplinary research efforts are unconnected.

In our project, we seek to use insights from both economics and sociology to study one particular managerial reaction to the environment: the decision by gold mining firms whether to open or shut mines in response to changes in gold prices. In previous research (Moel and Tufano 1999, included in the conference binder), we analyzed this decision using the real option framework of Brennan and Schwartz (1985). Using a hand-collected database, we tracked the annual opening and closing decisions of developed North American (US and Canada) gold mines in the period 1988-1997. Our analysis provided strong support for the real options approach as a useful model to describe and predict a mine's opening and shutting decisions. In particular, we found that the decision to open and close demonstrated hysteresis, and was sensitive to both the level and volatility of gold prices as well as to mines' operating costs.

Our prior research took the mine as the unit of observation, and tested if mine and market characteristics affected the decision to close. We used a narrow economic perspective, and tested whether managers behaved "rationally" in response to market and firm conditions. There are, however, different ways of looking at these decisions, where the frame of reference is not that of a "hyper-rational" decision maker. In particular, the fields of sociology and organizational behavior have developed models of

managerial decision-making where the organizational structure and context dictate the boundaries of the manager's decision-making capabilities. Sociologists and organizational theorists have, over the past twenty years, argued that economic transactions are embedded in social relations (Granovetter 1985). These social relations often account for what economists observe to be "non-rational" behavior. In this new research we explore this line of inquiry and examine the social and organizational factors that influence a firm's decision to close or reopen a mine. We recognize that important decisions such as whether to close a mine are made by managers, who often work in larger organizations (firms), and whose decision-making may reflect more than narrow economic criteria. Drawing upon the literature in sociology which deals with factors that might affect how firms respond to external stimuli, as well as the related behavior finance field, we will seek to understand how the "non-economic" factors could influence the decision whether or not to close a gold mine.

In particular, we attempt to link the normative economic models of real options with the organizational capabilities literature. To do so, we begin to explore what kinds of organizations (in this case, mining companies) are better prepared or designed to behave rationally from a purely economic perspective, and what are the organizational factors that make firms deviate from well-established rational action models, such as those postulated by the real options literature.

Drawing upon our prior work, we are again studying the closing decision in the gold mining industry. However, our focus for this paper is an intensive study of U.S. mines over the period 1995-1998, during which gold prices plunged and mine closures became much more likely. In this hostile price environment, we study the propensity of managers to close mines, in light not only of the strict economic factors, but also as a function of the following set of measures of the decision-making context facing the managers:

- **Stakeholder concerns:** Mine closings lead to the lay-offs of workers, and managers might take this into account; if so, closing activity might be related to the size of the workforce.
- **Decision maker characteristics:** The background of senior executives, such as whether they have mining or financial background, their age, and their compensation could affect the

decision to close. Other research has shown that these characteristics affect other financial decisions, such as the decision of whether and how much to hedge.

- **Organization structure:** Organizational structure (single line or multidivisional), size and age of the firm and mine could affect the decision to close in a variety of ways. They change the internal labor market for workers and affect the social bonds within the firm, which could affect a manager's willingness to close a mine.
- **Prior experience:** Managers who have previously closed mines have evidenced a willingness to act and be more likely to close unprofitable mines.
- **Overall organization profitability:** Managers at more profitable firms may be able to sustain unprofitable mines for a longer time.
- **Regulatory and legal costs:** Managers might be more likely to want to close "troublesome" mines, which have been subject to legal, regulatory, or environmental action by third parties, or plagued by labor disputes or high accident rates. These factors could be thought of as economic "costs" of operating the mine that would normally not be incorporated into real options analysis.
- **Financial impediments:** Prior debt and hedging contracts may affect a firm's ability and willingness to close a mine. For example, while the existence of a hedging contract should not necessarily affect the optimal decision of whether to close a mine, managers might be able to mentally justify keeping a hedged mine open, rather than shutting it and closing out its hedging contracts at a profit.

This new dataset is amalgam of information from financial statements, regulatory filings, industry surveys, press reports, and extant mining industry databases. We are in the process of collecting and analyzing these new data, and we will present preliminary results at the Real Options conference.

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Moel, Alberto and Peter Tufano (1999) "When are real options exercised? An empirical study of mine closings." Unpublished manuscript.

Granovetter, Mark. (1985) "Economic Action and Social Structure: The Problem of Embeddedness." *American Journal of Sociology* 91(3):481-510.