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BUSINESS MODEL AND FIRM'S FINANCIAL PERFORMANCE: EVIDENCE FROM THE CANADIAN MINING SECTOR

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***Abstract**: In this paper, we investigate the impact of business model design on the performance of Canadian mining companies. We propose a comprehensive typology of business models and use a variety of financial performance measures to test whether some business models do perform better than others. The findings indicate that all business models generate lower returns in comparison to a well diversified market portfolio. In addition, we have only weak evidence suggesting that some models (Productors and Streaming/Royalties) do have better financial performance than others. Overall, our results show that Canadian mining companies need to reevaluate the elements of their current business models.*

***Keywords**: Business model, financial performance, economic logic, value creation, value capture, conditional performance*

Introduction

Over the last decade, the term "business model" has become an integral part of business practices and an important issue to both the academic and business world. The emergence and development of this concept is linked to the need of understanding how companies create and capture sustainable value in an integrative approach (Sahut et al. 2013, Malone et al. 2006; Zott and Amit, 2007; Sumaiyah and Rosli, 2011). To date however, there has been little evidence suggesting that business model designs play a positive and powerful role in value creation. Therefore, we propose to examine in depth the relationship between business models and firms' financial performance, especially for Canadian mining companies. We specifically address the following questions: (1) *Can firms' financial performance be explained by heterogeneous business model designs?* (2) *Which business models in the mining sector have created substantial value for shareholders?* In the literature, a handful of papers have examined the connection between firms' business models and firms' financial performance. In this respect, the main motivation of our work is to reinforce the implementation of the business model concept as an explanatory variable for firm's financial performance. If differences in business model designs can explain differences in firms' performance, we can imply that business model concept does in fact correlates with firm's performance. This should pave the way for promising avenues for future research. For instance, academics could focus on identifying the main features of the business model that influence firm's performance, which may be useful to gain some insights into the economic logic behind successful business models. Through our analysis, we do not attempt to answer questions about why risk management and performance implications exist. We do not also address how managers can modify their business model in order to increase performance. We hope that our research will provide foundations for future work on these important questions.

So far, most studies that investigate the influence of business model focus on high-tech industries and on information and communication industries. In this study, we limit our sample to Canadian mining companies that are listed on Toronto Stock Exchange over a seven-year period (from 2007 to 2014). The importance of the mining sector to the Canadian economy is well established. We then hope that the study outcomes will contribute to a better understanding of the key drivers of superior performance in this sector. Results will also have implications on the scholarly debate about the main relevant firm-level factors that help create value for shareholders. Our analysis provides a theory-grounded proposition for a comprehensive typology of business models, but the main contribution is primarily empirical.

In this respect, our work contributes to the literature in two different ways. First, to the best of our knowledge, this study is the first theoretical and empirical analysis that addresses the important role of business models in the mining industry. We are not aware of any other paper showing that business models designs do matter to the performance of mining companies (in particular Canadian mining companies). We are confident that our findings will contribute to a better understanding of the mechanisms that have a direct impact on value creation in the mining industry. Second, we rely on conditional performance evaluation (e.g. conditional alpha) in addition to traditional performance evaluation (e.g. unconditional alpha). The conditional approach addresses one major shortcoming of the traditional approach (risk stability assumption). In fact, conditional performance approaches allow expected returns and risk to vary over time with the state of economy which is not the case of traditional performance measures (Ferson and Schadt, 1996). Furthermore, when we compute firms' financial performance, we also propose to relax the normality distribution hypothesis and take into consideration higher moments (e.g. third and fourth moments). So far, the existing literature that examines the relationship between business models designs and financial performance relies only on traditional performance measures.

Results from Jensen's alpha approach (traditional and conditional) suggest that all business models generate lower returns in comparison to a diversified market portfolio. In addition, our univariate tests show no significant differences in financial performance between our four business models. Finally, based on Tobin's Q multivariate approach, we find that some business models do perform better than others. For instance, *Streaming/Royalties* and *Productors* do better than *Explorers/Developers* and *Grassroots/Prospect generators*. Overall, our evidence suggests that there is no return premium linked to our four business models. We argue that even if some business models do offer good economic logics (e.g. Streaming/Royalties), it seems that there is a gap between economic logic and execution. Therefore, companies in the mining industry need to reinvent their business models in order to create value for shareholders.

The remainder of the paper is organized as follows. Section 2 reviews prior literature and develops our main hypotheses. In sections 3, we explain the measurement of financial performance and our research design. Section 4 describes the data, sample selection, and presents our main empirical findings. Section 5 concludes.

Literature Review and Hypotheses Development

To date, little empirical evidence relates business model designs to firms' performance. For instance, Malone et al. (2006) study is based on a business model typology that combines two criteria: 1) What type of assets is sold (e.g. financial or physical) and 2) what asset rights are sold (e.g. manufacturers who sell the ownership of an asset or brokers who sell the right to be matched with potential buyers and sellers). They find that manufacturers do better than distributors on physical assets. They also show that brokers of financial assets outperform distributors of physical assets. In the same line of reasoning, Zott and Amit (2007) differentiate between novelty-centered business models that adopt new ways of conducting business and efficiency-centered business models that adopt similar ways, as others established firms, but in a more efficient manner (e.g. through reduction of production costs). Their empirical findings suggest that novelty-centered designs outperform efficiency-centered designs. As for Sumaiyah and Rosli (2011), they focus on four business model dimensions: stakeholders, competencies, value creation and value capture. Their analysis suggests that only firm competencies have a significant impact on financial performance. Redis (2009) looked at three features of business models: the positioning of business activity on the industry value chain, the type of customer, and firm's income model. Redis (2009) results indicate that firm's positioning and customer type have a significant effect on profitability. In this study, we propose an operational classification based on how a firm creates and captures value and where it is positioned in the value chain.

Due to the multiplicity of business model components and the diversity of classification schemes in the literature, we argue that there is no single right way to characterize different types of business models especially in the mining industry. However, in this project, we propose an intuitive and simplified articulation of the business model. The objective is twofold: On the one hand, we will avoid injecting further noise into our empirical tests. On the other hand, we will be better able to explain our results to a variety of stakeholders (e.g. firms' managers, institutional investors and the general public). Recently, a handful of authors have attempted to uncover a more parsimonious set of factors that help describe the essential nature of a good business model. There appears to be an emerging consensus on the main elements of a good business model. For instance, these authors (e.g. Hamel, 2000; Shafer et al. 2005; Sumaiyah et al. 2008) agree that the main goal of a business model is to help firms create and capture value. Hamel (2000) suggests that the business model must deliver benefits that are worth more than the costs. Shafer et al. (2005) argue that: "business is fundamentally concerned with creating value and capturing returns from that value" (p.4). Sumaiyah et al. (2008) consider that business models should: "summarize the key factors underlying value creation" (p.9). These authors also agree that value creation and value capture should occur within a value network/chain (partners, suppliers and other stakeholders). According to Shafer et al. (2005): "the role a firm choose to play within its value network is an important element of its business model"(p.4). Rappa (2002) also suggests that the positioning of the firm's business on the value chain should influence its future earnings. Furthermore, such authors argue that business models should also reflect the strategic choices that have been made (e.g. firm's main mission, firm's positional advantages, firm's core competencies, firm's strategic resources....). We then formally define business models as: "a representation of a firm's underlying core logic and strategic choices for creating and capturing value within a value network" (Schafer et al. 2005, p.4). The business model typology we propose assumes that business models components that need to be examined should refer to this definition. The latter includes four key factors/components: 1) *strategic choices/economic logic, 2) value network, 3) value creation and*

4) value capture (see Schafer et al. 2005 and Table 1 for more details). As suggested earlier, firm's strategic choices and economic logic refer to firm's capabilities/competencies, the business mission/goal, the target market/supply chain ….etc. These choices should impact value creation and value capture. For instance, some firms in our sample will focus on early stage exploration based on their internal competencies (geological expertise). Others will focus on extraction and production using their managerial abilities (e.g. high operational efficiency, financial discipline etc.). We argue that the underlying logic behind focusing on exploration is to provide value to shareholders at lower costs and economic risk but a higher geological risk (See Table 1 for a definition of economic and geological risk). In the same line of reasoning, the underlying logic behind operating a mine is to provide value at higher costs and economic risks but a lower geological risk (in comparison to explorers). Furthermore, we argue that the positioning of the firm's business on the value chain should impact its future cash flows (Rappa, 2002; Redis, 2009). It will also affect the time to become profitable and the amount of capital raised from investors (Rappa, 2002; Redis, 2009). The value network component refers to suppliers, partners, coalitions etc... For instance, in constructing their business model, some mining companies may choose to partner with other firms to reduce costs, risks, increase their power and access critical resources. Others will not consider working with partners to avoid becoming too dependent upon the partner. Each of these alternatives will have different costs, revenues and risk implications. Ultimately, the impact on firm's value creation will also be different. Other important components of firms' business model will also be investigated based on the typology proposed in Table1. It is worth mentioning that our key factors/components overlap with several of the theoretical frameworks developed in the literature (e.g. Sumaiyah et al. 2008; Hamel, 2000).

To implement our empirical analysis, we should first classify our sample firms into different business model categories before we calculate key measures of financial performance for each business model type. The questions we address are the following: *which business model have created substantial value for shareholders? Which factors distinguish the business model that did well?* Such analysis will be applied to four types of business models (four portfolios). Table 1 identifies our main business models and explains the economic logic and components of each business model.

Table1: Components of Business Model (sources: Shafer et al. 2005 and Roderick, 2010)

Business Model	STRATEGIC CHOICES AND ECONOMIC LOGIC	VALUE NETWORK	VALUE CREATION	VALUE CAPTURE
Grassroots + Prospects generators (GRPG)	*Mission : early stage exploration *Competencies : geological expertise * Strategy and economic logic: providing value at lower costs and economic risk[1] but	*Information flows: geological, geochemical and geophysical information gathering are important *Early stage of the mineral supply chain	*Potential profits are high *The downside is nearly 100% (no discovery) *Value creation is highly correlated with continual funding and with	*inexpensive operations compared to advanced exploration and mining production

[1] Economic risk: a combination of technical, environmental, social, political and financial risk (Roderick, 2010). *Technical risk*: likelihood and degree to which actual recovery of a mineral during mining and processing differs from

Business Model	STRATEGIC CHOICES AND ECONOMIC LOGIC	VALUE NETWORK	VALUE CREATION	VALUE CAPTURE
	at a higher geological risk[2]	*No partnerships: Grassroots exploration, mineral deposit discovery and sales of rights to other companies *Partnerships and coalitions: Grassroots exploration, mineral deposit discovery and take on a partner to jointly undertake further exploration	the discovery of a deposit *Funding is highly correlated with commodity prices *Assets can be easily redeployed into another locations or countries (lower political risk)	
Explorers + Developers (EXDV)	Mission : advanced stage exploration *Competencies : geological expertise * Strategy and economic logic : providing value at higher costs and economic risk (in comparison to GRPG) but at a lower geological risk (in comparison to GRPG)	*Information flows: geological, geochemical and geophysical information gathering are important *Enter the supply chain at an advanced stage	*Potential profits are high *The downside risk remains higher *Value creation is highly correlated with the discovery of a deposit *Assets can be easily redeployed into another locations or countries (lower political risk)	* Expenditures are larger than GRPG but lower than mining.
Productors (PROD)	* Mission : Operating mines	*suppliers are important	*Potential profits are lower in	*Expenditures are larger than GRPG and EXDV

what was anticipated (Roderick, 2010). *Environmental, social and political risk*: likelihood and degree to which actual environmental degradation, impact on local communities, public attitudes and public policies differ from what was expected at the time of initial investment (Roderick, 2010). *Financial risk*: likelihood and degree to which actual revenues and costs differ from what was anticipated at the time of investment (Roderick, 2010).

[2] Geological risk: probability that exploration and development projects lead to a profitable mine (Roderick, 2010).

Business Model	STRATEGIC CHOICES AND ECONOMIC LOGIC	VALUE NETWORK	VALUE CREATION	VALUE CAPTURE
	*Competencies: efficient production systems and coordination; high capital productivity; information management; supply Management; technological and operational efficiency. *Strategy and economic logic: Providing value at higher costs and economic risks (in comparison to GRPG and EXDV) but a lower geological risk (in comparison to GRPG and EXDV)	*Downstream position in the value chain	comparison to GRPG and EXDV *Assets can't be redeployed cheaply (high political risk) *Costs efficiency-centered business models should create value for shareholders *Profits are highly correlated with mineral prices and production costs *Operating leverage is important (fixed versus variable costs)	*More efficient production systems should help firms capture more value *Costs control and financial discipline should help firms capture more value
Streaming+ Royalties Compagnies (STRM)	*Mission : streaming and royalties deals with multiple miners *Competencies: deals and contracts negotiation *Strategy and economic logic: providing value at lower costs, lower economic and geological risk	*Trade associations with multiple miners	*Potential profits are high *Risk diversification *Limited downside risk * More control on mineral prices variations	*inexpensive and less risky operations compared to GRPG, EXDV and PROD

The first business model refers to Grassroots and prospect generators (GRPG). Theoretically, companies that employ this business model are supposed to provide value for shareholders at lower costs and economic risk but at higher geological risk. This business model type focuses only on exploration. In fact, prior to the selection of a geological deposit, Grassroots continually raise money and employ their competencies to make a significant discovery without taking on a partner. This continual financing process results in shares dilution which reduces the potential reward of any discovery as time goes by. In addition, investors who focus only on grassroots exploration are exposed to the very poor odds of a significant discovery. In fact, the probability that a specific exploration project leads to an important discovery is very low. As suggested by Roderick (2010): “It takes 500-1,000 grassroots exploration projects to identify 100 targets for advanced exploration, which in turn lead to 10 development projects, 1 of which becomes a profitable mine” (p.4). On the other hand, when exploration is successful, the return on investment is very high. The GRPG business model includes also companies that emphasize grassroots exploration while partnering with larger mining companies that will fund the expenditures needed for the “big discovery”. Both partners will then share the rewards. Investors who buy stocks of grassroots and prospect generators get involved in early stages of finding a mine. Hence, by entering the supply chain at an early stage, they should wait longer before receiving expected revenues. On the other hand, in early stages of exploration the external effects from mining activities on the environment and local communities are minimal. It is worth mentioning that GRPG business model requires continual financing and can work when mineral prices are high. Therefore, funding plays an important role in value creation because during periods of low mineral prices, sources of financing for exploration are difficult to obtain. A portfolio of grassroots and prospects generators should not be considered as a diversified portfolio. As stressed by Cook (2009), if you put the shots at success at 1 in 100, investors need to fund 100 firms for a single firm having a significant discovery. On the other hand, even if a company stock price goes up 10 times in the event of an important discovery, this still means that investors should lose 90% of their investment (Cook, 2009). The presence of prospect generators in the portfolio will increase the diversity effect but prospect generators can also explore many years without discovering the next “holy grail”. Hence, adding prospect generators to the portfolio does not take away the downside risk. In the mining sector, it is well known that mineral exploration has very low probability of success. Unfortunately, the core strategies behind our first business model do not serve as a foundation for how to solve such important issue. For instance, the main economic logic behind our first business model is to have more exposure to the geological risk and less exposure to the economic risk. However, the exposure to a risk that has a high percent probability of occurring should not be a greater driver of value creation. The above arguments suggest that investing in a large portfolio of grassroots and prospect generators is a risky business with low odds of generating high returns.

Hypothesis 1: GRPG business model should not create value for shareholders

Companies in our second business model (Explorers/Developers: EXDV) enter the supply chain by participating in advanced exploration of a deposit already discovered by others or by developing a known but undeveloped deposit. This business model is supposed to provide value to shareholders at higher costs and economic risk but at lower geological risk (in comparison to GRPG). As suggested by Roderick (2010), by entering the supply chain at a later point, explorers/developers reduce the time it takes to mining but at the same time they are less likely to fully capture the high profitability of an important discovery. In fact, when a firm purchases a partially explored or developed deposit, it also commits to share the expected returns with the seller (Roderick, 2010). Furthermore, expenditures by explorers/developers are larger than those by grassroots and prospect generators. On the other hand, the probability of exploration success is higher. During advanced exploration and deposit development, environmental and social impacts remain moderate compared to those of mine development (e.g. construction of mine facilities and infrastructure, mineral processing etc…). A portfolio of explorers/developers should be considered as a more diversified portfolio in comparison to a GRPG portfolio. Such portfolio should generate more chances and more shots at success. But, even if it is true that geologic risks are low in comparison to GRPG business model, investing in explorers/developers is still a risky business. We argue that the payoff of investing in a handful of well managed explorers/developers can be sizable. However, the odds of making money investing in a large portfolio of explorers/developers are still low. Here again, the main economic logic is to be exposed to a particular risk (geological risk). The latter still has a high percentage of occurring. In fact, advanced exploration does not increase significantly the probability that exploration projects will lead to a profitable mine. Hence, we hypothesize that:

Hypothesis 2: EXDV business model should not create value for shareholders

Finally, whether EXDV business model should create more value than GRPG business model remains an empirical issue.

Our third business model refers to mining production (PROD); in which all associated facilities and infrastructure of a mine are planned and constructed. This business model incorporates the purely economic risk that future commodity prices and production costs differ from actual expectations. The main logic behind this model is to avoid geological risk and be more exposed to economic risk. In this business model, we argue that the most effective way for companies to create value for shareholders is to continually reduce operating costs (e.g. maintenance, labor, energy etc..) and improve capital productivity even during a commodity super cycle. In fact, when commodities prices are high, the focus should not be only on increasing production volumes to take full advantage of the upward cycle because such advantage could easily be compromised in market downturns if companies fail to achieve sustainable costs savings. In other words, costs reduction strategies should not be reactionary (e.g. when commodity prices go down). Hence, sustainable costs reduction approaches are very important for a sustainable shareholders value creation. In addition, improving capital productivity (flexible and effective capital expenditures) can also allow companies to be better prepared for inevitable market downturns (Lopez and Carter, 2015). This is important because as mining projects mature, the degree of influence over production costs plunges seriously in particular after the construction of facilities begins (Lopez and Carter, 2015). For these reasons, as suggested by Lopez and Carter (2015), it is crucial that projects capital expenditures and detailed designs be challenged early in the project development cycle (before construction begins and during the scoping, prefeasibility and feasibility). In the same line of reasoning, avoiding environmental degradations and local communities' disruptions are additional key factors for value creation because mining production can have significant impacts on the environment and local communities. The above arguments suggest that cost efficiency centred companies should create value for shareholders. On the other hand, if production companies are unable to adopt management practices that help achieve sustainable costs savings and improve capital productivity, our third business model should not create value for shareholders:

Hypothesis 3a: Cost-efficiency centred business models should create value for shareholders

Hypothesis 3b: cost-inefficiency centred business models should destroy value for shareholders

Hypothesis 3c: Cost-efficiency centred business models should create more value for shareholders in comparison to EXDV and GRPG business models

Our last business model includes royalty and streaming companies (STRM business model). Such companies provide capital to mining companies in exchange for the rights to receive revenues linked to mines output (royalties) or to buy a percentage of the production at agreed upon prices (streaming). The main purpose of this business model is to provide value for shareholders at lower costs and lower financial, environmental, social, technical and geological risk. The economic logic is to "minimize" both geological and economic risk. Companies that employ this business model have agreements with several mining companies. Hence, a portfolio of royalty and streaming companies can be considered as a diversified portfolio. In addition, royalty and streaming companies are exposed more to the upside potential profits but less to the downside risk. For instance, royalty companies are paid out of revenues of mines before operating costs are accounted for. In addition, by fixing prices, companies in this business model have control on mineral prices variations and are less exposed to such variations. Further, even if commodity prices were to drop below the fixed price, it is still possible to buy at the lower of the agreed upon price or the market price. Therefore, we hypothesize that:

Hypothesis 4a: STRM business model should create value for shareholders

Hypothesis 4b: STRM business model should create more value for shareholders in comparison to EXDV, GRPG, PROD business models

Empirical Methodology

Given the high level of uncertainty associated with mining companies' prospects, we argue that market performance (e.g. Tobin's Q and Jensen alpha) is a particularly suitable measure for our sample. We don't focus on realized performance measures (e.g. ROI, ROA and ROE) because many firms in our sample do not have sufficient accounting data to compute these measures.

Our first measure of financial performance is Tobin's Q (the ratio of the market evaluation of assets to the replacement cost of assets):

$$Q_{i,t} = (\textit{Market value of equity} + \textit{book value of assets} - \textit{book value of equity}) / \textit{book value of assets} \quad (1)$$

Higher Q (Q>1) indicates that firms are earning a rate of return higher than that justified by the cost of their assets. On the other hand, when the market is valuing firms assets below their replacement costs (Q<1), this indicates that investors expect the deployed assets to earn insufficient rates of return. Business models with high Tobin's Q will be considered as the ones who created more value for shareholders.

Our second measure of financial performance is Jensen's unconditional alpha. All papers that investigate the association between business models and financial performance use unconditional alphas as a proxy for such performance. However, the unconditional approach assumes that risk is constant over the entire evaluation period. In this study, we relax this hypothesis by using conditional performance evaluation. The latter allows portfolios risk and market premiums to vary over time with the state of the economy (Ferson and Schadt, 1996). This is important because it is acknowledged in the literature that investors' expectations and the second moments vary over time.

The traditional (unconditional) Jensen's alpha can be written as follows:

$$R_{Pt} - R_{ft} = \alpha_P + \beta_P (R_{Mt} - R_{ft}) + \varepsilon_{Pt} \quad (2)$$

Where α_P is the unconditional alpha (our second proxy for financial performance); R_{Pt} is the return of portfolio P (e.g. portfolio of grassroots and prospect generators); R_{ft} is the risk-free rate; R_{Mt} is the return of the market portfolio (Global mining industry index: our benchmark portfolio); β_P is the unconditional beta of portfolio P; and ε_{Pt} is an error term. α_P is the average abnormal return in excess of the return of the market portfolio. A positive and significant α_p indicates higher financial performance.

A conditional version of Jensen's alpha is represented by the following equation:

$$R_{Pt} - R_{ft} = \alpha_{cp} + \beta_{0p} (R_{Mt} - R_{ft}) + B'_{1p} (z_{t-1} \times (R_{Mt} - R_{ft})) + \varepsilon_{pt} \quad (3)$$

Where α_{cp} is the conditional alpha; B'_{1p} is the vector measuring the sensitivity of beta to the vector of public information variable (Z_{t-1}); β_{0p} is the average beta of portfolio P; z_{t-1} is the difference between the realization of the macroeconomic variables (public information) and their unconditional average ($Z_{t-1} - E(z)$). The conditional measure (equation 3) proposed by Ferson and Schadt (1996) assumes that beta is a linear function of predetermined public macroeconomic variables (Z_{t-1}) at period t-1. In fact, using a Taylor series expansion, our portfolios beta can be written as follows:

$$\beta_p (z_{t-1}) = \beta_{0p} + B'_{1p} z_{t-1} \quad (4)$$

In the financial literature, most studies use various predetermined macro-variables to measure the vector of public information variable (Z_{t-1}): e.g. market dividend yield, liquidity premiums and default risk premiums. In our analysis, we propose to include into equation 3 these macro-variables and a variety of risk factors that explain firm returns (Fama and French (1992) and Carhart (1997) factors). These additional factors will be measured by firm's size (SMB: small minus big); book-to-market ratio (HML: high minus low) and Carhart momentum factor (UMD: up minus down). SMB factor mimics small firms' anomaly. HML mimics income stocks anomaly, and UMD mimics the momentum anomaly. Hence, our extended measure of financial performance is represented by the following equation:

$$R_{Pt} - R_{ft} = \alpha_{cp} + \beta_{0p} (R_{Mt} - R_{ft}) + B'_{1p} (z_{t-1} \times (R_{Mt} - R_{ft})) + \beta_{2p} (SMB) + \beta_{3p} (HML) + \beta_{4p} (UMD) + \varepsilon_{pt} \quad (5)$$

α_{cp} in equation (5) should be our third proxy for financial performance. The conditional alpha represents the abnormal return in excess of the return of a combination of the market and investors dynamic strategies. A positive and significant conditional alpha (α_{cp}) indicates higher financial performance.

Results

Univariate analysis

Our sample consists of all mining firms (1356) listed on Toronto Stock Exchange (TSX) and Toronto Venture Exchange (cf. www.tsx.com for more details). To test the relationship between our business model designs and financial performance, we propose to perform univariate estimations for four portfolios pooled by business model typology (A portfolio estimation approach). We then construct value weighted portfolios over the period running from December 2007 to December 2014 and use weekly returns in our empirical tests. As in previous studies that rely on weekly data, we implicitly assume that investors trade and assess risks and returns using a one-week horizon. It is worth mentioning that our sample period is plagued by the financial crisis (2008). Hence, it is important to control for 2008 year effect. In the same line of reasoning, our sample of portfolios has the potential for survivorship bias as it contains only surviving mining companies at the end of our period. Survivorship may be expected to bias performance evaluation upward (Ferson and Schadt, 1996). Market prices (returns) for each firm are extracted from Yahoo Finance Database. In addition, we obtained accounting data for each firm (Total assets; Debt ratio; Return on assets etc…) from Ycharts Inc Database. Finally, the Bank of Canada website provides information on macro-variables that proxy the (Z_{t-1}) vector.

Table 2: Descriptive statistics

Statistics appearing in this Table (Panel A) are computed using weekly returns of 4 portfolios pooled by business model typology; a portfolio consisting of all mining companies in TSX and TSX Venture Database (OVERALL portfolio); and a market portfolio (global minig index). Panel B presents Tobin's Q measures for the 4 portfolios pooled by business model typology. We provide the mean, standard deviation, minimum, maximum, and the number of observations. The sample period is from December 2007 to December 2014.

Panel A

Returns	Mean	Std dev	Min	Max	N
GRPG Portfolio	-0.0012	0.0297	-0.2046	0.1105	365
EXDV Portfolio	-0.0019	0.0439	-0.2021	0.1595	365
PROD Portfolio	0.0042	0.0443	-0.1859	0.2051	365
STRM Portfolio	0.0021	0.0490	-0.1821	0.2337	365
OVERALL Portfolio	0.0025	0.0427	-0.1632	0.1949	365
Market Portfolio	-0.0015	0.0461	-0.2675	0.1937	365

Panel B

Tobin's Q	Mean	Std dev	Min	Max	N
GRPG Portfolio	2.9311	11.5112	0.0021	363.054	2655
EXDV Portfolio	2.6175	8.5758	0.0035	214.674	2532
PROD Portfolio	1.8006	3.7328	0.0123	72.1972	641
STRM Portfolio	2.9277	5.1473	0.0148	21.1215	66

Table 2 presents descriptive statistics for our four business models portfolios (GRPG (691 firms); EXDV (528 firms); PROD (122 firms) and STRM (15 firms)); a portfolio that include all mining companies regardless of their business model typology (OVERALL portfolio); and for a value weighted global mining index (our proxy for the market portfolio). In term of total mean return (cf. Panel A of Table 2), the performance of PROD portfolio (0.00427 or 0.427% return per week) is greater than the performance of the remaining portfolios (e.g. -0.0019 for EXDV, -0.0012 for GRPG, and -0.0015 for the market portfolio). Our primary findings also indicate that STRM portfolio generates higher returns in comparison to EXDV, GRPG and the market portfolio. In addition, the standard deviations of the returns do not differ greatly from one portfolio to the other, expect for GRPG portfolio that exhibits the lowest standard deviation of returns (0.0297). This seems puzzling knowing that investing in a GRPG portfolio is a risky business. To test whether these differences in mean returns are significant, we perform mean difference tests (see Table 3 for more details). The latter suggest that all differences in financial performance are not significant (in term of mean return).

Table 3: Z-test results for differences in the means

This table presents mean difference tests. The sample period is from December 2007 to December 2014. One, two, and three asterisks denote significance at 10%, 5%, and 1% respectively.

	Z-test GRPG vs. EXDV	Z-test GRPG vs. STRM	Z-test GRPG vs. PROD	Z-test EXDV vs. STRM	Z-test EXDV vs. PROD	Z-test STRM vs. PROD	Z-test GRPG vs. Market	Z-test EXDV vs. Market	Z-test STRM vs. Market	Z-test PROD vs. Market
Difference in returns	0.0007	-0.0034	-0.0055	-0.0041	-0.0062	-0.0020	0.0003	-0.0003	0.0037	0.0058
Difference in Tobin's Q	0.3136	0.0033	1.130***	-0.3103	0.816***	1.1271				

Hence, based on portfolios returns, our primary analysis clearly supports the view that all business models designs do not outperform a value weighted market portfolio. In addition, there are no significant differences in financial performance between GRPG, EXDV, PROD and STRM portfolios. In term of Tobin's Q, our univariate findings (cf. Table 3 and Panel B of Table 2) indicate that some business models perform better than others. For instance, we show that GRPG (2.9311) and EXDV (2.6174) have significant superior Q Tobin's in comparison to PROD (both tests of mean difference are significant at 1% level). On the other hand, there is no difference in Tobin's Q between STRM business model (2.9277) and PROD business model (1.8006). Similarly, based on Tobin's Q, there are no significant differences between financial performances of GRPG, EXDV and STRM business models.

Taken together, we interpret our univariate results as evidence that our business model designs do not create value for shareholders. In other words, none of the business model designs seem superior across both performance measures. However, we argue that our empirical tests should also be performed using a multivariate analysis because conclusions from univariate tests do not account for the potential interrelationships among a variety of variables that may impact firm's financial performance.

Multivariate Analysis

Table 4 reports the coefficient estimates of equation 2 (cf. model 1) and variants of equation 5 (cf. model 2 and 3). As suggested earlier, one proxy for financial performance is Jensen's alpha (the slopes of equation 2 and 5). The latter measures the abnormal return in excess of the return of a market index combined with investment strategies that use readily available public information. Positive and significant coefficients mean that each portfolio generates higher financial performance. In other words, with alphas > 0, we can conclude that our portfolios have beaten the market over the sample period. On the other hand, negative alphas indicate poor average performance.

Table 4**:** Jensen's alpha and business model designs

For each business model design, we present OLS estimations of the unconditional version of Jensen alpha (cf. model1) and the conditional version (cf. Model2) of the four factors approach (Market, SMB, HML and UMD). In model (3), we include into equation (5) year dummies (coefficients not tabulated) to take into consideration year fixed effects. In addition, to control for investors dynamic strategies, we use interactions between market risk premium variable (R_{Mt} - R_{ft}) and lagged values of market yield dividend, liquidity premium and default risk premium (model 2 and 3). P-values for two-tailed tests are in parentheses. One, two, and three asterisks denote significance at 10%, 5%, and 1% respectively.

Independent Variables	GRPG Portfolio			EXDV Portfolio			PROD Portfolio			STRM Portfolio		
	Model 1	***Model 2***	***Model 3***	***Model 1***	***Model 2***	***Model 3***	***Model 1***	***Model 2***	***Model 3***	***Model 1***	***Model 2***	***Model 3***
Jensen alpha	**-0.0206 (0.001)*****	**-0.0189 (0.001)*****	**-0.0388 (0.001)*****	**-0.0202 (0.001)*****	**-0.0154 (0.001)*****	**-0.0372 (0.001)*****	**-0.0159 (0.001)*****	**-0.0124 (0.010)*****	**-0.0242 (0.005)*****	**-0.0172 (0.001)*****	**-0.0138 (0.010)*****	**-0.0280 (0.004)*****
R_{Mt} - R_{ft}	0.2612 (0.001)***	0.3263 (0.001)***	0.2104 (0.001)***	0.3142 (0.001)***	0.4977 (0.001)***	0.3741 (0.014)**	0.2476 (0.001)***	0.3804 (0.009)***	0.3064 (0.056)*	0.2745 (0.001)***	0.4314 (0.008)***	0.2931 (0.101)
Market dividend yied$_{t-1}$ x (R_{Mt} - R_{ft})		0.0022 (0.632)	0.0033 (0.467)		0.0170 (0.015)**	0.0179 (0.011)**		0.0105 (0.146)	0.0110 (0.135)		0.0164 (0.043)**	0.0183 (0.027)**
Liquidity premimum$_{t-1}$ x (R_{Mt} - R_{ft})		-0.0576 (0.212)	-0.0313 (0.505)		-0.1273 (0.067)**	-0.1003 (0.162)		-0.1048 (0.146)	-0.0880 (0.242)		-0.0611 (0.447)	-0.0210 (0.802)
Default risk premium$_{t-1}$ x (R_{Mt} - R_{ft})		0.0108 (0.799)	0.0392 (0.360)		0.0491 (0.442)	0.0788 (0.227)		0.0411 (0.534)	0.0586 (0.392)		0.0101 (0.891)	0.0435 (0.570)
SMB		0.0040 (0.071)*	0.0037 (0.093)*		0.0089 (0.009)***	0.0086 (0.011)**		0.0094 (0.008)***	0.0093 (0.009)***		0.0029 (0.455)	0.0029 (0.453)
HML		0.0061 (0.003)***	0.0052 (0.010)***		0.0038 (0.213)	0.0029 (0.347)		0.0036 (0.251)	0.0031 (0.339)		-0.0004 (0.903)	-0.0015 (0.667)
UMD		0.0006 (0.519)	0.0001 (0.879)		-0.0002 (0.890)	-0.0005 (0.710)		0.0004 (0.775)	0.0003 (0.844)		0.0012 (0.482)	0.0011 (0.548)
Year dummies (6 years)			YES			YES			YES			YES
R^2	0.1610	0.1951	0.2444	0.1085	0.1507	0.1817	0.0666	0.0984	0.1093	0.0667	0.0831	0.0960
N	365	365	365	365	365	365	365	365	365	365	365	365

Table 4 results show that estimates of the alphas are negative and significant at 1% level for all portfolios. For instance, the unconditional alpha for GRPG portfolio is -0.0206 with a p-value of .001. The conditional alpha for the same portfolio (cf. model 2) is also negative (-0.0189) and significant at 1% level (.001 p-value). When we add year dummies into equation 5 (cf. model 3) to account for years fixed effects (especially 2008 year fixed effect), the conditional alpha remains negative and significant (-0.0388 with a p-value of .001). This evidence is consistent with the presence of a significant negative relation between our business model designs and financial performance proxied by Jensen's alpha. Overall, Jensen's measure would lead to the inference that all business models have underperformed a well diversified mining index, suggesting that none of them have created value for shareholders over the period running from December 2007 to December 2014. To date, the findings are consistent with hypothesis 1, 2 and 3b but reject hypothesis 3a, 3c, 4a and 4b.

In addition to Jensen's alpha, we also use Tobin's Q as an additional proxy for corporate financial performance. More specifically, we run regressions where each business model type is an explanatory variable (dummy variable) and each firm's Tobin's Q is the dependant variable (firm-by-firm estimation approach). Our main specifications are:

$$Tobin's Q_{i,t} = \beta_0 + \sum_{i=1}^{n} \beta_i BM_{i,t} + Controls_{i,t-1} + Firm - effects + year - effects + \varepsilon_{i,t} \quad (6)$$

Where financial performance is firm's Tobin's Q, BM represents business models explanatory variables (dummies for each business model typology set to 1 if the firm belongs to a specified class of business models and 0 otherwise). We also include a variety of explanatory variables (firm-level data) that control for additional factors that determine firm value and performance. Table (5) summarizes the measurement of explanatory variables of equation 6.

Table 5: Variables definition and measurement

Variable		Variable measurement
1.STRM dummy		Dummy variable set to 1 if the firm belongs to STREAMERS /ROYALTIES business model and 0 otherwise
2. EXDV dummy		Dummy variable set to 1 if the firm belongs to EXPLORERS + DEVELOPPERS business model and 0 otherwise
3. GRPG dummy		Dummy variable set to 1 if the firm belongs to PROSPECTS GENERATORS+ GRASSROOTS business model and 0 otherwise
4. PROD dummy		Dummy variable set to 1 if the firm belongs to PRODUCTORS business model and 0 otherwise
5. LOGTA	Firm size	Log of total assets
6. DEBTR	Debt ratio	Total debt/total assets
7. RNDR	R&D expenditure ratio	Research and development expense / total assets
8. CAPEX	Capital expenditures (Investment)	Capital expenditure expense / total assets

Variable		Variable measurement
9. SGRWT	Sales Growth	Sales growth rate from t-1 to t
10. DIVR	Dividend ratio	Dividend /Book value of equity
11. ROA		Return on asset ratio

Our sample is an unbalanced panel that includes 5232 firm-year observations during the period December 2007 to December 2014. To address concerns about potential autocorrelations and unobserved heterogeneity in the data, we use a variety of estimation techniques for panel data analysis. First, to choose between fixed and random effects estimation, we use the Hausman test. The latter rejects the null hypothesis in favor of the fixed effects model. However, to further test the robustness of our results, we also use a random effects model. We include year dummies in some specifications to control for time fixed effects. Furthermore, standards errors in some models are adjusted for heteroskedasticity and clustering at the firm level (Petersen, 2009). We also propose to use the Newey-West heteroskedasticity and autocorrelation consistent (HAC) covariance matrix estimator. Finally, we winsorize the data at 1% and 99% to deal with outliers.

Table 6 reports coefficients estimates from equation 6. We test various specifications in which we use dummies for each business model. For instance, in the first specification (GRPG and Tobin's Q), the business model dummy (GRPG Dummy) is set equal to 1 for all firms that belong to GRPG business model design and 0 for all other firms (firms that belong to STRM, EXDV and PROD designs). In addition, for each specification, the empirical tests were performed using (1) firm-fixed effects models with standard errors adjusted for heteroskedasticity and clustering at the firm level (cf. model 1); (2) random effects estimation (cf. model 2) and (3) Newey-West estimation (cf. model 3). Because we are interested in whether business model designs impact financial performance, we focus on coefficients of each dummy variable.

Table 6**:** Tobin's Q and business model designs

This table reports the results of equation (6), where Tobin's Q is our proxy for firm's financial performance and the dependant variable. Equation (6) independent variables are defined in Table 5. The sample period is from December 2007 to December 2014. To avoid drawing spurious inferences from extreme values, regression results are robust to outliers. We propose 4 specifications based on our model business typology. For each specification, tests were performed using 3 models. Model 1 represents firm-fixed effects estimation with standard errors adjusted for heteroskedasticity and clustering at the firm level based on Petersen (2009) approach. Firm-fixed effects account for unobserved time-invariant relations between explanatory variables and Tobin's Q. Further, in model 1, year dummies are included but not reported. For model 2, we run random effects estimation. For model 3, we use Newey-West estimation to further control for serial correlation and heteroskedasticity in error terms. P-values for two-tailed tests are in parentheses. One, two, and three asterisks denote significance at 10%, 5%, and 1% respectively.

Independent Variables	GRPG and Tobin's Q			EXDV and Tobin's Q			PROD and Tobin's Q			STRM and Tobin's Q		
	Model 1	***Model 2***	***Model 3***	***Model 1***	***Model 2***	***Model 3***	***Model 1***	***Model 2***	***Model 3***	***Model 1***	***Model 2***	***Model 3***
Intercept	4.4961	4.5829	3.3240	2.8068	4.0476	2.8068	4.1234	4.1695	2.9335	4.0966	4.1408	2.8930
	(0.001)***	(0.001)***	(0.001)***	(0.001)***	(0.001)***	(0.001)***	(0.001)***	(0.001)***	(0.001)***	(0.001)***	(0.001)***	(0.001)***
STRM Dummy										**1.6416**	**1.7750**	**1.6253**
										(0.189)	**(0.090)** *	**(0.037)** **
EXDV Dummy				**0.2174**	**0.2406**	**0.2174**						
				(0.301)	**(0.248)**	**(0.255)**						
GRPG Dummy	**-0.5885**	**-0.6592**	**-0.6162**									
	(0.032) **	**(0.005)** ***	**(0.013)** **									
PROD Dummy							**0.5794**	**0.6863**	**0.6569**			
							(0.022) **	**(0.065)** *	**(0.002)** ***			
LOGTA	-1.1404	-1.2019	-1.1520	-1.0119	-1.0568	-1.0119	-1.0952	-1.1593	-1.1137	-1.0150	-1.0647	-1.0200
	(0.001) ***	(0.001) ***	(0.001) ***	(0.001) ***	(0.001) ***	(0.001) ***	(0.001) ***	(0.001) ***	(0.001) ***	(0.001) ***	(0.001) ***	(0.001) ***
DEBTR	2.4002	2.3789	2.3628	2.4039	2.4192	2.4039	2.4057	2.3825	2.3657	2.4384	2.4183	2.4031
	(0.001) ***	(0.001) ***	(0.001) ***	(0.001) ***	(0.001) ***	(0.001) ***	(0.001) ***	(0.001) ***	(0.001) ***	(0.001) ***	(0.001) ***	(0.001) ***
RNDR	3.6670	3.5809	3.7563	3.7750	3.5986	3.7760	3.6779	3.5906	3.7668	3.6855	3.6001	3.7760
	(0.199)	(0.001) ***	(0.175)	(0.176)	(0.001) ***	(0.176)	(0.203)	(0.001) ***	(0.179)	(0.202)	(0.001) ***	(0.178)
CAPEX	-0.2229	-0.2257	-0.2387	-0.2375	-0.2247	-0.2375	-0.2207	-0.2237	-0.2363	-0.2204	-0.2233	-0.2361
	(0.001) ***	(0.001) ***	(0.001) ***	(0.001) ***	(0.001) ***	(0.001) ***	(0.001) ***	(0.001) ***	(0.001) ***	(0.001) ***	(0.001) ***	(0.001) ***
SGRWT	-0.0006	-0.0002	0.0032	0.0031	-0.0003	0.0031	-0.0007	-0.0003	0.0030	-0.0007	-0.0003	0.0031
	(0.926)	(0.976)	(0.672)	(0.684)	(0.965)	(0.684)	(0.908)	(0.959)	(0.691)	(0.919)	(0.967)	(0.683)
DIVR	-0.0511	-0.0724	0.1406	0.0991	-0.1161	0.0991	0.1135	0.1015	0.3259	-0.0531	-0.0723	0.1423
	(0.895)	(0.973)	(0.695)	(0.772)	(0.956)	(0.808)	(0.827)	(0.962)	(0.450)	(0.913)	(0.973)	(0.738)
ROE	0.0044	0.0047	0.0040	0.0043	0.0048	0.0043	0.0050	0.0053	0.0047	0.0047	0.0050	0.0045
	(0.528)	(0.441)	(0.553)	(0.538)	(0.425)	(0.538)	(0.483)	(0.384)	(0.502)	(0.500)	(0.407)	(0.520)
Year dummies (6 years)	YES			YES			YES			YES		
R^2	0.0975	0.0813		0.0848	0.0800		0.0975	0.0809		0.0967	0.0801	
N	5232	5232	5232	5232	5232	5232	5232	5232	5232	5232	5232	5232

The findings suggest that some business models appear to perform better than others (e.g. PROD and STRM business models). In particular, we show a positive and significant association between PROD business model and Tobin's Q (significance is at 10% for model 2; 5% for model 1 and 1% for model 3). This positive relation supports hypothesis 3a and 3c but contradicts hypothesis 3b. In the same line of reasoning, we also find evidence that STRM business model has a positive and significant impact on firm's performance (significance is at 5% for model 3 and 10% for model 2). For instance, the coefficient on STRM dummy is 1.6253 with a p-value of .0037 (cf. model 3). However, the same coefficient is positive but non significant when we run equation 6 using firm-fixed effects models (cf. model 1 where the coefficient of interest is 1.6416 with a p-value of 0.189). Hence, the findings are mixed for the STRM specification. On the other hand, we find strong evidence that GRPG business model reduces significantly firm's financial performance. In fact, the 3 GRPG dummy coefficients are negative and significant at 5% (cf. model 1 and 3) and at 1% (cf. model 2). This additional result supports hypothesis 1. Finally, when we run our tests for EXDV specification, all the coefficients on EXDV dummy variable are non significant suggesting a neutral association between EXDV business model and financial performance.

Conclusion

The relationship between business models and financial performance has received limited attention from researchers. We try to address this deficiency in the literature by providing a valuable setting that investigates such relationship. Our work is the first theoretical and empirical analysis that examines the influence of business model designs in the mining industry. With the proposed framework, we define four business models and propose a new empirical methodology (conditional alpha) for the first time in the business model literature. The results of our portfolio estimation approach suggest that all business models have underperformed a well diversified market portfolio. We also show that our four business models portfolios generate similar returns and Tobin's Q, suggesting that no business model seems to be superior in comparison to the others. On the other hand, the firm-by-firm approach (cf. equation 6) indicates that some business models do have an impact on wealth creation. Unfortunately, the "positive" relationship between business model and value creation is not consistent across our measures of financial performance. To sum up, we believe that Canadian mining companies do not achieve economic efficiency through their business models.

This research has several limitations. First, we do not investigate the impact of business model components on the firm's financial performance. Future research should focus on identifying the main characteristics of business model that influence value creation. Second, we do not attempt to answer questions about why there is a gap between good economic logics, execution, and value creation. In our study, even though the core economic logic behind some of our business models is relevant, the execution of such logic does not create value for shareholders. We hope that our work will provide foundations for future research on this important issue.

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