Wealth effects of strategic alliances in the resource industry in Australia

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I, Luiz Fernando Distadio declare that this thesis, is submitted in fulfilment of the requirements for the award of Doctor of Philosophy, in the Business School at the University of Technology Sydney.

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Abstract

This thesis examines interfirm arrangements in the resource industry. Coase (1937) argues firms' boundaries are the result of their pursuit of an optimal employment of economic resources in maximising wealth creation. Extant evidence from the financial economics literature on alliances suggests they are motivated by firms seeking to channel financial resources (Lerner, Shane & Tsai 2003; Robinson 2008), and to diversify risks and combine complementary resources (Beshears 2013; Palia, Ravid & Reisel 2007). The objective of this thesis is to examine motivations of extractive firms listed on the Australian Securities Exchange (ASX) to engage in two types of cooperative arrangements.The first alliance of interest is farmout agreements. Through keyword searches on Morningstar's Datanalysis Premium and Factiva databases, a sample of 589 farmor ('vendor') and 389 farminee ('buyer') announcements is collected for oil and gas companies over the period 1990−2016. Announcement returns show these arrangements are economically important, with farmors (farminees) experiencing positive abnormal returns of 3.60% (1.90%) over a three-day event window. In terms of motivation, cross-sectional evidence finds support for resource-pooling, with only mixed support for the expertise hypothesis. Furthermore, farmors' abnormal returns are positively associated with the volatility of crude oil prices, consistent with the real options theory. This thesis is the first empirical study of farmout agreements, with only descriptive evidence in Lowe (1987). Offtake agreements are the second type of alliance investigated. Using a sample of 396 offtakes announced by ASX resource firms from 1995 to 2018, there is evidence of a positive market reaction of 5.73% to project sponsors. Furthermore, there is evidence that returns are impacted by resource-pooling. For offtakes with intermediaries (e.g., trading houses), an adverse certification effect is found for the project firms. Finally, there is a positive relation between announcing firms' abnormal return and the price volatility of a basket of commodities, confirming real options theory implications for offtake projects.

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Chapter 1 – Introduction

1.1 Overview

This thesis investigates market reactions to announcements of two types of alliances by extractive companies listed on the Australian Securities Exchange (ASX). The first alliance of interest is known as farmout agreements. These interfirm arrangements are widely used by oil and gas companies to jointly conduct exploration and appraisal activities in the pursuit of economic discoveries of hydrocarbons. In other words, resource firms participate in farmouts to exchange partial exploration rights of the permit owner ("farmor") for benefits to be derived from the exploration activities undertaken by the incoming party ("farminee"). Unlike leases, where alliances are formed to strategically bid for offshore licenses. The parties in farmouts may have a long-term commitment to invest in all stages of oil and gas project. However, farmouts are mostly used to perform exploration activities in the initial stages of the project (i.e. geological surveys and exploration drilling), where farminees commonly carry some of the farmor's commitments. It is interesting to note that parties have more flexibility to walk away from the agreement and review their strategies due to the lower level of commitment. An example of funding terms contracted between the farmout parties is seen in Dart Energy's (farmor) announcement on 22 October 2013 with a subsidiary of the then GDF Suez (farminee, becoming Engie in 2015), a large company operating energy and industrial services related projects worldwide. In this strategic cooperation, the farmor relinquishes interests over licensed areas located in the UK. The farminee's initial commitment totals up to US$12 million to undertake unconventional exploration. Funding to undertake exploratory activities in US plays is also obtained by Australian Oil Company (AOC) as per a farmout agreement released on 8 October 2014 with Northern Gulf Petroleum Pte Ltd.[1]

[1] According to AOC's chairman "*The strategic alliance with the NGP group of companies is material in delivering our vision of being a major gas supplier in the very attractive Californian market. We are pleased to welcome NGP to our share registry as it expands our reach into Asia and with this alliance AOC shareholders can be confident that the significant gas potential in the Dempsey and Alvares prospects will be funded for*

The second type of contractual arrangement is an offtake agreement, which is a long-term contract between one firm (project sponsor) committing to deliver volumes of a good or service (in this case a commodity) to the offtaker (Gatti 2012, p. 64). There is evidence in the literature indicating the use of offtake agreements to support the execution of investment projects in the utilities industry, where activities are capital intensive. For example, Bonetti, Caselli & Gatti (2010) find evidence of a risk trade-off resulting from a long term offtake agreement between Meralco (offtaker) and Quezon Power's special purpose entity. This offtake arrangement was used as a financing channel for the construction of a power plan in the Philippines in addition to the issuance of bonds. In this offtake, Meralco agreed not only to partially fund the project but also to buy its future electricity output[2]. In this thesis, the importance of these two types of alliances to unlock the value of early-stage projects is considered in terms of wealth effects. Mining exploration entities (MEEs),[3] participating in either (sometimes both) the mining or oil and gas sub-sectors, compete for scarce equity funding to allocate to their early-stage projects. Alliances formed by MEEs are similar in many ways to those in the biotechnology industry, where financing of interfirm collaborations underpin small biotech firms' portfolios. Specific alliances are commonly used as a funding channel to support capital-constrained biotech firms with their R&D programs (Lerner & Merges 1998; Lerner, Shane & Tsai 2003; Pisano 1989; Robinson 2008).

Another example of the use of alliances is found in the industrial organisation of movie studios, where there is evidence of the presence of cooperative arrangements to pool complementary resources between film studios for large-budget projects (Palia, Ravid & Reisel

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drilling. This will provide shareholders with a highly leveraged opportunity for share value growth and enhancing the value of AOC's portfolio of gas and oil projects onshore California."

[2] In this study, the risk trade-off specifically refers to the project's lower market risk due to the offtaker's take-or-pay commitment. However, Bonetti, Caselli & Gatti (2010) also note a higher counterparty risk on the cost of funding based on a significant correlation between the spread of the project's bonds and the daily volatility of Meralco's share returns.

[3] Early-stage companies or developers are used interchangeably to refer to MEEs.

2007). In that setting, the authors find that high-risk films are undertaken via alliances, while low-risk projects are more likely to be produced in-house. In the oil and gas industry, there is evidence of superior operational performance stemming from alliances undertaken by oil and gas companies with prior expertise in operating projects in the Gulf of Mexico (Beshears 2013). These studies provide evidence of the importance of alliances in the industrial organisation of some industries.

The objective of this thesis is to investigate the motivations of extractive firms to engage in these two types of alliances. Specifically, the focus is on ASX constituents of the resource industry that participate in farmouts and offtakes to examine (i) the economic importance of these events based on market reactions to their initial announcements to the ASX, and (ii) the firm and project characteristics associated with the announcement abnormal return in the light of two strands of the financial economics literature. The first strand of literature considers the use of alliances and related wealth changes from a capital market perspective. Additionally, studies focusing on the determinants of interfirm arrangements are discussed to shed light on firms' motivations to form these collaborations. The second strand of literature focuses on the real options theory, which provides interesting insights in terms of the impact of the volatility of the project's underlying asset on wealth effects. This study benefits from ASX's continuous disclosure rules, which require the release of all materially price-sensitive information on the ASX announcement platform.

It is interesting to note the paucity of empirical studies focusing on alliances in the resource industry, given the unique characteristics of firms operating in this setting, where projects have distinctive life-cycle stages and very low probability of success. Hence, extractive firms face challenging choices to allocate scarce resources to their early-stage projects. Furthermore, the lack of revenue-generating projects and past production track records result in high levels of information asymmetry for firms in their development stage in this industry. This setting also features ample unique characteristics at the project and firm levels. For example, the use of farmout agreements by oil and gas firms to undertake exploration projects in areas prone to the presence of unconventional resources, whose exploration usually requires sophisticated drilling. In terms of offtakes, negative certification effects arise with counterparties classified as intermediaries, notably commodity traders. In addition, the homogeneous nature of a single-industry study would allow the inclusion of appropriate variables to control for omitted variables. This contrasts with existing studies of multi-industry samples, which are subject to the potential effect of omitted variables.

This thesis is composed of two separate studies to shed light on the motivations of ASX extractive firms to form farmout and offtake arrangements given their different characteristics in terms of the deal structure and underlying motivations. To estimate market reactions to the announcement of these arrangements, an event study approach is employed using the market-adjusted model. For the first study focusing on farmout agreements, a sample of 589 farmor and 389 farminee announcements is manually collected based on keyword searches using Morningstar's Datanalysis Premium and Factiva for ASX-listed oil and gas companies over the period from 1990 to 2016. A similar approach is used in the second study where a sample of 396 offtake agreements announced by ASX constituents of the Materials and Energy sectors is assembled over the period from 1995 to 2018.

With regard to the wealth effect estimates from the event study analysis, farmors experience a positive abnormal return of 3.60% over the three-day event window, while farminees yield 1.90%. Similarly, there is evidence of offtakes' economic importance given the positive abnormal return of 5.73% experienced by the ASX announcing companies. It is important to note that positive market reactions are observed across all four subsamples of firms announcing offtakes. For example, developers yield an average abnormal return of 6.57%, while producers experience a positive wealth change of 2.83%. When the sample is divided into mining and energy companies, positive event returns of 5.83% and 5.37% are observed, respectively. These wealth effects resulting from the announcement of both farmouts and offtakes indicate the economic importance of these events for the announcing firms, which strive to transition from the development stage to the production and sale of resources.

To test the hypothesis on the announcing firms' motivations to form interfirm arrangements, cross-sectional analysis is performed, including the construction of proxies discussed in the development of each hypothesis. In the case of farmouts, results from the OLS regressions support the 'resource pooling' hypothesis based on potential synergistic gains derived from economies of scope of complementary assets. Three different proxies are used to test this hypothesis. Similarly, evidence for this hypothesis is observed in the study of offtake announcements based on the funding commitment of the offtaker. The second hypothesis regarding certification effects stemming from the counterparty attracts no empirical support in the study of farmouts, where characteristics of the counterparty are used as certification proxies. However, negative certification effects are found for offtake arrangements with counterparties classified as 'intermediaries'. Thirdly, the expertise hypothesis is considered in the investigation of farmouts given the importance of specific technical skills required in the exploration of some areas.[4] This hypothesis is motivated by the evidence from Beshears (2013) who finds superior productivity in alliances formed by two or more oil and gas firms with expertise to drill offshore. However, only mixed evidence for this hypothesis is found using a proxy indicating the exploration of unconventional resources. This suggests technology and expertise transfer is unlikely to be the main motivation for oil and gas companies to form farmout agreements. Finally, evidence supporting a real options theory explanation for both farmouts and offtakes alliances is identified.

[4] This hypothesis is not tested in the study of offtakes due to the lack of a clear, objective and measurable proxy.

1.2 Motivation

Regarding farmout agreements, currently there is only descriptive evidence in the study by Lowe (1987), who focuses on the legal framework of these cooperative arrangements. Lowe (1987) argues the importance of farmouts to the oil and gas industry is similar to the importance of oil and gas project leases, which suggests these collaborations are an integral part of the industrial organisation of oil and gas firms. Indeed, consistent with this assertion, farmouts are widely used by ASX oil and gas companies based on information publicly available from Morningstar's Datanalysis Premium and Factiva databases. A further motivation is the presence of major oil and gas participants in the farmout market, indicating the importance of these arrangements to the development of early-stage projects. For example, Appendix 1 provides anecdotal evidence of two farmout agreements. In the first announcement, an ASX oil and gas firm (Beach Energy Limited) relinquishes interests in a joint-venture project to the subsidiary of a major US oil company (Chevron Corporation) in exchange for cash, according to pre-specified performance milestones. The second example involves two ASX oil and gas firms (Senex Energy being the farmor, and Origin Energy Limited being the farminee) engaged in evaluating exploration permits located in the Cooper-Eromanga Basin, an area prone to the existence of unconventional gas reservoirs. A feature of this disclosure is the sequential nature of these cooperative arrangements based on terms often describing the project's milestones and parties' commitment. Accordingly, it is argued the application of the real options theory is appropriate in this setting given that farmout partners are mutually exposed to the risks and benefits of the projects contingent on the volatility of the crude oil prices.

The development of reserves is of utmost importance to oil and gas firms' business strategy. In other words, these firms maximise their value creation not only based on the production and sale of energy commodities, but also on the development of assets to the point where they can be disposed in the production phase. Mohn & Osmundsen (2008) and Sabet &

Heaney (2016) provide evidence on the disposal of developed oil and gas reserves. Appendix 2 provides a figure used by Mohn & Osmundsen (2008) to demonstrate the two-way value development strategy in the oil and gas sector. Constituents of this sector develop their projects seeking to commercially sell oil and gas products over their reservoirs' lifetime. In addition, these companies develop their resources to the point that their disposal is considered a value-maximising transaction. Accordingly, the use of farmouts by oil and gas firms is regarded as a means to underpin both the exploration and development activities of risky early-stage ventures, which facilitates value-enhancing progression along the project's value chain.

These motivations are also applicable to offtake agreements. For example, Bonetti, Caselli & Gatti (2010) conduct a case study of a single power plant to provide evidence on risk transfer between the offtake parties. Byoun, Kim & Yoo (2013) examine the leverage of project-financed investments using a cross-country sample, but do not undertake analyses using event study approaches. It is interesting to note that in Byoun, Kim & Yoo (2013) sample, the highest offtake frequency is observed for project sponsoring firms operating in the resource industry,[5] confirming the importance of offtake alliance in this setting. Appendix 3 provides two examples of offtake agreements announced by ASX firms. The first offtake announcement involves Carpentaria Resources Ltd (project sponsor) and a Japanese trading house, Mitsui & Co. Ltd (offtaker). The offtaker seeks to secure a minimum volume of mineral outputs after project completion. In case the offtaker commits to underpin the project development, the mining firm receives US$ 60 million via a convertible debt in exchange for a 20-year offtake contract.

[5] In the study of Byoun, Kim & Yoo (2013), the following resource-related industries represent 56.6% of the entire sample: Mining, Oil & gas, Petroleum refining, Rubber & plastics, and Steel & non-ferrous metals.

1.3 Background of the extractive sector

The focus of this thesis is on two types of strategic alliances formed by extractive industry. This raises the importance of understanding some characteristics of the resource industry. To provide the necessary background, Section 1.3.1 below discusses each stage of the oil and gas value chain. Section 1.3.2 considers an overview of the mineral exploration cycle given the prevalent use of offtakes by mining firms as opposed to energy companies.[6]

1.3.1 Oil and gas industry

The oil and gas industry can be divided into three distinct sectors: upstream, midstream and downstream. Upstream activities refer to exploration, evaluation and production phases of hydrocarbon projects and are known to be high-risk. Oil and gas exploration companies are typically equity-funded and use their financial resources for exploration with the aim of achieving an oil and gas discovery. Discoveries, if economical, enable oil and gas explorers to become producers. Exploration rights over oil and gas leases (permits) are usually obtained through winning bids in auctions undertaken by governmental bodies (as in the US) or applied for and leased from the government when vacant (e.g., Australia). Permits are called 'wildcats' (oil and gas exploration) or 'greenfields' plays when no prior exploration has been undertaken (Hendricks & Porter 1996).

Midstream oil and gas participants are responsible for storage and movement of oil and gas from upstream production to downstream processing facilities. For example, midstream firms include logistics planning companies and those operating oil and gas pipeline infrastructure. Downstream participants conduct refining, retailing and marketing activities (Rudenno 2012; Tordo 2011). Some large companies vertically integrate the whole oil and gas value chain owing to the capital-intensive nature of the industry. These 'major' companies are

[6] This is an empirical observation based on the descriptive evidence provided in Section 4.3.

strategic players given their substantial resource base including, but not limited to, sophisticated technological expertise in exploration and production, along with vast oil and gas reserves, pipeline infrastructure, refining capacity and retailing infrastructure.

Prior studies on alliances have investigated oil and gas bidding strategies for oil leases and market competition (Hendricks & Porter 1992; Mead 1967), bidder information asymmetry (Hendricks, Porter & Boudreau 1987), drilling timing (Hendricks & Porter 1996), production efficiency (Beshears 2013; Kent 1991) and agency theory (Bertrand & Mullainathan 2005). The first alliance of interest in this study constitutes a specific type of arrangement related to the exploration of oil and gas projects (farmouts). According to Lowe (1987), farmouts are of real significance to the oil and gas exploration sector, being likened in terms of importance to the role of oil and gas lease acquisitions. Lowe (1987) explains that such agreements involve at least two parties—the farmor ("vendor") who holds exploration rights called permits, while the farminee ("buyer") seeks to obtain part of the permit's exploration rights in exchange for a financial commitment to the project in the form of exploration/appraisal activities and will usually bear some or even all of the exploration costs otherwise borne by the farmor. Such financial commitments can include upfront payments to cover sunk costs, obligations to cover (partially or wholly) geological tests in the permit area (e.g., seismic surveys and exploration wells), assumption of permit operatorship, technical assistance, etc. Farminees benefit from the project's upside valuation upon the discovery of resources proportionally to its equity interests. Therefore, farminees can take advantage of the relatively attractive entry cost in some farmout deals given their low valuation in the exploration stage. This explains the usual commitment borne by the farminee to free-carry part of the costs otherwise borne by the farmor. Unlike other industries where alliances are common at different stages of the project, farmouts occur mostly in the early, high-risk exploration stage of oil and gas projects. The level of commitment can vary greatly, with some farmouts similar to joint arrangements with binding contracts to enforce mutual obligations, whilst others refer to simple letters of intent.

1.3.2 Mining industry

The mining industry plays an important role as an economic driver in Australia given its abundant reserves of mineral resources[7] coupled with its openness to the Asian markets. Mining exploration entities form the largest cohort of listed mining firms in Australia. Information asymmetry is higher for exploration and development firms as compared to producers (Ferguson, Clinch & Kean 2011). While mineral and oil and gas explorers are highly dependent on equity funding to undertake their risky projects, mine producers experience less uncertainty given they are able to source internal funds and the debt markets (Myers & Majluf 1984) to finance project expansions. Other characteristics of the mining industry are discussed by Rudenno (2012), which include higher share price volatility of mining firms compared to manufacturing companies. This volatility is at least partially explained by fluctuations in commodities prices in the international markets. A unique feature of the mining industry is the large number of listed MEEs. During the exploration phase, the firms' objective is to raise capital to undertake exploration investments with the aim of making a resource discovery. Mining exploration, however, is extremely high-risk. Additionally, even a mining company with a track record of past exploration success still faces finite life of mineral reserves, prompting further exploration of other tenements often nearby. This is known as brownfield exploration.

[7] According to Australia Trade and Investment Commission (2019), Australia hosts the largest reserves of the following minerals: iron ore, gold, lead, zinc, nickel, mineral sands (rutile and zircon), and uranium. In terms of worldwide production, Australia supplies 42% of rutile, 41% of lithium on which the battery manufacturing industry is highly dependent, 38% of iron ore, and 31% of bauxite and of ilmenite. In terms of economic importance, the resources and energy sectors contribute to 45% of Australia's exports of goods and services in 2018 (Department of Industry Innovation and Science Resources and Energy 2019).

Resource and reserves are disclosed using a classification code based on geological certainty and economic viability. In Australia, the Joint Ore Reserves Committee (JORC) was created to define technical standards to guide the disclosure of mining companies' resources and reserve estimates. Among other requirements, the JORC Code (2012) highlights the responsibility borne by the technical professional, known as the Competent Person. ASX mining companies are required to publicly disclose resource and reserve estimates with a statement by the competent geologist. Appendix 4 provides the explanation of mineral resources and ore reserves, where mineral resources are classified as inferred, indicated and measured considering the level of geological confidence. Reserves can be either probable or proved, subject to economic viability and assets in place necessary to facilitate mineral production (JORC Code 2012). With regard to the competent person, Ferguson & Pündrich (2014) find evidence of an assurance role stemming from non-financial information disclosed by mining firms under the JORC Code. In other words, they find the role of assurance provided by the Competent Person in the technical reports is similar to that of audits for the company's financial statements.

It is important to note that offtake agreements are commonly undertaken in this setting, where extractive firms are seeking counterparties committed to buying future output in exchange for cash or contributions to project financing. Appendix 5 provides an example of a mining life-cycle, suggesting offtake arrangements are likely to be formed once an extractive project reaches the development stage. These offtake agreements are formed before the mine project is fully developed so that it can lever the extractive company's transition to the production stage through financing.

1.4 Summary of main findings

This thesis finds evidence suggesting farmout and offtake agreements are important economic events based on the results of event study analysis. The announcement of farmouts generates a positive cumulative abnormal return of 3.60% over a three-day event window. Univariate tests indicate these wealth changes are greater for farmors compared to farminees. Similarly, there is evidence for the economic significance of offtakes given their positive market reaction of 5.73% over a three-day event window for all announcing firms. Univariate tests indicate this wealth effect is greater for developers than for producers.

For farmouts, cross-sectional analysis of the three-day cumulative abnormal return as the dependent variable indicates the importance of funding disclosures. This confirms the 'resource pooling' hypothesis and consistent with the use of alliances as a financing channel similar in many respects to prior empirical work in the biotech setting. Evidence is found using measures based on the disclosure of financial commitments, of target reserve estimates and permit size. This evidence on resource pooling is consistent with the results shown in prior work on movie studios where larger film projects are more likely to prompt alliances between filmmakers to combine complementary resources.

A second hypothesis is tested focusing on potential endorsement effects from the alliance counterparty. In the case of farmouts, no evidence is found for firms announcing agreements based on the counterparties' location and the presence of major oil and gas companies. However, there is evidence of a negative certification effect stemming from offtake agreements with intermediaries (trading houses and financial institutions). This negative certification effect is more pronounced in arrangements with traders, suggesting these buyers offer less favourable deal terms, and may act opportunistically. A third hypothesis tests for the technology and expertise motivation for farmout arrangements. There is some evidence suggesting farmors who relinquish interests in permits with unconventional oil and gas reserves experience higher excess returns.

In this thesis, real options theory is used to explain the wealth changes arising from the announcement of farmouts and offtakes given the sequential nature of extractive projects' investment commitments. For farmout agreements, the volatility of crude oil prices is employed as a proxy for uncertainty with evidence suggesting agreements announced in months with higher oil price volatility generate higher abnormal returns. For offtake agreements, the volatility of two indexes comprised of a basket of commodities are employed as proxies for uncertainty. Again, there is evidence supporting the real options theory in the offtake setting based on the volatility proxy using a basket of mineral commodities. However, no significant evidence from the second volatility proxy based on a basket of mineral and energy commodities is found.

Sensitivity tests indicate the importance of controlling for noise in the study of farmout agreements, where tests on a sample restricted to agreements released on days without other price-sensitive announcements have a higher explanatory power. Additional tests adjusting for robust standard errors clustered by firm and time depicts similar results to primary tests. However, for farmouts agreements, the proxy based on the presence of unconventional reserves to test the expertise hypothesis weakens.

1.5 Structure of the thesis

The remainder of this thesis is structured as follows. Chapter 2 discusses the literature review commencing with Coase's (1937) theory of the firm. Two additional strands of the financial economics literature are explored in this chapter. Section 2.2 focuses on studies examining the motivations of firms' engagement in interfirm arrangements, including the investigation of alliances from a capital market perspective. Section 2.3 discusses the real options theory, which has rarely been applied to the investigation of interfirm arrangements, despite its popular application to growth investments for which volatility of the underlying asset can be reasonably estimated.

Chapter 3 presents the study of farmout agreements undertaken by ASX oil and gas firms, where Section 3.1 provides an overview. Hypotheses development is discussed in Section 3.2 based on four theoretical motivations for the farmout arrangements by oil and gas firms: resource pooling, certification theory, expertise and real options theory. Data and research method are described in Section 3.3, while descriptive statistics and results of the OLS regressions are discussed in Section 3.4. Further tests and concluding remarks on farmout agreements are provided in Sections 3.5 and 3.6, respectively.

Chapter 4 focuses on offtake agreements announced by extractive companies listed on ASX. Section 4.1 presents an overview of this form of strategic alliance, while Section 4.2 discusses the hypothesis development based on three main theories: resource pooling, certification, and real options. Sections 4.3 describes the data and research method, while results are presented and discussed in Section 4.4. Additional tests are found in Section 4.5. The conclusion of this chapter is presented in Section 4.6.

Chapter 5 summarises the findings from both Chapters 3 and 4. Limitations of the research design and suggestions for further research in this area are also discussed.

Chapter 2 – Literature review

2.1 Overview

This section provides an overview of studies investigating interfirm collaborations which are summarised in Appendix 6. Section 2.2 presents a detailed discussion of the studies used to underpin the hypothesis development, and Section 2.3 focuses on the development and application of real options theory.

The study of intercorporate arrangements builds upon seminal studies in the industrial organisation literature (Coase 1937, 1990). This literature discusses the organizational form and the optimal employment of economic resources. According to Coase (1937, 1990), the choice of corporate boundary (institutional structure of production) reflects the relative costs of other firms organizing their activities. Hence, a firm is likely to expand its boundaries until a given level where the cost to process a new transaction is equal either to the cost of carrying out the additional transaction on the market or to the cost of executing this specific transaction by another firm. Additionally, Coase argues that the way firms organise their activities is the cornerstone to determine the institutional structure of production, and consequently the level of transaction costs. For example, Robinson (2008) develops a model to explain the firm's boundaries choice when undertaking a new project. Robinson (2008) examines the firm's options to execute the project either internally or via an interfirm arrangement. The choice model considers contractual incentives of internal execution versus external alliance for high-risk projects. Specifically, 'longshots'[8] are likely to suffer a reallocation of capital *ex-post* to less-risky projects with higher profitability ('winner-picking'). Conversely, if a 'longshot' is executed via alliance, its resource allocation is likely to be fixed *ex-ante* in an enforceable contract by the exchange partners. So, in this case the probability of a capital reallocation to a

[8] According to Robinson (2008), a project whose probability of success is very low, but likely to yield high payoffs conditional on its success is classified as 'longshot'.

'winner-picking' by any party is low given the legal commitments mutually borne and enforced between the alliance partners. Furthermore, Robinson (2008) empirically tests this model using a sample comprising of 90,417 alliances retrieved from Securities Data Corporation (SDC) database. There is evidence that alliances are used for projects that are riskier than the firm's average inside project. Thus, this evidence suggests alliances are formed to undertake a project with differing (higher) risk characteristics to the partners' existing activities. Whereas, projects related to the firm's existing activities are likely to be executed internally.

In the capital markets context, some authors observe wealth gains associated with pooling complementary resources (Brooke & Oliver 2005; Chan et al. 1997; McConnell & Nantell 1985; Owen & Yawson 2015). Brooke & Oliver (2005) find a 1.6% cumulative abnormal return over a three-day window for 123 alliances announced by ASX firms. In the multivariate tests, it is observed that companies with lower market-to-book values are the main source of these wealth changes. The authors find no evidence for the knowledge, flexibility and hubris hypothesis. Chan et al. (1997) and McConnell & Nantell (1985) are the seminal studies examining interfirm arrangements. They find positive wealth gains associated with the announcement of alliances and joint ventures by US-listed firms. These two studies are further discussed in Section 2.2 given their contribution to the financial economics literature. Owen & Yawson (2015) investigate the role of R&D activities in strategic alliances formed between US and overseas firms. Owen & Yawson (2015) indicate that R&D intensive companies can maximise their R&D project's gains by distributing the products of these projects in different markets worldwide.[9] A mean cumulative abnormal return of 1.57% is observed for the sample firms announcing 4,189 non-equity strategic alliances. In that study, the cross-border subsample is restricted to agreements with both counterparty and project located overseas,

[9] Owen & Yawson (2015) build the study's hypothesis on evidence that firms engage in international R&D activities to strengthen their competitiveness at an international scale.

while the domestic group comprises exchange partners and projects located in the US. There is evidence that abnormal returns are higher for cross-border interfirm arrangements. Furthermore, it is observed that US firms with high R&D investments are more likely to engage in alliances in Europe and the Asian-Pacific region.

There is evidence in the literature supporting the transfer of expertise and technology as a motivation for firms engaging in interfirm arrangements. Berg & Friedman (1977) suggest that the exchange of technologies is the main motivation for joint ventures in the chemical industry. Das, Sen & Sengupta (1998) find evidence supporting the hypothesis that firms with early-stage projects are more likely to benefit from technological arrangements that firms involved in marketing collaborations. Additionally, Das, Sen & Sengupta (1998) argue that firms seeking technology development are more dependent on alliances[10] relative to companies whose alliance motivation is to improve their output marketability. An abnormal return of 0.50% if observed for the entire sample of arrangements, while firms announcing technological alliances yield a 1.1% two-day (0, 1) cumulative abnormal return, significant at $p<0.01$, and marketing alliances generate an insignificant mean cumulative abnormal return of 0.20%. Results of OLS regressions confirm both technology-related hypotheses in a sample of 119 alliances.

Similarly, Koh & Venkatraman (1991) find significant excess returns for companies in the information technology (IT) industry engaging in technology-exchange joint ventures. The role of information asymmetry in interfirm arrangements between US firms and overseas partners is investigated by Owen & Yawson (2015). They investigate the information costs related to the country hosting the international alliance counterparty of US companies. Three proxies are used to test whether the host country's information cost is associated with its

[10] Das, Sen & Sengupta (1998) argue that large pharmaceutical companies are more dependent on small biotechnology firms in technology related alliances (to develop drug candidates), while biotech firms are more vulnerable to opportunism in marketing collaborations where the pharmaceutical company has more bargain power.

alliance activity. The first proxy is based on the host country's GDP and its geographical distance to the US.[11] There is evidence of alliance counterparties originating from low-risk countries based on these three aforementioned proxies, indicating that US firms tend to team up with overseas partners located in relatively safer jurisdictions. Further evidence from alternative tests using the partners' characteristics suggests US firms are prone to team up with government parties in high-risk countries and in countries with a low level of stock market development. In this case, measures of information cost are no longer significant indicating a substitution effect in the overseas partner and location's institutional quality for international alliances formed by a US firm.

With regard to interfirm arrangements involving equity ties, Pisano (1989) investigates the reasons why companies form equity ties instead of using non-equity collaborative arrangements in the light of governance choices used to address issues arising from incomplete contracting. The sample comprises 195 alliances involving biotechnology firms, where 28% are arrangements involving equity investment. There is evidence supporting the transaction cost hypotheses based on three proxies.[12] R&D intensive arrangements and multiple-project alliances are more likely to have equity ties. Conversely, a greater presence of potential exchange partners is negatively associated with the use of equity linkages in interfirm arrangements. Demirkan & Zhou (2016) also depart from the incomplete contract theory to investigate whether alliance participation is associated with higher audit fees. Demirkan & Zhou (2016) find evidence supporting this prediction for alliance participation, but not when firms form joint ventures. Gore, Ji & Xue (2019) also examine the role of auditors in the light of the incomplete contract hypothesis. They focus on the association between alliance

[11] Distance in kilometres between the host country's capital and Washington, D.C.
[12] The first proxy indicates if the alliance involves R&D activities. The second proxy differentiates multiple-project alliances from arrangements focusing on a single project. Thirdly, the number of potential exchange partners is based on the quantity of firms pursuing commercial biotechnology applications in five industrial sectors (pharmaceuticals, diagnostics, animal health and agriculture, plant agriculture, and specialty chemicals).

specialised auditors and positive market reactions to alliance announcements. Gore, Ji & Xue (2019) find evidence suggesting that investors value alliances involving partners audited by auditors with expertise in these interfirm arrangements. Accordingly, the first argument indicates that alliance specialised auditors can help to mitigate hold-up problems arising from the partner's lack of exchange commitment through more complete enforceable contracts.

Secondly, they state that auditors with expertise[13] in contractual collaborations can reduce deal risk based on their assurance of the partner's financial reporting and internal controls. Results from the primary OLS tests confirm a positive association between the three-day cumulative abnormal return of alliance firms and auditor's expertise in interfirm collaborations based on the three proxies. Further alliance related evidence is drawn from Lerner, Shane & Tsai (2003) regarding the use of alliances as a funding channel for biotechnology firms in periods of equity scarcity. Robinson & Stuart (2007) also focus on biotechnology firms, finding evidence of the use of equity holdings to allocate control rights in intercorporate arrangement contracts.

2.2 Main theories underlying strategic alliances

Chan et al. (1997) examine the value creation associated with the announcement of alliances by US firms in relation to the resource pooling theory. The resource-based theory applied in the M&A literature suggests alliance partners can benefit from synergistic gains derived from economies of scope when assets are complementarily combined (Harrison et al. 1991, 2001). Complimentary assets are not identical, yet cooperative arrangements are used to combine different assets. Unlike M&A deals where both assets and management are combined, the formation of alliance involves a subset of resources where parties management is unchanged. Chan et al. (1997) analyse under what circumstances wealth is created when two

[13] There are three proxies for alliance specialised auditors: (i) the auditor's share of firms participating in alliances estimated annually, (ii) the auditor's share of firms participating in specific types of alliances estimated annually to capture auditor expertise in collaborations involving R&D and technology, and (iii) a dummy variable indicating the exchange partners share the same audit firm.

or more firms pool their efforts to pursue common goals consistent with resource pooling theory. Their sample is restricted to non-equity arrangements for which there is no creation of a new entity, comprising 345 observations spanning the period 1983 to 1992. An event study approach is used to calculate the alliance announcement wealth effects[14]. They find a positive market reaction of 0.64% on the announcement date. To test the prediction that organisational benefits are greater for high-growth firms and firms competing in high-technological environments, the sample is partitioned into low-tech and high-tech based on the firm's SIC code. Univariate tests confirm that high-tech firms experience a higher abnormal return significant at $p<0.01$ level. The authors also divide the sample into horizontal and non-horizontal alliances based on the firm's three-digit-SIC code. Higher wealth change is observed for the subsample of horizontal alliances compared to alliances formed between firms operating in unrelated industries (non-horizontal).

Das, Sen & Sengupta (1998) investigate the wealth effects of 119 two-party alliances spanning the 1987 to 1991 period focusing on their scope (technology vs. marketing). Technology alliances are likely to involve early-stage products for which product complexity and high development costs benefit from the formation of interfirm arrangements. In contrast, mature products suffering from lower growth can benefit from marketing alliances focused on increasing their demand. Therefore, shareholders may regard marketing alliances as a lack of product attractiveness, signalling declining future product sales expectations. Consistent with adverse assertions, firms announcing technological alliances yield a cumulative average abnormal return of 1.2% while companies announcing marketing alliances experience a negative cumulative abnormal return of 0.1% over the three-day window centred on the event date.

[14] For alliances involving two or more US-listed partners, the authors form a value-weighted portfolio based on the firms' market values on the twenty-first day prior to the event date. There are 114 value-weighted portfolios and 231 alliances with a single US-listed company.

Alliance types are based on the announcement disclosure and firm's industry classification is based on the two-digit SIC code. There are 49 technology alliances in the total sample of 119 documents, with 23 technology agreements announced companies operating in the industrial, commercial, machinery and equipment industry. Market-adjusted cumulative-abnormal returns of 0.40% and 0.50% are reported for the full sample using a three-day (-1, 1) and a two-day (0, 1) window, respectively. Technology alliances yield a cumulative-abnormal return of 1.20%, significant at the $p<0.05$ level over the three-day event window (-1, 1), and 1.10% over the two-day event window (0, 1), significant at the $p<0.01$ level. Marketing alliances generate a negative cumulative-abnormal return of 0.10% over a three-day event window (-1, 1), and 0.20% over a two-day event window (0, 1), but not significant in either case. Univariate tests report that wealth changes arising from the announcement of technology and marketing alliances are not equal at the $p<0.10$ level, confirming the prediction of higher gains for technology-related cooperative arrangements. OLS regressions confirm superior wealth changes from technology alliances interacted with the firm's ROI in six of the nine event windows.

Stuart, Hoang & Hybels (1999) examine the role of interfirm arrangements and certification effects of the prospect's quality in the biotechnology setting. The study is built upon the characteristics of the corporate network members formed by young biotechnology firms. Specifically, they explore the effect of financing alliance partners' prominence on the biotech company's ability to finance its activities. The study distinguishes two qualitative categories of information capable of influencing external perceptions of the young firm's survival odds. Firstly, investors' and customers' qualitative judgment over the young firm's achievements, having support from an external and independent party potentially conveys signals on the company's future growth prospects. Secondly, external agents can use the attributes of the junior corporate network constituents to assess its worth. In other words, the identity of exchange partners currently engaging with the young firm can be used by potential partners to decide on the level of resource commitment to that firm. The study motivation to focus on alliances mostly relies on the considerable uncertainties arising from the young firms' short track record coupled with their ongoing demand for funding their early-stage projects require different financing strategies. Accordingly, biotechnology firms engage in alliances to obtain equity funding from financiers, mostly pharmaceutical companies and venture capitalists. Thus, the implicit status transfer across interfirm arrangements proxied by the attributes of these exchange partners are used to develop three hypotheses. The first focuses on the association between the prominence level of the alliance counterparty[15] and the biotechnology firm's performance. The second hypothesis considers the impact of the equity alliance partner's prominence on the biotech company's performance. Evidence on the importance of investment banks' certification of young companies' quality underpins the third hypothesis, which focuses on effects stemming specifically from involvement of prestigious investment banks on the biotech firm's performance. A fourth hypothesis predicts a larger impact of prominent partners on biotechnology firms with higher levels of uncertainty.

The study sample comprises 301 biotechnology firms founded between 1978 and 1991. Two measures are used to proxy for the biotech firm's performance: the rate at which these firms go public via IPO,[16] and the market capitalisation of these companies experiencing an IPO event. The hypotheses are tested through proxies for the prominence of the exchange partners. For alliance partners and equity investors, the technology prominence relies on the exchange partner's patent citations. A commercial version for the counterparty's prominence is based on its previous participation in biotechnology alliances. For investment banks, the prominence proxy reflects their previous participation in IPOs as lead managers following

[15] The first hypothesis is primarily based on non-equity alliances focusing on research, marketing and product development.
[16] A hazard model is employed to compute the first proxy.

Carter & Manaster (1990). For models using the rate at which firms go public as the dependent variable, the coefficients on both commercial and technology prominence of equity partners are positive and significant at $p<0.05$ level, confirming endorsement effects stemming from equity investors are important for newly listed biotech firms. This certification effect is stronger for the group of biotechnology firms aged three years or less, supporting the fourth hypothesis' prediction. Results for the OLS regressions on the biotech firm's market valuation provide stronger evidence for the endorsement effect of financing partners. The coefficients on the commercial prominence for both alliance partner and equity investor are positive and significant at the $p<0.05$ level, along with the coefficient for the variable based on the investment bank's prestige. Furthermore, there is evidence confirming the fourth hypothesis given the negative coefficient and its decline in significance on the interaction of the partner's prominence and age of the biotech firm.[17]

Lerner, Shane & Tsai (2003) investigate the relation between equity financing variations resulting in market conditions and the project's right allocation in biotechnology firms. One of the study motivations is the significant variation observed in biotech firms' equity funding via capital markets coupled with data availability to explore the biotech setting. Their sample consists of 200 technology alliances spanning the period between 1980 and 1995. There is evidence in the biotechnology setting of a higher financing alliance activity in periods with little equity funding,[18] suggesting small biotech firms are more likely to obtain R&D financing via alliances in years of poor equity market conditions. They also find that in these years, biotech firms are more prone to assign project control rights to the alliance financing

[17] For the tests using the rate at which firms go public as the dependent variable, the proxies on the exchange partner's prominence are interacted with a dummy variable identifying young biotech firms (aged 3 years or less). Whereas, in the OLS models, the prominence related proxies are interacted with biotech firm's age measured in years.
[18] Two proxies based on equity resources raised by biotechnology firms in the year prior to the alliance are used to measure equity market conditions: volume of equity obtained by biotech firms from the public market in the previous year, and the total equity funding raised by biotech companies (from both private and public markets).

counterparty, indicating a higher bargaining power of financiers when available capital is constrained.

Palia, Ravid & Reisel (2007) examine the industrial organization of the movie industry in the US. They consider determinants of the movie studio to undertake a project internally or via an alliance. The main motivation for this study is the relative homogeneity observed in the industry setting where alliances are mostly formed in the "assembly" stage[19] of the film project.

Complementary Data collection resulted in a sample comprising 275 films produced by 12 studios. Following Chan et al. (1997) and Robinson (2008), alliances in this setting consist of co-financing agreements between two or more organisations without creating a specific purpose entity or joint-venture. Similar to alliances in the biotechnology industry marked by the engagement between a small biotechnology firm and a large pharmaceutical company, alliances in the film setting are usually formed between a studio and a small production firm.

The authors test seven theories to explain the choice determinants of financing a project internally or via an interfirm arrangement as follows: risk-reduction hypothesis, internal capital markets hypothesis,[20] managerial bargaining power hypothesis,[21] market-structure hypothesis,[22] resource-pooling hypothesis, specialisation hypothesis, and lemons hypothesis.[23] The main results indicate films with larger budgets prompt alliance formation, consistent with the resources pooling hypothesis. Additionally, there is evidence consistent with the risk reduction and internal capital market hypothesis with a lower probability of low-risk projects

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[19] Assembly stage refers to when studio executives have a comprehensive briefing of the film project including the screenplay, the estimated budget, definition of the creative team, primary cast members and the film director.
[20] The standard deviation of the rate of return for different types of movies based on the following project-level characteristics: (i) film is classified as sequel or original, (ii) audience rating, and (iii) whether they feature stars.
[21] Two movie-director related proxies are used to test this theory: (i) a dummy variable indicating the director has won an Academy Award, and (ii) an indicator variable indicating a multiple-role director (set as one if the director also accumulates one of the following roles: producer, scriptwriter, or actor/actress).
[22] Two proxies for competitiveness are used: (i) the Herfindahl index to capture the relative market concentration between film studios with data obtained from the *Hollywood Reporter*, and (ii) the inclusion of year dummies in the model for the time trend observed in some settings that experienced a higher frequency of alliance formation in more recent years.
[23] The following project's variables are used in the logarithmic form: rate of return, total revenues, and revenue per site.

being undertaken via alliances. Further, they find that studios with a higher alliance frequency are more likely to be financially constrained.

Beshears (2013) investigates the economic implications arising from intercorporate arrangements. Specifically, he compares the operating performance of projects undertaken via alliances to the ones executed by a single firm (solo)[24] and is comprised of 1,070 winner bid leases. Lease bids are administered by the Minerals Management Service (MMS) in the US, which gathers granular data related to the offshore oil and gas activities. The study sample spans twenty-two years (1954 through 1975)[25] of offshore drilling activity in the Gulf of Mexico. The author calculates the operating profit based on estimates for both revenue and cost related to the drilling projects over the sample period. On the one hand, operating revenue is objectively estimated based on the separate production of oil and gas. For each lease, the monthly production is multiplied by the average commodity price.[26] On another hand, offshore drilling costs are more complex to estimate because of the project's technical variables necessary to meet the geological conditions of the exploration area.

It is important to note the project allocation to alliances and solo firms is not random as oil and gas firms have different strategies when bidding for leases. For example, the access to a geological database is essential to have an initial assessment of the hydrocarbon discovery odds in a specific block. Hence, drilling productivity is primarily dependent on how large the exploration area is, and secondly how efficiently the drilling activities are executed. To treat these endogeneity concerns, Beshears (2013) employs a research discontinuity design based on

[24] Bids are classified as follows: i) solo: when a single firm is fully responsible for the bid; (ii) alliance: when more than one firm is jointly responsible for the bid, but none having more than half of the bid, and (iii) consortium: organizational form with a single firm retaining more than 50% of the bid. The main results focus exclusively observations classified as either on solo or alliance. Sensitivity tests with all consortia related data classified alliances provide similar results relative to the main tests.
[25] At the end of 1975 due to concerns regarding the lack of competitiveness between the lease auction bidders, lease bidding rules changed not allowing the formation of alliances by the eight major oil companies.
[26] Offshore Louisiana wellhead crude oil and Offshore Louisiana natural gas.

the bid ratio,[27] allowing the author to focus on leases where one organization form defeats the other by a small margin.

OLS regressions indicate a negative coefficient on the single firm dummy, significant at the 1% and 5% levels depending on the bid-ratio's bandwidth. Further tests are run to explore the alliance's superior operating performance, and the author uses a proxy based on the previous drilling experience for each alliance member. Specifically, he counts the number of leases previously operated by firms for each set of leases in the same area according to the MMS' territorial divisions. A firm with more previously owned leases than the median firm is classified as "high-experience". Tests indicate a lower difference between the solo bidders and alliances comprising either zero or one high-experience firm. In contrast, the superior drilling performance is significantly higher when comparing solo to alliances with two or more high-experience firms. Thus, Beshears (2013) finds evidence consistent with the information and expertise hypothesis as a source of superior performance.

Ozmel, Robinson & Stuart (2013) address two interrelated research questions regarding funding provided by both venture capitalists (VCs) and alliance partners to biotechnology start-up firms. Firstly, they investigate how these two funding channels complement or substitute each other. Secondly, they examine whether the start-ups' funding strategy (VC or alliances) effects their exit outcomes. Data collection for biotechnology firms results in a final sample of 1,903 biotech firm births before 2004, which registered 5,203 strategic alliances and 7,148 VC financing rounds. For exit outcomes, there are 353 IPOs and 230 acquisitions.

The authors use a hazard model based on the function of a subsequent funding event occurring during a small time as a function of time and independent variables.[28] Results for

[27] The bid-ratio is computed on a lease-level basis and for a winning alliance is the division of the highest solo firm's bid by the winning alliance bid. Whereas, if a single firm wins the lease, the bid-ratio is the highest alliance's bid divided by the winning solo's bid.

[28] There are four groups of independent variables from which the variables are drawn: (i) VC's characteristics: two centrality proxies are constructed to capture VC's reputation and access to information channels; (ii) alliance characteristics: number of alliances over a five-year (sliding) window, amount of equity stakes sold to alliance

eleven models with the dependent variable based on the time since the last VC funding record indicate a biotech firm with more prior rounds of VC funding has a higher probability of receiving an additional VC round. The coefficient for each proxy based on the VC centrality is also positive and significant at the $p<0.05$ level. For example, a one standard deviation increase in the VC centrality proxy has a positive effect on the hazard of receiving a subsequent VC funding round of 18%. This finding indicates the importance of prominent VCs backing biotech firms, potentially conveying signals of start-up quality. Conversely, results for the past alliance track are negative and significant, suggesting a possible conflict of interests between VC investors and alliance partners.

For the hazard of going public (IPO), the dependent variable is set to zero for all months before the biotech firm's IPO and set to one from the month when the IPO occurs onwards. Both past VC funding and alliance activity have a positive and significant effect on the hazard of going public. Positive and significant effects are also observed for the coefficients on the proxies based on the VC centrality, confirming the importance of certification signals from prominent venture capitalists. Similar results are reported in the models with the dependent variable based on the acquisition of the biotech firm. These results confirm the value-adding and certification effects associated with well-positioned VCs, and alliance partners.

Kim & Palia (2014) consider the alliance formation between private equity acquirers.[29] The study focuses on the reasons underlying acquisitions via alliance compared to acquisitions made by solo equity firms. Data is obtained for completed acquisition deals[30] involving US firms over the period between 1980 and 2009. There are 68 alliances formed between private

partners and other project related milestones fixed in alliance agreements; (iii) firm quality: cumulative number of patent applications in the past five years, and a dummy indicating the presence of a drug candidate submitted to FDA clinical trials, and (iv) market conditions: one proxy to control for the IPO activity (number of IPOs in the last three months divided by the number of venture-backed biotech firms at risk of an IPO), a further proxy is used to control for the aggregate equity market conditions based on the NASDAQ composite monthly index return.

[29] Although there is data for deals with public acquirers, only 29 alliances are identified involving public bidders. Thus, the alliance analysis focuses on deals involving private equity bidders.

[30] Sampling restricted to completed deals where bidder(s) owns 50% of the target firm after the transaction.

equity bidders and 458 deals involving a single private equity bidder. These alliance deals are classified as diversifying (non-horizontal) given the different industry classifications of participants.[31] A probit model is employed where the dependent variable indicates alliance formation between private equity bidders. The coefficient on the target firm's ROA, used to test the lemon hypothesis, is positive and significant at the $p<0.10$ level.

Contrary to the lemon hypothesis predictions, results indicate private equity alliances are used to bid for more profitable target companies. The size of the target firm[32] is used to test the resource pooling hypothesis, predicting large-scale projects are likely to prompt bidder alliances or clubs. The coefficient on size is positive but not significant, indicating pooling of resources is not a determinant in the formation of alliances between private equity bidders. Further results are discussed in the light of value creation through the use of an event study based on the SDC's merger announcement date. A market-model three-day cumulative-abnormal return shows an average wealth gain of 14.1% stemming from target firms acquired by alliances between private equity bidders. For deals involving a single private equity bidder, the target firm yields a higher cumulative-abnormal return of 22.2%. To explore this abnormal return differential, further tests show that target firm characteristics rather than alliance formation are important in explaining the wealth effects.

2.3 Real options theory

2.3.1 Introduction

Options are part of the overarching class of derivatives, and according to Hull (2012) are defined as "*financial instruments whose value depends on the values of other, more basic, underlying variables*". In the financial market, stock options are traded on stock exchanges

[31] Industry classification is based on the two-digit SIC code. Sensitivity tests show similar results when the alliances are classified using the three-digit SIC code.
[32] Target firm size is measured in logarithmic form.

worldwide as well as on over-the-counter markets. For example, an investor obtains a call option through a premium payment, can exercise the right to buy the stock at the strike price within a specified period as per the option contract.[33] In other words, the option exercise is subject to the discretion of the holder whose rational decision making is based on the factors affecting the option value.[34] Option valuation methods have evolved, and the Black & Scholes (1973) model has become the benchmark to estimate the value of financial options.[35] However, some authors suggest the existence of embedded options in investment decisions. For example, the decision to expand a manufacturing operation, an option to close a mine or to drill further wells in the pursuit of oil and gas. These investment decisions have similarities with stock options, such as the holder's right to exercise decisions over time, and the options value sensitiveness to the volatility of its underlying asset. However, these 'options' stemming from investment opportunities are not traded in regulated markets with clearly specified parameters; rather growth investments involve physical assets, human resources, technology and other inputs. Accordingly, they are called 'real options' given their exercise implies the execution of a project usually involving a myriad of inputs and economic consequences at the firm-level. Real options theory is further discussed in Section 2.3.2, which explores studies focused on the use of options theory to investment projects undertaken by firms. Section 2.3.3 discusses measures used to test real options theory.

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[33] American options give the holder the right to exercise at any point in time until its expiration date. Conversely, European options allow the holder to exercise right on the expiry date only. Most traded options are American though (Hull 2012).

[34] The following variables affect the value of a stock option: current stock price, strike price, time to expiration, the volatility of the stock price, the risk-free interest rate, and the dividends that are expected to be paid if any (Hull 2012).

[35] According to Black & Scholes (1973), the option volatility is higher than the volatility of its underlying stock price given the former is a derivative of the stock price and the period of time until the option expiration date, under the assumption that the following parameters are kept constant to reflect ideal market conditions: (i) short-term interest is known and constant, (ii) stock price follows a random walk (price distribution is lognormal and return variance is constant), (iii) no dividends are paid until the expiration date, (iv) option is "European", (v) neither stock nor options related transactions bear transaction costs, (vi) it is possible to borrow, at short-term interest rates, any fraction of the security price, and (vii) there are penalties to short selling given the possibility of a financial settlement in case economic conditions are favourable to the option buyer at the end of the option contract.

2.3.2 Development of the real options theory

Geske (1979) explores the concept of compound options illustrated with a call option on a firm's stock, as the stock per se can be regarded as an option on the firm's asset value. As such the call option is regarded as "an option on an option". Likewise, farmout agreements meet the definition of a compound option as:

"(…) *an opportunity with a sequential nature, where latter opportunities are available only if earlier opportunities are undertaken." (Geske 1979, p. 63)*

Myers (1977) considers whether a real investment project can be regarded as a call option given the project's value derives at least partially from sequential incremental investments. The project's value derives from the cash flows generated by the assets in place and those afforded by a future discretionary expansion and/or asset redeployment. The value of assets in place can be calculated from conventional valuation approaches (i.e., discounted cash flows). Valuing the future expansion possibilities demands a more sophisticated valuation approach due mostly to the embedded flexibility to undertake, or not, sequential actions. This is considered the option growth value. The development of this real options valuation theory fostered a body of literature focused on the valuation of extractive industry projects (Brennan & Schwartz 1985; Moel & Tufano 2002; Paddock, Siegel & Smith 1988; Tourinho 1979). Brennan & Schwartz (1985) approach considers the stochastic nature of the output (commodity) price as well as the importance of management's flexibility to face the commodity price variation, given the significant volatility observed in some commodity prices at that time.[36]

[36] For example, Bodie & Rosansky (1980) report the standard deviation of the futures prices for copper, silver and platinum over 1950-1976 reached 47.2%, 25.6% and 25.2%, respectively.

2.3.3 Application of the real options theory

Paddock, Siegel & Smith (1988) and Cortazar & Schwartz (1997) focus on the development of valuation models for real options on undeveloped oil fields. Both studies note the importance of identifying the distinct project's life-cycle stages, with the compound nature of investments in offshore oil leases made up of three distinct phases: exploration, development and extraction. Paddock, Siegel & Smith (1988) note the high level of uncertainty in the exploration stage for which geological and technical information is necessary to assess the prospect's potential. Cortazar & Schwartz (1997) emphasise the use of future prices to avoid variability stemming from spot price predictions. Both studies indicate the relevance of the project timing (flexibility) as one of the determinants of the real option value, with flexibility allowing managers to decide the timing of field exploration based on the commodity prices. Cortazar & Schwartz (1997) find evidence that fractional value attributed to the waiting option is negatively related to the oil prices. In other words, the higher the oil price the lower the option value related to 'waiting'.

Grullon, Lyandres & Zhdanov (2012) examine the positive contemporaneous association between stock returns and volatility at the firm level. Their motivation is based on conflicting evidence found on the association between volatility and stock returns. For example, there is evidence on the negative relation between volatility and market returns at the aggregate level, which is supported by asset pricing theory based on both the leverage and premia hypotheses. Specifically, the leverage hypothesis states that in periods of stock price decline, firms become more levered relative to their market value, increasing volatility. In contrast, the premium hypothesis suggests an increase in the aggregate volatility affects risk premium, which in turn reduces firm value.

On the other hand, there is empirical evidence supporting a positive relation between volatility and stock returns at the firm level (Albuquerque 2012; Duffee 1995). Grullon, Lyandres & Zhdanov (2012) consider the use of real options theory at the market level. The main argument in favour of this theory to explain the positive relation between volatility and stock return is that this link holds at a firm level. Accordingly, companies accumulating non-exercised investment opportunities can better adapt to volatility increases caused by good news (i.e., gains in scale, increase in market share, etc.), and bad news (i.e., cost inflation, drop in demand, inputs shortage, etc.). In other words, firms with growth opportunities can benefit from timing the projects execution according to their needs and market conditions. Therefore, companies with investment opportunities can maximise their profits facing unexpected changes in volatility.

To differentiate companies with investments opportunities from firms with a large proportion of assets-in-place, measures of investment opportunities (firm size, R&D expenditure and sales growth), as well as measures of operating flexibility (sensitivity of company value to profits and sales), are used. The volatility measure is based on the firm's share price given it incorporates real options effects. Following Ang et al. (2006), Ang et al. (2009), Duffee (1995), and Grullon, Lyandres & Zhdanov (2012) calculate the firm return volatility as the monthly standard deviation of the firm's daily share price return. For a subsample comprising 72 oil and gas companies, data on reserves is collected from annual reports.

The firm's excess returns are the dependent variable in the first set of multivariate regressions which estimated for each month in the time series starting in 07/1963 through 12/2008. The first model's regressors are the market factor loading, log book-to-market ratio and log market equity. As expected as per evidence in the asset pricing literature (Fama et al. 1969; Gibbons, Ross & Shanken 1989), the coefficients on market factor loading and log-book-to-market are positive and significant at the $p<0.01$ while the coefficient on log market equity is negative and significant at the $p<0.01$, and the R^2 is 3.6%. The second multivariate model includes the difference between the volatility measures for the current month (t_0) and for the previous month ($t - 1$). The coefficient on this month-month return volatility is positive and highly significant, the model's R^2 increases to 7.1% while no change is observed for the other regressors. The third model includes the firm's 6-month-lagged returns and does not include the month-to-month return volatility. The model's R^2 is 4.1% and the coefficient on the lagged return is positive and significant at the $p<0.01$ level. Following the specification of model 3, the fourth regression adds the month-to-month return volatility whose coefficient is again positive and significant at the $p<0.01$ level, and the R^2 reaches 7.7%. The two final models replicate the specification of the third and fourth regressions, respectively, and include the monthly trading volume divided by the number of shares outstanding following Karpoff (1987). The main change is observed for the coefficient on the lagged firm return, which becomes negative and no longer significant. This is consistent with related studies because of this variable's relative sensitivity to the inclusion of other variables. It is important to note that the coefficient on the month-to-month return volatility remains positive and significant at the $p<0.01$ level independently of the inclusion of further variables. This preliminary finding supports the use of return volatility to explain share price returns at the firm level in light of the real options theory.

To focus on the relation between return volatility and firm's excess returns, Grullon, Lyandres & Zhdanov (2012) use two sets of proxies to identify the firm's investment opportunities and the firm's operating flexibility. For the investment opportunities, the proxies are normalized and interacted with the month-to-month return volatility. Then, the firms form investment-opportunity-based quintiles at the end of each year. The first investment opportunity proxy is firm size,[37] for which coefficient is negative and significant at the $p<0.01$

[37] Firm size is calculated as the log of the book value of total assets. Accordingly, larger companies are seen as having more assets in place and less growth opportunities.

level. This result indicates the larger the firm size, the lower is the effect of return volatility on the firm excess return, which is consistent with large companies having more assets in place relative to small firms. The second proxy is the firm age,[38] whose coefficient is also negative and significant at the $p<0.01$ level. R&D ratio[39] is the third proxy of the investment opportunities, whose interaction coefficient with the month-to-month return volatility is positive and significant at the $p<0.10$ level. This finding suggests the effect of return volatility on the firm's excess return is higher for R&D-intensive firms. The interaction coefficient on the last proxy based on future sales growth is also positive and significant at the $p<0.01$ level. Results for both R&D and future-sales growth related proxies confirm a stronger correlation between the firm's share price returns and the firm's volatility for companies with higher-growth potential. Overall evidence based on the first set of investment opportunity proxies is consistent with the prediction that volatility has a positive association with the share price returns of both small firms and companies with higher growth potential.

A further set of tests are reported to explore the relation between return volatility and firm share price return based on industries for which constituents are more prone to higher real options effects from their investment opportunities. These industries are the following: natural resources,[40] high-technology,[41] pharmaceutical and biotechnology. An indicator variable for each of these industries is interacted with the month-to-month return volatility. Results indicate that the coefficients on these interactions are positive and significant, suggesting a stronger relationship between the return volatility and share price return for companies operating in these industries. It is important to note the largest coefficient is observed for the interaction

[38] Firm age is computed as the log of the number of years between the current year and the firm foundation (in the absence of the foundation date, incorporation year or the first year when the firm appears in the CRSP database).
[39] The R&D ratio is based on the total R&D expenditures over total assets.
[40] The following industries are classified as natural resources: precious metals, mining, and oil and natural gas.
[41] An industry is classified as high-technology industry if the firm operates in one of the following industries: electrical equipment, telecommunications, computers, computer software, electronic equipment, and measuring and control equipment.

between natural resources and return volatility, indicating that firms in this industry are more sensitive to the effect of real options due to their growth investments. Subsequently, the authors focus on the subsample of oil and gas firms to explore real options theory using the volatility of oil and gas prices as a more direct proxy compared to the return volatility. As non-developed resources are seen as unexercised real options available for the use at the discretion of oil and gas firms, data is collected from their annual reports to construct proxies derived from the resource portfolio held by these firms: the proportion of undeveloped oil and gas reserves, and weighted average of these two proportions for the overall hydrocarbon portfolio. Each of these proxies is used in the primary regression interacted with the oil and gas volatility measure. In all three models, the coefficients on the interaction are positive and highly significant, their economic magnitude is higher than the other independent variables. These results provide stronger evidence for the relation between the volatility of the underlying asset and the firm's share return for companies with a higher proportion of unexercised investment options (real options).

Sabet & Heaney (2016) build upon Grullon, Lyandres & Zhdanov (2012) and investigate the impact of information asymmetry and real options created around oil and gas reserves and acreage acquisitions. These acquisitions are important for oil and gas companies once their existing projects mature, with risks of production declines. In their study, the real options hypothesis is based on the association between the market reaction to the acquisition of these two types of assets and crude oil volatility. The use of the volatility of the oil price is consistent with the valuation of options in general to reflect the worth of the underlying assets. Sabet & Heaney (2016) suggest the acquisition of acreage has a higher option value given the potential for acreage to be developed and then put into production if economically feasible.

Conversely, an investment in reserves provides the acquirer with an extraction choice. Thus, acreage acquisition is likely to have higher intrinsic value from a real options perspective arising from its larger waiting option to further development, and subsequent extraction decision. The study also tests the information asymmetry hypothesis in the light of investments. Specifically, the acquisition of reserves relative to the purchase of acreage is seen as a stronger signal to the market of the companies' future value creation based on their decision to increase their existing projects portfolio. Additional hypotheses build upon the acquirer's track record and existing reserves.

The study sample obtained from the Herold merger and acquisition database and checked using the SDC database and Factiva. There are 1,391 announcements of upstream acquisitions split into 485 acreages and 906 reserves. Abnormal returns are calculated using Carhart's four-factor model (Carhart 1997) for both subsamples of acquisition announcements. Acreage acquirers yield an average positive abnormal return of 0.35%, but is not significant, whereas firms acquiring reserves experience a positive average abnormal return of 0.99%, significant at the $p<0.01$ level. Results from the OLS models report a positive coefficient on the interaction between the dummy variable indicating the acquisition of acreages and the crude volatility, and significant at the $p<0.01$ level, indicating oil and gas firm's stock prices are more sensitive to the volatility of the oil price for acreage acquisitions compared to reserve purchases. Their results suggest that the embedded waiting option present in the acreage acquisition has a substantial value once oil price volatility increases, allowing the acquirer to decide the optimal timing of further exploration investments.

With regard to the existing reserves hypothesis, there is evidence of positive market reactions to acquisition announcements by oil and gas firms with low reserve-to-production ratios.[42] The study also provides evidence for the fourth hypothesis based on positive market reactions to the announcement of acreage by firms with a better exploration track record.

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[42] Reserve production ratio is used to measure the oil and gas firm's future production in years based on the existing level of reserves. Specifically, this ratio is calculated as follows: firm's total proven reserves over the firm's total production, divided by 1,000.

Chapter 3 – Farmout agreements

3.1 Overview

This chapter focuses on the market reactions to announcements of farmout agreements by oil and gas companies listed on the Australian Securities Exchange (ASX). Farmout agreements are widely used by oil and gas companies to jointly conduct exploration and appraisal activities in the pursuit of economic discoveries of hydrocarbons. Currently, there is only descriptive evidence, but no empirical studies on these types of corporate arrangements. Lowe (1987) defines a farmout agreement in the oil and gas industry as follows:

"*An oil and gas farmout agreement is an agreement by one who owns drilling rights to assign all or a portion of those rights to another in return for drilling and testing on the property*."

Accordingly, the main objective of undertaking such an interfirm arrangement is to exchange partial exploration rights of the permit owner ("farmor") for benefits to be derived from the exploration activities undertaken by the incoming party ("farminee"). In other words, the farmor agrees to partially transfer working interests over a given area to the farminee in exchange for exploration commitments substantially covered by the latter.[43]

Farmout agreements considered in this chapter are analysed in the context of cooperative arrangements in the financial economics literature.[44] Although the related definitions vary to some extent, these farmout arrangements meet the broad scope of an alliance, being an informal agreement involving at least two separate firms with some level of

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[43] For example, in Appendix 1, on 25 February, 2013 Beach Energy (the farmor) announced a farmout agreement with an Australian subsidiary of Chevron Corporation (farminee). In this case, the farmor relinquishes interests over two oil and gas areas located in the states of South Australia and Queensland. Chevron's financial commitment potentially totals up to $US349 million based on a two-stage work program.

[44] Other alliance studies of oil and gas companies have examined bidding strategies for oil leases and market competition (Hendricks & Porter 1992; Mead 1967), bidder information asymmetry (Hendricks, Porter & Boudreau 1987), drilling timing (Hendricks & Porter 1996), production efficiency (Beshears 2013; Kent 1991) and agency theory (Bertrand & Mullainathan 2005).

mutual commitment (Chan et al. 1997; Weston & Weaver 2004). As these specific arrangements can take many forms, starting from loosely agreed upon terms through to complex embedded option structures bound by a joint arrangement, the wider concept of alliance (cooperative arrangement or interfirm relationship) embraces this varying level of mutual commitment. Hence, farmouts can take the form of medium-term non-binding agreements between two or more firms as well as long duration alliances focused on sequential or staged exploration effort of a given oil and gas permit.

This chapter investigates the determinants of wealth changes associated with farmout announcements in light of four theories. First, the 'pooling of resources' theory argues that participants conduct alliances to combine complementary resources necessary for undertaking the project of interest. Motivation to build on this hypothesis is sourced in Palia, Ravid & Reisel (2007) who find evidence of resource pooling in the movie industry setting for film projects with large budgets. Second, the certification theory assumes that characteristics of the incoming party in a project have the potential to convey quality signals on either the venture prospects or the project vendor. Ozmel, Robinson & Stuart (2013), for instance, find evidence of the contribution of past alliances with pharmaceutical companies and venture capitalists to biotech firms' exit outcomes either going public or being acquired by another company is found. Third, the expertise theory suggests the use of alliances to transfer technology between participants to undertake a joint project. Beshears (2013) documents evidence supporting the expertise theory in the oil and gas lease bidding context where alliances perform better compared to single companies in drilling performance outcomes. The fourth hypothesis builds upon real options theory which considers investment projects as call options due to their sequential nature. Thus, if farmout agreements occur during a time of greater uncertainty, the project is more in the money given the positive relation between the option value and uncertainty. Therefore, farmors experience positive abnormal returns when farmouts are announced in periods of higher oil price volatility.

The event study approach is used to examine market reactions to farmout agreements announced by ASX listed energy firms between 1990 and 2016. The sample comprises 589 and 389 announcements released by farmors and farminees, respectively. Results show that farmout agreements are important economic events, exhibiting an average excess return of 2.51% for the farmors on the announcement day. The corresponding average market reaction to farminees' announcements is 0.40%. Over a three-day window [-1, 1], farmout announcements generate a cumulative average abnormal return of 3.60% compared with 1.90% for farminees.

The multivariate analysis of event returns provides evidence consistent with resource pooling. For example, the coefficient on project size, measured by acreage, is positive and significant. A further two proxies are used to test of resource pooling, being financial commitment and the presence of target oil and gas reserve estimate disclosures. Both are positively related to abnormal returns. More positive market reactions are observed for permits featuring unconventional exploration targets, suggesting farmors' seek partners with expertise to explore more complex opportunities. Finally, evidence supports the interpretation that farmouts are real options with a positive association between oil price uncertainty and the farmors' abnormal returns. That is, if farmout agreements happen in a time of greater uncertainty, the project is then more in the money given the positive relation between the option value and uncertainty.

This chapter is organised as follows. Section 3.2 discusses hypothesis development. The literature review explores ASX oil and gas companies' motivations to relinquish permit interests via farmout agreements from alliance related theories. This includes literature on oil and gas arrangements in a real option context with an extractive industry focus. Data and the research methods are explained in Section 3.3. Specifically, the event study approach is applied to estimate the market reactions to the announcement of farmout agreements and is described in Section 3.3.1. The empirical results are discussed in Section 3.4 where the wealth changes estimated resulting of the farmouts are described in Section 3.4.1 Results for the primary cross-sectional model, and alternative model specifications are discussed in Section 3.4.2. Additional analyses are discussed in Section 3.5, including consideration of potential noise effects arising from other market-sensitive announcements in Section 3.5.1.

Further tests clustering the cross-sectional models' standard errors by firm and time are presented in Section 3.5.2. The third set of additional tests is discussed in Section 3.5.3 for the use of different share price data sources. Concluding remarks relating to this empirical analysis of farmout announcements by ASX oil and gas firms follow in Section 3.6.

3.2 Hypotheses development

The discussion of the hypothesis tested in the farmout setting is based on the alliance literature discussed in Chapter 2. In Chapter 2, empirical studies on interfirm arrangements consider three main theories: resource pooling, certification, and expertise and technology. Firstly, it is predicted that farmors seek farminees to co-finance high risk exploration project areas given the farmors' lack of resources. Three proxies are used to test the resource-pooling hypothesis as discussed in Section 3.2.1. The second hypothesis is motivated by certification (endorsement) effects resulting from cooperative arrangements in the biotechnology industry. Specifically in that setting, the presence of large pharmaceutical companies and prominent financiers are viewed as endorsements of early-stage projects undertaken by small biotech firms. The certification hypothesis applied to the farmout setting is discussed in Section 3.2.2. The third hypothesis focuses on the expertise shared between the alliance's partners, where a prior track record of winning bids for companies operating in the Gulf of Mexico is explored, Section 3.2.3 examines the expertise hypothesis.

Considering the sequential nature of extractive projects and specifically in the farmout setting where the farmor is exposed to the risks and benefits arising from the alliance, the real options hypothesis is tested. Section 3.2.4 reports the real options theory proxied by oil price volatility.

3.2.1 Resource-pooling theory

McConnell & Nantell (1985) investigate the wealth effects of joint venture announcements by US companies testing for synergies arising from resource pooling. The synergy argument suggests the deal ultimately benefits shareholders of all participants, due to more efficient asset employment (Berkovitch & Narayanan 1993; Johnson & Houston 2000). Thus, joint ventures are an appropriate setting to test resource pooling controlling for the effects of management displacement, since the management of the venture partners remains intact. Similar to oil and gas exploration firms, small biotechnology firms hold portfolios of risky, capital-intensive projects and face capital rationing due to their restricted access to funding in the capital markets. Lerner, Shane & Tsai (2003) investigate the shifting sources of project funding for small biotechnology firms. There is evidence suggesting public market conditions are an important determinant prompting the use of alliances as a financial channel. They find that relinquishment of project control rights is significantly associated with periods where the project owner raises little external financing.

Palia, Ravid & Reisel (2007) investigate co-financing strategies in the movie industry between small production firms and large studios. When film projects reach the ‘assembly’ stage, most of the necessary inputs, such as budget, casting and project manager, are agreed. At this stage, budget size determines the need for co-financing alliances with other studios.

They test the resource pooling hypothesis using a project-level sample comprising 275 film projects over the 1994 to 2000 period. There is evidence that larger film projects, in terms of budget size, are more likely to be undertaken via alliances. The median budget for projects financed via alliances is $US 47.05 million, compared to $US 33.90 million for films solely developed by one production house. Although movie projects have a shorter life than those in the oil and gas and biotechnology settings, studios face challenges allocating limited resources across many projects, hence the attraction of resource pooling.

Oil and gas farmouts are a useful setting for testing the resource pooling theory as firms are likely to engage in co-financing strategies with the common objective of making an oil and gas discovery. Based on the resource-based theory applied in the M&A literature, farmout partners can benefit from synergistic gains derived from economies of scope when assets are complementarily combined. Small oil and gas exploration companies holding exploration permit portfolios often lack the necessary financial resources to explore all their prospects. In contrast, larger companies are interested in participating in risky ventures with potentially high payoffs. Thus, it is expected higher excess returns to be associated with cases where the farminees' financial commitments disclosed in farmout announcements. [45]Farmors seeking farminees to further explore and develop potential resources given some previous exploration had already been undertaken before the farmout announcement. That is, having the identification of target resources in the farmout agreement is important because of the exploration risk range in these projects. . Thus, it is predicted farmout agreements with quantitative disclosure of the permit's target hydrocarbon potential to be associated with higher abnormal returns to farmors. In addition, following the rationale of Palia, Ravid & Reisel (2007) suggesting larger projects are more likely to be undertaken via alliances due to their higher demand for resources, project size is used to proxy for farmors' needs for resource

[45] Greenfields are unexplored areas where resources existence is unknown.

pooling. It is expected project size, as measured by exploration area or acreage, to be positively associated with farmors' abnormal returns. Accordingly, the resource pooling hypotheses are developed as follows:

H1.a: Farmors announcing farmout agreements disclosing financial commitments from counterparties are associated with higher abnormal returns.

H1.b: Farmors announcing farmout agreements with hydrocarbon reserve targets disclosure experience higher abnormal returns.

H1.c: Farmors announcing farmout agreements with larger exploration areas experience higher abnormal returns.

3.2.2 Certification theory

Young firms usually face challenges in signalling their project's potential to the market. The existence of early-stage projects in young firms' portfolios increases external pressures for operational disclosure to enable market participants to assess firm value in the face of high information asymmetry. Prior studies acknowledge that high information asymmetry stems not only from project uncertainty, but also from small firms' lack of verifiable public information (Leland & Pyle 1977; Myers & Majluf 1984). There is ample evidence of certification provided by prestigious investment banks and prominent venture capital firms for initial public offerings (IPOs), applying agency theory featuring moral hazard and incomplete information in which information is classified as either "hard" or "soft" (Miloud 2016).

Stuart, Hoang & Hybels (1999) explore the role of certification in venture capital-backed early-stage biotechnology firms seeking to access the capital necessary to undertake R&D projects. They examine the effects of different exchange partners (alliance partners, equity partners and investment bank) on the biotechnology firm's IPO performance and find evidence of positive alliance partner certification effects on biotech firm valuation. More recently, Ozmel, Robinson & Stuart (2013) test the certification theory considering the role strategic alliances and venture capital play in biotechnology firms' exit outcomes (either going public or being acquired by another company). The study finds that biotech firms' past alliance track record and backing by a better-positioned venture capitalist increases the likelihood of either exit outcome. This study builds on prior work by Nicholson, Danzon & McCullough (2005) who find evidence of a positive effect of biotech firm alliances with pharmaceutical companies. This early work finds that junior biotech firms relinquish, at a significantly discounted price, not only equity interests but also rights to the R&D projects. However, the discounted value offered by the counterparty is likely to be offset by future higher valuations from venture capitalists and/or investors. Similarly, the operational quality of an oil and gas explorer cannot be observed directly, but a better valuation of its early-stage projects can be obtained when certified by prestigious alliance partners.

Unlike the resources pooling hypothesis where synergistic gains create value, the signalling effects of partner certification can increase project value. That is, information asymmetry in early-stage projects is pervasive, inhibiting increased external valuation. By attracting partners with certain characteristics, this information asymmetry can be mitigated improving perceptions of the project quality. Permit information is limited in early stage-exploration where the likelihood of finding hydrocarbons is remote.[46] Two partner characteristic variables are used to proxy for the certification of project quality including the origin of the farmout partner (foreign versus domestic oil company) and whether this foreign partner is a 'major' oil company. Accordingly, the certification hypotheses are developed as follows:

[46] Paddock et al (1988, p.483) notes the lack of oil and gas lease information at the early exploration stage (bidding stage) as a source of project uncertainty resulting in a wide range of valuations of oil and gas exploration firms.

H2.a: Farmors announcing farmout agreements with foreign farminees experience higher abnormal returns;

H2.b: Farmors announcing farmout agreements with oil and gas 'majors' experience higher abnormal returns.

3.2.3 Expertise hypothesis

Hayek (1945) discusses how the distribution of knowledge impacts organisational structure and how decision rights are decentralised based on the agents' level of knowledge. Jensen & Meckling (1995) build upon this study by analysing two main categories of knowledge: specific and general. Specific knowledge refers to specific skills or a particular way to employ economic resources. This type of knowledge is unlikely to be aggregated or summarised, hence its transfer to another agent is deemed to be significantly costly. From this perspective, the main argument is not whether such knowledge transfer is possible, but at what cost such knowledge transfer occurs. Jensen & Meckling (1995) note the importance of whether such transfer is worthwhile, based on benefits the knowledge affords managers in making better decisions. In contrast, general knowledge is more available in an organisational network and more easily gained or transferred. The authors emphasise that in a market as in other societal systems, the decision rights are likely to flow towards the agents that value them most, who in turn are likely to be the ones with specific knowledge to use them more efficiently.

In an alliance context, Chan et al. (1997) investigate whether alliances involving specific knowledge or proprietary information (proxied by the presence of R&D), yield higher excess returns to the partner's shareholders relative to non-R&D deals. Although there is evidence of significant abnormal returns to both groups, excess returns stemming from R&D related alliances are not statistically different from the remainder of the sample. Das, Sen & Sengupta (1998) examine the value creation of technological alliances in a study of 119 non-joint venture arrangements in the US over the period 1987-1991. They note the importance of technological arrangements between companies developing early-stage products, mostly involving upstream value chain activities. As such, these alliances are likely to last longer and promote specific knowledge transfer between participants over time.

Beshears (2013) examines the performance of oil and gas drilling projects undertaken by alliances and solo firms in the Gulf of Mexico spanning the period 1954-1975. The author investigates bidding prices paid by alliances and solo firms for the rights to explore for hydrocarbons in offshore leases. The main analysis is based on a final sample comprising 1,070 leases won by 563 alliance bids and 507 solo firm bids. The main theoretical explanation motivating the formation of these alliances, when bidding for and executing these projects, is based on the benefits of sharing information and expertise. Accordingly, Beshears (2013) predicts that projects carried out by cooperative arrangements are likely to outperform those undertaken by a single company and finds evidence of the superior performance of alliances versus single companies in drilling outcomes.[47]

Thus, alliance partners contribute expertise in undertaking drilling exploration in areas already exposed to previous exploration effort more efficiently. However, the author also notes the alliance’s relative outperformance weakens when it consists of a single high-experience partner. It is suggested that highly complex drilling activities are likely to demand the participation of more than one partner with a high level of specific knowledge, in this case, offshore exploration expertise. This result contrasts univariate evidence in Kent (1991), who investigates data on lease permit bidding and exploration output over 1954-1973. This earlier study finds no significant difference in performance between exploration projects undertaken by joint ventures versus single companies.

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[47] The experience proxy is based on the number of leases previously held by the exploration companies in the same area of the lease auction.

In the farmout context, it is possible to test the technology and expertise hypothesis using three project-level proxies. First, an important characteristic of oil and gas exploration projects is the nature of the geology subject to exploration and the drilling techniques required to access any oil and gas targets. Conventional resources accumulate in well-defined reservoirs whose exploration is possible using simple drilling techniques. In contrast, unconventional hydrocarbons are found in rocks with lower levels of permeability and porosity, requiring complex drilling techniques such as the use of horizontal wells and hydraulic fracturing (Zou 2017). Although project complexity for both types of exploration approach varies significantly, unconventional resources pose specific challenges such as the need for ongoing appraisal effort and related expenditures, and higher environmental risk (Sweeny et al. 2013). Thus, permits containing unconventional exploration targets will motivate farmors to seek more experienced partners.

Second, oil and gas exploration activity is broadly divided into two types: offshore and onshore. Following Beshears (2013), offshore oil and gas projects are regarded as more complex. Technology and experience are critical factors in offshore exploration as targets may be located at significant depths. Thus, the second proxy indicates the presence of offshore permits subject to the farmout agreement with farmors likely to seek partners with higher technological capabilities to undertake deeper offshore exploration. Furthermore, farmors may elect to relinquish control rights over the day to day exploration management of the permit in favour of the farminee, referred to as a change in project operatorship. This discussion gives rise to the following testable hypotheses:

H3.a: Farmors announcing farmout agreements targeting unconventional resources experience higher abnormal returns.

H3.b: Farmors announcing farmout agreements over offshore tracts experience higher abnormal returns.

H3.c: Farmors announcing farmout agreements where project operatorship is relinquished experience higher abnormal returns.

3.2.4 Farmout agreements as real options

Geske (1979) explores the concept of compound options illustrated with a call option on a firm's stock, as the stock per se can be regarded as an option on the firm's asset value. As such the call option is regarded as "an option on an option". Likewise, farmout agreements meet the definition of a compound option as:

"(…) *an opportunity with a sequential nature, where later opportunities are available only if earlier opportunities are undertaken."* Geske (1979, p. 63)

Following Cortazar & Schwartz (1997) who find evidence that fractional value attributed to the waiting option is negatively related to oil prices, the optionality embedded in farmouts responds to changes in oil prices. Grullon, Lyandres & Zhdanov (2012) provide the first evidence of the real options theory using the volatility of oil and gas prices based on additional tests on a subsample of oil and gas firms. They consider non-developed resources of oil and gas firms as assets bearing unexercised real options. The firm's excess returns are the dependent variable in the first set of multivariate regressions which are estimated for each month in the time series starting on 07/1963 through 12/2008. Thus, data is manually collected to construct proxies derived from the resource portfolio held by oil and gas firms. Each of these proxies is interacted with the change in the oil and gas volatility measure, and results from the cross-sectional models indicate the coefficients on the interaction term are positive and statistically significant. Grullon, Lyandres & Zhdanov (2012) find evidence of the relation between the volatility of the underlying asset and the firm's share return for oil and gas firms with a higher proportion of unexercised investment options. That is, share returns of firms with non-developed resources are higher when volatility increases.

Sabet & Heaney (2016) find a positive relation between the market reaction to the acquisition of acreage and the volatility of the crude oil. However, there is no evidence of a positive association between the abnormal return of companies purchasing reserves and the oil price volatility.[48]

The real options theory is tested in studies focused on strategic alliances. Kogut (1991) views joint ventures as real options with firms seeking partners not only to share project's uncertainty but also to exploit efficiencies. Kogut (1991) considers two possible venture outcomes as the real option exercise: either the venture being acquired by one of the parties or its ultimate termination. He finds that increases in venture value stemming from unexpected industry growth increases the likelihood of option exercise through acquisition.

In the farmout alliance context, the party relinquishing interests in the project is still exposed to the risks and benefits arising from the staged project exploration. A farmout allows participants to learn about the permit's oil and gas prospects. This alliance provides both partner access to a growth option, securing upside gains that would otherwise not exist. What is intrinsic to growth options that are exploratory in nature is the high level of uncertainty (Folta 1998; Vassolo, Anand & Folta 2004). From this perspective, the value of farmout projects as other real options is positively associated with high uncertainty levels. That is, if farmout agreements happen in a time of greater uncertainty, the project is more 'in the money' given the positive relation between the option value and uncertainty. The crude oil price volatility is used as a proxy for the uncertainty related to the underlying commodity price, to which farmors remain partially exposed. Accordingly, the testable hypothesis follows.

[48] It is noted that oil and gas reserves convey the same waiting option value arising from oil and gas company's discretion as to when they should be exploited which is dependent on the oil price, a prediction not confirmed by Sabet & Heaney (2016).

H4: Farmors announcing farmout agreements in periods with higher crude oil volatility experience higher abnormal returns.

3.3 Data and research method

Farmout announcements by ASX listed oil and gas firms are manually collected over the period January 1990–December 2016. Two data sources are used to search for these announcements being Morningstar's Datanalysis Premium[49] and Factiva. Search on these databases has the advantage of including delisted firms, which assists in mitigating survival bias. The search for farmouts follows a two-step process. The first step queries Morningstar's Datanalysis Premium database, which contains searchable ASX full-text announcements over the sample period.[50] The second step involves repeating the same process using Factiva over the period from 1990 to 2000 (during this period Morningstar's Datanalysis Premium has limitations in terms of searchable announcement text).[51] Cases involving an ASX listed non-energy farminee are retained.[52] A total of 2,449 announcements are identified, with sample attrition documented in Table 3.1. Following Chan et al. (1997), only the initial or first announcement of the deal to the ASX is included. Typically, the deal conclusion may take months and involve many sequential announcements, with a project identifier used to track

[49] GICS code 1010 is used to search documents reported by companies from the energy industry.

[50] Queries included "farm in", "farm out", "farmin" and "farmout". Subsequently, it was observed that some valid announcements were being missed due to the idiosyncratic nature of some disclosure. Slightly broader and more generic search criteria were applied. All ASX-listed energy firms' announcements headlines were analysed with: (i) a VBA query employed to identify headlines containing the word "farm"; (ii) content analysis undertaken focusing on some related key words ("expansion", "agreement", "new acreage" and "new investment").

[51] The key words used are "farmout" and "farmin" with the following source filters: (i) four sectors in the energy industry (Crude Oil/Natural Gas Upstream Operations, Downstream Operations, Natural Gas Processing, and Oil/Natural Gas Midstream Operations), and (ii) news source limited to the Australian Stock Exchange Company Announcements.

[52] For example, on 14/07/1994 The Broken Hill Proprietary Company Limited (BHP) announced a farmout agreement with two farminees, namely Mobil Exploration & Producing Australia Pty Ltd and Indonesia Petroleum Ltd, over two permits located in Western Australia. Although BHP's principal business is mineral exploration and production (Materials), the company has significant exposure to oil and gas projects through its subsidiary, BHP Petroleum Pty Ltd. In terms of frequency, there are 14 (2.4%) farmouts from firms in the Materials industry, which like the BHP example undertake oil and gas projects as a secondary economic activity. Regarding farminees, there are 33 announcements (8.5%) from non-energy firms classified in five different industries with Materials the most frequent classification having 23 announcements (5.9%).

deal announcement histories, which enables to identify initial and subsequent deal announcements. After excluding 1,447 subsequent announcements, another 18 transactions are deemed not to be farmouts and a further 6 announcements are deemed as lacking sufficient details, a remaining sample of 978 announcements, comprising 589 disclosed by farmors or vendors and 389 disclosed by farminees or buyers. These companies participate in 722 unique farmout deals as some of the agreements involve more than one ASX-listed companies.

[Insert Table 3.1 about here]

Table 3.2, Panel A reports the distribution of farmout agreements by year. The highest frequency of deals is observed in the years 2006 (53), 2007 (60) and 2010 (54). Farmors are more active in the years 2005 (51), 2006 (48) and 2007 (49). While farminees are most active in 2007 (35), followed by 24 deals announced in 2005, 2009 and 2010. Overall, a more active market for farmouts occurred in mid-2000's through 2010, with an increase in 2012 corresponding to periods of higher oil prices as shown in Table 3.2, Panel B.[53]

[Insert Table 3.2 about here]

Table 3.3, Panel A, reports descriptive statistics for the continuous variables.[54] The size of farmout announcers is measured using the market capitalisation in Australian dollars at the end of the fiscal year prior to the farmout announcement (*MCAP*). Farmors have a mean (median) market capitalisation of $469.1 million ($23.7 million). In contrast, farminees are larger, with a mean (median) market capitalisation of $2,077.0 million ($29.0 million). The

[53] Farmout numbers are highly correlated with one-year-leading futures prices for West Texas Intermediate (WTI) Crude.
[54] This paper primarily considers farmor announcements and their motivations to relinquish permits interest based on project and partner characteristics. Data on farminees are provided for descriptive purposes given there is no descriptive evidence available to date in the literature.

MCAP distribution indicates skewness to the right due to the presence of relatively large companies, including 47 non-energy participants.[55]

[Insert Table 3.3 about here]

FIRMAGE is firm age, measured as the time, in years, between a firm's listing date on ASX and the farmout announcement date. Farmors in the sample are listed for a mean (median) of 12.6 (9.1) years. This compares with the farminees' mean (median) age of 17.7 (11.8) years suggesting farminees are relatively older. The variable *TOP20* captures shareholder concentration, measured by the equity stake held by the twenty largest shareholders sourced from annual reports in the prior fiscal year. The top twenty shareholders hold a mean (median) stake of 49.6% (49.7%) of farmors' equity, compared to 53.2% (51.4%) for farminees, respectively. The variable *NFIRMS* indicates the number of farmout participants per announcement. A mean (median) *NFIRMS* of 2.2 (2.0) suggests that the average deal involves only one farmor and one farminee.[56] For farmout announcements released by both farmors and farminees, the maximum number of participants is five.

Extant literature on mergers and acquisitions includes measures of political uncertainty of the target Glambosky, Gleason & Murdock (2015). To control for the political risk inherent to project locations, data is extracted from the PRS Group's International Country Risk Guide

[55] The mean (median) market capitalization of non-energy farmors is $9,452.9 million ($27.3 million) compared to $265.7 million ($23.4 million) for oil and gas farmors. Similarly, non-energy farminees are larger with a mean (median) market capitalization of $10,478.0 million ($23.7 million) compared to the mean (median) *MCAP* of oil and gas farminees of $1,343.4 million ($29.4 million).

[56] Although some permits are held by many oil and gas companies prior to the farmout agreement, only the active agreeing parties are considered in the sample based on the announcement disclosure. For example, if prior to the agreement the permit is held by two companies of which only one is seeking partner through a farmout agreement, the announcement is usually clear which permit holder is relinquishing interests to the incoming party (farminee). Therefore, only the two agreeing parties are considered in the deal. It is important to note that in some cases, the farminees identity is missing due to confidentiality provisions or insufficient disclosure.

covering 141 jurisdictions (*CRISK*).[57,58] Farmors relinquish interests in projects located in jurisdictions with an average (median) political risk of 0.81 (0.88). This political risk index is employed due to its broad coverage and has been used by Glambosky, Gleason & Murdock (2015) to measure the risk of loss due to weakness in the legal system, expropriation, bureaucratic hurdles and repudiation of debt in their study of cross-border acquisitions. Permit area (*ACREAGE*) is measured in acres and disclosed for a total of 448 farmor and 311 farminee announcements with the mean (median) permit size being 2,172,369 (1,361,201) acres for farmors and 508,173 (431,199) acres for farminees. This data is skewed to the right due to the presence of vast acreages in some agreements. Oil price data is obtained from the US Energy Information Administration for the WTI futures contract.[59] Oil price volatility (*OILPVOL*) is calculated based on the daily price change over the month of the farmout announcement (Sabet & Heaney 2016). The mean (median) volatility is 0.02 (0.02) for farmouts with similar volatility observed for farminees. Additionally, there are periods in which the oil price volatility reached nearly 0.08 during the commodities boom, and falling to as low as 0.01 in years when oil prices were depressed. Such large variance is expected given the sample spans 27 years, and complete oil price cycles are observed.

Table 3.3, Panel B reports the univariate tests of the difference in means for the continuous variables. Results confirm farmors are smaller than farminees ($p<0.01$) in terms of

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[57] The PRS political risk measure ranges from zero to one, with a higher value indicating lower risk. It is composed of six risk dimensions: voice and accountability, political stability and absence of violence, government effectiveness, regulatory quality, rule of law and control of corruption. In this study, the average of all these six dimensions in the year prior to the farmout announcement date is used. Index figures for the year 1997 is allocated to projects in prior years due to the limited data coverage for the 1990-1996 period, with a similar approach used for any other missing data. For countries with incomplete data, the average index year closest to the announcement date is used. The following countries are not covered by PRS over the full sample period: Mauritania, Timor, Seychelles, Kyrgyzstan and the Republic of Georgia. French Guiana's index mirrors France as the former is part of France overseas territories. This approach is consistent with Kogut (1991).

[58] Owen & Yawson (2015) also use the International Country Risk Guide developed by the PRS Group as a proxy for the institutional quality of countries hosting alliance counterparties. They find a high correlation between the political risk drawn from PRS Group and specific measures used in other studies (i.e., disclosure quality and investor protection). Owen & Yawson (2015) find similar effects of country risk based on both proxies used in their analysis of overseas alliances.

[59] Data available at U.S. Energy Information Administration's website: www.eia.gov.

market capitalisation (*MCAP*). Similarly, farmors are younger than farminees ($p<0.01$) based on listing tenure (*FIRMAGE*). Farminees' equity stake held by the twenty largest shareholders (*TOP20*) is higher than farmors ($p<0.01$).

Table 3.3, Panel C depicts descriptive statistics for the indicator variables. There are 257 farmor and 170 farminee announcements specifying financial commitments underpinning the alliance (*FINCOM*). An indicator variable is used to control for potential permit recycling where a permit is subject to many separate farmout agreements over time. There are 322 farmout agreements announced by farmors where the exploration permit(s) is (are) farmed out for the first time (*FIRSTFARM*). There are 265 announcements where exploration areas are being farmed into for the first time. In terms of participation by foreign (non-Australian) companies, 274 announcements disclosed by farmors have at least one foreign farminee (*FOREIPART*). In addition, 30 farmors and 13 farminees agreements involve an oil and gas 'major' participant (*MAJORPART*). An oil and gas 'major' is defined in the following way. First, a ranking of the twenty largest energy companies based on total oil and gas revenues is obtained using Factiva.[60] This list of 20 companies is modified based on: (i) company's primary industry classification to capture firms operating mostly in the upstream sector using segment reporting, and (ii) the presence of at least one overseas project.[61] Figure 3.1 shows 13 oil and gas companies matching these criteria. Table 3.3, Panel C shows that there are 30 farmors and 13 farminees announcing agreements with 'major' participants (*MAJORPART*).

There are 273 farmor and 154 farminee announcements containing permit areas subject to offshore exploration (*OFFSHORE*).[62] The operator of the project has the day to day decision making rights over the project. There are 341 farmor announcements disclosing operatorship,

[60] Factiva's peer comparison tool enables selection of the energy industry, based on the Dow Jones Industry Classification. The rankings are based on 2016 fiscal year's total sales from Factiva's peer comparison.
[61] Crude Oil/Natural Gas Upstream Operations (SIC code 1311) or Oil and Gas Field Exploration Services (SIC code 1382).
[62] Annual reports from announcing firms are used to identify exploration type when not disclosed in the farmout agreement.

of which 209 indicate the farmor retains project operatorship and 132 announcements where the farmor relinquishes operatorship to the farminee (*OPERCHANG)*. The farminee assumes operatorship in 78 of 218 deals disclosing *OPERCHANG*, while the permit holder retains operatorship in 140 farminee announcements. Some announcements involve permits where holders have conducted sufficient work to estimate potential target resources (*POTENRES*). There are 253 farmor and 207 farminee announcements disclosing *POTENRES*. With regards to the complexity of the resources, there are 70 farmor announcements with unconventional targets (*UNCONV*). There are 53 farminee announcements with unconventional targets. Regarding farmout project location, 236 farmor (167 farminee) projects are based geographically overseas (*PROJLOC*). Table 3.3, Panel D shows that 55% of unique farmout projects are located in Australia followed by the US, hosting 9.7% and New Zealand with 4.4%. Similarly, Australia, US and New Zealand host 72.7% of farmors' projects and 72.8% of farminees' projects.[63] Table 3.3, Panel E, depicts the number of exploration permits per farmout project. There are 523 announcements with projects comprising one permit, accounting for 72.4% of the entire sample. There are 118 announcements with two-permit projects, which represents 16.3% of the sample. Thus, 88.8% of farmout projects comprise up to two permits. This permit distribution is similar to the one observed in the announcements by farmors (farminees) where 89.5% (89.5%) of projects comprise one or two permits.

Table 3.4 reports Pearson correlation coefficients for the variables related to sample of farmor announcements. *FIRMAGE*, *MCAP* and *ACRES* are logged (*LFIRMAGE, LMCAP* and *LACRES*, respectively) due to skewness. *LFIRMAGE* and *LMCAP* are positively correlated. This indicates the longer a farmor is listed, the higher its market capitalisation. The country political risk of farmout project's (*CRISK*) is negatively correlated with acreage (*LACRES*)

[63] This high concentration of projects in jurisdictions viewed as having favourable-business conditions is consistent with the high mean (median) of CRISK depicted in Table 3, Panel A for both farmors and farminees.

suggesting farmors relinquish smaller acreages in less risky countries. Similarly, farmouts with foreign farminees (*FOREIPART*) are negatively associated with project country's political risk (*CRISK*) indicating farmors seek foreign partners to undertake projects located in high-risk countries. Offshore projects (*OFFSHORE*) are positively correlated with foreign partners (*FOREIPART*) suggesting that farmors seek foreign farminees to undertake offshore exploration. Projects targeting unconventional resources (*UNCONV*) are negatively correlated with offshore exploration (*OFFSHORE*) implying unconventional resources are primarily located onshore. Project location (*PROJLOC*) is negatively correlated with project's country's political risk (*CRISK*) suggesting farmors relinquish interests in overseas projects in countries with high political risks. This result is intuitive as projects located in Australia are assumed to be of low risk. *PROJLOC* is positively associated with foreign partners suggesting farmors attract overseas farminees to undertake projects located in countries outside Australia.

[Insert Table 3.4 about here]

3.3.1 Event study approach

In this thesis, it is adopted the event-study approach of Ball & Brown (1968)) and Fama, Fisher, Jensen and Roll (1969) to assess market reactions to farmout announcements by farmors and farminees. Under ASX's continuous disclosure requirement, oil and gas farmout announcements have a precise date and time stamps available on ASX's company announcement platform. A market-adjusted model is employed to calculate abnormal returns around the announcement day as follows:[64]

$$AR_{i,t} = ln\left[\frac{P_{i,t}}{P_{i,t-1}}\right] - ln\left[\frac{P_{m,t}}{P_{m,t-1}}\right] \quad (1)$$

[64] This benchmark ensures minimal data attrition considering the significant number of small firms in the sample. Further, daily data on Fama-French-Cahart factors are not available for the Australian market Ferguson & Lam (2016, p. 106).

Abnormal or excess returns (ARs) are calculated as the difference between the log price relatives of the announcing firm (P_i) and the ASX All Ordinaries market index (P_m). *ARs* are cumulated (*CARs*) over a three-day event window centred on the farmout announcement day as follows:

$$CAR_i(-1,+1) = \sum_{t=-1}^{1} AR_{i,t} \qquad (2)$$

Stock prices for ASX announcing firms are obtained from Datastream for 92.5% of the sample, with the remainder sourced from the Securities Industry Research Centre of Asia-Pacific (SIRCA) Core Research Data (CRD) database. The benchmark All Ordinaries Index used to calculate abnormal returns is based on the market capitalisation of the 500 largest firms listed on ASX.[65] Market capitalization data (*MCAP*) for announcing firms is obtained at the fiscal year-end before the farmout announcement from Datastream.[66]

In conducting the event study, it is important to consider a sample of announcements that are not plagued by other confounding announcements, missing stock prices or non-synchronous trading over the three-day event window. To this end, the following announcements are excluded from the sample: (i) late farmout announcements that are pre-empted by an earlier announcement released by the counterparty, (ii) farmout announcements that contains non-related material transactions, (iii) multiple farmout announcements released by the same party on the same date relating to the same deal, and (iv) farmout announcements associated with firm capitalization changes,[67] non-trading, missing stock prices over the three-day event window. This leaves 505 farmor and 317 farminee announcements remaining in the event study sample. Contemporaneous events violate the assumption of cross-sectional

[65] The "All Ordinaries" or simply "All Ords" index is available on Datastream under the ticker ASXAORD from 29/05/1992 onwards. Prior to this date, this market index is identified as AUSTOLD in the database.
[66] Market capitalization is sourced from Datastream (90%), Morningstar's Datanalysis Premium (7%), and firm's annual reports (3%).
[67] E.g., equity issues, private placements, share buybacks and share purchase plans.

independence of returns. An advantage of this setting is that farmouts announcements are not time clustered (see Table 2). To mitigate any further concerns of cross-sectional independence of returns, all significance tests (‘t-tests’) are reported following Kolari & Pynnönen (2010) for both abnormal and cumulative abnormal returns.

3.3.2 Model specification

To explore how wealth effects from farmout announcements vary across the sample with firm and project characteristics[68], the following ordinary least square (OLS) regression model is specified:

$$CAR(-1,+1) = \beta_0 + \beta_1 FINCOM + \beta_2 FOREIPART + \beta_3 UNCONV + \beta_4 OILPVOL + \beta_5 FIRSTFARM + \beta_6 CRISK + \beta_7 NFIRMS + \beta_8 LMCAP + \beta_9 TOP20 + \beta_{10} LFIRMAGE + e_i \quad (3)$$

where the dependent variable is the three-day cumulative abnormal return over the event window. Note that the above cross-sectional model is implemented to the sample of farmor announcements only. This is because many of the farminees are foreign or private companies and their level of disclosure is not as high as for ASX-listed firms. The lack of details in their announcements result in severe data attrition problem for the sample of farminees.

Experimental variables are included to test the hypotheses developed in Section 3.2. To test the resource pooling hypothesis, it is included *FINCOM*, an indicator variable for the presence of financial commitment terms in the farmout announcement in the model (H1a). As alternative measures, it is included *POTENRES* (for H1b), an indicator variable for the disclosure of potential reserve targets in the permit area, and *LACRES* (for H1c), the natural

[68] A choice model is not employed as a means to control for selection effects on the basis that there were no firms incidentally identified or observed when compiling the sample used in the oil and gas sector that did not undertake a farm-out agreement. Further detailed investigation of the possibility of any oil and gas participants not undertaking farm-out agreements is left to post-thesis work.

logarithm of permit acreage, to proxy for resource pooling. For all three proxies, a positive and significant coefficient would provide support of the resource pooling hypothesis.

The certification hypothesis is examined by using *FOREIPART* (for H2a), an indicator variable for foreign farminee, and *MAJORPART* (for H2b), an indicator variable for farminee being an oil and gas 'major' company. If foreign or 'major' farminees provide certification to farmors announcing the deal, there should be a positive and significant coefficient for these two variables.

To explore the expertise hypothesis, three test variables are used. *UNCONV* is an indicator variable for farmout projects targeting unconventional resources (for H3a). *OFFSHORE* is an indicator variable for the presence of permit areas subject to offshore exploration (for H3b). *OPERCHANG* is an indicator variable for disclosure of permit operatorship change (for H3c). A positive and significant coefficient for these three proxies of farminee expertise would lend support to the expertise hypothesis. Finally, to test H4 (on real options), a continuous variable *OILPVOL* is included to proxy for the volatility of crude oil prices.

In addition to the test variables, variables are included to control for other firm and project characteristics in the model. *FIRSTFARM* is an indicator variable to control for projects farmed out for the first time. *CRISK* is a continuous variable to control for political risks of the jurisdiction where the permit is located using the PRS political risk index. *NFIRMS* is a continuous variable controlling for the total number of farmout participants disclosed in the announcement. *LMCAP* is the natural logarithm of the announcing firm's market capitalization at the fiscal year-end prior to the farmout announcement. *TOP20* is the equity stake held by the twenty largest shareholders in the announcing firm to control for shareholder monitoring. Control for differences in firm age is also included, in logarithmic form (*LFIRMAGE*) across the sample of announcing firms. Older and more established firms benefit from better investment opportunities (Lemmon & Zender 2010). Accordingly, older farmors can benefit from better bargaining power relative to small firms.

3.4 Results

3.4.1 Market reaction to announcements of farmout agreements

Descriptive statistics on market reactions to the farmout announcements released by farmors and farminees are reported in Table 3.5, Panel A, which presents daily abnormal returns from five days before to five days after the announcement. The discussion focuses primarily on the three-day event window [-1, 1]. There is evidence suggesting that farmout agreements are significant market events for farmors who experience a mean abnormal return of 2.51% on the announcement date, (significant at the $p<0.01$ level). On the day prior (day −1), there is also evidence of a positive and significant mean abnormal return of 0.63% ($p<0.10$). The mean abnormal return in the day after is 0.41%, but not significant. also It is also worth noting that *AAR* in the remaining days over the 11-day event window is of much lower magnitude and statistically insignificant from zero. The percentage positive statistic is 53%, 59% and 49% over each of the three event days, respectively.

As for farminees, Table 3.5, Panel A, shows some evidence of market anticipation, with the day prior to announcement (day −1) recording a positive and statistically significant mean abnormal return of 1.53% ($p<0.01$). This result is in contrast to the less significant mean abnormal return of 0.40% on the event day (t_0) ($p<0.10$), indicating information leakage is observed in farminee announcements. To confirm this finding and rule out potential leakage from foreign counterparties, untabulated mean-comparison tests show the abnormal return observed in farminee announcements with foreign firms is not significantly different to the ones involving domestic firms in any of the three days centred on the event date. The day following the announcement exhibits a mean abnormal return of 0.05%, but is not significant.

The percentage positive statistic for farminees over the three days in the event window is 54%, 54% and 46%, respectively. Univariate tests confirm farmout announcements are more significant economic events for farmors than for farminees, with the difference in mean abnormal returns highly significant at the $p<0.01$ level on the announcement day. Table 3.5 (Panel B) reports further descriptive statistics on the distribution of abnormal returns on announcements released by farmors and farminees.

Visual inspection of the chart depicted in Table 3.5, Panel C, confirms significant market reactions on the event date with a spike for the announcements by farmors. The economic magnitude of wealth changes for farmors is usually higher compared to farminees where the first experience a higher wealth change.

[Insert Table 3.5 about here]

The abnormal returns observed in the sample of farmouts are slightly stronger than for prior studies of alliances and joint ventures. For example, a positive and significant mean abnormal return of 0.64% is observed in the alliance study by Chan et al. (1997), and a mean two-day excess return of 0.73% is observed in the study of joint ventures by McConnell & Nantell (1985). The count of positive abnormal returns on the announcement day of 59% is similar to the 55% and 67% observed by Chan et al. (1997), and McConnell & Nantell (1985), respectively. Further, when compared to other single-industry studies, Sabet & Heaney (2016) find an average positive abnormal return of 0.53%[69] for oil and gas firms announcing acreage and reserve acquisitions. Farmout agreements yield a modestly higher abnormal return, which is unsurprising given the smaller size of firms conducting farmouts. In contrast to acreage and reserve outright acquisitions in which all project's risks and benefits are transferred to the

[69] The three aforementioned studies do not provide descriptive data on the abnormal return distribution, limiting comparison of median and distributional properties.

acquirer (Sabet & Heaney 2016), farmouts allow participants to partially share risks and benefits inherent in the ongoing exploration.

Table 3.6, Panel A, reports the cumulative average abnormal returns (*CAR*s) observed from farmouts, which confirm both economic and statistical significance of these events. The three-day average *CAR* is 3.60% with the count positive of 61%. Farminee announcements also experience a positive and statistically significant wealth effect over the 3-day event window of 1.90% on average, which is significantly lower than farmouts but remains statistically significant at $p<0.01$ level. The farmin event window count positive is 54%. Table 3.6, Panel B, depicts the distribution of farmout *CAR*s, yield a median three-day *CAR* of 1.67%. For farmins, the median three-day is 0.27%. Farmout univariate tests confirm that *CAR*s are significantly greater than farmins for all three event windows and the following cross-sectional analysis focuses on farmouts, consistent with theory and hypothesis already discussed.

Table 3.6, Panel C exhibits wealth effects based on the abnormal returns for farmout events. Farmors realises a positive mean (median) dollar change of $1.46 (0.18) million on the event day, confirming the economic relevance of these announcements. However, farminee announcements experience a negative mean (median) wealth effect of $1.30 ($0.02) million on the announcement date. Table 3.6, Panel D shows cumulative average dollar changes observed for the combination of wealth effects for unique deals, and separately for farmors and farminees. For unique deals, firms experience a negative (positive) mean (median) dollar change of $12.72 million ($0.26 million) over the three-day event window. These results reflect the relative size of farmors and farminees.

[Insert Table 3.6 about here]

3.4.2 Determinants of abnormal returns

Table 3.7 reports OLS regression results for the primary model in Equation (3) and modified specifications based on alternative proxies for each hypothesis. In terms of control variables, Table 3.7, Panel A shows the three-day cumulative abnormal returns are negatively related to firm size (*LMCAP*) of the farmors and the result is statistically significant across different specifications of the model. This result is not surprising given that wealth effect of farmouts is measured as a percentage of firm market capitalization. Firm age (*LFIRMAGE*) is another control variable that is significantly related to the event *CAR* across model specifications. The positive coefficient on firm age suggests the older the farmor announcing the deal, the higher the abnormal return.

Regression results from Table 3.7 (Columns 1–3) provide evidence consistent with the 'resource pooling' hypothesis. Column 1 shows the coefficient on *FINCOM* is positive (0.028), and significant at the $p<0.01$ level indicating the exchange of permit interests for disclosed financial commitments results in higher abnormal returns for the farmor. This result is consistent with predictions, due to the capital constraints of smaller oil and gas participants. In Column (2), the positive (0.020) and significant ($p<0.05$) coefficient on *POTENRES* lends further support to the prediction that farmout agreements with existing hydrocarbon reserve estimates, being closer to production, would gain more from contributions by farminees in filling the funding gap for further development (H1b). In addition, Column (3) reveals the coefficient on *LACRES* (i.e., farmout permit acreage) is positive (0.007) and significant at the $p<0.05$ level. This finding suggests larger wealth effects to farmors relinquishing interests in larger permits, consistent with the prediction of H1c.

[Insert Table 3.7 about here]

In the certification hypothesis, it is argued that the presence of foreign farminees (*FOREIPART*), and particularly 'major' oil and gas farminees (*MAJORPART*) would result in a higher abnormal return to the farmor because of the certification effect provided by these reputable participants in signalling the quality of the prospect. Results from Columns (1) and (4) show that the coefficient on both *FOREIPART* (H2a) and *MAJORPART* (H2b) is positive but not statistically significant. Likewise, *FOREIPART* is not significant in other model specifications in Table 3.7. Thus, this study finds no support for the certification hypothesis.

The expertise hypothesis is tested by using three proxy variables: *UNCOV* (H3a), *OFFSHORE* (H3b) and *OPERCHANG* (H3c). Regression results from Table 3.7 show that there is a positive relation between projects targeting unconventional resources and farmor's abnormal return on farmout announcement. For instance, Column (1) reveals a positive (0.026) and significant (p<0.10) coefficient on *UNCONV* in the primary model, which is also observed when alternative models are specified (Columns 2 and 4). This evidence tends to support the expertise hypothesis (H3a). When alternative proxies for expertise are employed in the model, no significant association with abnormal returns can be found. Specifically, Column (5) shows the estimated coefficient on *OFFSHORE* is negative (−0.009) but not significant. This is inconsistent with the prediction of H3b that projects requiring offshore exploration would potentially attract farminees with greater expertise and thus a positive wealth effect. When change in project operatorship (*OPERCHANG*) is used, Column (6) shows a positive (0.014) but insignificant coefficient on *OPERCHANG*, leading to hypothesis H3c not being supported. The lower level of disclosure for change in operatorship in farmout agreements restricts the sample size in this model specification to 274 observations.[70]

Concerning the real options hypothesis (H4), which argues a positive relation between the farmor's abnormal returns and the oil price volatility (*OILPVOL*)[71], the coefficient on *OILPVOL* is positive and significant at the p<.01 level across all model specifications except

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[70] This sample comprises farmor announcements disclosing permit's operatorship status.
[71] Sensitivity tests can be done using the change in crude oil futures price or other oil price volatility proxies given the approaches available in the financial economics literature (Grullon, Lyandres & Zhdanov 2012; Sadorsky 2006; Wei, Wang & Huang 2010).

Column (6), where the sample is restricted to 274 observations. This finding is strongly consistent with the real options theory as farmors remain exposed to the project with residual or trailing interests after the farmout.

Table 3.7, Panel B reports OLS regression results for the primary model in Equation (3) and modified specifications for the farminees. Unlike farmors, these cross-sectional models are not able to identify the variables associated with the farminees abnormal returns. This is expected given the heterogeneity of the farminees subsample. Table 3.7, Panel C exhibits regression results for the combined dollar change observed by farmors and farminees. Column (1) shows the three-day cumulative dollar changes are positive and significantly related to firms' size (*LMCAP*) at the $p<0.05$ level. Testing the certification hypothesis, the coefficient on *FOREIPART* is positive and statistically significant ($p<0.05$), confirming that the presence of foreign partners results in a higher wealth effects. Column (5) also depicts a positive and significant coefficient on *FOREIPART* ($p<0.05$). Testing the expertise hypothesis, the coefficient on *OFFSHORE* is negative and significant ($p<0.05$). This result suggests that farmouts of offshore projects are seen as bad news by the market participants.

3.5 Further tests

3.5.1 Disclosure noisiness

Additional tests are conducted to control for noise from other firm-level price sensitive announcements released over the three-day farmout event window. There are 134 farmout agreements with either one or more market sensitive announcements on the event day (or data not available by the ASX), and 231 farmouts over the three-day window. Table 3.8 reports sensitivity tests after removing these announcements with confounding noise. Column (1) indicates that the model's explanatory power increases to 13.3%. Similarly, the coefficients of two experimental variables for this model (*FINCOM* and *OILPVOL*) are larger in terms of magnitude than those in the primary analysis reported in Table 3.7, and significant at the $p<0.01$

level. However, the coefficient on *UNCONV* is no longer significant. Results are similar to those reported in Column (1) after removing 231 farmout agreements with contemporaneous price sensitive announcements over the three-day event window from the sample (Column 2). Results also remain unchanged after the inclusion of a count of the number of contemporaneous price sensitive announcements in the model (Column 3).

[Insert Table 3.8 about here]

3.5.2 Robustness test adjusting the standard errors to clusters by firm and time

The regression analysis in Table 3.7 is re-run by using robust standard errors clustered by firm and year. Table 3.9 depicts results indicating no change in the significance level for the experimental variables: *FINCOM, POTENRES*, *LACRES* and *OILPVOL*. However, *UNCONV* is only significant at the $p<.10$ level (Column 2). Also, the volatility of the crude oil price is now significant only at 5% for models 1, 3 and 4. Thus, controlling for robust standard errors does not significantly change the main results.

[Insert Table 3.9 about here]

3.5.3 Different sources of stock prices

Any effects of using two different data sources for stock prices (Datastream and SIRCA) is considered. The six models in Table 3.7 are re-run on the sample for which announcing firms' abnormal returns are computed on data exclusively obtained from Datastream. Table 3.10 shows the results are similar to the primary analysis reported in Table 3.7.

[Insert Table 3.10 about here]

3.6 Summary

This study is the first to examine empirically the wealth effects stemming from farmout announcements by ASX listed oil and gas companies. These alliances are common in the oil and gas sector. Using a hand-collected Australian sample of farmout agreements, it is found that farmors ("vendors") are smaller and younger than farminees ("buyers"). There is evidence showing that farmouts are important economic events in a market context, attracting a positive cumulative abnormal return of 3.60% over a three-day event window. Univariate tests indicate farmouts are economic events for which abnormal returns are greater for farmors compared to farminees.

Cross-sectional analysis of the three-day event window indicates the importance of funding disclosures, confirming the resources pooling hypothesis and consistent with the use of alliances as a financing channel as observed in the biotech setting. Further evidence is found for the resources pooling theory in farmouts disclosing target reserve estimates as well as in deals featuring larger sized permits, both exhibiting higher abnormal returns. This evidence on resource pooling is similar to prior alliance studies of movie studios where larger film projects are more likely to prompt alliances where filmmakers combine complementary resources. With regards to the certification theory, no supporting evidence is found. A third hypothesis tests for the technology and expertise motivation with evidence of farmors relinquishing interests in permits with unconventional reserves experiencing higher excess returns, although it is significant only at $p<0.10$ level.

Farmouts can be argued to be an ideal empirical setting for testing the real options theory given the sequential nature of oil and gas exploration commitments. The volatility of crude oil price is employed as a proxy for uncertainty with statistical evidence that farmout agreements announced in years with higher oil price volatility yield higher abnormal returns, consistent with Sabet & Heaney (2016). Sensitivity tests indicate the importance of controlling for noise. Restricting the sample to the farmout agreements released on days without other relevant announcements increases considerably the explanatory power of the model, driven mainly by oil price volatility. Further robustness checks confirm that no issues arise from the use of two different stock price data sources. Additional tests adjusting for robust standard errors clustered by firm and time report similar results to the primary tests except for the expertise hypothesis proxied by the presence of unconventional reserves.

In terms of limitations, there is a paucity of disclosure for some variables. For example, the identification of oil and gas majors in the farmout agreements is restricted due to either the presence of non-disclosure provisions or the use of subsidiaries when disclosing the agreements to the market. Further, the lack of an accepted definition of a ‘major’ and a capital market literature featuring oil and gas ‘majors’ is a limitation. The fact that daily data for the Fama-French-Cahart model is not available for the Australian market and the presence of small and young oil and gas firms in this paper’ sample restrict the use of alternative return benchmarks.

Chapter 4 – Offtake agreements

4.1 Overview

The objective of this chapter is to investigate the market reactions to announcements of offtake agreements by extractive companies listed on the Australian Securities Exchange (ASX). Offtakes are a means to reduce the project risk where a counterparty commits to (partially) buy resources from a mining project's future production. According to Gatti (2012), offtake agreements are a long-term contract where the project sponsor commits to deliver volumes of a good or service to the offtaker (buyer). Gatti (2012) indicates a common use of offtakes in the power sector and in PPP initiatives in which the general motivation is to decrease a project's future cash flow volatility, enabling its execution. In general, the use of offtakes can be an effective means to manage market risk, which primarily relates to product pricing and demand.

Byoun, Kim & Yoo (2013) investigate a multi-country sample comprised of project-financed investments in twenty-seven sub-industries, where there is evidence of the use of offtakes as a substitute to leverage. Their study focuses on the link between a project's capital structure and its characteristics (i.e., risk, size, presence of build-own-operate provision, among others). Although they point out the utilities industry has the highest frequency of offtakes (38%), a significant number is observed in the extractive industries.[72] Thus, the extractive industries are an ideal setting to investigate the project sponsor's motivations to engage in offtake agreements.

Bonetti, Caselli & Gatti (2010) examine the trade-off between lower market and higher counterparty risks using an offtake-backed power plant. The project involved is structured as a specific purpose vehicle (SPV), making viable its construction with the aid of risk-reducing

[72] Specifically, 46.7% considering both oil and gas and mining related industries, increasing to 56.6% if petroleum downstream is included.

contracts. A 20-year bond is issued in the US market at the end of the construction phase raising US$215 million. The authors find evidence of the counterparty's (buyer's) credit risk impact on the project's bond spread, supporting the trade-off theory. Interestingly, there is no further empirical evidence on the effects on counterparty characteristics in the offtake setting.

Offtake agreements considered in this thesis are analysed in the context of cooperative arrangements from the financial economics literature. Although the related definitions vary to some extent, these agreements meet the broad scope of an alliance being a contractual agreement involving at least two separate firms with some level of mutual commitment (Chan et al. 1997; Weston & Weaver 2004).

This chapter examines the determinants of market reactions to offtake announcements in light of three theories. Firstly, the 'pooling of resources' theory argues that participants conduct alliances to combine complementary resources necessary for undertaking the project of interest. Evidence of an offtake agreement used to combine complementary resources is the announcement by Albidon Ltd (ASX ticker: ALB) on December 5th 2006. ALB seeks to develop its nickel project in Africa with Jinchuan Group, China's largest producer of nickel, cobalt and a major producer of copper. In the announcement ALB refers to Jinchuan's technological capabilities in metal concentration and smelting. As part of the offtake partnership, ALB obtains a substantial financial commitment from Jinchuan Group, and operational and technical cooperation to design and construct a concentrator to optimise the project performance[73]. Palia, Ravid & Reisel (2007) find mixed evidence of resource pooling in the movie industry setting in which larger film projects are more likely to be undertaken via

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[73] Further evidence is found in the offtake announced by CondorBlanco Mines (ASX ticker: CDB) on 20 September 2012. CDB announces offtake alliances with two Chinese companies in order to unlock value from its Copper assets in Chile. A third example is Southern Titanium NL (ASX ticker: STN) announcement on May 27th 2002, pursuing an offtake deal with an Austrian trading house to market all planned production from its project in South Australia. Under the alliance, STN obtains a $5 million loan to strengthen its working capital and offers a board seat to the offtaker. STN identifies benefits from the partners marketing structure, expertise in finance, logistics and customer service.

alliances. Palia, Ravid & Reisel (2007) argue the importance of the use of alliances to co-finance the 'skyrocketing costs of films', which is observed in capital-intensive industries notably in mining projects. Secondly, the certification theory assumes that characteristics of the incoming party in a project have the potential to convey quality signals on either the venture prospects or the project vendor. For example, evidence of the contribution of past alliances with pharmaceutical companies and venture capitalists to biotech firms' exit outcomes, either going public or being acquired by another company, is found (Ozmel, Robinson & Stuart, 2013). The third hypothesis builds upon real options theory which considers investment projects as real options due to their sequential nature. Myers (1977) supports the interpretation of real investment projects as a call option given the project's value derives at least partially from sequential or incremental investments.

Evidence on alliance formation in the capital market context is relatively scarce. This thesis contributes to the strategic alliance literature in the following ways. It is the first empirical study of the capital market implications of offtake agreements. Secondly, this study broadens the strategic alliance literature to consider a new industry, the extractive industry. To date, the few alliance studies in this area of extractive activities focus on the strategies used either to bid for oil and gas leases or to buy acreage with established oil reserves. For example, Sabet & Heaney (2016) test the relation between oil reserve and acreage acquisitions and environmental uncertainty levels using real options theory. Conversely, McConnell & Nantell (1985) and Chan et al. (1997) undertake studies of strategic alliances applying an event study approach to cross-industry samples. They find significant wealth changes around the deal announcement, which is consistent with the synergy hypothesis. However, both of these studies are restricted by small sample sizes.[74] Lastly, the use of real options theory has yet to be tested

[74] McConnell & Nantell (1985) examine 136 joint-venture announcements, while Chan et al. (1997) investigate a sample of 345 alliances.

in the strategic alliance context. In this study, the use of offtake agreements to underpin extractive projects is viewed as an indication of the sponsor's option-exercise commitment.

The event study method using market-adjusted abnormal returns is employed to investigate market reactions to offtake agreements announced by ASX-listed extractive firms between 1995 and 2018. The sample comprises 396 announcements by project companies. Evidence suggests offtake agreements are important economic events exhibiting a mean (median) excess return of 5.78% (3.10%) on the announcement date. Over a three-day window [-1, 1], ASX extractive firms yield a cumulative abnormal return of 5.73%. Multivariate analysis provides evidence consistent with the resource pooling hypothesis. Specifically, the coefficient of the quantitative funding disclosure variable is positive and significant. In addition, there is some evidence supportive of the certification hypothesis, consistent with Bonetti, Caselli & Gatti (2010). ASX extractive firms announcing offtake agreements with intermediaries (trading houses and financial institutions) experience less positive wealth changes relative to offtakes with non-intermediary counterparties. Further adverse certification effects are observed in offtakes with at least one trading house, suggesting the market reacts less positively to offtake terms agreed with commodities traders. Finally, evidence supports the interpretation that offtakes are real options with a positive association between commodity price uncertainty and the ASX announcing firm's abnormal returns.

This chapter is organised as follows. Section 4.2 discusses the development of testable hypotheses. This section explores ASX extractive companies' motivations to undertake projects via offtake agreements in the alliance literature context. Additionally, this section includes a hypothesis in the light of commodity-related arrangements in a real options context. Data and the research methods are discussed in Section 4.3. Specifically, the event study approach is described in Section 4.3.1, while Section 4.3.2 discusses the model specification of the OLS regression. Empirical results are presented in Section 4.4 with abnormal returns discussed in Section 4.4.1 and the cross-sectional analysis discussed in Section 4.4.2. Additional analyses are performed in Section 4.5. Specifically, there are two sets of sensitivity tests. Section 4.5.1 reports results after filtering potential confounding effects arising from concurrent market-sensitive announcements disclosing non-offtake related information. Results for cross-sectional models adjusting the standard errors to cluster by firm and time are presented in Section 4.5.2. Concluding remarks for the empirical investigation of offtake agreements undertaken by ASX extractive firms follow in Section 4.6.

4.2 Hypotheses development

Evidence from the alliance literature is discussed in Chapter 2 where firms' motivations to engage in interfirm arrangements are examined in the light of three main theories: resource pooling, certification, and expertise. The offtake setting provides unique characteristics to explore two of them. Firstly, it is predicted that the project sponsor uses offtakes as a potential funding channel, allowing the project to transition from the development stage to the production phase. Section 4.2.1 sheds light on the resource-pooling theory as a motivation for ASX extractive firms to engage in offtake agreements. Secondly, existing evidence in the biotechnology industry indicates the importance of the certification (endorsement) effects, stemming from alliances and other types of interfirm arrangements, that pharmaceutical companies and financiers have on small biotech firms. The certification hypothesis in the context of offtake agreements is discussed in Section 4.2.2.

Considering the staged investment nature of extractive projects, the real options hypothesis is tested in the offtake setting, given it is possible to measure the price volatility of the project's underlying assets (mineral or energy commodities). Real options theory in the offtake context is discussed in Section 4.2.3.

4.2.1 Resource-pooling

Lerner, Shane & Tsai (2003) investigate the shifting sources for small biotechnology firms' project funding. There is evidence that public market conditions are an important determinant prompting the use of alliances as a financing channel. They find that the relinquishment of project control rights is significantly associated with periods where the project owner raises little external financing. The biotechnology sector features the active presence of venture capitalists. However, in contrast to venture capital arrangements used as a tool to capitalise the firm as a whole, alliances with pharmaceutical companies are a means by which capital is injected into specific R&D projects, rights to which are extensively negotiated with the alliance partner (Robinson & Stuart 2007). Offtake agreements are similar to alliances with pharmaceutical companies in the sense that the output derives from a specific mineral deposit or project.

Palia, Ravid & Reisel (2007) investigate co-financing strategies in the movie industry between small production firms and large studios when film projects reach the 'assembly' stage where most necessary inputs such as budget, casting and project manager are agreed. At the 'assembly' stage, budget size determines the need for co-financing alliances with other studios. There is evidence that larger film projects, in terms of budget size, are more likely to be undertaken via alliances. Although movie projects have a shorter life than those in the mineral, oil and gas and biotechnology settings, studios face challenges allocating limited resources across many projects, hence the attraction of resource pooling.

Offtakes are a useful setting for testing the resource pooling theory, as extractive companies are likely to engage in co-financing strategies to financially support the project. Accordingly, for extractive firms with projects in the development stage,[75] an offtake agreement can be used as a financing channel for project development promoting its transition

[75] Developers and early-stage companies are used interchangeably for extractive firms in the development stage.

to the production stage. Mineral developers lack the financial resources to exploit and develop all their prospects. Thus, it is predicted that higher excess returns will be associated with offtakers providing funding in offtake announcements.

H1: Extractive firms announcing offtake agreements disclosing funding commitments by their counterparties are associated with higher abnormal returns.

4.2.2 Certification theory

The existence of early-stage projects in young firms' portfolios increases external pressures for operational disclosure to enable market participants to assess firm value in the face of high information asymmetry. In the biotechnology sector, studies acknowledge that high information asymmetry stems not only from their project uncertainty, but also from the small firm's lack of verifiable public information (Leland & Pyle 1977; Myers & Majluf 1984). Studies document certification effect provided by prestigious investment banks and prominent venture capital firms for initial public offerings (IPOs), where moral hazard and hidden information is pervasive. Such information is classified as either hard or soft (Miloud 2016).

There is evidence in the financial economics literature of the certification effect associated with the participation of different financiers in interfirm arrangements. In his seminal paper on the incentive problems between borrowers and lenders, Diamond (1989) finds these problems become substantially less severe for good-reputation borrowers. The author uses borrower size and age as reputation proxies. Stuart, Hoang & Hybels (1999) explore the role of certification in venture capital-backed early-stage biotechnology firms seeking to access the capital necessary to undertake their R&D projects. They examine the effects of different exchange partners (alliance partners, equity partners and investment bank) on the biotechnology firm's IPO performance and find evidence of positive alliance partner certification effects on biotech firm valuation. The certification effects with mining exploration entities (MEEs) could be argued to be stronger on the basis that many MEEs have no prior track record of borrowing (Diamond 1989). That is, similar to R&D projects held by junior biotech firms, the operational quality of an oil and gas explorer cannot be observed directly, but a better valuation of its early-stage projects can be obtained when certified by prestigious and high reputation alliance partners.

More recently, Demiroglu & James (2010) shed light upon the role of private equity group reputation in the financing structure of buyouts. They find evidence that buyouts underpinned by high-reputation private equity groups[76] have narrower loan spreads and more favourable loan terms, such as longer maturities. Ozmel, Robinson & Stuart (2013) test the certification theory considering the role strategic alliances and venture capital play in biotechnology firms' exit outcomes (either going public or being acquired by another company). The study finds that a biotech firm's past alliance track record and backing by a better-positioned venture capitalist increase the likelihood of either exit outcome. This study built on prior work by Nicholson, Danzon & McCullough (2005) who find evidence of a positive long-term valuation effect of biotech firm alliances with pharmaceutical companies. The junior biotech firm relinquishes, at a significantly discounted price, not only equity interests but also rights to the R&D projects, but the discounted value offered by the counterparty is likely offset by future higher valuations from venture capitalists and/or investors.

The assessment of the potential cash generation flowing from exploration and development projects is highly uncertain in the extractive industry.[77] Unlike the resources pooling hypothesis where synergistic gains from the combination of complementary resources

[76] Reputation proxies used by Demiroglu & James (2010) are based on the private equity groups' market share (in number of deals and dollar amounts) and age.
[77] Paddock, Siegel & Smith (1988, *p.* 483) notes the lack of oil and gas lease information at the early exploration stage (bidding stage) as a source of the project uncertainty resulting in a wide range of valuations of oil and gas exploration firms.

creates value, the signalling effect through partner certification unlocks extant project value which would otherwise be unobserved by market participants. That is, information asymmetry in these projects can be pervasive, inhibiting a higher external valuation. However, by attracting partners with certain characteristics conveying positive signals about project quality some additional value can be unlocked. In addition to the uncertainty arising from the commodity prices in international markets, incremental investments necessary to fully develop the project until it reaches the production stage are routinely very difficult to obtain due to the high-risk nature of mining projects. Therefore, capital-constrained MEEs face challenging choices when attracting an offtake counterparty. The MEE, in order to obtain support to develop the project, is willing to guarantee a long-term resource supply to the offtaker. In contrast, offtakers, who are typically larger and more established firms with greater international connections and marketing expertise, are seeking potential gains from assuming an intermediary role in such transactions. Thus, alliance partner characteristics can convey information to the market on the probabilities of mine development proceeding. The industry in which the offtake counterparty operates is used to construct the certification proxies in this study. In contrast to the strand of the financial economics literature focusing on the certification role of private equity groups and venture capitalists for which capital gains resulting from prospects' higher valuation is the ultimate goal, the motivations of offtake counterparties may vary considerably. Extractive firms attract a heterogeneous group of offtakers with different objectives. Following the industry relatedness between exchange partners used in Pisano (1989) who argues that vertically-related partners are less likely to behave opportunistically considering both parties do not compete in the same segmentThe certification hypothesis is based on the counterparty's position in the mining value chain. That is, a counterparty sharing the same industry classification of the offtaker is still a competitor despite its offtake commitments. Whereas a counterparty operating in a segment other than the offtaker's potentially signals a higher commitment to the deal relative to counterparties classified as peers. So, the first proxy classifies the offtake agreement as either horizontal or non-horizontal depending on the matching between the announcing firm's and counterparty's industry classification.[78] Following Pisano (1989), it is predicted that sponsor firms benefit more from non-horizontal partners given their willingness to undertake a mutually beneficial collaboration. A second proxy breaks down non-horizontal offtakes into two groups: one comprised of counterparties likely to use the offtake-committed resources in their manufacturing process (end-users, such as smelters), and one with buyers likely to act as intermediaries (i.e., financial institutions and trading houses), where end-users (intermediaries) are seen as highly (less) committed counterparties, conveying a positive (negative) signal about the prospects of the offtake project.

H2.a: Extractive firms announcing non-horizontal offtake agreements experience higher abnormal returns.

H2.b1: Extractive firms announcing offtake agreements with end-users will experience higher abnormal returns.

H2.b2: Extractive firms announcing offtake agreements with intermediaries will experience lower abnormal returns.

To further explore the certification effects associated with intermediaries, it is expected a potentially negative effect arising from commodities-trader-backed offtakes as non-commodities intermediaries may act as genuine long-term financiers.

H2.b3: Extractive firms announcing offtake agreements with commodities traders will experience lower abnormal returns.

[78] When both the project company and offtaker share the same industry classification, the offtake agreement is classified as 'horizontal'.

4.2.3 Real options theory applied to offtakes

Geske (1979) explores the concept of compound options illustrated with a call option on a firm's stock, as the stock can be regarded as an option on the firm's asset value. As such, the call option is regarded as "an option on an option". Likewise, offtake projects meet the definition of a compound option considering their staged nature.

Myers (1977) considers whether a real investment project can be regarded as a call option given the project's value derives at least partially from sequential incremental investments. The financial assessment of a project's future expansion possibilities demands sophisticated valuation approaches based on the existing flexibility to execute the investments and fulfil the intermediate milestones. The development of this real options valuation theory fostered a body of literature focused on the valuation of extractive industry projects (Brennan & Schwartz 1985; Moel & Tufano 2002; Paddock, Siegel & Smith 1988; Tourinho 1979).

Paddock, Siegel & Smith (1988) and Cortazar & Schwartz (1997) focus on the development of valuation models for real options on undeveloped oil fields. Both studies note the importance of identifying the project's distinct life-cycle stages, with the compound nature of investments in offshore oil leases made up of three distinct phases: exploration, development and extraction. Paddock, Siegel & Smith (1988) note the high level of uncertainty in the exploration stage for which geological and technical information is necessary to assess a prospect's potential.

It is argued that offtake alliances provide access to a growth option through development of the project, securing the projects transition to the production stage that would otherwise be dependent on other sources of finance (Myers & Majluf 1984). So, in the case of offtake agreements, mining projects are closer to the production stage but its completion still has some level of uncertainty (Vassolo, Anand and Folta, 2004; Folta, 1998). From this perspective, the value of mining projects as other real options is positively associated with a high uncertainty level and the extractive company is increasing its exposure to the offtake project given the commitment to reach the production stage. The use of offtake funding to back development projects indicates the project sponsor's option-exercise commitment. The price volatility of a basket of commodities is used as a proxy for the uncertainty related to the underlying commodity price to which the mining project developer (sponsor) remains exposed.

H4: Extractive firms announcing offtake agreements in periods with higher commodity price volatility experience higher abnormal returns.

4.3 Data and research method

Offtake announcements by ASX-listed mining and energy companies are manually collected between 1995 and 2018. Two data sources, Morningstar's Datanalysis Premium[79] and Factiva, are used to identify these announcements. Search on these databases has the advantage of including delisted firms, which assists in mitigating survival bias. The search for offtake agreements follows a two-step process. Firstly, Morningstar's Datanalysis Premium database containing searchable ASX full-text announcement is queried using the keywords "off-take" and "offtake" over the period from 1995 to 2018.[80] The second step involves repeating the same process using Factiva over the same period.[81] After analysing the announcements from both data sources, 27 offtake deals are identified in announcement disclosures of other offtake deals but not captured by these data sources. A total of 2,046 announcements are identified, with data attrition documented in Table 4.1. Following Chan et

[79] Materials and Energy industry selections are used to search documents reported by ASX listed companies.
[80] Although the search period started in 1990, the earliest offtake agreement was announced in 1995.
[81] Two separate queries on Factiva using the keywords "off-take" and "offtake" are conducted. The first search with the following source filters: (i) three sectors in the mining industry (Mining/Quarrying, Primary Metals, and Coal mining), (ii) four sectors in the energy industry (Crude Oil/Natural Gas Upstream Operations, Natural gas processing, and Oil/Natural Gas Midstream Operations), and (iii) news source limited to the ASX Company Announcements. The second search is restricted to the Ferrous Metals sector from the text version of ASX Company Announcements.

al. (1997), only the initial or first announcement of the offtake deal to the ASX is sampled. Typically, the deal conclusion may take months and involve many sequential announcements, with a project identifier used to track deal announcement histories. This means it is relatively simple to identify initial and subsequent deal announcements. After deleting 1,636 'secondary' announcements and 14 announcements from purchasers (offtakers), a remaining sample of 396 offtake agreements announced by project sponsors is identified. These announcing firms are divided into two groups based on their life-cycle stages[82]: developers (comprising 312 offtake deals) and producers (comprising 84 deals). These companies participate in 389 unique offtake deals as some agreements involve more than one ASX-listed company.

[Insert Table 4.1 about here]

Table 4.2 reports the distribution of the offtake agreements by year. The highest frequency of deals is observed in the years 2017 (54 deals), 2018 (46 deals) and 2016 (37 deals). Developers have a similar pattern of announced deals in the years 2017 (49 deals), 2018 (43 deals) and 2015 (29 deals). Producers are more active in 2007 and 2016 (both with nine deals), followed by eight deals announced in each of 2009 and 2012.

[Insert Table 4.2 about here]

Table 4.3, Panel A, reports descriptive statistics for the continuous variables of the offtake sample. *SALESREV* is total revenue from the sales of natural resources in the fiscal year prior to the offtake announcement. Extractive firms progress from the development stage, in which operating revenue is nil, to the production phase, when resources are successfully exploited. For the entire sample, announcing firms' mean (median) *SALESREV* is $68.1 million

[82] Sales revenue for the fiscal year prior to the offtake announcement is collected from the Income Statement data available in Morningstar's Datanalysis Premium for all ASX announcing firms. Firms with no Sales revenue are classified as early-stage companies (developers) whereas companies that started to generate revenues from their resources sales are classified as non-early-stage companies (producers). Table 4.3–Panel A provides descriptive statistics on the Sales Revenue for the entire sample and producers.

($0.0 million). The distribution of *SALESREV* indicates skewness to the right due to the higher proportion of offtake announcements by developers (312 out of 396). The mean (median) *SALESREV* for producers is $321.2 million ($58.1 million).

There are three cashflow-related variables collected at the fiscal year end prior to the offtake announcement: operating cash flow (*OPCF*), investing cash flow (*INVCF*), and financing cash flow (*FINCF*). For the entire sample, the mean (median) *OPCF, INVCF*, and *FINCF* is $11.5 million (-$1.9 million), -$28.7 million (-$3.4 million), and $21.5 million ($5.4 million), respectively. The mean (median) *OPCF* of developers and producers are -$4.3 million (-$2.2 million) and $70.3 million ($3.8 million), respectively. The mean (median) cash flow generated from financing activities (*FINCF*) by developers and producers are $17.2 million ($5.4 million) and $37.4 million ($4.3 million), respectively.

The size of offtake announcers is measured by the market capitalisation in Australian dollars at the prior fiscal year end (*MCAP*).[83] For the entire sample, the mean (median) market capitalisation is $248.1 million (36.0 million). Developers have a mean (median) market capitalisation of $106.4 million ($27.3 million). In contrast, producers are larger with a mean (median) market capitalisation of $785.5 million ($190.0 million). The *MCAP* distribution indicates some skewness to the right, again due to the larger sample presence of developers. However, some large companies also sponsor their projects through offtakes.[84]

[Insert Table 4.3 about here]

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[83] Market capitalisation data (*MCAP*) for announcing firms is calculated at the fiscal year-end prior to the offtake announcement. 97% of *MCAP* data is retrieved from Datastream and 2% are collected from Datanalysis for one year prior to the announcement date. There are three announcements for which the announcing firm's *MCAP* is missing due to two earlier-than-IPO offtake announcements by one developer, and to the lack of financial data in either data source for one producer.

[84] For example, there are 40 offtake deals announced by the largest ten percent announcing firms whose mean (median) MCAP is $1,1811.4 million ($1,030.9 million). Accordingly, the top one percent announcing firms in size are: Santos Ltd ($11,523.1 million in December 2009) and Woodside Petroleum Ltd ($8,620.0 million in June 200) operating in the Energy industry, and Fortescue Metals Group Ltd ($6,878.2 million in November 2008) and Zinifex Ltd ($4,525.5 million in June 2006 but delisted in July 2008) in the Materials industry.

FIRMAGE is the time in years between a firm's listing date on the ASX and the day on which the offtake is announced. For the entire sample, announcing firms are listed for a mean (median) of 11.1 (8.7) years. Developers are listed for a mean (median) of 10.1 (8.1) years compared to the producers' mean (median) age of 15.1 (12.2) years, respectively, indicating producers are relatively older. The measure of shareholder concentration is the equity stake held by the twenty largest shareholders sourced from annual reports from the prior fiscal year (*TOP20*). For the entire sample, the mean (median) *TOP20* is 58.8% (57.1%). The top-twenty shareholders hold a mean (median) stake of 56.8% (54.3%) of developers' equity, compared to 66.2% (66.7%) for producers, respectively.

Extant literature on cross-border acquisitions typically control for the political uncertainty of the target (Glambosky, Gleason & Murdock 2015). To control for the political risk of different project locations, risk measures are extracted from The PRS Group's International Country Risk Guide covering 141 jurisdictions (*CRISK*).[85] Overall, announcing firms engage in offtake deals for projects located in jurisdictions with relatively low political risk, with a mean (median) political risk measure of 0.79 (0.89), with similar level of political risk measures observed for both developer-sponsored and producer-sponsored projects. This political risk index is employed due to its wide coverage and has been used by Glambosky, Gleason & Murdock (2015) to measure the risk of loss due to weakness in the legal system, expropriation, bureaucratic hurdles and repudiation of debt in their study of cross-border acquisitions.

[85] The PRS political risk index comprises six risk dimensions: voice and accountability, political stability and absence of violence, government effectiveness, regulatory quality, rule of law and control of corruption. In this study, the average of all these six dimensions for the year prior to the offtake announcement date is used. Index figures for the year 1997 are allocated to deals announced prior to 1997 due to the limited data coverage for the 1990-1996 period, with a similar approach used for any other missing data. For countries with incomplete data, the average index year closest to the announcement date is used. Countries hosting offtake projects not covered by PRS are: Laos, Fiji, Solomon Islands and Eritrea.

The mean (median) number of pages (*PAGE*) of an offtake announcement is 2.7 (2.0) for both the overall sample and developers. Producers' announcements have on average (median) 2.5 (2.0) pages. *NCOMM* indicates the number of different commodities per offtake announcement, being usually single-commodity deals with the presence of multi-resource agreements (including up to five commodities) for both developers and producers. For all announcements disclosing forward resource sales (*OFFTKVAL*), the average (median) total sales revenue is $649.1 ($114.1) million. There are 49 announcements disclosing *OFFTKVAL*, of which 41 agreements are announced by developers, suggesting developers are more prone to either fix pricing terms in earlier stages of the project or disclose to the market in the first offtake announcement relative to producers. The time duration of the commitment between the offtake parties (*OFFTKTIME*) in years is disclosed in 231 announcements. For the entire sample, the mean (median) offtake duration is 6.4 (5.0) years. Developers are committed to selling their sponsor project resources for a mean (median) of 6.6 (5.0) years, while the mean (median) for producers is 5.7 (5.0) years. Offtake commitment in resource volumes on an annual basis (*OFFTYRVO*) are disclosed in 226 announcements[86] with a mean (median) of 997.4 (100.0) thousand tonnes of mineral ore. Two Core Commodity CRB indexes retrieved from Datastream are used to calculate commodity price volatility. The main index refers to a commodity basket excluding energy (*VCRBEXEN*), whereas the second one is a more comprehensive index including both mining and energy commodity prices (*VCRB*). Both measures of commodity price volatility are calculated based on daily price changes over the month of the offtake announcement (Sabet & Heaney 2016). For the entire sample, the mean (median) *VCRBEXEN* and *VCRB* are 0.008 (0.007) and 0.007 (0.007), respectively, with similar volatility observed for both developers and producers. Additionally, there are periods

[86] There is a few announcements disclosing *OFFTYRVO* in units other than tonnes. These data points are set as missing given the output volumes are expressed in different units. Specifically,two observations use barrels, and two others disclose gem offtakes in carats. Additionally, petajoules and packs are used in one announcement each.

in which *VCRBEXEN* and *VCRB* reached nearly 0.04 and 0.02, respectively, during the commodities boom, and dropped to a low of approximately 0.003 for both volatility proxies in years when commodity prices were depressed. Such large variance is expected given the sample spans 24 years and complete price cycles are observed for both mineral and energy commodities.

Table 4.3, Panel B, reports the univariate tests of the difference in means for the continuous variables. Results confirm developers are smaller than producers in terms of market capitalisation (*MCAP*) at $p<0.01$ level. Similarly, developers are younger than producers based on their listing tenure (*FIRMAGE*), significant at $p<0.01$ level. Producers' equity stake held by the twenty largest shareholders (*TOP20*) is higher than for developers at $p<0.01$ level. Developers' offtake-related projects are located in less stable jurisdictions (significant at $p<0.10$ level) based on country political risk measures. Results for the cash flow variables confirm the different life-cycle stages of the extractive firms in this sample. Developers generate lower operating cash flow relative to producers (at $p<0.01$ level), confirming significant cash flow constraints experienced by developers given their cash flow generation status. Developers, however, make significantly more investment compared to producers, suggesting producers' portfolios comprise projects already in the production phase requiring only incremental investments.

Table 4.3, Panel C, depicts descriptive statistics for the indicator variables. There are two distinct groups based on the industry classification, with a great majority (87.1%) of the sample constituents being mining firms while the remaining firms are operating in the energy industry (12.9%). A similar pattern is observed for the developers subsample. For the subsample of producers, 81.0% and 19.0% of them are mining and energy companies, respectively. There are 65 and 19 announcements by developers and producers, respectively, specifying funding commitments underpinning the offtake deal (*FUNDING*). In other words, offtakes are used in 84 announcements (21.2%) to channel financial resources from the offtaker to the sponsor through either equity or debt as a means to assist in project financing. An indicator variable (*NON_HORIZ*) is used for capturing the potential certification effect stemming from offtake counterparties.[87, 88] Appendix 7 provides further details of the construction of proxies used to test the certification hypothesis. For the entire sample, 53.5% of announcements have a non-horizontal counterparty, whereas 40.4% of offtakes have a counterparty operating in the same industry of the announcing firm. Developers have a higher frequency (58.7%) of offtake deals with counterparties operating in a different industry (*NON_HORIZ*), compared to producers (34.5%). A second indicator variable based on the counterparty's industry classification splits *NON_HORIZ* offtakes into two categories: end-users and intermediaries. *END_USER* is coded '1' if the buyer's industry classification indicates offtake-committed-resources will be used as an input in its manufacturing process (*END_USER*), and '0' otherwise. A second variable (*INTERMEDIARY*) indicates the presence of an offtake counterparty acting as a middle-man, such as commodities traders or financial institutions. This breakdown of non-horizontal offtakes is important in this setting considering

[87] Following Chan et al. (1997), offtakes are classified as horizontal and non-horizontal alliances based on firms' three-digit SIC code. For ASX listed companies, GICS methodology assigns each firm to a four-level industry classification where the third level 'Industry' is equivalent to the three-digit SIC code. *NON_HORIZ* takes the value of '1' when there is at least one counterparty (buyer) operating in an industry different from the announcing firm's (sponsor's). There is one announcement with three counterparties disclosed, of which two counterparties operate in different industries ('Industrial Conglomerate' and 'Trading companies and distributors'). In this particular case, the partner classification is set as 'Trading companies and distributors', considering an industrial conglomerate can also have trading or distribution as part of its diverse range of activities.

[88] Data for the industry classification of non-ASX listed counterparties is obtained from three main sources. (i) Bloomberg webpages are used for 237 announcements (there are four multi-counterparty announcements of which the source of industry classification varies for each counterparty; in these cases, the industry classification source is based on the buyer with the highest level of financial commitment in two agreements, the buyer's size in one agreement, and for a three-counterparty announcement in which Bloomberg is the prevalent data source for two of them); (ii) disclosure available in the offtake announcement for 84 agreements (there is one multi-counterparty announcements for which the source of industry classification varies for each counterparty so the industry classification source is based on the buyer with a higher level of financial commitment); (iii) Morningstar Datanalysis Premium is used to identify the offtaker's industry for 25 offtakes; (iv) other sources for 25 announcements where the counterparty of 10 of them is Glencore International AG, whose industry classification is based on its segment reporting due to its wide range of activities according to the Note 2 of its 2016 Annual Report. There are 24 observations set as missing values due to the lack of counterparty's identification and/or economic activity. The first-level micro-sector is used for observations sourced through Bloomberg Industry Classification Systems.

the buyers' purchase commitments are likely to vary depending on the planned use of the offtake resources. While manufacturing firms are more likely to be concerned about the continuous supply of a given raw material, intermediaries are willing to take advantage of pricing opportunities and use the off-take deal as a form of direct rent extraction from the supplier. There are 114 (28.8%) offtake announcements with end-users (*END_USER*) and 98 (24.7%) deals with intermediaries (*INTERMEDIARY*). There is a higher frequency of both *END_USER* and *INTERMEDIARY* for developers (31.7% and 26.9%, respectively) relative to the frequency for producers (17.9% and 16.7%, respectively). In other words, producers are more likely to have a same-industry offtake counterparty reflecting their lower needs for financing. For all *INTERMEDIARY* announcements, a further breakdown of the counterparty's industry classification indicates whether it operates as a trading house (*TRADER* assumes '1'). There are 79 (19.9%) announcements whose counterparty is a trading company. Developers have a higher frequency of offtake announcements with traders (21.8%) compared to producers (13.1%).

With regard to the legal commitments between the offtake parties, there are 58 (14.6%) announcements with binding terms. This low level of legal commitment is unsurprising considering the sample is comprised of initial or first announcements of offtake agreements. Developers announce 47 (15.1%) binding offtake agreements whereas producers announce 11 (13.1%). There are 47 (11.9%) announcements in which the counterparty is committed to the announcing firm over the life of the project (*LIFEMINE*). For developers, 12.2% of announcements have a life-of-mine commitment from the buyer and 10.7% for Producers. Table 4.3, Panel D, reports the univariate tests of the difference in means for the indicator variables. Results confirm a higher proportion of mining firms in the developer subsample ($p<0.10$). In addition, producers engage more in offtake deals with same-industry partners

($p<0.01$). Developers have a higher frequency of offtake agreements with intermediaries and traders ($p<0.10$).

Table 4.4 reports the Pearson correlation coefficients for the independent variables related to all offtake announcements. The positive correlation between *OFFTKTIME* and *OFFTKVAL* and between *OFFTYRVO* and *OFFTKTIME* is consistent with the description of deal commitment in more detailed agreements. Similarly, *FUNDING* and *OFFTKVAL* are positively correlated as announcements disclosing financial commitment commonly provide a break-down of the amount in relation to forward sales and funding. *NON_HORIZ* and *MINING* are negatively correlated, suggesting mining sponsors are more likely to have an offtake counterparty operating in the same industry. *END_USER* and *NON_HORIZ* are positively correlated, indicating most counterparties participating in non-horizontal offtakes utilise the offtake resources in their manufacturing process. *END_USER* and *INTERMEDIARY* are negatively correlated, consistent with the industry classification method of splitting *NON_HORIZ* into these two categories. *TRADER* and *INTERMEDIARY* are positively correlated, consistently with the higher frequency of trading houses in the group of offtake counterparties classified as intermediaries.

[Insert Table 4.4 about here]

4.3.1 Event study approach

Offtake announcements have a precise date and time stamps available on the ASX's company announcement platform filed under continuous disclosure requirements. The event study approach based on Ball & Brown (1968) and Fama et al. (1969) is employed to analyse the market reactions of announcing firms. A market-adjusted model is used to calculate abnormal returns around announcement dates as follows:[89]

$$AR_{i,t} = ln\left[\frac{P_{i,t}}{P_{i,t-1}}\right] - ln\left[\frac{P_{m,t}}{P_{m,t-1}}\right] \quad (1)$$

where abnormal or excess returns (*AR*s) are calculated as the difference between the logged daily price relatives of the announcing company (P_i) and the logged daily price relatives of the ASX All Ordinaries index (P_m). Cumulated abnormal returns (*CAR*s) are computed over a three-day event window centred on the farmout announcement date as follows:

$$CAR(-1,+1) = \sum_{t=-1}^{1} AR_{i,t} \quad (2)$$

Adjusted stock prices for ASX announcing firms are obtained from Datastream for 98.7% of the sample, and the remainder is sourced from Morningstar's Datanalysis Premium. The benchmark All Ordinaries Index used to calculate the abnormal returns is based on the market capitalisation of the 500 largest firms listed on the ASX.[90] To mitigate confounding noise effects resulting from non-mineral related projects (i.e., biomass and other renewable energy sources), eight offtake announcements are omitted. There are three other agreements involving two or more ASX announcing firms where one of them discloses the offtake deal later than its peer. In these cases, the late announcements are deleted. Finally, two other announcements are excluded because of limited stock price data available, not allowing the execution of the event study. This leaves 383 offtake announcements remaining after sample attrition. Offtake announcements are, essentially, not contemporaneous events. Nevertheless, to mitigate potential concerns of cross-sectional dependence of returns, significance tests (*t*-

[89] This benchmark ensures minimal data attrition considering the significant number of small firms in the sample. Further, daily data on Fama-French-Cahart factors are not available for the Australian market (Ferguson & Lam 2016, *p*. 106).
[90] The "All Ordinaries" or simply "All Ords" index is available on Datastream under the ticker ASXAORD.

tests) are reported following Kolari & Pynnönen (2010) for both abnormal and cumulative abnormal returns.

4.3.2 Model specification

To explore how wealth effects of offtakes are associated with firm and project characteristics, an ordinary least square (OLS) cross-sectional model is specified as follows:

$$CAR(-1,+1) = \beta_0 + \beta_1 FUNDING + \beta_2 NON\_HORIZ + \beta_3 VCRBEXEN + \beta_4 BINDING + \beta_5 LMCAP + \beta_6 TOP20 + \beta_7 CRISK + \beta_8 LFIRMAGE + \beta_9 LPAGE + e_i \quad (3)$$

where the dependent variable is the three-day *CAR* over the event window using market-adjusted returns. The first experimental variable (*FUNDING*) is an indicator variable coded '1' for announcements specifying funding commitments underpinning the offtake deal, '0' otherwise. The second explanatory variable (*NON_HORIZ*) is an indicator variable coded '1' for offtakes where both the project sponsor and counterparty do not operate in the same industry, '0' otherwise. The next experimental variable (*VCRBEXEN*) is a continuous variable proxying for the price volatility of a commodity basket index.

Several control variables are included in the model specification. An indicator variable (*BINDING*) is included to control for the legal commitment between the offtake parties. A size control (*LMCAP*) is included, calculated as the natural logarithm of the announcing firms' market capitalisation denominated in Australian dollars, lagged one year before the offtake announcement date. To control for shareholder monitoring, a continuous variable (*TOP20*) based on the announcing firm's equity stake held by the twenty largest shareholders at the fiscal year-end before the offtake announcement date is included. A continuous variable (*CRISK*) is used to control for the political risk of the country hosting the offtake project using the PRS political risk index. *LFIRMAGE* is a continuous variable measured as the natural logarithm of the period in years between the listing date and the offtake announcement date. The last variable is the natural logarithm of the number of pages of each announcement (*LPAGE*) to control for the announcing firm's level of disclosure.

4.4 Results

4.4.1 Descriptive statistics

Descriptive statistics on market reactions to offtake announcements are reported in Table 4.5, Panels A and B. The analysis focuses on the three-day event window [–1, 1]. There is evidence that offtakes are significant market events for ASX-listed extractive firms, which experience a mean (median) abnormal return of 5.78% (3.10%) on the announcement date, significant at the $p<0.01$ level. On the day before ($t - 1$) and after ($t + 1$) the event date, there is no evidence of abnormal returns. Additionally, it is noted the mean abnormal returns on the remaining days over the 11-day event window are of a much lower economic magnitude and statistically insignificant, except on day $t - 3$ when the abnormal return is 0.66%, significant at the $p<0.10$ level. The percentage positive count statistic is 51%, 72% and 48%, over each of the three event days [–1, 1], respectively. A similar pattern of abnormal returns is observed for the subsamples comprising developers and producers. Developers experience a higher mean (median) abnormal return of 6.57% (3.92%) in comparison to 2.83% (1.40%) for producers on the announcement date (both are significant at the $p<0.01$ level). The positive count statistic is 73% and 68% for developers and producers over the announcement date, respectively, indicating offtakes are value-creating events for both. Univariate tests indicate developers experience significantly higher average abnormal returns relative to producers ($p<0.01$).

Visual inspection of Table 4.5, Panel C, confirms significant market reactions on the event date with a spike in abnormal returns for both the entire sample and developers and producers subsamples. In addition, it is clear that the economic magnitude of wealth changes for developers is more than double that for producers.

Table 4.5, Panels D and E, report abnormal returns for the sample split into mining and energy announcing firms. The subsample comprising energy projects has only 45 observations. The mean (median) abnormal returns observed in offtakes announced by mining firms of 5.83% (3.49%), significant at $p<0.01$, are higher than for deals by energy firms, which experience a mean (median) abnormal return of 5.37% (1.55%), significant at $p<0.05$. However, univariate tests indicate that the average abnormal return experienced by mining and energy announcing firms are not significantly different. This is confirmed by a visual inspection of Table 4.5, Panel F, which indicates the three lines plotting the average abnormal returns experienced by all, mining and energy firms on the event date are hardly distinguishable from each other.

[Insert Table 4.5 about here]

Overall, the wealth effects experienced by firms announcing offtake arrangements are much higher than those documented in the extant strategic alliance literature. For example, a positive and significant mean abnormal return of 0.64% is observed in strategic alliance announcements by Chan et al. (1997), and a mean two-day excess return of 0.73% is observed in joint ventures by McConnell & Nantell (1985). The wealth increase observed in all offtake events depicts a 72% count positive on the announcement date, compared to 55% and 67% observed by Chan et al. (1997), and McConnell & Nantell (1985), respectively. Further, when compared with other single-industry studies, Sabet & Heaney (2016) find an average positive abnormal return of 0.53% for oil and gas firms announcing acreage and reserve acquisitions.[91] Not surprisingly, offtake agreements yield higher abnormal returns relative to other types of alliances, given their importance to unlock value from projects transitioning from the development to the production stage. Furthermore, offtakes are of higher importance for

[91] The three aforementioned studies do not provide descriptive data on the abnormal return distribution, not facilitating comparison.

developers, which are cash-restricted and highly dependent on financing activities due to the lack of cash inflow from the sale of resources.[92]

Table 4.6, Panels A and B, report the cumulative abnormal returns (*CAR*s) observed from offtakes, which confirm both the economic and statistical significance of these events for all announcing firms. The three-day mean (median) *CAR* is 5.73% (3.65%) with a count positive of 69%. Developers experience a positive and statistically significant mean (median) *CAR* of 6.31% (3.99%), higher than the 3.58% (2.28%) experienced by producers.

Table 4.6, Panels C and D, report the cumulative abnormal returns (*CAR*s) for the mining and energy subsamples. Mining firms experience a mean (median) *CAR* of 5.85% (3.91%) over a three-day event window, which is higher than the 4.82% (3.39%) experienced by energy firms. Mining firms (energy firms) have a 69% (64%) count positive for the three-day *CAR*.

[Insert Table 4.6 about here]

4.4.2 Cross-sectional analysis of abnormal returns

Table 4.7 reports the OLS regression results for the pooled sample based on the primary model of equation (3) and alternative model specifications. In testing the 'resource pooling' hypothesis, the variable indicating funding commitment (*FUNDING*) is used. In Column 1, the coefficient on *FUNDING* is positive (0.027) and significant (p<0.10), suggesting projects funded through offtakes result in higher abnormal returns relative to offtakes without the disclosure of funding terms. This result is consistent with the prediction of H1. When a dummy variable for developers is controlled for, the coefficient on the *DEVELOPER* dummy is positive

[92] Table 3, Panel A, reports cash flow data in the fiscal year prior to the offtake announcement in support of developers' cash restriction status. On one hand, developers have a mean (median) operating cash outflow (*OPCF*) of $4.3 million ($2.2 million), and a mean (median) cash inflow of $17.2 million ($5.4 million) from financing activities (*FINCF*). On the other hand, producers generate a mean (median) cash inflow of $70.3 million ($3.8 million) from its operating activities (*OPCF*), and a mean (median) financing cash inflow of $37.4 million ($4.3 million).

(0.007) but not significant, suggesting no statistically discernible difference in market reactions to offtakes with funding commitments between developers and producers. The control for developers in the sample has little impact on the coefficient on *FUNDING*, although the significance level increases to $p<0.05$. Column (3) reports results after controlling for the presence of mining firms (*MINING*). Similar to the control for developers, the coefficient on *MINING* is positive, but not significant. For this model specification, the coefficient on *FUNDING* remains positive (0.027) and significant at the $p<0.10$ level. Across the remaining model specifications controlling for offtaker type (Columns 4 to 6), the coefficient on *FUNDING* remains positive, ranging from 0.029 (Column 5) to 0.031 (Column 4), and significant at the $p<0.05$ level. This evidence indicates larger wealth effects to offtakes disclosing funding commitments from the counterparty, consistent with the expectation of H1. In all regression models, the adjusted R^2 lies within the range between 6.3% and 9.2%, with the F-statistic significant at the $p<0.01$ level.

[Insert Table 4.7 about here]

For tests of the certification hypothesis, a variable (*NON_HORIZ*), coded '1' for the presence of at least one offtaker operating in an industry other than the announcing company's industry, is included in the primary model. Column 1 (Table 4.7) depicts a negative coefficient on *NON_HORIZ* (-0.005) but not significant. Similar results for *NON_HORIZ* are observed in other model specifications controlling for the presence of developers and mining firms (Columns 2 and 3). Upon splitting the offtakers into end-users (*END_USER*) and intermediaries (*INTERMEDIARY*), results from Column (4) show the coefficient on *END_USER* is positive (0.012) but not significant, and the coefficient on *INTERMEDIARY* is negative (-0.024) and statistically significant at the $p<0.10$ level. Thus, there is evidence of lower market reactions to offtake agreements with intermediaries relative to deals with counterparties classified as either end-users or peers (i.e., when *NON_HORIZ* is coded '0').

This result implies that the terms of an offtake agreement with an intermediary as the counterparty are regarded less favourably by the market in comparison to offtakes with non-intermediary counterparties. In other words, the market reacts less positively to the announcement of offtakes with financiers and trading houses. To explore this relative certification effect, a further proxy is created based on *INTERMEDIARY* to indicate the presence of trading houses (*TRADER*). In Column (5), with *TRADER* proxying for the certification effect, the coefficient on *TRADER* is negative (-0.035) and significant at the $p<0.05$ level. Comparing the adjusted R^2 and the coefficient on *INTERMEDIARY* and *TRADER* across the model specifications in Columns (4) and (5), the results seem to suggest lower market reactions to offtake agreements where the offtake counterparties are trading houses.

To test the real options hypothesis, two proxies based on the volatility of commodity prices (*VCRBEXEN* and *VCRB*) are employed[93]. Firstly, across the primary and modified models (Columns 1 through 5), the coefficient on *VCRBEXEN* is consistently positive (ranging from 5.233 to 5.461) and significant at the $p<0.05$ level. This finding is consistent with the real options theory as the announcing companies remain exposed to their projects' pricing risks after the offtake. The alternative proxy for the real options theory based on a more comprehensive commodity basket (*VCRB*) reported in Column (6) is positive (1.547), but not significant. This is expected due to the inclusion of energy commodity prices in this index, diluting the non-energy commodity price changes.

Developers and Producers

To shed further light on the motivations of developers and producers to engage in offtake agreements, Table 4.8 depicts the OLS regression results for these two subsamples

[93] Sensitivity tests can be done using the change in crude oil futures price or other oil price volatility proxies given the approaches available in the financial economics literature (Grullon, Lyandres & Zhdanov 2012; Sadorsky 2006; Wei, Wang & Huang 2010).

based on the primary model and modified specifications using alternative proxies for each hypothesis. In testing the 'resource pooling' hypothesis, the coefficient on *FUNDING* is positive, ranging from 0.033 (Columns 1 and 3) to 0.037 (Columns 4), and significant at the $p<0.05$ level across the primary and modified models for developers. As for the producers subsample, the coefficient on *FUNDING* is positive but not significant across specifications. Thus, there is evidence supporting the 'resource pooling' hypothesis for the subsample comprising developers. This finding is consistent with the results of Byoun, Kim & Yoo (2013) from probit regressions, indicating that offtakes are more likely to be used by project sponsors with high cash flow risk. The lack of significance of *FUNDING* for producers suggests pooling of resources is not the main motivation for these companies to engage in offtake agreements. This is expected as producers would likely have internal funding resources (Myers & Majluf 1984). However, a caveat is that the result for the producers subsample is based on only 75 offtake announcements, as compared with 281 for developers.

For tests of the certification hypothesis, Columns (1) and (4) depict a negative coefficient for *NON_HORIZ* (-0.008 and -0.010, respectively) for the subsample comprising developers, and neither coefficient is statistically significant. In contrast, for the producers subsample, the coefficient on *NON_HORIZ* is positive (0.013 in both Columns 5 and 8), but not significant. Subsample results for testing the certification hypothesis through *INTERMEDIARY* and *TRADER* further reveal the coefficient on TRADER is negative (-0.04) and significant ($p<0.05$) for developers (Column 3) while the coefficient on END_USER is positive (0.043) and significant ($p<0.10$) for producers (Column 7). These results suggest a negative certification effect for developers when the offtake counterparty is an intermediary and a trader. In contrast, a positive certification effect is found for producers when the offtake counterparty is an end-user.

The two proxies used to test the real options hypothesis based on the volatility of commodity prices (*VCRBEXEN* and *VCRB*) are reported in Columns (1) to (4) for developers and in Columns (5) to (8) for producers. The coefficients on *VCRBEXEN* is consistently positive (ranging from 6.095 to 6.418) for developers, significant at the $p<0.05$. It is interesting to note that the coefficient on *VCRB* for this subsample is positive (2.527), and significant at the $p<0.10$ level. For the subsample comprising producers, the coefficients on both *VCRBEXEN* and *VCRB* are negative (ranging from -3.155 to -1.729), but not significant. These results support the real options hypothesis for developers but not for producers. This finding is consistent with extractive firms having more options to exercise in the latter stages of their life-cycle. That is, upon transitioning to the production stages, mining firms have exercised most of their growth options. Likewise, Grullon, Lyanders & Zhdanov (2012) find a higher share price return for oil and gas firms with greater undeveloped oil reserves. In other words, the share price of extractive firms holding early-stage projects are more sensitive to the change in the commodity volatility in comparison to companies with mature mining projects.

Mining firms

Table 4.9 depicts the OLS regression results for the subsample comprising mining firms[94] only using the primary model and modified specifications applying alternative proxies for testing each hypothesis. The coefficient on *FUNDING* is positive across all models, ranging from 0.025 (Column 1) to 0.029 (Column 2), and significant at the $p<0.10$ level. Thus, there is evidence supporting the 'resource pooling' hypothesis for offtakes announced by mining firms. The adjusted R^2 for this subsample ranges from 7.2% to 10.0%, and the F-statistic is significant at the $p<0.01$ level.

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[94] The subsample comprising energy firms has only 45 observations. Thus, no results are reported for this subsample due to the high data attrition.

Concerning the certification hypothesis, tests using the mining firm subsample indicate a similar pattern as reported in the pooled sample. The coefficient on *NON_HORIZ* reported in Columns (1) and (4) is negative (-0.012 and -0.013, respectively), but not significant. Upon splitting non-horizontal counterparties into *END_USER* and *INTERMEDIARY*, Columns (2) and (3) depict positive coefficients on *END_USER* (0.007 and 0.005) but not statistically significant. Column (2) depicts a negative coefficient on *INTERMEDIARY* (-0.030), being significant at the $p<0.10$ level. The negative certification effect is also found when *TRADER* is included in model replacing *INTERMEDIARY*. The coefficient on *TRADER* is -0.042 and significant at the $p<0.01$ level (Column 3). These findings suggest that wealth changes observed for mining firm offtake agreements are associated with negative certification effects stemming from offtakes with intermediaries and trading houses.

The coefficient on *VCRBEXEN* used to test the real options hypothesis is positive (ranging from 4.004 to 4.369), and significant at the $p<0.10$ level. However, no significant result is found for *VCRB*. Thus, there is evidence supporting the real options hypothesis for the mining firm subsample.

4.5 Further tests

4.5.1 Robustness test adjusting the standard errors to cluster by firm and time

The analysis in Tables 4.7 to 4.9 are re-run, using robust standard errors clustered by firm and year and the results are reported in Table 4.10. Panel A reports results for the pooled sample, indicating some loss of statistical significance for the coefficient on *FUNDING*, dropping from $p<0.05$ to $p<0.10$ level.

Table 4.10, Panel B, reports the results for the subsamples comprising developers and producers adjusting the standard errors to cluster by firm and time. For developers, the coefficient on *VCRB* indicates higher statistical significance at the $p<0.05$ level instead of $p<0.10$. No significant changes in results are found for the producers. For the subsample comprising mining firms, Table 4.10, Panel C, reveals the coefficient on *FUNDING* is no longer significant for two alternative models (Columns 3 and 4).

Overall, despite the robustness tests indicating some loss of significance for the *FUNDING* proxy, its coefficient remains significant for most model specifications at the $p<0.10$ level. This suggests the evidence to support resources pooling as a motivation for extractive firms to engage in offtakes is robust to adjusting the standard errors of the coefficient estimates to cluster by firm and time.

[Insert Table 4.10 about here]

4.5.2 Disclosure noisiness

Controls for noise from other firm-level price sensitive announcements released over the event window are undertaken. Table 4.11, Panel A, reports sensitivity tests after removing offtake announcements with confounding noise identified on the event date. No significant changes are observed in the reported results. However, further sensitivity tests (Table 4.11, Panel B), where announcements with confounding noise identified over the three-day window are excluded, reveal the coefficient on *FUNDING* weakens and is no longer significant. Furthermore, there is a decline in the models' adjusted R^2 (ranging from 5.5% to 7.1%), potentially resulting from the significant data attrition observed in the (sub)samples.

[Insert Table 4.11 about here]

4.5.3 Robustness test removing offtakes with duration of two years or less

Further tests address the issue of misclassification of one-off transactions and similar deals with low levels of commitment between the parties as offtakes are conducted. The variable *OFFTKTIME* is used to identify deals for which the sales commitments last only a short period of time. Accordingly, agreements with duration of two years or less[95] are removed from the sample to mitigate the issues arising from the misclassification of one-off sales transactions as offtakes. Table 4.12, Panel A, depicts similar results compared to the main models reported in Table 4.7. The coefficient on *FUNDING* is significant at the $p<0.10$ level, except in Column (4) where it is significant at the $p<0.05$ level. Conversely, the coefficient on *TRADER* reported in Column (5) is stronger in terms of magnitude (-0.042) and statistical significance ($p<0.01$) compared to $p<0.05$ in Table 4.7. For subsample results for developers and producers, Table 4.12, Panel B, reports similar results as in Table 4.8, except for the coefficient on *FUNDING* which weakens, and it is significant at $p<0.10$ level. For the tests on the subsample of mining firms, there are two main changes (see Table 4.12, Panel C). First, the coefficient on the volatility proxy (*VCRBEXEN*) weakens in Column (1), and it is no longer significant. Second, the coefficients on two of the proxies used to test the certification hypothesis become stronger: *INTERMEDIARY* in Column (2), and on *TRADER* in Column (3).

Overall, these sensitivity tests on the sample restricted to offtakes with higher commitment based on *OFFTKTIME* indicate *FUNDING* has become less important from a capital market perspective. Certification effects, however, are stronger, mostly for the mining firms.

[Insert Table 4.12 about here]

4.6 Summary

In an alliance context, this study is the first study to shed light on the wealth effects stemming from offtake announcements by ASX-listed extractive industry companies. These agreements are common among cash-restricted companies seeking to transition from the development to the production stage. Descriptive evidence for both developers and producers

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95 Observations not disclosing the duration of the offtake remain in these tests given one-off transactions are likely to provide this data on the first announcement.

indicate the former are smaller and younger. It also indicates that cash from financing activities is the only source of financial resources for developers. There is evidence that offtakes are important economic events in a capital market context, attracting a positive cumulative abnormal return of 5.73% over a three-day event window for all announcing firms. Univariate tests also indicate the market reacts more positively when offtakes are announced by developers than by producers.

Cross-sectional analysis of the three-day cumulative abnormal returns indicates the importance of funding disclosures for all announcing firms and for the subsample comprising developers, confirming the 'resource pooling' hypothesis. This is consistent with the use of alliances as a financing channel, similar to what is observed in the biotech setting. A second hypothesis tests for the certification effect stemming from the offtake counterparties (buyers) with evidence consistent with a negative effect from deals with intermediaries. This is the first study in the alliance literature indicating adverse certification effects from alliance partners. This negative effect is more evident from the offtake agreements with trading houses, which suggests these buyers offer less favourable deal terms and/or act more opportunistically, vis-a-vis the project sponsor.

Offtakes can be argued to be an ideal empirical setting for testing the real options theory given the sequential nature of extractive industry project commitments. The price volatility of two indexes comprised of a basket of commodities are employed as a proxy for uncertainty. There is evidence that offtake agreements announced in months having higher commodity price volatility yield higher abnormal returns based on one proxy, which is consistent with Sabet & Heaney (2016). Additional tests adjusting for robust standard errors clustered by firm and time report similar results to the primary tests, with the exception of the 'resource pooling' hypothesis.

In terms of limitations, there is a paucity of disclosure for some of the variables of interest as the first document announcing an offtake to the market may contain less in the way of deal-specific information. The fact that daily data for the Fama-French-Cahart four-factor model is not available for the Australian market and the presence of smaller and younger extractive firms in the sample restrict research design choice in terms of returns benchmarks in this setting.

Chapter 5 – Summary and conclusions

5.1 Summary

This thesis examines the motivations of ASX extractive firms to form two types of alliances: farmouts and offtakes. To execute this study, an event study approach is employed to estimate market reactions to the announcement of farmout agreements by oil and gas firms, and offtake agreements by mining and energy firms listed on ASX. The empirical analysis of these interfirm arrangements is performed separately because of differences in terms of deal structure and underlying motivations. The two samples are constructed based on manually-collected initial announcements using two data sources. The farmout sample consists of 27 years of farmout agreements from 1990 through 2016, while the offtake sample comprises announcements collected over the period from 1995 to 2018. These hand-collected data allowed the identification of deal characteristics specific to this setting. For example, the use of farmout agreements by oil and gas firms to undertake exploration projects in areas prone to unconventional resources is observed. Another example is the presence of different types of counterparties in offtake agreements, such as extractive firms, smelters (end-users), trading houses, and financial institutions (intermediaries).

This thesis finds oil and gas firms announcing farmout agreements experience a positive abnormal return of 3.60% over the three-day event window. Similarly, there is evidence of offtakes' economic importance, given the positive market reaction of 5.73% experienced by ASX-listed announcing companies. Cross-sectional analysis finds support for the 'resource pooling' hypothesis based on three different proxies for farmout agreements. In contrast, mixed evidence supporting this hypothesis is found in the study of offtake announcements. In addition, no support for the certification hypothesis is available from the farmout analysis but a negative certification effect is found for offtake arrangements with intermediaries, notably traders. Further mixed evidence for the expertise hypothesis is found, with some evidence suggesting technology and/or expertise transfer is a motivation for oil and gas companies to form farmout arrangements. Finally, support for the implications of the real options theory as applied to both farmouts and offtakes is identified.

5.2 Contributions and implications

This thesis contributes to the existing literature in the following ways. This is the first study to explore farmout and offtake arrangements from a capital market perspective. Four different hypotheses in the study of farmouts, and three hypotheses relating to offtake agreements are investigated. Examining the wealth effect associated with the announcement of these alliances, results suggest both farmouts and offtakes are important economic events for extractive companies given the significant value creation. Evidence suggests that oil and gas firms seek farminees to combine complementary resources, which is also a general motivation for alliance formation in other settings. This thesis also finds the first evidence of a negative certification effect arising from the participation of intermediaries in offtake agreements. Existing studies on alliances have shown positive endorsement effects from exchange partners; however, in the offtake setting, it is observed that partners can also have adverse wealth effects. These results are robust to controlling for confounding effects of disclosure noise in the farmouts context. This thesis also provides evidence supporting a real options theory interpretation. This is unsurprising given that investment in extractive projects is conducted in distinctive stages. The real options theory has, to this point, remained unexplored in the alliance literature despite its importance to both financial and non-financial investment options.

5.3 Potential limitations and suggestions for further research

One potential limitation arises from the disclosure of farmouts and offtakes given the use of initial announcements. The use of initial announcements has the advantage of better identification of new information. However, initial announcements, in some cases, are likely to provide only preliminary arrangement terms rather than the final terms available when the alliance negotiation is completed. It is important to note that this research design choice is common in the alliance literature, considering a final alliance agreement involves many stages of negotiation between the parties.

Another limitation stems from the use of the market-adjusted model to perform the event study analysis. While studies in the alliance literature commonly employ the four-factor model of Carhart (1997), the market-adjusted model is likely to be the best approach in this setting, considering (i) the lack of daily risk-factor data for the Australian market, and (ii) the presence of non-synchronous trading observed in the time-series of share prices for small oil and gas firms.

This thesis opens further avenues to examine interfirm arrangements. A related setting is arrangements to underpin infrastructure-related projects in the oil and gas industry, such as the construction of offshore platforms and pipelines which require massive investments in this type of project. Also, it would be interesting to investigate firm characteristics associated with negative certification effects. Another potential source of negative endorsement effects can be the practice used by a counterparty to guarantee their benefits in the arrangement at the expense of the other partner(s). This is consistent with the incomplete contract theory, indicating potential opportunistic behaviour from parties tied to an incomplete contractual arrangement. Further research can also examine the determinants of interfirm arrangements in this setting to identify characteristics of the project and/or of sponsoring company associated with the choice to execute the project in-house or via alliance.

Tables and Figures for Chapter 3

Table 3.1 – Sample selection

This table reports details on the sample selection process. Announcements on farmout agreements are first identified in Morningstar's Datanalysis Premium database for oil and gas firms listed on ASX spanning the period 1990−2016. The sample is then augmented with additional keyword searches on Factiva for the period 1990−2000 confined to constituents of the oil and gas sector listed on ASX.

Description		Announcements	Percent
Morningstar's Datanalysis Premium:		1,820	74.3%
Keyword search	331		13.5%
Content analysis of the announcement headlines	1,489		60.8%
Add: Factiva		582	23.8%
Add: Non-energy companies' announcements		47	1.9%
Equal: Total announcements		2,449	100.0%
Less: Exclusions		1,471	60.1%
Subsequent announcements	1,447		59.1%
Announcements disclosing non-farmout events	18		0.7%
Announcements lacking sufficient disclosure	6		0.2%
Equal: Final sample		978	39.9%
Announcements by ASX farmor (vendor) firms	589		24.1%
Announcements by ASX farminee (buyer) firms	389		15.9%
Less: Agreements announced by two or more ASX firms		256	10.5%
Equal: Unique farmout agreements		722	29.5%

Table 3.2 – Panel A: Announcement frequency over time

This table reports the distribution of farmout agreements for unique deals and related announcements released by the farmors and farminees across the sample period 1990−2016.

Year	Unique farmout agreements			Announcements by farmors			Announcements by farminees		
	Freq	Percent	Cum. Percent	Freq	Percent	Cum. Percent	Freq	Percent	Cum. Percent
1990	10	1%	1%	9	2%	2%	4	1%	1%
1991	10	1%	3%	13	2%	4%	4	1%	2%
1992	14	2%	5%	10	2%	5%	9	2%	4%
1993	15	2%	7%	9	2%	7%	9	2%	7%
1994	13	2%	9%	11	2%	9%	7	2%	8%
1995	19	3%	11%	13	2%	11%	12	3%	12%
1996	15	2%	13%	9	2%	13%	11	3%	14%
1997	35	5%	18%	26	4%	17%	25	6%	21%
1998	19	3%	21%	11	2%	19%	13	3%	24%
1999	16	2%	23%	20	3%	22%	5	1%	25%
2000	21	3%	26%	16	3%	25%	14	4%	29%
2001	15	2%	28%	12	2%	27%	14	4%	33%
2002	26	4%	32%	23	4%	31%	15	4%	37%
2003	22	3%	35%	19	3%	34%	14	4%	40%
2004	31	4%	39%	26	4%	39%	23	6%	46%
2005	51	7%	46%	51	9%	47%	24	6%	52%
2006	53	7%	53%	48	8%	55%	19	5%	57%
2007	60	8%	62%	49	8%	64%	35	9%	66%
2008	30	4%	66%	24	4%	68%	15	4%	70%
2009	40	6%	71%	27	5%	72%	24	6%	76%
2010	54	7%	79%	45	8%	80%	24	6%	82%
2011	30	4%	83%	23	4%	84%	12	3%	85%
2012	41	6%	89%	27	5%	88%	21	5%	91%
2013	34	5%	93%	29	5%	93%	13	3%	94%
2014	26	4%	97%	17	3%	96%	15	4%	98%
2015	10	1%	98%	10	2%	98%	3	1%	99%
2016	12	2%	100%	12	2%	100%	5	1%	100%
Total	722	100%	-	589	100%	-	389	100%	-

Table 3.2 – Panel B: Frequency of farmout announcements and the lead average of futures prices for the crude WTI

The number of announcements released by farmors and farminees, and the lead average for futures prices of the crude WTI – West Texas Intermediate are overlaid. WTI futures prices are sourced from the U.S. Energy Information Administration (EIA).

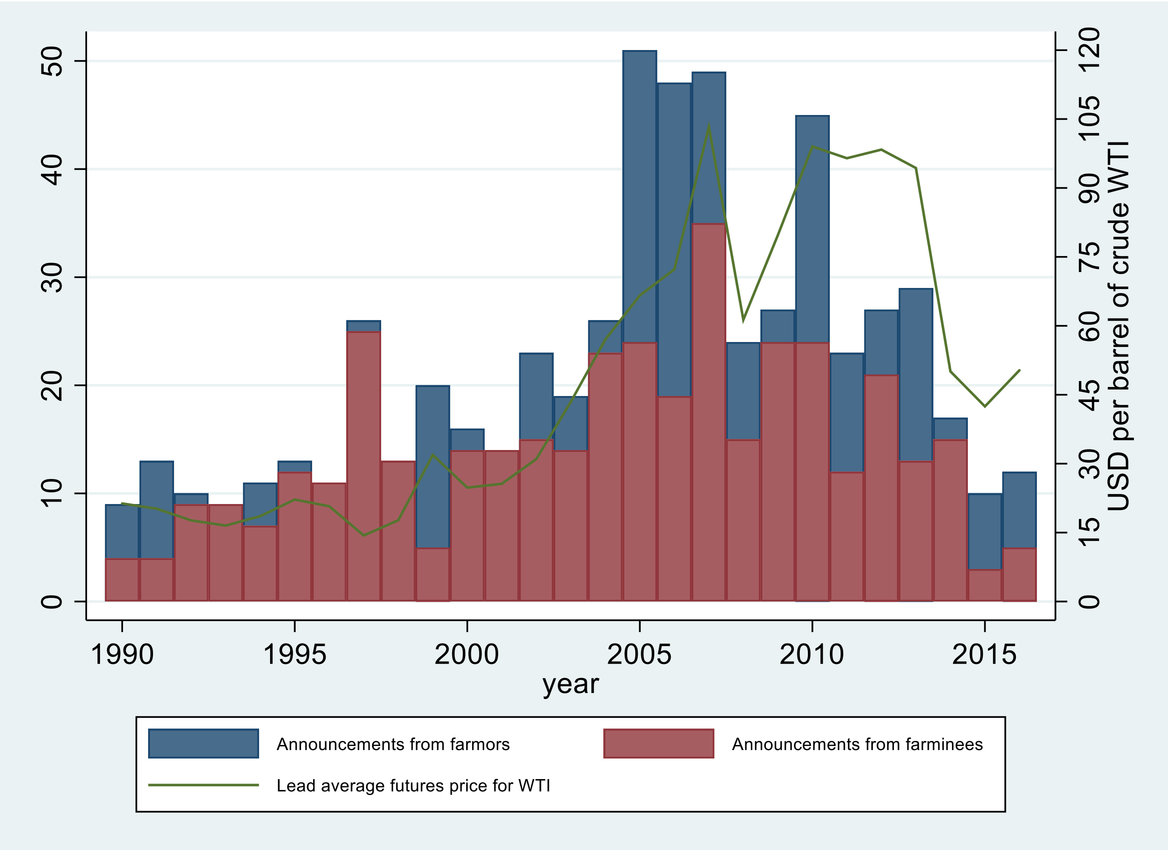

Table 3.3 – Panel A: Descriptive statistics for the continuous variables

This table reports the descriptive statistics of the continuous variables for announcements by farmors and farminees separately. *MCAP* and *FIRMAGE* are the announcing firm's market capitalisation in AUD million and age (year count from its listing date until the farmout announcement date). *TOP20* is the announcing firm's equity stake held by the twenty largest shareholders around one year prior to the farmout announcement date and is manually collected from Morningstar's Datanalysis Premium. *NFIRMS* is the number of participant firms per farmout announcement. *CRISK* proxies for the overall political risk related to the jurisdiction in which the farmout area is located for the year prior to the event date. This data is obtained from the PRS Group's International Country Risk Guide. *ACREAGE* is the farmout area surface measured in acres. *OILPVOL* is the WTI oil price volatility calculated based on the daily price change over the month of the farmout announcement. WTI oil price data is sourced from the U.S. Energy Information Administration (EIA). All variables are winsorised at 1% and 99% except *NFIRMS* and *OILPVOL*.

	Variable	N	Missing	Mean	Median	SD	Min	Max
Farmors	MCAP	587	2	469.134	23.710	3,263.303	0.001	46,590.850
	FIRMAGE	588	1	12.6	9.1	13.3	0.1	119.8
	TOP20	588	1	0.4959	0.4970	0.1904	0.1128	0.9255
	NFIRMS	589	0	2.3	2.0	0.6	2.0	5.0
	CRISK	570	19	0.8211	0.8870	0.1411	0.4025	0.9495
	ACREAGE	448	141	2,172,369	508,173	11,100,000	160	191,000,000
	OILPVOL	589	0	0.0205	0.0191	0.0089	0.0068	0.0771
Farminees	MCAP	386	3	2076.992	29.035	10,863.860	0.040	143,065.100
	FIRMAGE	388	1	17.7	11.8	18.1	0.0	126.8
	TOP20	384	5	0.5320	0.5142	0.1784	0.1204	0.9255
	NFIRMS	389	0	2.3	2.0	0.7	2.0	5.0
	CRISK	383	6	0.8160	0.8838	0.1451	0.4025	0.9495
	ACREAGE	311	78	1,361,201	431,199	3,806,171	320	49,400,000
	OILPVOL	389	0	0.0207	0.0194	0.0088	0.0067	0.0771

Table 3.3 – Panel B: Difference in means for the continuous variables

The t-statistics for the difference in means are calculated for the variables reported in Table 3.3 – Panel A, assuming unequal variance. *, ** and *** indicate significance at the 10%, 5% and 1% levels, respectively.

	Difference in means	
Variable	(1) – (2)	t-stat
MCAP	-1,607.86	-2.83***
LMCAP	-0.5463	-3.54***
FIRMAGE	-5.0732	-4.74***
LFIRMAGE	-0.2612	-3.07***
TOP20	-0.0362	-3.01***
NFIRMS	-0.0676	-1.56
CRISK	0.0052	0.55
ACREAGE	811,168.4	1.43
LACRES	0.2356	1.58
OILPVOL	-0.0002	-0.34

Table 3.3 – Panel C: Frequency of the indicator variables

This table reports the dummy variables used in the cross-sectional regressions. *FINCOM* is coded '1' for the announcement disclosure of financial commitment between the farmout parties. *FIRSTFARM* is coded '1' for oil and gas permits subject to a first farmout agreement over the sample period. *FOREIPART* is coded '1' for the disclosure of one or more foreign participants in the farmout agreement. *MAJORPART* is a subgroup of *FOREIPART* and is coded '1' for the disclosure of oil and gas majors. *OFFSHORE* is coded 1 for oil and gas permits in offshore areas (marine tracts). *OPERCHANG* is coded '1' for the disclosure of the permit operatorship status. *POTENRES* is coded '1' for the disclosure of potential resources targets in the permit area. *UNCONV* is coded '1' for the disclosure of farmouts targeting unconventional resources. *PROJLOC* is coded '1' for the disclosure of overseas permits (not located in Australia).

		FINCOM		FIRSTFARM		FOREIPART		MAJORPART		OFFSHORE		OPERCHANG		POTENRES		UNCONV		PROJLOC	
		Freq	%	Freq	%	Freq	%	Freq	%	Freq	%	Freq	%	Freq	%	Freq	%	Freq	%
Farmor	0	332	56%	267	45%	315	53%	559	95%	316	54%	209	35%	336	57%	519	88%	353	60%
	1	257	44%	322	55%	274	47%	30	5%	273	46%	132	22%	253	43%	70	12%	236	40%
	Missing	0	0%	0	0%	0	0%	0	0%	0	0%	248	42%	0	0%	0.0%	0%	0	0%
	Total	589	100%	589	100%	589	100%	589	100%	589	100%	589	100%	589	100%	589	100%	589	100%
Farminee	0	219	56%	124	32%	243	62%	376	97%	235	60%	140	36%	182	47%	336	86%	222	57%
	1	170	44%	265	68%	146	38%	13	3%	154	40%	78	20%	207	53%	53	14%	167	43%
	Missing	0	0%	0	0%	0	0%	0	0%	0	0%	171	44%	0	0%	0.0%	0%	0	0%
	Total	389	100%	389	100%	389	100%	389	100%	389	100%	389	100%	389	100%	389	100%	389	100%

Table 3.3 – Panel D: Location of farmout projects
This table reports the countries where farmout projects are located (*PROJLOC*).

Country	Unique farmout agreements			Announcements by farmors			Announcements by farminees		
	Freq.	Percent	Cum. Percent	Freq.	Percent	Cum. Percent	Freq.	Percent	Cum. Percent
Australia	397	55.0%	55.0%	353	59.9%	59.9%	222	57.1%	57.1%
USA	70	9.7%	64.7%	49	8.3%	68.3%	42	10.8%	67.9%
New Zealand	32	4.4%	69.1%	26	4.4%	72.7%	19	4.9%	72.8%
Papua New Guinea	27	3.7%	72.9%	20	3.4%	76.1%	15	3.9%	76.6%
Philippines	27	3.7%	76.6%	25	4.2%	80.3%	12	3.1%	79.7%
Indonesia	17	2.4%	78.9%	7	1.2%	81.5%	13	3.3%	83.0%
UK	15	2.1%	81.0%	13	2.2%	83.7%	3	0.8%	83.8%
Tunisia	13	1.8%	82.8%	10	1.7%	85.4%	5	1.3%	85.1%
Italy	9	1.2%	84.1%	7	1.2%	86.6%	4	1.0%	86.1%
Mauritania	7	1.0%	85.0%	7	1.2%	87.8%	1	0.3%	86.4%
Vietnam	7	1.0%	86.0%	6	1.0%	88.8%	1	0.3%	86.6%
China	6	0.8%	86.8%	5	0.8%	89.6%	6	1.5%	88.2%
Kenya	6	0.8%	87.7%	6	1.0%	90.7%	3	0.8%	88.9%
Somalia	6	0.8%	88.5%	4	0.7%	91.3%	2	0.5%	89.5%
Timor	6	0.8%	89.3%	7	1.2%	92.5%	1	0.3%	89.7%
Argentina	4	0.6%	89.9%	1	0.2%	92.7%	3	0.8%	90.5%
Canada	4	0.6%	90.4%	1	0.2%	92.9%	3	0.8%	91.3%
Tanzania	4	0.6%	91.0%	3	0.5%	93.4%	2	0.5%	91.8%
Turkey	4	0.6%	91.6%	3	0.5%	93.9%	3	0.8%	92.5%
Others	61	8.4%	100.0%	36	6.1%	100.0%	29	7.5%	100.0%
Total	722	100.0%	-	589	100.0%	-	389	100.0%	-

Table 3.3 – Panel E: Distribution of exploration permits per farmout project

This table reports the number of exploration permits for each farmout project in the sample.

No. of	Unique farmout agreements			Announcements by farmors			Announcements by farminees		
permits	Freq.	Percent	Cum. Percent	Freq.	Percent	Cum. Percent	Freq.	Percent	Cum. Percent
1	523	72.4%	72.4%	428	72.7%	72.7%	288	74.0%	74.0%
2	118	16.3%	88.8%	99	16.8%	89.5%	60	15.4%	89.5%
3	45	6.2%	95.0%	35	5.9%	95.4%	24	6.2%	95.6%
4	19	2.6%	97.6%	14	2.4%	97.8%	8	2.1%	97.7%
5	6	0.8%	98.5%	5	0.8%	98.6%	3	0.8%	98.5%
7 or more	11	1.5%	100.0%	8	1.4%	100.0%	6	1.5%	100.0%
Total	722	100%	-	589	100%	-	389	100%	-

Table 3.4 – Pearson correlation matrix: announcements released by farmors

This table presents Pearson correlation coefficients for the variables reported in Table 3 in relation to the sample of announcements released by farmors only. *LMCAP*, *LFIRMAGE* and *LACRES* are the natural logarithm of market capitalization, firm age and farmout surface area in acres, respectively. All other variables are as defined in Table 3. *, ** and *** indicate significance at the 10%, 5% and 1% levels, respectively

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
(1) LMCAP	1														
(2) LFIRMAGE	0.403***	1													
(3) TOP20	0.061	-0.190**	1												
(4) NFIRMS	-0.063	0.092	0.178**	1											
(5) LACRES	-0.023	-0.010	0.007	0.067	1										
(6) CRISK	-0.004	-0.102	-0.049	-0.109	-0.264***	1									
(7) OILPVOL	0.052	0.007	0.024	-0.028	-0.174**	-0.006	1								
(8) FINCOM	-0.058	-0.052	-0.016	-0.037	0.065	-0.195**	-0.089	1							
(9) FIRSTFARM	-0.010	-0.046	0.195**	0.136*	0.017	-0.002	-0.075	-0.106	1						
(10) FOREIPART	0.092	0.030	0.017	0.143*	0.013	-0.330***	-0.084	0.083	0.115	1					
(11) MAJORPART	0.103	0.038	0.093	0.047	0.198**	-0.110	-0.045	0.022	0.072	0.224***	1				
(12) OFFSHORE	0.077	0.156*	0.184**	0.194**	0.151*	-0.141*	-0.039	-0.066	0.059	0.218***	0.070	1			
(13) OPERCHANG	-0.108	-0.077	0.091	-0.126*	-0.013	0.018	0.010	0.032	0.039	0.068	0.048	-0.016	1		
(14) POTENRES	-0.066	-0.017	-0.034	-0.018	-0.041	-0.040	0.020	0.073	0.037	-0.108	-0.087	-0.002	-0.118	1	
(15) UNCONV	-0.034	-0.098	0.011	-0.139*	0.001	0.201**	0.013	0.189**	0.007	-0.147*	-0.036	-0.409***	0.121	-0.081	1
(16) PROJLOC	-0.024	0.118	0.066	0.142*	0.025	-0.690***	0.074	0.163**	0.168**	0.390***	0.082	0.177**	-0.055	0.062	-0.143*

Table 3.5 – Panel A: Market-adjusted mean abnormal returns

This table reports the average market-adjusted abnormal returns (*AAR*) for the farmout agreements announced by farmors and farminees over the 11-day event window centred on the announcement date (day 0). Count positive is the proportion of abnormal returns higher than 0. The *t*-statistics reported for the abnormal returns follow Kolari and Pynnonen (2010). *t*-statistics for the difference in means are calculated assuming unequal variance. *, ** and *** indicate significance at the 10%, 5% and 1% levels, respectively.

	Farmors (1)					Farminees (2)					Difference in means	
T	N	AAR	t-test	Count Positive AAR	% Positive AAR	N	AAR	t-test	Count Positive AAR	% Positive AAR	Diff. (1) – (2)	t-stat
-5	493	0.0012	0.68	238	48%	306	0.0033	0.29	154	50%	-0.0020	-0.57
-4	489	0.0026	0.93	237	48%	302	0.0010	0.12	142	47%	0.0015	0.28
-3	490	-0.0019	-0.26	224	46%	308	-0.0023	-1.09	133	43%	0.0004	0.11
-2	485	0.0048	1.25	247	51%	299	0.0017	0.26	145	48%	0.0031	0.81
-1	492	0.0063	1.93*	261	53%	302	0.0153	3.01***	162	54%	-0.0089	-1.75*
0	500	0.0251	5.37***	294	59%	311	0.0040	1.58*	167	54%	0.0211	3.75***
1	495	0.0041	0.96	243	49%	305	0.0005	0.11	141	46%	0.0036	0.87
2	488	- 0.0017	-0.25	232	48%	301	0.0021	1.11	159	53%	-0.0039	-0.98
3	489	-0.0046	-0.97	214	44%	298	-0.0001	-0.09	151	51%	-0.0046	-1.11
4	491	-0.0059	-1.49	211	43%	302	0.0028	1.22	169	56%	-0.0087	-2.17**
5	489	0.0034	0.97	245	50%	302	-0.0010	-0.40	142	47%	0.0045	1.20

Table 3.5 – Panel B: Descriptive statistics for the market-adjusted mean abnormal returns

This table reports descriptive statistics of market-adjusted abnormal returns for the farmout agreements announced by farmors and farminees over the 11-day event window centred on the announcement date (day 0).

	Farmors						Farminees					
T	N	Mean	Median	SD	Min	Max	N	Mean	Median	SD	Min	Max
-5	493	0.0012	-0.0007	0.0543	-0.3090	0.3147	306	0.0033	0.0002	0.0463	-0.2042	0.2379
-4	489	0.0026	-0.0009	0.0538	-0.2960	0.2304	302	0.0010	-0.0013	0.0862	-0.3980	1.1563
-3	490	-0.0019	-0.0014	0.0517	-0.2537	0.2719	308	-0.0023	-0.0020	0.0512	-0.1797	0.3947
-2	485	0.0048	0.0003	0.0505	-0.2084	0.2899	299	0.0017	-0.0005	0.0540	-0.5521	0.2239
-1	492	0.0063	0.0009	0.0575	-0.3980	0.3244	302	0.0152	0.0011	0.0763	-0.1706	0.7135
0	500	0.0251	0.0054	0.0840	-0.3336	0.4368	311	0.0040	0.0014	0.0742	-0.6936	0.3303
1	495	0.0041	-0.0005	0.0633	-0.2092	0.3553	305	0.0005	-0.0009	0.0516	-0.2365	0.2472
2	488	-0.0017	-0.0012	0.0567	-0.2258	0.3451	301	0.0021	0.0009	0.0525	-0.1995	0.2683
3	489	-0.0046	-0.0020	0.0565	-0.2405	0.4164	298	-0.0001	0.0009	0.0561	-0.3424	0.3525
4	491	-0.0059	-0.0023	0.0709	-0.9144	0.3193	302	0.0028	0.0015	0.0423	-0.1482	0.1712
5	489	0.0034	0.0001	0.0591	-0.1993	0.3903	302	-0.0010	-0.0008	0.0444	-0.2179	0.1935

Table 3.5 – Panel C: Plot of market-adjusted mean abnormal returns (AAR) for farmors and farminees

This figure depicts the mean abnormal return of farmors and farminees over a 21-day window centred on the farmout announcement date (day 0).

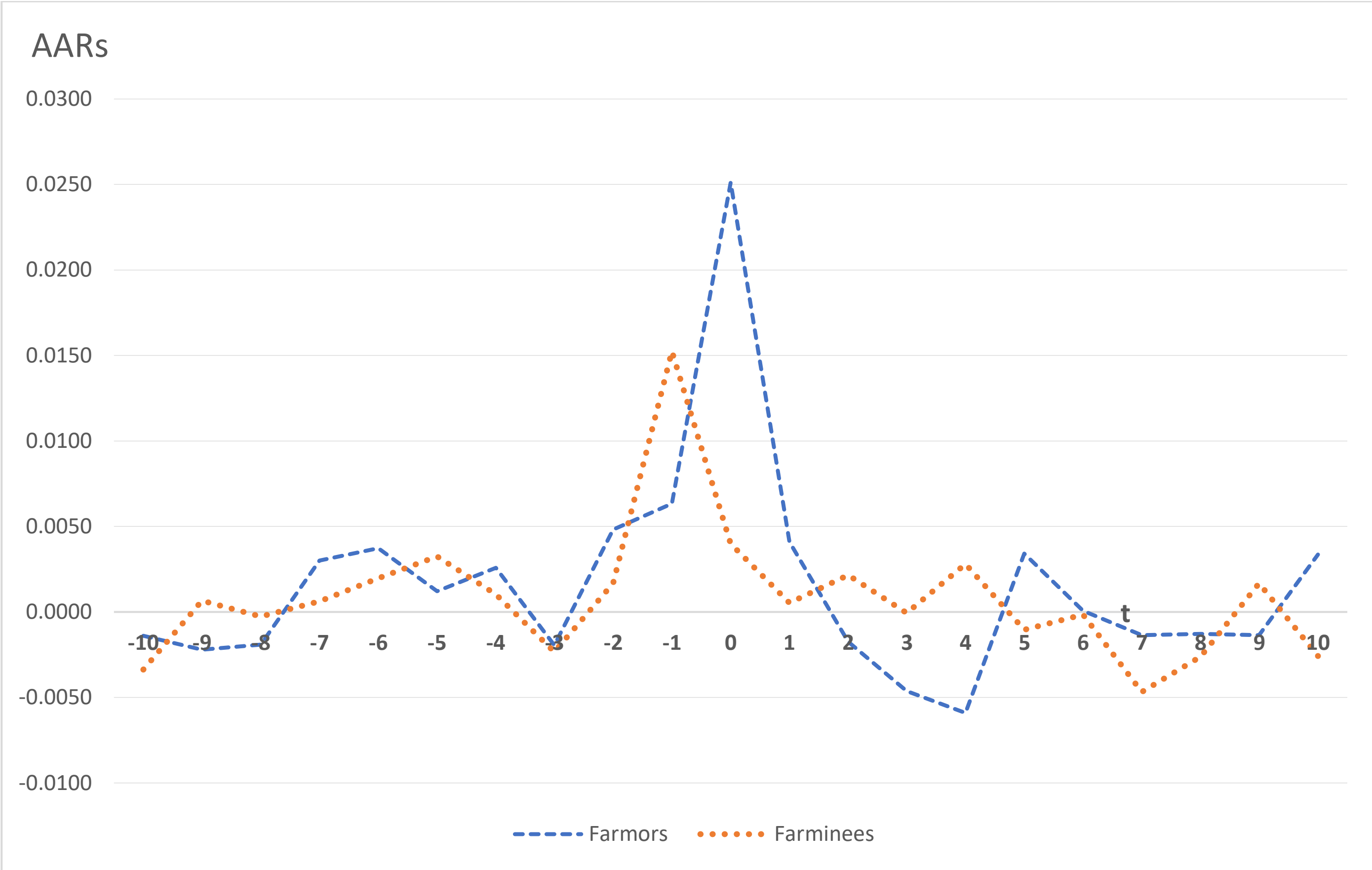

Table 3.6 – Panel A: Market-adjusted mean cumulative abnormal returns

This table reports the cumulative average of the market-adjusted abnormal returns (*CAAR*) for the farmout agreements announced by farmors and farminees based on three event windows centred on the announcement date (day 0). Count positive is the proportion of abnormal returns higher than 0. The *t*-statistics reported for the cumulative average abnormal returns follow Kolari and Pynnonen (2010). *t*-statistics for the difference in means are calculated assuming unequal variance. *, ** and *** indicate significance at the 10%, 5% and 1% levels, respectively.

	Farmors (1)					Farminees (2)					Difference in means	
Event window	No. of Firms	CAAR	t test	Count Positive CAAR	% Positive CAAR	No. of Firms	CAAR	t test	Count Positive CAAR	% Positive CAAR	Diff. (1)-(2)	t-stat
[0,1]	487	0.0291	5.15***	281	58%	296	0.0049	1.61	149	50%	0.0242	3.62***
[-1,0]	485	0.0318	5.51***	293	60%	299	0.0193	3.25***	173	58%	0.0125	1.92*
[-1,1]	480	0.0360	5.48***	292	61%	293	0.0190	3.13***	159	54%	0.0170	2.34**

Table 3.6 – Panel B: Descriptive statistics for the market-adjusted mean cumulative abnormal returns

This table presents the descriptive statistics for the cumulative average market-adjusted abnormal returns (*CAAR*) for the farmout agreements announced by farmors and farminees based on three event windows centred on the announcement date (day 0).

Event	Farmors						Farminees					
window	N	Mean	Median	SD	Min	Max	N	Mean	Median	SD	Min	Max
[0,1]	487	0.0291	0.0100	0.0996	-0.2517	0.5097	296	0.0049	0.0001	0.0845	-0.6797	0.3370
[-1,0]	485	0.0318	0.0101	0.0954	-0.2713	0.6218	299	0.0193	0.0060	0.0840	-0.2310	0.5530
[-1,1]	480	0.0360	0.0167	0.1075	-0.2349	0.5121	293	0.0190	0.0027	0.0925	-0.2212	0.5470

Table 3.6 – Panel C: Analysis of daily wealth effects

This table presents the wealth effects for the farmout agreements announced by farmors and farminees based on abnormal returns relative to the announcement date.

	Farmors (1)			Farminees (2)			Difference in means	
t	N	Mean dollar change in wealth ($M)	Median dollar change in wealth ($M)	N	Mean dollar change in wealth ($M)	Median dollar change in wealth ($M)	Diff. (1)-(2)	t-stat
-5	493	2.36	-0.01	305	23.05	0.00	-20.69	-0.99
-4	489	2.11	-0.01	301	0.78	-0.01	1.33	0.25
-3	490	-0.36	-0.02	307	5.08	-0.05	-5.43	-1.02
-2	485	-0.61	0.00	298	-1.80	0.00	1.18	0.31
-1	492	0.04	0.01	301	-11.91	0.02	11.94	0.62
0	500	1.46	0.18	310	-1.30	0.02	2.76	0.27
1	495	-0.51	-0.01	304	-14.64	-0.02	14.13	0.96
2	488	-4.44	-0.01	300	2.33	0.01	-6.76	-1.69*
3	489	-1.90	-0.04	297	-4.11	0.00	2.20	0.50
4	491	2.60	-0.04	301	1.19	0.02	1.41	0.41
5	489	1.89	0.00	301	-8.66	-0.01	10.55	2.19**

Table 3.6 – Panel D: Analysis of cumulative wealth effects

This table presents the wealth effects for the unique deals and farmout agreements announced by farmors and farminees based on the cumulative abnormal returns relative to the announcement date.

	Unique deals			Farmors (1)			Farminees (2)			Difference in means	
Event window	N	Mean dollar change in wealth ($M)	Median dollar change in wealth ($M)	N	Mean dollar change in wealth ($M)	Median dollar change in wealth ($M)	N	Mean dollar change in wealth ($M)	Median dollar change in wealth ($M)	Diff. (1)-(2)	t-stat
[0,1]	597	-6.27	0.09	487	0.95	0.21	295	-16.15	0.01	17.09	1.04
[-1,0]	606	-4.46	0.31	485	1.23	0.33	298	-13.76	0.15	14.99	0.76
[-1,1]	586	-12.72	0.26	480	0.68	0.31	292	-30.08	0.08	30.76	0.91

Table 3.7 – Panel A: Cross-sectional models for farmor announcements
This table presents the estimated coefficients from the regression of the three-day cumulative market-adjusted abnormal return *CAR*[–1, 1] for the farmout agreements released by farmors. Column (1) reports results for the base model (Equation 3) for testing the main hypotheses: pooling of resources is tested through *FINCOM*, certification is tested through *FOREIPART*, expertise and knowledge is tested through *UNCONV* and real options theory is tested through *OILPVOL*. The results for alternative proxies for these hypotheses are shown in Columns (2)−(6). See Table 3 for definitions of the variables used. All continuous variables are winsorised at 1% and 99%, except *NFIRMS* and *OILPVOL*. Standard errors are in parentheses. *, ** and *** indicate significance at the 10%, 5% and 1% levels, respectively.

	Dependent variable = *CAR*[–1, 1]					
VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)
FINCOM	0.028***			0.028***	0.030***	0.036***
	(0.01)			(0.01)	(0.01)	(0.01)
POTENRES		0.020**				
		(0.01)				
LACRES			0.007**			
			(0.00)			
FOREIPART	0.005	0.007	0.009		0.006	–0.005
	(0.01)	(0.01)	(0.01)		(0.01)	(0.01)
MAJORPART				0.004		
				(0.02)		
UNCONV	0.026*	0.034**	0.008	0.026*		
	(0.01)	(0.01)	(0.02)	(0.01)		
OFFSHORE					–0.009	
					(0.01)	
OPERCHANG						0.014
						(0.01)
OILPVOL	1.856***	1.782***	2.358***	1.863***	1.841***	0.742
	(0.53)	(0.53)	(0.59)	(0.53)	(0.53)	(0.66)
LMCAP	–0.006**	–0.007**	–0.010***	–0.006**	–0.006**	–0.008**
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
TOP20	–0.020	–0.016	0.011	–0.020	–0.016	–0.025
	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)
FIRSTFARM	–0.006	–0.008	–0.006	–0.006	–0.006	–0.001
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
CRISK	–0.004	–0.027	0.025	–0.009	0.001	0.011
	(0.04)	(0.04)	(0.04)	(0.04)	(0.04)	(0.04)
NFIRMS	–0.011	–0.013	–0.016	–0.011	–0.012	–0.008
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
LFIRMAGE	0.011**	0.010**	0.013**	0.011**	0.011**	0.011*
	(0.00)	(0.00)	(0.01)	(0.00)	(0.00)	(0.01)
CONSTANT	0.023	0.050	–0.080	0.027	0.024	0.027
	(0.05)	(0.04)	(0.07)	(0.04)	(0.05)	(0.06)
Observations	463	463	349	463	463	274
Adjusted *R*-sq.	0.059	0.052	0.061	0.059	0.054	0.041
F-statistic	3.91	3.55	3.26	3.89	3.62	2.18
Prob.>*F*-stat	0.000	0.000	0.000	0.000	0.000	0.020

Table 3.7 – Panel B: Cross-sectional models for farminee announcements
This table presents the estimated coefficients from the regression of the three-day cumulative market-adjusted abnormal return *CAR*[−1, 1] for the farmout agreements released by farminees. Column (1) reports results for the base model (Equation 3) for testing the main hypotheses: pooling of resources is tested through *FINCOM*, certification is tested through *FOREIPART*, expertise and knowledge is tested through *UNCONV* and real options theory is tested through *OILPVOL*. The results for alternative proxies for these hypotheses are shown in Columns (2)−(6). See Table 3 for definitions of the variables used. All continuous variables are winsorised at 1% and 99%, except *NFIRMS* and *OILPVOL*. Standard errors are in parentheses. *, ** and *** indicate significance at the 10%, 5% and 1% levels, respectively.

	Dependent variable = CAR[-1, 1]					
VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)
FINCOM	0.009			0.010	0.010	0.019
	(0.01)			(0.01)	(0.01)	(0.01)
POTENRES		0.010				
		(0.01)				
LACRES			0.005			
			(0.00)			
FOREIPART	0.006	0.006	0.003		0.005	0.002
	(0.01)	(0.01)	(0.01)		(0.01)	(0.01)
MAJORPART				0.016		
				(0.03)		
UNCONV	-0.003	-0.002	-0.008	-0.003		
	(0.01)	(0.01)	(0.02)	(0.01)		
OFFSHORE					0.014	
					(0.01)	
OPERCHANG						-0.014
						(0.01)
OILPVOL	-0.348	-0.380	0.138	-0.323	-0.282	0.597
	(0.56)	(0.56)	(0.62)	(0.56)	(0.56)	(0.62)
LMCAP	-0.004	-0.004	-0.005*	-0.004	-0.004	-0.003
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
TOP20	-0.015	-0.014	-0.009	-0.015	-0.018	0.025
	(0.03)	(0.03)	(0.04)	(0.03)	(0.03)	(0.04)
FIRSTFARM	-0.004	-0.003	-0.005	-0.003	-0.004	-0.013
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
CRISK	-0.035	-0.036	-0.052	-0.039	-0.029	0.036
	(0.04)	(0.04)	(0.05)	(0.04)	(0.04)	(0.04)
NFIRMS	-0.006	-0.007	-0.008	-0.005	-0.007	-0.003
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
LFIRMAGE	-0.004	-0.003	-0.001	-0.004	-0.005	-0.006
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
CONSTANT	0.100**	0.099**	0.051	0.101**	0.093*	0.001
	(0.05)	(0.05)	(0.07)	(0.05)	(0.05)	(0.05)
Observations	284	284	228	284	284	161
Adjusted R-sq.	-0.002	-0.002	0.005	-0.002	0.003	0.017
F-statistic	0.930	0.940	1.110	0.940	1.080	1.273
Prob.>F-stat	0.504	0.495	0.358	0.496	0.379	0.250

Table 3.7 – Panel C: Cross-sectional models for unique deals

This table presents the estimated coefficients from the regression of the dollar change over the three-day cumulative market-adjusted abnormal return *CAR*[−1, 1] for the unique dals combining farmors and farminees. Column (1) reports results for the base model (Equation 3) for testing the main hypotheses: pooling of resources is tested through *FINCOM*, certification is tested through *FOREIPART*, expertise and knowledge is tested through *UNCONV* and real options theory is tested through *OILPVOL*. The results for alternative proxies for these hypotheses are shown in Columns (2)−(6). See Table 3 for definitions of the variables used. All continuous variables are winsorised at 1% and 99%, except *NFIRMS* and *OILPVOL*. Standard errors are in parentheses. *, ** and *** indicate significance at the 10%, 5% and 1% levels, respectively.

	Dependent Variable = dollar change over the three-day cumulative market-adjusted abnormal return					
VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)
FINCOM	2.162			2.789	2.153	0.798
	(4.28)			(3.60)	(3.67)	(6.32)
POTENRES		-2.539				
		(3.31)				
LACRES			0.123			
			(0.78)			
FOREIPART	9.975**	10.085**	9.403*		11.067**	12.374*
	(4.45)	(4.52)	(5.23)		(4.65)	(7.22)
MAJORPART				18.955		
				(13.33)		
UNCONV	4.997	5.368	7.216	4.602		
	(5.86)	(5.42)	(6.54)	(5.31)		
OFFSHORE					-9.377**	
					(4.28)	
OPERCHANG						4.862
						(6.75)
OILPVOL	-33.317	-38.045	-58.609	-8.051	-54.735	-247.004
	(216.29)	(338.35)	(395.16)	(338.38)	(337.85)	(619.88)
LMCAP	2.815**	2.671	1.496	2.801	3.090	3.236
	(1.24)	(2.46)	(2.65)	(2.50)	(2.46)	(3.26)
TOP20	3.562	1.996	4.227	1.993	7.248	15.481
	(12.18)	(12.10)	(14.48)	(12.11)	(11.95)	(19.45)
FIRSTFARM	1.094	1.103	0.115	2.129	0.319	3.950
	(4.33)	(3.96)	(4.34)	(3.96)	(3.94)	(6.59)
CRISK	9.381	8.254	9.080	2.033	7.193	8.806
	(15.22)	(18.30)	(21.31)	(18.35)	(19.24)	(26.22)
NFIRMS	-3.999	-4.130	-5.077	-3.112	-3.419	-5.819
	(3.72)	(3.20)	(3.63)	(3.25)	(3.29)	(4.90)
LFIRMAGE	3.198	3.179**	3.728**	2.766*	3.652**	4.751*
	(2.05)	(1.62)	(1.83)	(1.61)	(1.68)	(2.45)
CONSTANT	-21.593	-16.943	-15.788	-12.984	-19.758	-27.218
	(19.36)	(21.56)	(30.98)	(23.54)	(24.17)	(34.51)
Observations	566	566	443	566	566	327
Adjusted R-sq.	0.021	0.022	0.008	0.019	0.028	0.021
F-statistic	2.240	1.590	1.290	1.030	1.700	1.324
Prob.>F-stat	0.015	0.105	0.231	0.420	0.078	0.216

Table 3.8 – Cross-sectional models for sensitivity analysis

This table presents the estimated coefficients from the regression of the three-day cumulative market-adjusted abnormal return *CAR*[–1, 1] for the farmout agreements released by farmors, controlling for confounding announcements. Column (1) reports results for the base model (Equation 3) based on a restricted sample after excluding 134 farmout agreements announced on days with other market sensitive announcement. Column (2) reports results for the base model based on a restricted sample after excluding 231 farmout agreements with contemporaneous market sensitive announcement released over a 3-day event window centred on the event date. Column (3) reports results for the base model with the inclusion of a control (*CONFOUN3DAY*) for the count of market sensitive announcements released by farmor over the three-day event window centred on the event date. See Appendix 8, Part B for definitions of the variables used. All continuous variables are also winsorised at 1% and 99% except *NFIRMS* and *OILPVOL*. Standard errors are reported in parentheses. *, ** and *** indicate significance at the 10%, 5% and 1% levels, respectively.

	Dependent variable = *CAR*[–1, 1]		
VARIABLES	(1)	(2)	(3)
FINCOM	0.034***	0.033**	0.028**
	(0.01)	(0.01)	(0.01)
FOREIPART	0.010	–0.004	0.007
	(0.01)	(0.02)	(0.01)
UNCONV	0.026	–0.002	0.023
	(0.02)	(0.02)	(0.02)
OILPVOL	3.260***	3.277***	2.624***
	(0.67)	(0.81)	(0.63)
LMCAP	–0.010**	–0.009*	–0.009**
	(0.00)	(0.00)	(0.00)
TOP20	0.038	0.047	0.018
	(0.04)	(0.04)	(0.04)
FIRSTFARM	–0.009	-0.013	–0.007
	(0.01)	(0.01)	(0.01)
CRISK	0.022	0.015	0.011
	(0.05)	(0.06)	(0.04)
NFIRMS	–0.010	–0.002	–0.010
	(0.01)	(0.01)	(0.01)
LFIRMAGE	0.019***	0.021***	0.016***
	(0.01)	(0.01)	(0.01)
CONFOUN3DAY			0.004
			(0.01)
CONSTANT	–0.064	–0.074	–0.030
	(0.06)	(0.07)	(0.06)
Observations	329	232	382
Adjusted *R*-sq.	0.133	0.126	0.094
F-statistic	4.87	3.18	3.48
Prob.>*F*-stat	0.000	0.001	0.000

Table 3.9 – Panel A: Cross-sectional models with robust standard errors for farmors
This table presents the estimated slope coefficients and t-statistics from the regression of the three-day cumulative market-adjusted abnormal return *CAR*[-1, 1] for the farmout agreements released by farmors. Column (1) presents the base model based on the hypotheses' main proxies: pooling of resources is tested through *FINCOM*, certification is tested through *FOREIPART*, expertise and knowledge is tested through *UNCONV,* and real options theory is tested through *OILPVOL*. The results of the secondary proxies for these hypotheses are shown in Columns (2) to (6). All continuous variables are winsorised at 1% and 99% except *NFIRMS* and *OILPVOL.* Robust standard errors clustered by firm and time are reported in parentheses. *, ** and *** indicate significance at the 10%, 5% and 1% levels, respectively.

	Dependent variable = *CAR*[−1, 1]					
VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)
FINCOM	0.028***			0.028***	0.030***	0.036***
	(0.01)			(0.01)	(0.01)	(0.01)
POTENRES		0.020**				
		(0.01)				
LACRES			0.007**			
			(0.00)			
FOREIPART	0.005	0.007	0.009		0.006	-0.005
	(0.01)	(0.01)	(0.01)		(0.01)	(0.01)
MAJORPART				0.004		
				(0.02)		
UNCONV	0.026	0.034*	0.008	0.026		
	(0.02)	(0.02)	(0.02)	(0.02)		
OFFSHORE					-0.009	
					(0.01)	
OPERCHANG						0.014
						(0.01)
OILPVOL	1.856**	1.782**	2.358***	1.863**	1.841**	0.742
	(0.77)	(0.77)	(0.82)	(0.77)	(0.76)	(1.10)
LMCAP	-0.006**	-0.007**	-0.010***	-0.006**	-0.006**	-0.008**
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
TOP20	-0.020	-0.016	0.011	-0.020	-0.016	-0.025
	(0.03)	(0.03)	(0.04)	(0.03)	(0.03)	(0.04)
FIRSTFARM	-0.006	-0.008	-0.006	-0.006	-0.006	-0.001
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
CRISK	-0.004	-0.027	0.025	-0.009	0.001	0.011
	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.04)
NFIRMS	-0.011	-0.013	-0.016	-0.011	-0.012	-0.008
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
LFIRMAGE	0.011**	0.010*	0.013*	0.011**	0.011**	0.011
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
CONSTANT	0.023	0.050	-0.080	0.027	0.024	0.027
	(0.04)	(0.04)	(0.06)	(0.04)	(0.04)	(0.05)
Observations	463	463	349	463	463	274
R-squared	0.080	0.073	0.088	0.079	0.074	0.076
F-statistic	2.93	2.79	2.27	2.94	2.99	2.33
Prob.>*F*-stat	0.001	0.002	0.014	0.001	0.001	0.012

Table 3.9 – Panel B: Cross-sectional models with robust standard errors for farminees
This table presents the estimated slope coefficients and t-statistics from the regression of the three-day cumulative market-adjusted abnormal return *CAR*[-1*,* 1] for the farminee agreements released by farmors. Column (1) presents the base model based on the hypotheses' main proxies: pooling of resources is tested through *FINCOM*, certification is tested through *FOREIPART*, expertise and knowledge is tested through *UNCONV,* and real options theory is tested through *OILPVOL*. The results of the secondary proxies for these hypotheses are shown in Columns (2) to (6). All continuous variables are winsorised at 1% and 99% except *NFIRMS* and *OILPVOL.* Robust standard errors clustered by firm and time are reported in parentheses. *, ** and *** indicate significance at the 10%, 5% and 1% levels, respectively.

	Dependent variable = *CAR*[–1, 1]					
VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)
FINCOM	0.009			0.010	0.010	0.019
	(0.01)			(0.01)	(0.01)	(0.01)
POTENRES		0.010				
		(0.01)				
LACRES			0.005*			
			(0.00)			
FOREIPART	0.006	0.006	0.003		0.005	0.002
	(0.01)	(0.01)	(0.01)		(0.01)	(0.01)
MAJORPART				0.016		
				(0.02)		
UNCONV	-0.003	-0.002	-0.008	-0.003		
	(0.02)	(0.02)	(0.02)	(0.02)		
OFFSHORE					0.014	
					(0.01)	
OPERCHANG						-0.014
						(0.01)
OILPVOL	-0.348	-0.380	0.138	-0.323	-0.282	0.597
	(0.56)	(0.56)	(0.58)	(0.56)	(0.55)	(0.63)
LMCAP	-0.004	-0.004	-0.005*	-0.004	-0.004	-0.003
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
TOP20	-0.015	-0.014	-0.009	-0.015	-0.018	0.025
	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)
FIRSTFARM	-0.004	-0.003	-0.005	-0.003	-0.004	-0.013
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
CRISK	-0.035	-0.036	-0.052	-0.039	-0.029	0.036
	(0.04)	(0.04)	(0.04)	(0.03)	(0.04)	(0.04)
NFIRMS	-0.006	-0.007	-0.008	-0.005	-0.007	-0.003
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
LFIRMAGE	-0.004	-0.003	-0.001	-0.004	-0.005	-0.006
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
CONSTANT	0.100**	0.099**	0.051	0.101**	0.093**	0.001
	(0.05)	(0.05)	(0.07)	(0.04)	(0.05)	(0.05)
Observations	284	284	228	284	284	161
R-squared	-0.002	-0.002	0.005	-0.002	0.003	0.017
F-statistic	1.190	1.310	1.680	1.080	1.420	1.190
Prob.>*F*-stat	0.296	0.226	0.086	0.376	0.169	0.302

Table 3.10 – Cross-sectional models with Datastream only data source for stock prices
This table presents the estimated slope coefficients and *t*-statistics from the regression of the three-day cumulative market-adjusted abnormal return *CAR*[-1, 1] for the farmout agreements released by farmors. The sample is restricted to the observations for which abnormal returns are computed on stock prices sourced only from Datastream. All continuous variables are also winsorised at 1% and 99% except *NFIRMS* and *OILPVOL*. Standard errors are reported in parentheses. *, ** and *** indicate significance at the 10%, 5% and 1% levels. Column (1) presents the primary model based on the hypotheses' main proxies: pooling of resources is tested through *FINCOM*, certification is tested through *FOREIPART*, expertise and knowledge is tested through *UNCONV,* and real options theory is tested through *OILPVOL*. The results of the secondary proxies for these hypotheses are shown in Columns (2) to (6).

	Dependent variable = *CAR*[–1, 1]					
VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)
FINCOM	0.027***			0.028***	0.030***	0.037***
	(0.01)			(0.01)	(0.01)	(0.01)
POTENRES		0.020*				
		(0.01)				
LACRES			0.007**			
			(0.00)			
FOREIPART	0.005	0.007	0.009		0.007	-0.007
	(0.01)	(0.01)	(0.01)		(0.01)	(0.01)
MAJORPART				0.012		
				(0.02)		
UNCONV	0.028*	0.036**	0.006	0.027*		
	(0.01)	(0.01)	(0.02)	(0.01)		
OFFSHORE					-0.010	
					(0.01)	
OPERCHANG						0.013
						(0.01)
OILPVOL	1.873***	1.799***	2.213***	1.895***	1.863***	0.835
	(0.56)	(0.57)	(0.61)	(0.56)	(0.57)	(0.70)
LMCAP	-0.008**	-0.008**	-0.012***	-0.008**	-0.008**	-0.010**
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
TOP20	-0.009	-0.006	0.032	-0.009	-0.003	-0.010
	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.04)
FIRSTFARM	-0.008	-0.010	-0.008	-0.008	-0.008	-0.000
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
CRISK	-0.004	-0.024	0.033	-0.007	0.001	0.008
	(0.04)	(0.04)	(0.04)	(0.04)	(0.04)	(0.04)
NFIRMS	-0.007	-0.008	-0.009	-0.006	-0.008	0.000
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
LFIRMAGE	0.011**	0.010*	0.013**	0.011**	0.011**	0.010
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
CONSTANT	0.014	0.040	-0.100	0.019	0.017	0.009
	(0.05)	(0.05)	(0.07)	(0.05)	(0.05)	(0.06)
Observations	432	432	328	432	432	261
R-squared	0.079	0.072	0.086	0.079	0.073	0.076
F-statistic	3.62	3.27	2.99	3.61	3.34	2.04
Prob.>*F*-stat	0.000	0.000	0.001	0.000	0.000	0.030

Figure 3.1 – List of major oil and gas companies

This figure lists oil and gas 'majors' is defined as follows: firstly, a ranking of the twenty largest energy companies based on total sales is obtained by using Factiva (ranking based on the total sales in 2016 from Factiva's peer comparison). Subsequently, the list of 20 companies is modified based on: (i) company's primary industry classification to capture companies operating mostly in the upstream sector (Crude Oil/Natural Gas Upstream Operations, SIC code 1311, or Oil and Gas Field Exploration Services, SIC code 1382), (ii) segment reporting showing the upstream segment's sales and (iii) the presence of at least one overseas project.

Rank	Major	Jurisdiction	Sales in the FY 2016 (USD billion)
1	Royal Dutch Shell Group	Netherlands	261.7
2	China Petroleum & Chemical Corp.	China	256.1
3	PetroChina Co. Ltd.	China	215.4
4	BP Plc	United Kingdom	205.0
5	Exxon Mobil Corp.	United States	197.5
6	Total SA	France	124.6
7	Chevron Corp.	United States	110.5
8	Gazprom PJSC	Russia	92.3
9	Petrobras Petróleo Brasileiro SA	Brazil	74.4
10	Eni SpA	Italy	60.0
11	JXTG Holdings	Japan	57.0
12	Statoil ASA	Norway	44.3
13	Repsol SA	Spain	37.3

Tables and Figures for Chapter 4

Table 4.1 – Sample selection

This table reports details on the sample selection process. Announcements on offtake agreements are first identified in Morningstar's Datanalysis Premium database for firms operating in the Materials or Energy sectors, and listed on ASX spanning the period 1990−2018. The first offtake deal is announced in 1995 delimiting the sample to 1995 through 2018. The sample is then augmented with additional keyword searches on Factiva for the same period.

Description		**Announcements**	**%**
Morningstar's Datanalysis Premium:		496	24.2%
Filtered by GICS Sector Materials	437		
Filtered by GICS Sector Energy	59		
Add: Factiva		1,523	74.4%
Add: Cross-references		27	1.3%
Equal: Total announcements		**2,046**	**100.0%**
Less: Exclusions		1,650	80.6%
Secondary announcements	1,636		0.0%
Announcements from buyers (offtakers)	14		0.0%
Equal: Final sample		**396**	**19.4%**
Announcements by ASX listed developers	312		15.2%
Announcements by ASX listed producers	84		4.1%
Excluding Duplicates		**7**	**0.3%**
(=) Unique offtake deals		**389**	**19.0%**

Table 4.2 – Offtake announcement frequency over time
This table reports the distribution of offtake agreements for the entire sample, and related announcements released by developers and producers across the sample period 1995−2018.

Year	Entire sample			Developers			Producers		
	Freq.	Percent	Cum. Percent	Freq.	Percent	Cum. Percent	Freq.	Percent	Cum. Percent
1995	1	0.3%	0.3%	0	0.0%	0.0%	1	1.2%	1.2%
1996	1	0.3%	0.5%	1	0.3%	0.3%	0	0.0%	1.2%
1997	3	0.8%	1.3%	1	0.3%	0.6%	2	2.4%	3.6%
1998	4	1.0%	2.3%	3	1.0%	1.6%	1	1.2%	4.8%
1999	1	0.3%	2.5%	0	0.0%	1.6%	1	1.2%	6.0%
2000	4	1.0%	3.5%	4	1.3%	2.9%	0	0.0%	6.0%
2001	7	1.8%	5.3%	4	1.3%	4.2%	3	3.6%	9.5%
2002	15	3.8%	9.1%	8	2.6%	6.7%	7	8.3%	17.9%
2003	4	1.0%	10.1%	4	1.3%	8.0%	0	0.0%	17.9%
2004	0	0.0%	10.1%	0	0.0%	8.0%	0	0.0%	17.9%
2005	3	0.8%	10.9%	3	1.0%	9.0%	0	0.0%	17.9%
2006	14	3.5%	14.4%	10	3.2%	12.2%	4	4.8%	22.6%
2007	18	4.5%	18.9%	9	2.9%	15.1%	9	10.7%	33.3%
2008	12	3.0%	22.0%	10	3.2%	18.3%	2	2.4%	35.7%
2009	21	5.3%	27.3%	13	4.2%	22.4%	8	9.5%	45.2%
2010	25	6.3%	33.6%	22	7.1%	29.5%	3	3.6%	48.8%
2011	23	5.8%	39.4%	16	5.1%	34.6%	7	8.3%	57.1%
2012	28	7.1%	46.5%	20	6.4%	41.0%	8	9.5%	66.7%
2013	24	6.1%	52.5%	19	6.1%	47.1%	5	6.0%	72.6%
2014	18	4.5%	57.1%	16	5.1%	52.2%	2	2.4%	75.0%
2015	33	8.3%	65.4%	29	9.3%	61.5%	4	4.8%	79.8%
2016	37	9.3%	74.7%	28	9.0%	70.5%	9	10.7%	90.5%
2017	54	13.6%	88.4%	49	15.7%	86.2%	5	6.0%	96.4%
2018	46	11.6%	100.0%	43	13.8%	100.0%	3	3.6%	100.0%
Total	396	100%	-	312	100%	-	84	100%	-

Table 4.3 – Panel A: Descriptive statistics for the continuous variables
This table reports descriptive statistics for the continuous variables of firms announcing offtake agreements and project-level variables for the entire sample and developers. Appendix 8, Part B lists the variables related to the offtake agreements.

	Variable	Unit	N	Missing	Mean	Median	SD	Min	Max
ENTIRE SAMPLE	*TOP20*	decimal	396	0	0.5878	0.5707	0.1700	0.2103	0.9347
	FIRMAGE	years	394	2	11.1	8.7	9.6	0.4	56.2
	MCAP	$ million	393	3	248.1	36.0	896.5	0.7	11,523.1
	SALESREV	$ million	396	0	68.1	0.0	525.0	0.0	9,599.0
	OPCF	$ million	396	0	11.5	-1.9	115.2	-129.1	1,516.5
	INVCF	$ million	396	0	-28.7	-3.4	139.3	-2,411.0	90.9
	FINCF	$ million	396	0	21.5	5.4	125.6	-947.9	1,954.0
	PAGE	integer	396	0	2.7	2.0	1.9	1.0	26.0
	CRISK	decimal	387	9	0.7909	0.8936	0.1595	0.2519	0.9340
	OFFTKVAL	$ million	49	347	649.1	114.1	1,077.6	0.5	4,000.0
	NCOMM	integer	396	0	1.15	1.00	0.53	1.00	5.00
	OFFTKTIME	years	231	165	6.4	5.0	5.4	0.1	30.0
	OFFTYRVO	'000 tonnes	226	170	997.4	100.0	4,337.9	0.0	50,000.0
	VOLCRBEXEN	decimal	396	0	0.0083	0.0065	0.0060	0.0025	0.0416
	VOLCRB	decimal	396	0	0.0070	0.0065	0.0028	0.0030	0.0203
DEVELOPERS	*TOP20*	decimal	312	0	0.5677	0.5432	0.1633	0.2103	0.9290
	FIRMAGE	years	312	0	10.1	8.1	8.5	0.4	47.7
	MCAP	$ million	311	1	106.4	27.3	252.2	0.7	2,943.6
	SALESREV	$ million	312	0	0.0	0.0	0.0	0.0	0.0
	OPCF	$ million	312	0	-4.3	-2.2	9.4	-117.8	30.1
	INVCF	$ million	312	0	-10.6	-2.2	36.9	-473.1	90.9
	FINCF	$ million	312	0	17.2	5.4	44.1	-49.8	558.5
	PAGE	integer	312	0	2.7	2.0	1.9	1.0	26.0
	CRISK	decimal	305	7	0.7832	0.8936	0.1616	0.2746	0.9340
	OFFTKVAL	$ million	41	271	513.2	92.0	953.5	0.5	4,000.0
	NCOMM	integer	312	0	1.14	1.00	0.51	1.00	5.00
	OFFTKTIME	years	174	138	6.6	5.0	5.4	0.1	30.0
	OFFTYRVO	'000 tonnes	187	125	965.9	100.0	4,531.5	0.1	50,000.0
	VOLCRBEXEN	decimal	312	0	0.0081	0.0063	0.0054	0.0026	0.0416
	VOLCRB	decimal	312	0	0.0070	0.0065	0.0029	0.0032	0.0203

Table 4.3 – Panel A – Descriptive statistics for the continuous variables (cont.)

This table reports descriptive statistics for the continuous variables of producers announcing offtake agreements and project-level variables. Appendix 8, Part B lists the variables related to the offtake agreements.

	Variable	Unit	N	Missing	Mean	Median	SD	Min	Max
PRODUCERS	*TOP20*	decimal	84	0	0.6624	0.6674	0.1745	0.2712	0.9347
	FIRMAGE	years	82	2	15.1	12.2	12.2	0.5	56.2
	MCAP	$ million	82	2	785.5	190.0	1,810.1	2.8	11,523.1
	SALESREV	$ million	84	0	321.2	58.1	1,108.8	0.0	9,599.0
	OPCF	$ million	84	0	70.3	3.8	241.6	-129.1	1,516.5
	INVCF	$ million	84	0	-95.8	-26.7	285.5	-2,411.0	54.0
	FINCF	$ million	84	0	37.4	4.3	259.7	-947.9	1,954.0
	PAGE	integer	84	0	2.5	2.0	1.7	1.0	7.0
	CRISK	decimal	82	2	0.8198	0.8936	0.1489	0.2519	0.9182
	OFFTKVAL	$ million	8	76	1,345.7	1,053.7	1,450.5	0.6	3,823.0
	NCOMM	integer	84	0	1.19	1.00	0.59	1.00	5.00
	OFFTKTIME	years	57	27	5.7	5.0	5.3	0.5	25.0
	OFFTYRVO	‘000 tonnes	39	45	1,148.5	60.0	3,298.2	0.0	20,000.0
	VOLCRB1	decimal	84	0	0.0092	0.0076	0.0080	0.0025	0.0416
	VOLCRB2	decimal	84	0	0.0068	0.0065	0.0024	0.0030	0.0157

Table 4.3 – Panel B: Difference in means for the continuous variables

This table reports the t-statistics for the difference in means between developers and producers calculated for the variables reported in Table 4.3 – Panel A, assuming unequal variance. *, ** and *** indicate significance at the 10%, 5% and 1% levels, respectively.

	Difference in means	
Variable	Developer − Producer	*t*-stat
TOP20	-0.0947	-4.47***
FIRMAGE	-5.1	-3.55***
MCAP	-679.1	-3.39***
OPCF	-74.6	-2.83***
INCF	85.2	2.73***
FINCF	-20.2	-0.71
PAGE	0.2	0.76
CRISK	-0.04	-1.94*
OFFTKVAL	-832.6	-1.56
NCOMMODIT	0.0	-0.70
OFFTKTIME	0.9	1.17
OFFTYRVOL	-182.7	-0.29
VOLCRBEXEN	-0.0011	-1.25
VOLCRB	0.0002	0.50

Table 4.3 – Panel C: Frequency of the indicator variables

This table reports the dummy variables used in the cross-sectional regressions. MINING is coded '1' for offtakes announced by ASX firms operating in the 'Materials" GICS industry. *FUNDING* is coded '1' for the announcement disclosure of the offtaker's funding commitment. *NON-HORIZ* is coded '1' when offtake parties do not share the same industry classification. *END_USER* is coded '1' if the offtaker's industry classification indicates the use offtake-committed-resources as an input in its manufacturing process. *INTERMEDIARY* is coded '1' if the offtaker operates as a middle-man. *TRADER* is coded '1' if the offtaker is a trading house. *BINDING* is coded '1' for offtake agreements indicating binding mutual commitments between the agreeing parties. *LIFEMINE* is coded '1' for the disclosure of the parties' commitment over the life of the resource project.

		MINING		*FUNDING*		*NON_HORIZ*		*END_USER*		*INTERMEDIARY*		*TRADER*		*BINDING*		*LIFEMINE*	
		Freq.	%	Freq.	%	Freq.	%	Freq.	%	Freq.	%	Freq.	%	Freq.	%	Freq.	%
Entire sample	0	51	12.9%	312	78.8%	160	40.4%	258	65.2%	274	69.2%	293	74.0%	338	85.4%	349	88.1%
	1	345	87.1%	84	21.2%	212	53.5%	114	28.8%	98	24.7%	79	19.9%	58	14.6%	47	11.9%
	Missing	0	0.0%	0	0.0%	24	6.1%	24	6.1%	24	6.1%	24	6.1%	0	0.0%	0	0.0%
	Total	396	100.0%	396	100.0%	396	100.0%	396	100.0%	396	100.0%	396	100.0%	396	100.0%	396	100.0%
Developers	0	35	11.2%	247	79.2%	112	35.9%	196	62.8%	211	67.6%	227	72.8%	265	84.9%	274	87.8%
	1	277	88.8%	65	20.8%	183	58.7%	99	31.7%	84	26.9%	68	21.8%	47	15.1%	38	12.2%
	Missing	0	0.0%	0	0.0%	17	5.4%	17	5.4%	17	5.4%	17	5.4%	0	0.0%	0	0.0%
	Total	312	100.0%	312	100.0%	312	100.0%	312	100.0%	312	100.0%	312	100.0%	312	100.0%	312	100.0%
Producers	0	16	19.0%	65	77.4%	48	57.1%	62	73.8%	63	75.0%	66	78.6%	73	86.9%	75	89.3%
	1	68	81.0%	19	22.6%	29	34.5%	15	17.9%	14	16.7%	11	13.1%	11	13.1%	9	10.7%
	Missing	0	0.0%	0	0.0%	7	8.3%	7	8.3%	7	8.3%	7	8.3%	0	0.0%	0	0.0%
	Total	84	100.0%	84	100.0%	84	100.0%	84	100.0%	84	100.0%	84	100.0%	84	100.0%	84	100.0%

Table 4.3 – Panel D: Difference in means for the indicator variables

This table reports the t-statistics for the difference in means are calculated for the variables reported in Table 4.3 – Panel C, assuming unequal variance. *, ** and *** indicate significance at the 10%, 5% and 1% levels, respectively.

Variable	Difference in means	
	Developer – Producer	*t*-stat
MINING	0.08	1.68*
FUNDING	-0.02	-0.35
NON_HORIZ	0.24	3.91***
END_USER	0.14	2.65***
INTERMEDIARY	0.10	2.00**
TRADER	0.09	1.86*
BINDING	0.02	0.47
LIFEMINE	0.01	0.38

Table 4.4 – Pearson correlation matrix for the entire sample

This table presents Pearson correlation coefficients for the variables reported in Table 3, Panels A and C in relation to the entire sample of offtake announcements *, ** and *** indicate significance at the 10%, 5% and 1% levels, respectively.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)
(1)TOP20	1																				
(2)FIRMAGE	0.225	1																			
(3)MCAP	0.128	0.0441	1																		
(4)SALESREV	0.455*	-0.089	0.0442	1																	
(5)OPCF	-0.0691	0.128	-0.0627	0.107	1																
(6)INVCF	-0.131	-0.173	-0.729***	-0.0756	0.12	1															
(7)FINCF	0.161	0.0575	0.760***	0.00726	-0.416*	-0.779***	1														
(8)PAGE	-0.21	-0.198	0.111	-0.119	0.00084	-0.0514	0.0415	1													
(9)CRISK	-0.0545	-0.251	0.256	0.163	-0.0623	-0.0634	0.219	-0.438*	1												
(10)OFFTKVAL	0.219	-0.0589	-0.126	0.347	-0.105	-0.015	-0.09	0.213	-0.103	1											
(11)NCOMM	-0.157	-0.173	-0.126	-0.0807	0.0568	0.0722	-0.115	-0.19	0.303	0.217	1										
(12)OFFTKTIME	-0.0223	0.158	0.0414	-0.0035	0.224	0.199	-0.196	0.267	-0.0428	0.584**	-0.0085	1									
(13)OFFTYRVO	0.0711	0.102	0.236	-0.0943	0.217	0.282	-0.107	-0.04	0.132	0.178	-0.107	0.741***	1								
(14)VCRBEXEN	0.0165	-0.0316	-0.118	-0.281	-0.102	0.0852	-0.166	-0.244	0.185	0.0118	-0.0058	0.0594	0.101	1							
(15)VCRB	0.168	-0.0608	0.117	-0.109	-0.468*	0.0596	0.502**	-0.233	0.339	-0.193	-0.0579	-0.14	0.103	0.2	1						
(16)MINING	-0.348	-0.0214	0.178	-0.0969	0.281	0.0112	0.077	0.193	0.165	-0.349	0.158	-0.21	-0.121	-0.17	0.05	1					
(17)FUNDING	0.0284	-0.0683	-0.232	0.0678	-0.255	0.0607	-0.125	0.236	-0.0033	0.532**	0.15	0.146	-0.0865	0.163	-0.172	-0.285	1				
(18)NON_HORIZ	-0.0051	-0.202	-0.295	0.0262	0.0348	0.122	-0.045	0.135	0.163	0.184	-0.0449	0.102	-0.15	-0.111	0.056	-0.0995	0.169	1			
(19)END_USER	0.0309	-0.199	-0.139	0.163	0.146	0.128	0.0251	0.0645	0.282	-0.198	-0.21	-0.127	-0.213	-0.0379	0.219	0.207	-0.0771	0.623***	1		
(20)INTERMEDIARY	-0.0408	-0.012	-0.189	-0.153	-0.124	-0.0017	-0.081	0.0857	-0.127	0.440*	0.184	0.263	0.0649	-0.0871	-0.181	-0.35	0.285	0.469*	-0.399*	1	
(21)TRADER	0.0807	-0.136	-0.0612	-0.0807	-0.216	0.0492	-0.066	0.251	-0.159	-0.0179	-0.0833	-0.0295	-0.0831	-0.19	-0.124	-0.184	0.15	0.247	-0.21	0.527**	1
(22)BINDING	-0.174	-0.123	0.114	0.0419	0.0447	-0.35	0.167	0.274	-0.149	0.0997	-0.192	-0.0075	-0.11	-0.001	-0.184	-0.0304	-0.0289	0.0649	0.0404	0.0304	-0.192

Table 4.5 – Panel A: Market-adjusted mean abnormal returns for developers and producers

This table reports the average market-adjusted abnormal returns (*AAR*) for the offtake agreements announced by all firms, and by developers and producers over the 11-day event window centred on the announcement date (day 0). Count positive is the proportion of abnormal returns higher than 0. The *t*-statistics reported for the abnormal returns follow Kolari & Pynnonen (2010). *t*-statistics for the difference in means are calculated assuming unequal variance. *, ** and *** indicate significance at the 10%, 5% and 1% levels, respectively.

	Entire Sample				Developers (1)				Producers (2)				Difference in means	
t	*N*	*AAR*	*t*-test	% Positive *AAR*	*N*	*AAR*	*t*-test	% Positive *AAR*	*N*	*AAR*	*t*-test	% Positive *AAR*	Diff. (2) – (1)	*t*-stat
-5	383	-0.0002	0.54	54%	302	-0.0022	-0.15	53%	81	0.0073	1.55	56%	0.0095	1.72*
-4	383	0.0019	0.67	50%	302	0.0011	0.27	49%	81	0.0048	1.31	56%	0.0038	0.63
-3	383	0.0066	1.79*	53%	302	0.0069	1.50	52%	81	0.0055	1.07	57%	-0.0014	-0.23
-2	383	0.0020	0.63	46%	302	0.0017	0.73	47%	81	0.0030	0.06	43%	0.0013	0.22
-1	383	0.0036	1.00	51%	302	0.0025	0.38	49%	81	0.0075	1.54	56%	0.0050	0.92
0	383	0.0578	8.87***	72%	302	0.0657	8.64***	73%	81	0.0283	3.00***	68%	-0.0373	-3.15***
1	383	-0.0041	-0.16	48%	302	-0.0051	-0.48	46%	81	-0.0001	0.68	54%	0.0051	0.68
2	383	-0.0030	-0.80	41%	302	-0.0011	-0.02	43%	81	-0.0099	-1.75*	35%	-0.0087	-1.37
3	383	-0.0007	-0.20	47%	302	0.0012	0.47	48%	81	-0.0076	-1.34	43%	-0.0088	-1.68*
4	383	-0.0040	-0.35	48%	302	-0.0051	-0.27	48%	81	0.0002	-0.29	48%	0.0053	0.91
5	383	-0.0026	-0.86	42%	302	-0.0022	-0.56	41%	81	-0.0038	-0.87	48%	-0.0016	-0.32

Table 4.5 – Panel B: Descriptive statistics for the market-adjusted mean abnormal returns for developers and producers
This table reports the descriptive statistics of market-adjusted mean abnormal returns for the offtake agreements announced by all firms, and by developers and producers over the 11-day event window centred on the announcement date (day 0).

	Entire sample						Developers						Producers					
t	N	Mean	Median	SD	Min	Max	N	Mean	Median	SD	Min	Max	N	Mean	Median	SD	Min	Max
-5	383	-0.0002	0.0014	0.0550	-0.6026	0.2486	302	-0.0022	0.0013	0.0583	-0.6026	0.2486	81	0.0073	0.0014	0.0399	-0.1176	0.1754
-4	383	0.0019	0.0001	0.0738	-0.3546	0.6941	302	0.0011	-0.0003	0.0813	-0.3546	0.6941	81	0.0048	0.0015	0.0332	-0.0896	0.0933
-3	383	0.0066	0.0010	0.0689	-0.4707	0.6955	302	0.0069	0.0007	0.0748	-0.4707	0.6955	81	0.0055	0.0026	0.0405	-0.1979	0.0949
-2	383	0.0020	-0.0007	0.0467	-0.2882	0.1849	302	0.0017	-0.0007	0.0463	-0.2882	0.1584	81	0.0030	-0.0018	0.0482	-0.1600	0.1849
-1	383	0.0036	0.0002	0.0533	-0.3174	0.4097	302	0.0025	-0.0006	0.0565	-0.3174	0.4097	81	0.0075	0.0047	0.0390	-0.1479	0.1589
0	383	0.0578	0.0310	0.1160	-0.7008	0.6936	302	0.0657	0.0392	0.1216	-0.7008	0.6936	81	0.0283	0.0140	0.0862	-0.3497	0.4730
1	383	-0.0041	-0.0011	0.0693	-0.4098	0.4152	302	-0.0051	-0.0016	0.0726	-0.4098	0.4152	81	-0.0001	0.0019	0.0556	-0.2724	0.1674
2	383	-0.0030	-0.0035	0.0730	-0.4042	0.6947	302	-0.0011	-0.0030	0.0794	-0.4042	0.6947	81	-0.0099	-0.0049	0.0404	-0.1766	0.1024
3	383	-0.0007	-0.0014	0.0511	-0.2796	0.2890	302	0.0012	-0.0013	0.0540	-0.2796	0.2890	81	-0.0076	-0.0059	0.0380	-0.1554	0.0716
4	383	-0.0040	-0.0008	0.0698	-0.6821	0.2217	302	-0.0051	-0.0008	0.0766	-0.6821	0.2217	81	0.0002	-0.0012	0.0341	-0.1060	0.1240
5	383	-0.0026	-0.0031	0.0554	-0.3338	0.4126	302	-0.0022	-0.0032	0.0601	-0.3338	0.4126	81	-0.0038	-0.0005	0.0326	-0.0979	0.0921

Table 4.5 – Panel C: Plot of market-adjusted mean abnormal returns (AAR) for developers and producers

This figure depicts the mean abnormal return of firms announcing offtakes over a 21-day window centred on the event date (day 0).

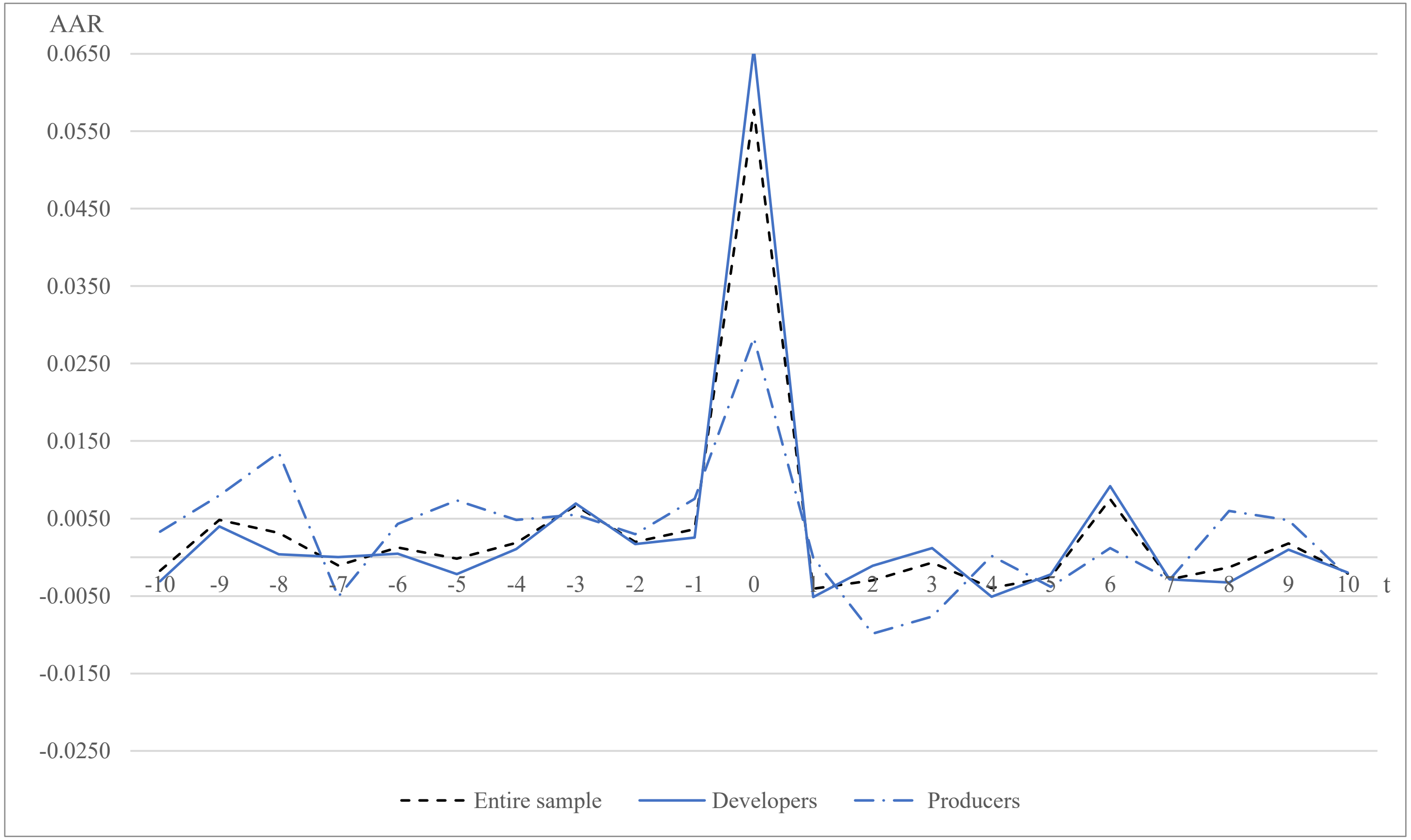

Table 4.5 – Panel D: Market-adjusted mean abnormal returns for Mining and Energy subsamples

This table reports the average market-adjusted abnormal returns (*AAR*) for the offtake agreements announced by all firms, and by the mining companies (Mining) and energy companies (Energy) over the 11-day event window centred on the announcement date (day 0). Count positive is the proportion of abnormal returns higher than 0. The *t*-statistics reported for the abnormal returns follow Kolari & Pynnonen (2010). *t*-statistics for the difference in means are calculated assuming unequal variance. *, ** and *** indicate significance at the 10%, 5% and 1% levels, respectively.

	Entire Sample				Mining (1)				Energy (2)				Difference in means	
t	*N*	*AAR*	*t*-test	% Positive *AAR*	*N*	*AAR*	*t*-test	% Positive *AAR*	*N*	*AAR*	*t*-test	% Positive *AAR*	Diff. (2) - (1)	*t*-stat
-5	383	-0.0002	0.54	54%	338	-0.0003	0.48	55%	45	0.0011	0.27	44%	0.0014	0.22
-4	383	0.0019	0.67	50%	338	0.0007	0.22	49%	45	0.0110	1.24	60%	0.0103	1.05
-3	383	0.0066	1.79*	53%	338	0.0067	1.61	53%	45	0.0061	0.78	49%	-0.0006	-0.08
-2	383	0.0020	0.63	46%	338	0.0013	0.53	46%	45	0.0067	0.39	51%	0.0054	0.85
-1	383	0.0036	1.00	51%	338	0.0044	1.04	50%	45	-0.0027	0.11	53%	-0.0071	-0.71
0	383	0.0578	8.87***	72%	338	0.0583	8.50***	73%	45	0.0537	2.41**	60%	-0.0047	-0.26
1	383	-0.0041	-0.16	48%	338	-0.0042	-0.66	47%	45	-0.0028	1.13	51%	0.0014	0.10
2	383	-0.0030	-0.80	41%	338	-0.0029	-0.61	41%	45	-0.0031	-0.62	38%	-0.0002	-0.01
3	383	-0.0007	-0.20	47%	338	-0.0005	-0.06	46%	45	-0.0017	-0.47	49%	-0.0011	-0.17
4	383	-0.0040	-0.35	48%	338	-0.0016	0.29	49%	45	-0.0220	-1.30	42%	-0.0204	-1.51
5	383	-0.0026	-0.86	42%	338	-0.0036	-1.05	41%	45	0.0053	0.37	56%	0.0089	1.16

Table 4.5 – Panel E: Descriptive statistics for the market-adjusted mean abnormal returns for Mining and Energy subsamples
This table reports the descriptive statistics of average market-adjusted abnormal returns for the offtake agreements announced by all firms, and by the mining companies (Mining) and energy companies (Energy) over the 11-day event window centred on the announcement date (day 0).

	Entire sample						Mining						Energy					
t	N	Mean	Median	SD	Min	Max	N	Mean	Median	SD	Min	Max	N	Mean	Median	SD	Min	Max
-5	383	-0.0002	0.0014	0.0550	-0.6026	0.2486	338	-0.0003	0.0015	0.0567	-0.6026	0.2486	45	0.0011	-0.0012	0.0399	-0.1244	0.1522
-4	383	0.0019	0.0001	0.0738	-0.3546	0.6941	338	0.0007	-0.0003	0.0755	-0.3546	0.6941	45	0.0110	0.0017	0.0595	-0.1206	0.3100
-3	383	0.0066	0.0010	0.0689	-0.4707	0.6955	338	0.0067	0.0010	0.0712	-0.4707	0.6955	45	0.0061	-0.0002	0.0491	-0.1618	0.1637
-2	383	0.0020	-0.0007	0.0467	-0.2882	0.1849	338	0.0013	-0.0008	0.0476	-0.2882	0.1849	45	0.0067	0.0000	0.0391	-0.0738	0.0995
-1	383	0.0036	0.0002	0.0533	-0.3174	0.4097	338	0.0044	0.0001	0.0515	-0.1642	0.4097	45	-0.0027	0.0010	0.0653	-0.3174	0.1589
0	383	0.0578	0.0310	0.1160	-0.7008	0.6936	338	0.0583	0.0349	0.1164	-0.7008	0.6936	45	0.0537	0.0155	0.1137	-0.1319	0.3960
1	383	-0.0041	-0.0011	0.0693	-0.4098	0.4152	338	-0.0042	-0.0013	0.0663	-0.2724	0.4152	45	-0.0028	0.0002	0.0898	-0.4098	0.1541
2	383	-0.0030	-0.0035	0.0730	-0.4042	0.6947	338	-0.0029	-0.0031	0.0709	-0.4042	0.6947	45	-0.0031	-0.0047	0.0881	-0.2465	0.3975
3	383	-0.0007	-0.0014	0.0511	-0.2796	0.2890	338	-0.0005	-0.0017	0.0522	-0.2796	0.2890	45	-0.0017	0.0000	0.0424	-0.1870	0.1315
4	383	-0.0040	-0.0008	0.0698	-0.6821	0.2217	338	-0.0016	-0.0006	0.0669	-0.6821	0.2217	45	-0.0220	-0.0021	0.0873	-0.4092	0.1109
5	383	-0.0026	-0.0031	0.0554	-0.3338	0.4126	338	-0.0036	-0.0034	0.0564	-0.3338	0.4126	45	0.0053	0.0024	0.0472	-0.0979	0.1629

Table 4.5 – Panel F: Plot of market-adjusted mean abnormal returns (AAR) for Mining and Energy subsamples

This figure depicts the mean abnormal return of firms announcing offtakes over a 21-day window centred on the event date (t_0).

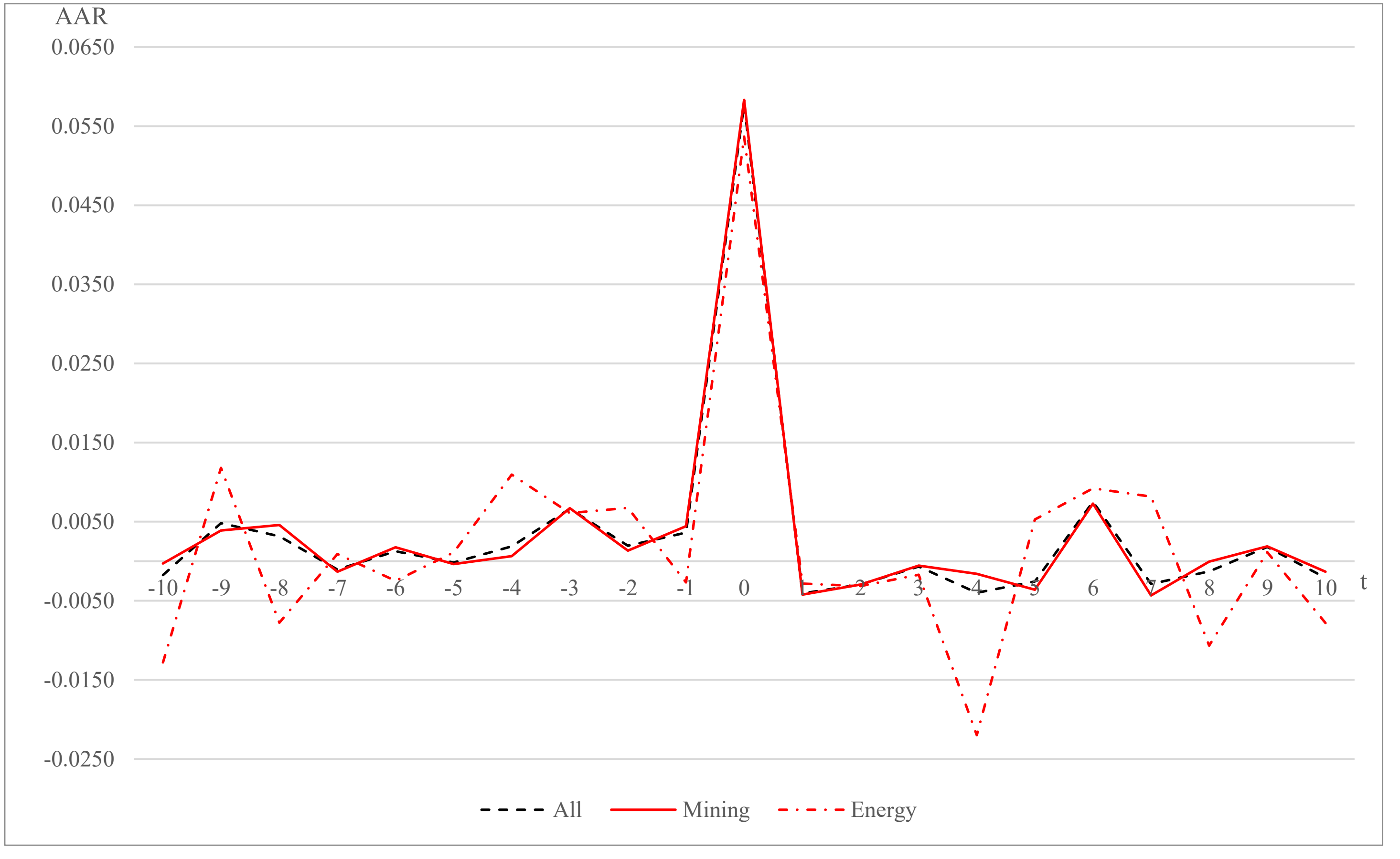

Table 4.6 – Panel A: Market-adjusted cumulative average abnormal returns for developers and producers

This table reports the cumulative average of market-adjusted abnormal returns (*CAAR*) for offtake agreements announced by all firms, developers and producers, based on three event windows centred on the announcement date (day 0). Count positive is the proportion of abnormal returns greater than zero. The *t*-statistics reported for the cumulative average abnormal returns follow Kolari & Pynnonen (2010). *t*-statistics for the difference in means are calculated assuming unequal variance. *, ** and *** indicate significance at the 10%, 5% and 1% levels, respectively.

	Entire sample				Developers (1)				Producers (2)				Difference in means	
Event window	*N*	*CAAR*	*t*-test	% Positive CAAR	*N*	*CAAR*	*t*-test	% Positive CAAR	*N*	*CAAR*	*t*-test	% Positive *CAAR*	Diff. (2)-(1)	*t*-stat
[0,1]	383	0.0537	8.33***	69%	302	0.0605	7.91***	71%	81	0.0283	3.20***	63%	-0.0323	-2.71***
[-1,0]	383	0.0614	7.86***	73%	302	0.0682	7.39***	74%	81	0.0359	3.17***	68%	-0.0323	-2.51**
[-1,1]	383	0.0573	7.53***	69%	302	0.0631	6.92***	69%	81	0.0358	3.35***	67%	-0.0273	-2.18**

Table 4.6 – Panel B: Descriptive statistics for the market-adjusted cumulative abnormal returns for developers and producers

This table presents descriptive statistics for the market-adjusted cumulative abnormal returns for offtake agreements announced by all firms, developers and producers, based on three event windows centred on the announcement date (day 0).

	Entire sample						Developers						Producers					
Event window	N	Mean	Median	SD	Min	Max	N	Mean	Median	SD	Min	Max	N	Mean	Median	SD	Min	Max
[0,1]	383	0.0537	0.0340	0.121	-0.7061	0.6811	302	0.0605	0.0374	0.1284	-0.7060	0.6811	81	0.0283	0.0249	0.0842	-0.3410	0.2709
[-1,0]	383	0.0614	0.0341	0.1244	-0.7152	0.6948	302	0.0682	0.0376	0.1306	-0.7152	0.6948	81	0.0359	0.0236	0.0941	-0.3576	0.4652
[-1,1]	383	0.0573	0.0365	0.1258	-0.7205	0.6697	302	0.0631	0.0399	0.1334	-0.7205	0.6697	81	0.0358	0.0228	0.0891	-0.3488	0.2773

Table 4.6 – Panel C: Market-adjusted cumulative average abnormal returns for mining and energy subsamples

This table reports the cumulative average of market-adjusted abnormal returns (*CAAR*) for offtake agreements announced by all firms, mining companies (mining) and energy companies (energy) based on three event windows centred on the announcement date (day 0). Count positive is the proportion of abnormal returns greater than zero. The *t*-statistics reported for the cumulative average abnormal returns follow Kolari & Pynnonen (2010). *t*-statistics for the difference in means are calculated assuming unequal variance. *, ** and *** indicate significance at the 10%, 5% and 1% levels, respectively.

	Entire sample				Mining (1)				Energy (2)				Difference in means	
Event window	*N*	*CAAR*	*t*-test	% Positive *CAAR*	*N*	*CAAR*	*t*-test	% Positive *CAAR*	*N*	*CAAR*	*t*-test	% Positive *CAAR*	Diff. (2) – (1)	*t*-stat
[0,1]	383	0.0537	8.33***	69%	338	0.0541	7.79***	69%	45	0.0509	2.74***	67%	-0.0032	-0.17
[-1,0]	383	0.0614	7.86***	73%	338	0.0628	7.42***	74%	45	0.0510	2.36**	64%	-0.0117	-0.65
[-1,1]	383	0.0573	7.53***	69%	338	0.0585	6.95***	69%	45	0.0482	2.70***	64%	-0.0103	-0.58

Table 4.6 – Panel D: Descriptive statistics for the market-adjusted cumulative abnormal returns for mining and energy subsamples

This table presents descriptive statistics for the market-adjusted cumulative abnormal returns for offtake agreements announced by all firms, mining companies (mining) and energy firms (energy), based on three event windows centred on the announcement date (day 0).

	Entire sample						Mining						Energy					
Event window	N	Mean	Median	SD	Min	Max	N	Mean	Median	SD	Min	Max	N	Mean	Median	SD	Min	Max
[0,1]	383	0.0537	0.0341	0.1210	-0.7061	0.6811	338	0.0541	0.0341	0.1212	-0.7061	0.6811	45	0.0509	0.0366	0.1207	-0.1957	0.4473
[-1,0]	383	0.0614	0.0341	0.1244	-0.7152	0.6948	338	0.0628	0.0360	0.1261	-0.7152	0.6948	45	0.0510	0.0183	0.1113	-0.1198	0.3956
[-1,1]	383	0.0573	0.0365	0.1258	-0.7205	0.6697	338	0.0585	0.0391	0.1278	-0.7205	0.6697	45	0.0482	0.0339	0.1101	-0.1748	0.4483

Table 4.7 – Cross-sectional models for the pooled sample

This table presents the estimated coefficients from the regression of the three-day cumulative market-adjusted abnormal return *CAR*[-1, 1] for the pooled sample of offtake agreements. Column (1) presents the base model based on the hypotheses' main proxies: pooling of resources is tested through *FUNDING*, certification is tested through *NON_HORIZ*, and real options theory is tested through *VCRBEXEN*. Columns (2) and (3) present the base model including an indicator variable for early-stage companies (*DEVELOPER*) and mining firms (*MINING*), respectively. The results of the secondary proxies for these hypotheses are shown in Columns (4) to (6). All continuous variables are also winsorised at 1% and 99% except *VCRBEXEN* and *VCRB*. Standard errors are reported in parentheses. *, ** and *** indicate significance at the 10%, 5% and 1% levels, respectively.

	Dependent variable = *CAR*[−1, 1]					
VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)
FUNDING	0.027*	0.028**	0.027*	0.031**	0.029**	0.030**
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
NON_HORIZ	-0.005	-0.006	-0.004			-0.006
	(0.01)	(0.01)	(0.01)			(0.01)
END_USER				0.012	0.011	
				(0.01)	(0.01)	
INTERMEDIARY				-0.024*		
				(0.01)		
TRADER					-0.035**	
					(0.01)	
VCRBEXEN	5.341**	5.257**	5.461**	5.434**	5.233**	
	(2.20)	(2.21)	(2.22)	(2.19)	(2.18)	
VCRB						1.547
						(0.96)
BINDING	0.071***	0.071***	0.071***	0.071***	0.069***	0.068***
	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)
LMCAP	-0.013***	-0.012***	-0.013***	-0.012***	-0.012***	-0.011***
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
TOP20	0.024	0.025	0.026	0.025	0.026	0.016
	(0.04)	(0.04)	(0.04)	(0.04)	(0.04)	(0.04)
CRISK	-0.025	-0.024	-0.029	-0.018	-0.018	-0.030
	(0.04)	(0.04)	(0.04)	(0.04)	(0.04)	(0.04)
LFIRMAGE	0.004	0.004	0.005	0.005	0.004	-0.000
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
LPAGE	0.004	0.004	0.004	0.004	0.005	0.004
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
DEVELOPER		0.007				
		(0.02)				
MINING			0.009			
			(0.02)			
CONSTANT	0.048	0.039	0.040	0.038	0.040	0.084*
	(0.05)	(0.05)	(0.05)	(0.05)	(0.05)	(0.04)
Observations	356	356	356	356	356	356
Adjusted *R*-sq.	0.072	0.070	0.070	0.085	0.092	0.063
F-statistic	4.06	3.67	3.68	4.28	4.59	3.66
Prob.>*F*-stat	0.000	0.000	0.000	0.000	0.000	0.000

Table 4.8 – Cross-sectional models for developers and producers

This table presents the estimated coefficients from the regression of the three-day cumulative market-adjusted abnormal return *CAR*[-1, 1] for developers and producers. Columns (1) and (5) present the base model based on the hypotheses' main proxies: pooling of resources is tested through *FUNDING*, certification is tested through *NON_HORIZ*, and real options theory is tested through *VCRBEXEN*. The results of the secondary proxies for these hypotheses are shown in Columns (2) to (4) for the developers and in Columns (6) to (8) for the producers. All continuous variables are also winsorised at 1% and 99% except *VCRBEXEN* and *VCRB*. Standard errors are reported in parentheses. *, ** and *** indicate significance at the 10%, 5% and 1% levels, respectively.

	Developers				Producers			
VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
FUNDING	0.033**	0.036**	0.033**	0.037**	0.029	0.038	0.036	0.028
	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)
NON_HORIZ	-0.008			-0.010	0.013			0.013
	(0.01)			(0.01)	(0.02)			(0.02)
END_USER		0.007	0.003			0.039	0.043*	
		(0.02)	(0.02)			(0.02)	(0.02)	
INTERMEDIARY		-0.024				-0.018		
		(0.02)				(0.02)		
TRADER			-0.040**				-0.008	
			(0.02)				(0.03)	
VCRBEXEN	6.418**	6.399**	6.095**		-3.155	-1.729	-1.750	
	(2.58)	(2.57)	(2.56)		(4.22)	(4.19)	(4.21)	
VCRB				2.527*				-0.890
				(1.30)				(1.14)
BINDING	0.073***	0.073***	0.071***	0.070***	0.097***	0.092***	0.095***	0.100***
	(0.02)	(0.02)	(0.02)	(0.02)	(0.03)	(0.03)	(0.03)	(0.03)
LMCAP	-0.014***	-0.013***	-0.013**	-0.012**	-0.000	-0.001	-0.001	-0.002
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
TOP20	0.046	0.048	0.049	0.039	-0.121*	-0.115*	-0.116*	-0.115*
	(0.04)	(0.04)	(0.04)	(0.04)	(0.07)	(0.06)	(0.06)	(0.06)
CRISK	-0.032	-0.024	-0.024	-0.036	-0.024	-0.031	-0.019	-0.017
	(0.04)	(0.04)	(0.04)	(0.04)	(0.07)	(0.07)	(0.07)	(0.07)
LFIRMAGE	0.003	0.003	0.003	-0.001	0.014	0.014	0.015	0.018
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
LPAGE	0.007	0.007	0.008	0.004	-0.005	-0.009	-0.009	-0.009
	(0.01)	(0.01)	(0.01)	(0.01)	(0.02)	(0.02)	(0.02)	(0.02)
CONSTANT	0.038	0.028	0.033	0.074	0.107	0.104	0.089	0.086
	(0.05)	(0.05)	(0.05)	(0.05)	(0.09)	(0.09)	(0.08)	(0.08)
Observations	281	281	281	281	75	75	75	75
Adjusted *R*-sq.	0.063	0.070	0.081	0.055	0.106	0.146	0.140	0.106
F-statistic	3.15	3.11	3.45	2.81	1.97	2.26	2.20	1.98
Prob.>*F*-stat	0.001	0.001	0.000	0.004	0.057	0.024	0.029	0.056

Table 4.9 – Cross-sectional models for mining firms

This table presents the estimated coefficients from the regression of the three-day cumulative market-adjusted abnormal return *CAR*[-1, 1] for a subsample comprised of mining firms. Column (1) presents the base model based on the hypotheses' main proxies: pooling of resources is tested through *FUNDING*, certification is tested through *NON_HORIZ*, and real options theory is tested through *VCRBEXEN*. The results of the secondary proxies for these hypotheses are shown in Columns (2) to (4). All continuous variables are also winsorised at 1% and 99% except *VCRBEXEN* and *VCRB*. Standard errors are reported in parentheses. *, ** and *** indicate significance at the 10%, 5% and 1% levels, respectively.

VARIABLES	Mining firms			
	(1)	(2)	(3)	(4)
FUNDING	0.025*	0.029*	0.026*	0.027*
	(0.01)	(0.01)	(0.01)	(0.01)
NON_HORIZ	-0.012			-0.013
	(0.01)			(0.01)
END_USER		0.007	0.005	
		(0.02)	(0.02)	
INTERMEDIARY		-0.030*		
		(0.02)		
TRADER			-0.042***	
			(0.02)	
VCRBEXEN	4.004*	4.369*	4.181*	
	(2.39)	(2.38)	(2.37)	
VCRB				1.003
				(1.00)
BINDING	0.067***	0.066***	0.065***	0.064***
	(0.02)	(0.02)	(0.02)	(0.02)
LMCAP	-0.017***	-0.016***	-0.016***	-0.015***
	(0.00)	(0.00)	(0.00)	(0.00)
TOP20	0.031	0.035	0.037	0.025
	(0.04)	(0.04)	(0.04)	(0.04)
CRISK	-0.042	-0.032	-0.034	-0.044
	(0.04)	(0.04)	(0.04)	(0.04)
LFIRMAGE	0.007	0.007	0.007	0.003
	(0.01)	(0.01)	(0.01)	(0.01)
LPAGE	0.002	0.002	0.004	0.002
	(0.01)	(0.01)	(0.01)	(0.01)
CONSTANT	0.083*	0.066	0.069	0.111**
	(0.05)	(0.05)	(0.05)	(0.05)
Observations	311	311	311	311
Adjusted R-sq.	0.078	0.089	0.100	0.072
F-statistic	3.90	4.04	4.43	3.68
Prob.>F-stat	0.000	0.000	0.000	0.000

Table 4.10 – Panel A: Cross-sectional models with robust standard errors for the pooled sample

This table presents the estimated coefficients from the regression of the three-day cumulative market-adjusted abnormal return *CAR*[-1, 1] for the pooled sample of offtake agreements. Column (1) presents the base model based on the hypotheses' main proxies: pooling of resources is tested through *FUNDING*, certification is tested through *NON_HORIZ*, and real options theory is tested through *VCRBEXEN*. Columns (2) and (3) present the base model including an indicator variable for developers and mining firms (*MINING*), respectively. The results of the secondary proxies for these hypotheses are shown in Columns (4) to (6). All continuous variables are also winsorised at 1% and 99% except *VCRBEXEN* and *VCRB*. Robust standard errors clustered by firm and time are reported in parentheses. *, ** and *** indicate significance at the 10%, 5% and 1% levels, respectively.

VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)
FUNDING	0.027*	0.028*	0.027*	0.031**	0.029*	0.030*
	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)
NON_HORIZ	-0.005	-0.006	-0.004			-0.006
	(0.01)	(0.01)	(0.01)			(0.01)
END_USER				0.012	0.011	
				(0.01)	(0.01)	
INTERMEDIARY				-0.024*		
				(0.01)		
TRADER					-0.035**	
					(0.01)	
VCRBEXEN	5.341**	5.257**	5.461**	5.434**	5.233**	
	(2.49)	(2.49)	(2.49)	(2.45)	(2.45)	
VCRB						1.547*
						(0.80)
BINDING	0.071***	0.071***	0.071***	0.071***	0.069***	0.068***
	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)
LMCAP	-0.013***	-0.012***	-0.013***	-0.012***	-0.012***	-0.011***
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
TOP20	0.024	0.025	0.026	0.025	0.026	0.016
	(0.04)	(0.04)	(0.04)	(0.04)	(0.04)	(0.04)
CRISK	-0.025	-0.024	-0.029	-0.018	-0.018	-0.030
	(0.04)	(0.04)	(0.04)	(0.04)	(0.04)	(0.04)
LFIRMAGE	0.004	0.004	0.005	0.005	0.004	-0.000
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
LPAGE	0.004	0.004	0.004	0.004	0.005	0.004
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
DEVELOPER		0.007				
		(0.01)				
MINING			0.009			
			(0.02)			
CONSTANT	0.048	0.039	0.040	0.038	0.040	0.084*
	(0.05)	(0.05)	(0.05)	(0.05)	(0.05)	(0.04)
Observations	356	356	356	356	356	356
R-sq.	0.096	0.096	0.096	0.110	0.117	0.087
F-statistic	3.16	2.85	2.82	4.16	4.57	3.03
Prob.>*F*-stat	0.001	0.002	0.002	0.000	0.000	0.002

Table 4.10 – Panel B: Cross-sectional models with robust standard errors for developers and explorers subsamples

This table presents the estimated coefficients from the regression of the three-day cumulative market-adjusted abnormal return *CAR*[-1, 1] for the developers and explorers subsamples. Columns (1) and (5) present the base model based on the hypotheses' main proxies: pooling of resources is tested through *FUNDING*, certification is tested through *NON_HORIZ*, and real options theory is tested through *VCRBEXEN*. The results of the secondary proxies for these hypotheses are shown in Columns (2) to (4) for developers and in Columns (6) to (8) for producers. All continuous variables are winsorised at 1% and 99% except *VCRBEXEN* and *VCRB*. Robust standard errors clustered by firm and time are reported in parentheses. *, ** and *** indicate significance at the 10%, 5% and 1% levels, respectively

VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
FUNDING	0.033*	0.036*	0.033*	0.037*	0.029	0.038	0.036	0.028
	(0.02)	(0.02)	(0.02)	(0.02)	(0.03)	(0.03)	(0.03)	(0.03)
NON_HORIZ	-0.008			-0.010	0.013			0.013
	(0.01)			(0.01)	(0.02)			(0.02)
END_USER		0.007	0.003			0.039	0.043*	
		(0.02)	(0.02)			(0.03)	(0.03)	
INTERMEDIARY		-0.024				-0.018		
		(0.02)				(0.02)		
TRADER			-0.040**				-0.008	
			(0.02)				0.03	
VCRBEXEN	6.418**	6.399**	6.095**		-3.155	-1.729	-1.750	
	(2.84)	(2.80)	(2.80)		(4.24)	(4.73)	(4.71)	
VCRB				2.527**				-0.890
				(1.15)				(0.75)
BINDING	0.073***	0.073***	0.071***	0.070***	0.097**	0.092**	0.095**	0.100**
	(0.02)	(0.02)	(0.02)	(0.02)	(0.04)	(0.04)	(0.04)	(0.04)
LMCAP	-0.014***	-0.013**	-0.013**	-0.012**	-0.000	-0.001	-0.001	-0.002
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
TOP20	0.046	0.048	0.049	0.039	-0.121	-0.115	-0.116	-0.115
	(0.05)	(0.05)	(0.05)	(0.05)	(0.08)	(0.08)	(0.08)	(0.08)
CRISK	-0.032	-0.024	-0.024	-0.036	-0.024	-0.031	-0.019	-0.017
	(0.04)	(0.04)	(0.04)	(0.04)	(0.07)	(0.07)	(0.65)	(0.07)
LFIRMAGE	0.003	0.003	0.003	-0.001	0.014	0.014	0.015	0.018
	(0.01)	(0.01)	(0.01)	(0.01)	(0.02)	(0.02)	(0.02)	(0.02)
LPAGE	0.007	0.007	0.008	0.004	-0.005	-0.009	-0.009	-0.009
	(0.01)	(0.01)	(0.01)	(0.01)	(0.02)	(0.02)	(0.02)	(0.02)
CONSTANT	0.038	0.028	0.033	0.074	0.107	0.104	0.089	0.086
	(0.05)	(0.06)	(0.06)	(0.05)	(0.11)	(0.10)	(0.10)	(0.10)
Observations	281	281	281	281	75	75	75	75
R-sq.	0.095	0.106	0.113	0.085	0.214	0.261	0.256	0.215
F-statistic	2.41	3.03	3.61	2.33	2.27	2.82	2.79	2.37
Prob.>*F*-stat	0.010	0.001	0.000	0.015	0.028	0.006	0.006	0.022

Table 4.10 – Panel C: Cross-sectional models with robust standard errors for mining firms

This table presents the estimated coefficients from the regression of the three-day cumulative market-adjusted abnormal return *CAR*[-1, 1] for the subsample comprised of mining firms.. Column (1) presents the base model based on the hypotheses' main proxies: pooling of resources is tested through *FUNDING*, certification is tested through *NON_HORIZ*, and real options theory is tested through *VCRBEXEN*. The results of the secondary proxies for these hypotheses are shown in Columns (2) to (4). All continuous variables are also winsorised at 1% and 99% except *VCRBEXEN* and *VCRB*. Robust standard errors clustered by firm and time are reported in parentheses. *, ** and *** indicate significance at the 10%, 5% and 1% levels, respectively.

VARIABLES	Mining firms			
	(1)	(2)	(3)	(4)
FUNDING	0.025*	0.029*	0.026	0.027
	(0.01)	(0.02)	(0.02)	(0.02)
NON_HORIZ	-0.012			-0.013
	(0.01)			(0.01)
END_USER		0.007	0.005	
		(0.02)	(0.02)	
INTERMEDIARY		-0.030**		
		(0.01)		
TRADER			-0.042***	
			(0.01)	
VCRBEXEN	4.004*	4.369*	4.181*	
	(2.39)	(2.41)	(2.40)	
VCRB				1.003
				(0.70)
BINDING	0.067***	0.066***	0.065***	0.064***
	(0.02)	(0.02)	(0.02)	(0.02)
LMCAP	-0.017***	-0.016***	-0.016***	-0.015***
	(0.00)	(0.00)	(0.00)	(0.00)
TOP20	0.031	0.035	0.037	0.025
	(0.04)	(0.04)	(0.04)	(0.04)
CRISK	-0.042	-0.032	-0.034	-0.044
	(0.04)	(0.04)	(0.04)	(0.04)
LFIRMAGE	0.007	0.007	0.007	0.003
	(0.01)	(0.01)	(0.01)	(0.01)
LPAGE	0.002	0.002	0.004	0.002
	(0.01)	(0.01)	(0.01)	(0.01)
CONSTANT	0.083*	0.066	0.069	0.111**
	(0.05)	(0.05)	(0.05)	(0.05)
Observations	311	311	311	311
R-sq.	0.104	0.119	0.129	0.099
F-statistic	3.90	4.00	4.51	3.02
Prob.>*F*-stat	0.000	0.000	0.000	0.002

Table 4.11 – Panel A: Cross-sectional models for sensitivity analysis of noise resulting from the announcement of other market-sensitive documents on the event date

This table presents the estimated coefficient from the regression of the three-day cumulative market-adjusted abnormal return *CAR*[-1, 1] for the base model and the alternative regression with the certification hypothesis tested through *TRADER*. To control for noise, the sample is restricted to offtake observations for which no other market-sensitive document is announced on the event date. Columns (1) and (2) report results for the pooled sample of offtake agreements. Columns (3) and (4) report results for the developers subsample. Columns (5) and (6) report results for the mining firms. All continuous variables are winsorised at 1% and 99% except *VCRBEXEN*. Standard errors clustered by firm and time are reported in parentheses. *, ** and *** indicate significance at the 10%, 5% and 1% levels, respectively.

VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)
FUNDING	0.028*	0.030*	0.032*	0.034*	0.026	0.025
	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)
NON_HORIZ	-0.005		-0.011		-0.013	
	(0.01)		(0.02)		(0.01)	
END_USER		0.015		0.010		0.008
		(0.01)		(0.02)		(0.02)
TRADER		-0.035**		-0.042**		-0.044***
		(0.02)		(0.02)		(0.02)
VCRBEXEN	6.388***	6.543***	7.733***	7.672***	5.412**	5.930**
	(2.43)	(2.41)	(2.88)	(2.85)	(2.67)	(2.65)
BINDING	0.076***	0.075***	0.079***	0.077***	0.070***	0.070***
	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)
LMCAP	-0.012***	-0.011***	-0.011**	-0.010*	-0.015***	-0.014***
	(0.00)	(0.00)	(0.01)	(0.01)	(0.00)	(0.00)
TOP20	0.031	0.032	0.049	0.054	0.043	0.050
	(0.04)	(0.04)	(0.05)	(0.05)	(0.04)	(0.04)
CRISK	-0.028	-0.018	-0.036	-0.026	-0.064	-0.057
	(0.04)	(0.04)	(0.05)	(0.05)	(0.04)	(0.04)
LFIRMAGE	-0.001	-0.000	0.000	0.001	0.003	0.004
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
LPAGE	0.001	0.001	-0.001	-0.001	0.000	0.002
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
CONSTANT	0.049	0.036	0.038	0.023	0.092*	0.075
	(0.05)	(0.05)	(0.06)	(0.06)	(0.05)	(0.05)
Observations	303	303	242	242	264	264
Adjusted *R*-sq.	0.079	0.102	0.064	0.088	0.081	0.107
F-statistic	3.88	4.43	2.83	3.33	3.57	4.15
Prob.>*F*-stat	0.000	0.000	0.002	0.000	0.000	0.000

Table 4.11 – Panel B: Cross-sectional models for sensitivity analysis of noise resulting from the announcement of other market-sensitive documents over a three-day window centred on the event date

This table presents the estimated coefficients from the regression of the three-day cumulative market-adjusted abnormal return *CAR*[-1, 1] for the base model and the alternative regression with the certification hypothesis tested through *TRADER*. To control for noise, the sample is restricted to offtake observations for which no other market-sensitive document is announced over the three-day window centred on the event date. Columns (1) and (2) report results for the pooled sample of offtake agreements. Columns (3) and (4) report results for the developers subsample. Columns (5) and (6) report results for mining firms. All continuous variables are winsorised at 1% and 99% except *VCRBEXEN*. Standard errors clustered by firm and time are reported in parentheses. *, ** and *** indicate significance at the 10%, 5% and 1% levels, respectively.

VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)
FUNDING	0.022	0.024	0.025	0.027	0.017	0.017
	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)
NON_HORIZ	-0.012		-0.018		-0.023	
	(0.01)		(0.02)		(0.01)	
END_USER		0.016		0.011		0.003
		(0.02)		(0.02)		(0.02)
TRADER		-0.031*		-0.037*		-0.041**
		(0.02)		(0.02)		(0.02)
VCRBEXEN	5.644**	6.344**	7.353**	7.931**	3.526	4.545
	(2.84)	(2.82)	(3.37)	(3.34)	(2.99)	(3.00)
BINDING	0.065***	0.065***	0.068***	0.067***	0.056***	0.057***
	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)
LMCAP	-0.012**	-0.011**	-0.011*	-0.010	-0.015***	-0.014***
	(0.00)	(0.00)	(0.01)	(0.01)	(0.00)	(0.00)
TOP20	0.041	0.042	0.063	0.065	0.041	0.048
	(0.04)	(0.04)	(0.05)	(0.05)	(0.05)	(0.05)
CRISK	-0.024	-0.017	-0.036	-0.030	-0.060	-0.058
	(0.05)	(0.04)	(0.05)	(0.05)	(0.05)	(0.05)
LFIRMAGE	0.000	0.002	0.001	0.002	0.001	0.002
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
LPAGE	-0.003	-0.003	-0.006	-0.008	-0.004	-0.003
	(0.01)	(0.01)	(0.02)	(0.02)	(0.01)	(0.01)
CONSTANT	0.047	0.028	0.039	0.019	0.111*	0.090
	(0.06)	(0.05)	(0.07)	(0.06)	(0.06)	(0.06)
Observations	248	248	195	195	220	220
Adjusted *R*-sq.	0.054	0.072	0.046	0.063	0.057	0.071
F-statistic	2.56	2.92	2.05	2.31	2.46	2.67
Prob.>*F*-stat	0.008	0.002	0.036	0.014	0.011	0.004

Table 4.12 – Panel A: Cross-sectional models for the pooled sample excluding offtakes with duration of two years or less

This table presents the estimated coefficients from the regression of the three-day cumulative market-adjusted abnormal return *CAR*[-1, 1] for the pooled sample of offtake agreements excluding offtakes with duration of two years or less. Column (1) presents the base model based on the hypotheses' main proxies: pooling of resources is tested through *FUNDING*, certification is tested through *NON_HORIZ*, and real options theory is tested through *VCRBEXEN*. Columns (2) and (3) present the base model including an indicator variable for developers (*DEVELOPER*) and mining firms (*MINING*), respectively. The results of the secondary proxies for these hypotheses are shown in Columns (4) to (6). All continuous variables are winsorised at 1% and 99% except *VCRBEXEN* and *VCRB*. Standard errors are reported in parentheses. *, ** and *** indicate significance at the 10%, 5% and 1% levels, respectively.

VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)
FUNDING	0.026*	0.026*	0.026*	0.030**	0.028*	0.028*
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
NON_HORIZ	-0.007	-0.007	-0.007			-0.007
	(0.01)	(0.01)	(0.01)			(0.01)
END_USER				0.014	0.011	
				(0.02)	(0.01)	
INTERMEDIARY				-0.029*		
				(0.02)		
TRADER					-0.042***	
					(0.02)	
VCRBEXEN	4.817**	4.818**	4.799**	4.876**	4.558**	
	(2.33)	(2.34)	(2.35)	(2.31)	(2.30)	
VCRB						1.658
						(1.15)
BINDING	0.068***	0.068***	0.068***	0.067***	0.065***	0.065***
	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)
LMCAP	-0.016***	-0.016***	-0.016***	-0.015***	-0.015***	-0.014***
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
TOP20	0.037	0.037	0.037	0.039	0.040	0.033
	(0.04)	(0.04)	(0.04)	(0.04)	(0.04)	(0.04)
CRISK	-0.043	-0.043	-0.042	-0.035	-0.035	-0.046
	(0.04)	(0.04)	(0.04)	(0.04)	(0.04)	(0.04)
LFIRMAGE	0.005	0.005	0.005	0.005	0.005	0.001
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
LPAGE	0.002	0.002	0.002	0.002	0.003	0.002
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
DEVELOPER		-0.000				
		(0.02)				
MINING			-0.002			
			(0.02)			
CONSTANT	0.073	0.073	0.074	0.061	0.066	0.100**
	(0.05)	(0.05)	(0.05)	(0.05)	(0.05)	(0.05)
Observations	318	318	318	318	318	318
Adjusted *R*-sq.	0.071	0.068	0.068	0.088	0.098	0.064
F-statistic	3.68	3.30	3.30	4.05	4.46	3.41
Prob.>*F*-stat	0.000	0.000	0.000	0.000	0.000	0.001

Table 4.12 – Panel B: Cross-sectional models for developers and producers excluding offtakes with duration of two years or less

This table presents the estimated coefficients from the regression of the three-day cumulative market-adjusted abnormal return *CAR*[-1, 1] for developers and producers excluding offtakes with duration of two years or less. Columns (1) and (5) present the base model based on the hypotheses' main proxies: pooling of resources is tested through *FUNDING*, certification is tested through *NON_HORIZ*, and real options theory is tested through *VCRBEXEN*. The results of the secondary proxies for these hypotheses are shown in Columns (2) to (4) for the developers and in Columns (6) to (8) for the producers. All continuous variables are winsorised at 1% and 99% except *VCRBEXEN* and *VCRB*. Standard errors are reported in parentheses. *, ** and *** indicate significance at the 10%, 5% and 1% levels, respectively.

VARIABLES	Developers				Producers			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
FUNDING	0.033*	0.037**	0.034*	0.036**	0.013	0.021	0.021	0.012
	(0.02)	(0.02)	(0.02)	(0.02)	(0.03)	(0.03)	(0.03)	(0.03)
NON_HORIZ	-0.008			-0.009	0.006			0.004
	(0.02)			(0.02)	(0.02)			(0.02)
END_USER		0.009	0.004			0.035	0.040	
		(0.02)	(0.02)			(0.03)	(0.03)	
INTERMEDIARY		-0.027				-0.029		
		(0.02)				(0.03)		
TRADER			-0.045**				-0.016	
			(0.02)				(0.03)	
VCRBEXEN	6.022**	5.951**	5.495**		-3.854	-2.137	-2.298	
	(2.69)	(2.68)	(2.67)		(4.73)	(4.66)	(4.69)	
VCRB				2.477*				-1.760
				(1.44)				(1.62)
BINDING	0.071***	0.070***	0.068***	0.068***	0.078**	0.072**	0.077**	0.081**
	(0.02)	(0.02)	(0.02)	(0.02)	(0.03)	(0.03)	(0.03)	(0.03)
LMCAP	-0.017***	-0.016***	-0.016***	-0.014***	-0.008	-0.008	-0.008	-0.008
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
TOP20	0.058	0.060	0.060	0.051	-0.090	-0.084	-0.087	-0.100
	(0.05)	(0.05)	(0.05)	(0.05)	(0.08)	(0.07)	(0.07)	(0.08)
CRISK	-0.051	-0.042	-0.042	-0.053	-0.047	-0.053	-0.041	-0.043
	(0.05)	(0.05)	(0.05)	(0.05)	(0.08)	(0.08)	(0.07)	(0.08)
LFIRMAGE	0.003	0.003	0.003	-0.001	0.018	0.017	0.018	0.021
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
LPAGE	0.006	0.006	0.006	0.002	-0.006	-0.011	-0.010	-0.013
	(0.01)	(0.01)	(0.01)	(0.01)	(0.02)	(0.02)	(0.02)	(0.02)
CONSTANT	0.062	0.050	0.058	0.092*	0.156	0.154	0.136	0.148
	(0.06)	(0.06)	(0.06)	(0.05)	(0.10)	(0.10)	(0.10)	(0.10)
Observations	258	258	258	258	60	60	60	60
Adjusted R-sq.	0.063	0.073	0.087	0.055	0.110	0.165	0.151	0.119
F-statistic	2.92	3.03	3.46	2.68	1.81	2.16	2.05	1.88
Prob.>F-stat	0.003	0.001	0.000	0.006	0.090	0.037	0.048	0.077

Table 4.12 – Panel C: Cross-sectional models for mining firms excluding offtakes with duration of two years or less

This table presents the estimated coefficients from the regression of the three-day cumulative market-adjusted abnormal return *CAR*[-1, 1] for a subsample comprised of mining firms excluding offtakes with duration of two years or less. Column (1) presents the base model based on the hypotheses' main proxies: pooling of resources is tested through *FUNDING*, certification is tested through *NON_HORIZ*, and real options theory is tested through *VCRBEXEN*. The results of the secondary proxies for these hypotheses are shown in Columns (2) to (4). All continuous variables are winsorised at 1% and 99% except *VCRBEXEN* and *VCRB*. Standard errors are reported in parentheses. *, ** and *** indicate significance at the 10%, 5% and 1% levels, respectively.

VARIABLES	Mining firms			
	(1)	(2)	(3)	(4)
FUNDING	0.027*	0.030*	0.028*	0.029*
	(0.02)	(0.02)	(0.02)	(0.02)
NON_HORIZ	-0.016			-0.018
	(0.01)			(0.01)
END_USER		0.003	-0.000	
		(0.02)	(0.02)	
INTERMEDIARY		-0.034**		
		(0.02)		
TRADER			-0.049***	
			(0.02)	
VCRBEXEN	3.868	4.217*	3.899	
	(2.54)	(2.53)	(2.52)	
VCRB				0.982
				(1.22)
BINDING	0.064***	0.063***	0.061***	0.061***
	(0.02)	(0.02)	(0.02)	(0.02)
LMCAP	-0.019***	-0.018***	-0.018***	-0.017***
	(0.00)	(0.00)	(0.00)	(0.00)
TOP20	0.030	0.034	0.035	0.025
	(0.04)	(0.04)	(0.04)	(0.04)
CRISK	-0.059	-0.048	-0.049	-0.059
	(0.04)	(0.04)	(0.04)	(0.04)
LFIRMAGE	0.008	0.009	0.009	0.005
	(0.01)	(0.01)	(0.01)	(0.01)
LPAGE	-0.000	0.001	0.002	-0.001
	(0.01)	(0.01)	(0.01)	(0.01)
CONSTANT	0.108**	0.090*	0.095*	0.133***
	(0.05)	(0.05)	(0.05)	(0.05)
Observations	283	283	283	283
Adjusted *R*-sq.	0.076	0.088	0.102	0.071
F-statistic	3.59	3.71	4.19	3.38
Prob.>*F*-stat	0.000	0.000	0.000	0.001

Tables and Figures for Chapter 5

Figure 1 – Matrix of proxies used to test the study's hypotheses

This figure presents the sign and statistical significance of proxies' coefficients grouped into hypotheses according to the primary model for farmouts and offtakes.

Hypothesis	Alliance type	Proxy	Coefficient	Evidence
Resource-pooling	Farmout	Financial commitment (*FINCOM*)	Positive and significant at $p<0.01$	✓
		Potential resources (*POTENRES*)	Positive and significant at $p<0.05$	✓
		Log of acreage (*LACRES*)	Positive and significant at $p<0.05$	✓
	Offtake	Funding (*FUNDING*)	Positive and significant at $p<0.05$	✓
Certification	Farmout	Foreign counterparty (*FOREIPART*)	Positive and insignificant	✗
		Major counterparty (*MAJORPART*)	Positive and insignificant	✗
	Offtake	Non-horizontal (*NON_HORIZ*)	Positive and insignificant	✗
		End-user (*END_USER*)	Positive and insignificant	✗
		Intermediary (*INTERMEDIARY*)	Negative and significant at $p<0.10$	✓
		Trader (*TRADER*)	Negative and significant at $p<0.05$	✓
Expertise	Farmout	Unconventional resources (*UNCONV*)	Positive and mixed significance	✓
		Offshore permit (*OFFSHORE*)	Negative and insignificant	✗
		Operatorship change (*OPERCHANG*)	Positive and insignificant	✗
Real options	Farmout	Oil price volatility (*OILPVOL*)	Positive and significant at $p<0.01$	✓
	Offtake	Mineral commodities price volatility (*VCRBEXEN*)	Positive and significant at $p<0.05$	✓
		Mineral and energy commodities price volatility (*VCRB*)	Positive and insignificant	✗

Appendices

Appendix 1 – Example 1: ASX farmout announcement by Beach Energy Limited

BEACH ENERGY

ASX Release

Beach Energy Ltd
ABN: 20 007 617 969
ASX Code: BPT

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info@beachenergy.com.au

For Immediate Release – 25 February 2013
Ref. #007/13

ASX Ltd/SGX Singapore Exchange Ltd
Companies Announcement Office
Electronic Lodgement System

Dear Sir,

BEACH FARM-OUT OF EXPLORATION ACREAGE IN NAPPAMERRI TROUGH TO CHEVRON

Beach will transfer up to 60% of its interests in PEL 218 (Beach 100%) and ATP 855 (Beach 60%) to Chevron. It is envisaged that Beach will potentially receive US$349 million over two stages for both permits over several years.

Beach Energy Limited (ASX: BPT, "Beach") and Beach group subsidiaries, have signed documents with Chevron Australia Exploration 1 Pty Ltd and Chevron Australia Holdings Pty Ltd ("Chevron") to farm-out a portion of their interests in the PEL 218 (South Australia) and ATP 855 (Queensland) joint ventures.

Completion of the transaction is conditional upon:

- all relevant government approvals, including FIRB approval;
- approval and registration of the farm-in agreement in relation to PEL 218 by government authorities in South Australia;
- indicative approval of the transfers of interests in ATP 855 to Chevron by government authorities in Queensland; and
- approval and registration of the transfers of the interests by relevant authorities for each stage.

Icon Energy Ltd (ASX: ICN, "Icon"), Beach's joint venture partner in ATP 855, has consented to and waived its pre-emptive rights in relation to each stage of the transaction.

Subject to joint venture approvals, the key work program elements envisaged across the two permits involve an intial exploration program to be followed by pilot production programs.

The financial commitment by Chevron to Beach is detailed in the table below:

	PEL 218	ATP 855
Stage 1	Acquire an initial equity interest of 30% through: • US$36 million cash • US$95 million carry	Acquire an initial equity interest of 18% through: • US$59 million cash

Page 1

	PEL 218	ATP 855
Stage 2	On completion of Stage 1 work program, Chevron election to proceed to Stage 2	Chevron election to proceed to acquire Stage 2 in the period from 1 September 2014 to 31 March 2015
	Acquire an additional 30% interest through: • US$41 million cash • US$47 million carry	Acquire an additional 18% interest through: • US$36 million cash
Post Stage 2	On completion of Stage 2 work program, Chevron election to proceed	Chevron election, from 1 October 2016 to 31 December 2016, to proceed
	Commitment bonus payment of US$35 million	

Note 1: Stage 1 has already commenced and includes wells after Encounter-1 and Holdfast-1 for PEL 218
Note 2: Timing of the stages for PEL 218 are expected to be in line with that of ATP 855

If after Stage 1, Chevron elects not to proceed to acquire Stage 2, the interest held by Chevron will be re-assigned to Beach for no consideration. If after Stage 2, Chevron elects not to proceed, Beach may elect to receive a re-assignment of the interests held by Chevron.

As a result of this farm-out to Chevron, Beach is well positioned for long-term appraisal and development of the Nappamerri Trough gas resources. Post Stage 2, Beach will support Chevron should it nominate for operatorship.

Beach has led the way in unconventional exploration of the Nappamerri Trough in both South Australia and Queensland. Beach's identification of this shale and basin centred gas opportunity in the Cooper Basin resulted in Beach taking an early landholding position in both PEL 218 and ATP 855, with six vertical wells in PEL 218 and one in ATP 855 drilled to date.

Beach's Managing Director, Reg Nelson, said: "This transaction vindicates in many ways the vision that the company has in relation to the potential of unconventional gas in the Cooper Basin. We look forward to working closely with Chevron and Icon Energy in the continued rejuvenation of the Cooper Basin."

Icon put option

A put option has been granted by Beach to Icon, exercisable by Icon up to 30 June 2013, for Beach to acquire 4.9% of ATP 855 from Icon on payment by Beach of US$18 million.

Yours sincerely,

Reg Nelson
Managing Director, FAusIMM

For more information contact

Corporate		
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Investor Relations		
Chris Jamieson	Beach Energy Ltd	08 8338 2833
Media		
Ian Howarth	Collins Street Media	0407 822 319

About Chevron

Chevron is one of the world's leading integrated energy companies and through its Australian subsidiaries, has been present in Australia for 60 years. With the ingenuity and commitment of more than 3,000 people, Chevron Australia leads the development of the Gorgon and Wheatstone natural gas projects; manages its equal one-sixth interest in the North West Shelf Venture; and operates Australia's largest onshore oil field on Barrow Island and the Thevenard Island oil fields.

Chevron contact: Andrew Smith – Tel: +61 8 9216 4280 or smitha@chevron.com

Appendix 1 – Example 2: ASX farmout announcement by Senex Energy Limited

Senex
Senex Energy Limited

ASX Announcement

Senex and Origin Energy agree Cooper Basin gas farm-out

Release Date: 24 February 2014

Senex Energy Limited (Senex, ASX: SXY) and Origin Energy Limited (Origin, ASX: ORG) have agreed to evaluate tight gas sands in key areas of South Australia's southern Cooper-Eromanga Basin involving a work program of up to $252 million.

KEY POINTS

- Two farm-out agreements signed providing exposure to tight gas sand, shale and deep coal plays:
  - Area A (36% of total areas of PEL 516 and PEL 115 (Senex 100%) and,
  - Area B (47% of total area of PEL 514, Deeps only (Senex 80% and operator, Planet Gas Limited (Planet, ASX: PGS) 20%)
- Up to $252 million may be invested by the joint venture partners in a two-stage work program involving the drilling of at least 15 wells and substantial 2D and 3D seismic acquisition programs
- Senex is free-carried for its share of the first $185 million of work program, with Senex, Origin and Planet having the option to contribute a further $67 million on a participating interest basis
- Senex will retain operatorship of the permits during the two-stage work program, with Origin having the option to become operator following completion of Stage 2

FOCUSED ON COMMERCIALISATION

The parties have agreed a two-stage work program totalling $185 million with additional work program expenditure of up to $67 million, which is subject to operating committee approval. The first stage will evaluate the potential of the tight gas sands, provide exposure to shales and deep coal seams, and provide proof of concept. The second stage will evaluate the commerciality of the gas resource by undertaking extended flow testing through separate pilot programs.

Senex Managing Director Ian Davies said Origin is the ideal partner to help commercialise the Cooper-Eromanga Basin's significant unconventional gas potential.

"Origin has built an unrivalled position in the eastern Australian gas market and has access to international markets through its APLNG export facilities in Gladstone. Origin is a natural partner for Senex to accelerate the commercialisation of a potentially massive gas resource, especially given its long-standing position in the South Australian Cooper Basin Joint Venture.

"These agreements cover 40% of the total area of PEL 514 and PEL 516, with Senex retaining its material interests to explore the remainder of these hydrocarbon rich permits," he said.

TRANSACTION DETAILS

The following table summarises the transaction, which is conditional on certain approvals including registration of interests. Completion is expected by 30 June 2014.

	AREA A	AREA B	TOTAL
Total petroleum exploration licence (PEL) areas Farm-out areas	2,876 km^2 (PEL 516 and PEL 115) 1,031 km^2 (255,000 acres) (36% of total PEL areas)	1,917 km^2 (PEL 514) 904 km^2 (223,000 acres) (Deeps only, 47% of total PEL area)	
Stage 1 work program[1] Participating interest earned by Origin	$65 million 40%	$40 million 30%	**$105 million**
Stage 2 work program[1] Participating interest earned by Origin	$40 million 10%	$40 million 10%	**$80 million**
Additional Area B work program Stage 1 and 2 work program (equity basis)	N/A	$67 million	**$67 million**
Total work program	**$105 million**	**$147 million**	**$252 million**

1 Senex 100% free carried

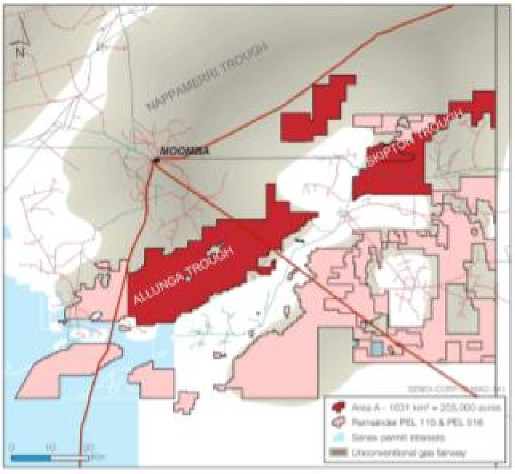

Figure 1: Area A in relation to PEL 516 and PEL 115

AREA A – PEL 516 AND PEL 115

Area A comprises a 1,008 square kilometre portion of PEL 516 and a 23 square kilometre portion of PEL 115 in the southern South Australian Cooper Basin (refer Figure 1 and 3). This will allow operations to focus on the tight gas prospectivity of the Allunga, Skipton and Nappamerri troughs.

The Area A work programs will involve a 300 line kilometre 2D seismic survey, the drilling of up to eight exploration and appraisal wells, fracture stimulation and flow testing. The first well is expected to be drilled within 12 months.

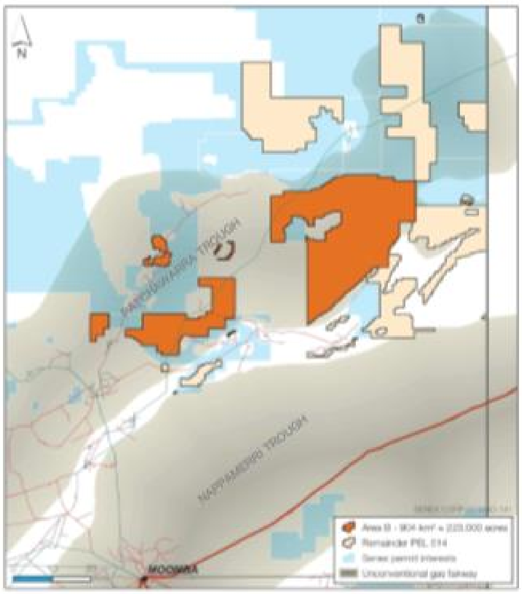

Figure 2: Area B in relation to PEL 514

AREA B – PEL 514 (DEEPS ONLY)

Area B comprises a 904 square kilometre portion of the Permian system of PEL 514 (**Deeps**) in the Patchawarra Trough in the northern South Australian Cooper Basin (refer Figure 2, 3 and 4). Senex retains its interests in the oil prone sequences above the Permian (**Shallows**), as shown in Figure 4. The Area B work programs will involve a 250 square kilometre 3D seismic survey, the drilling of up to seven exploration and appraisal wells, fracture stimulation and flow testing.

In Area B, the joint venture parties may elect to fund an additional work program, subject to operating committee approval, totalling $67 million. This will involve additional exploration and appraisal work during both stages.

For further information contact:

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About Origin Energy Limited

Origin (ASX: ORG) is the leading Australian energy company focused on gas and oil exploration and production, power generation and energy retailing. A member of the S&P/ASX 20 Index, the company has more than 6,000 employees and is a leading producer of gas in eastern Australia. Through Australia Pacific LNG, its incorporated joint venture with ConocoPhillips and Sinopec, Origin is developing one of Australia's largest CSG to LNG projects based on Australia's largest 2P CSG reserves base.

About Senex Energy Limited

Senex (ASX: SXY) is an S&P/ASX 200 energy company with a diversified portfolio of oil and gas assets in Australia's Cooper, Eromanga and Surat Basins. The Company is an experienced operator in Australia's oil and gas industry and has attracted a highly qualified team of professionals to grow the business safely and efficiently.

Figure 3: Location of Area A and Area B in relation to Senex permits in the Cooper-Eromanga Basin

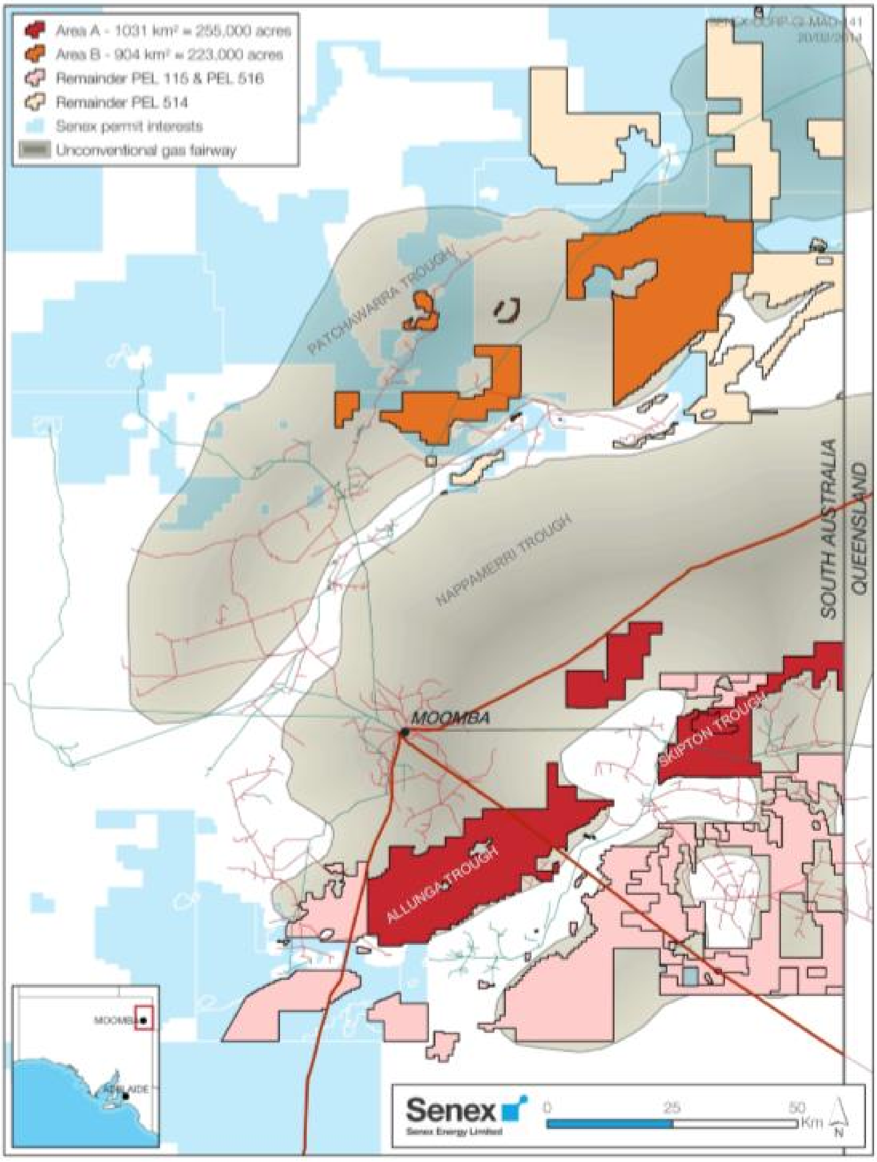
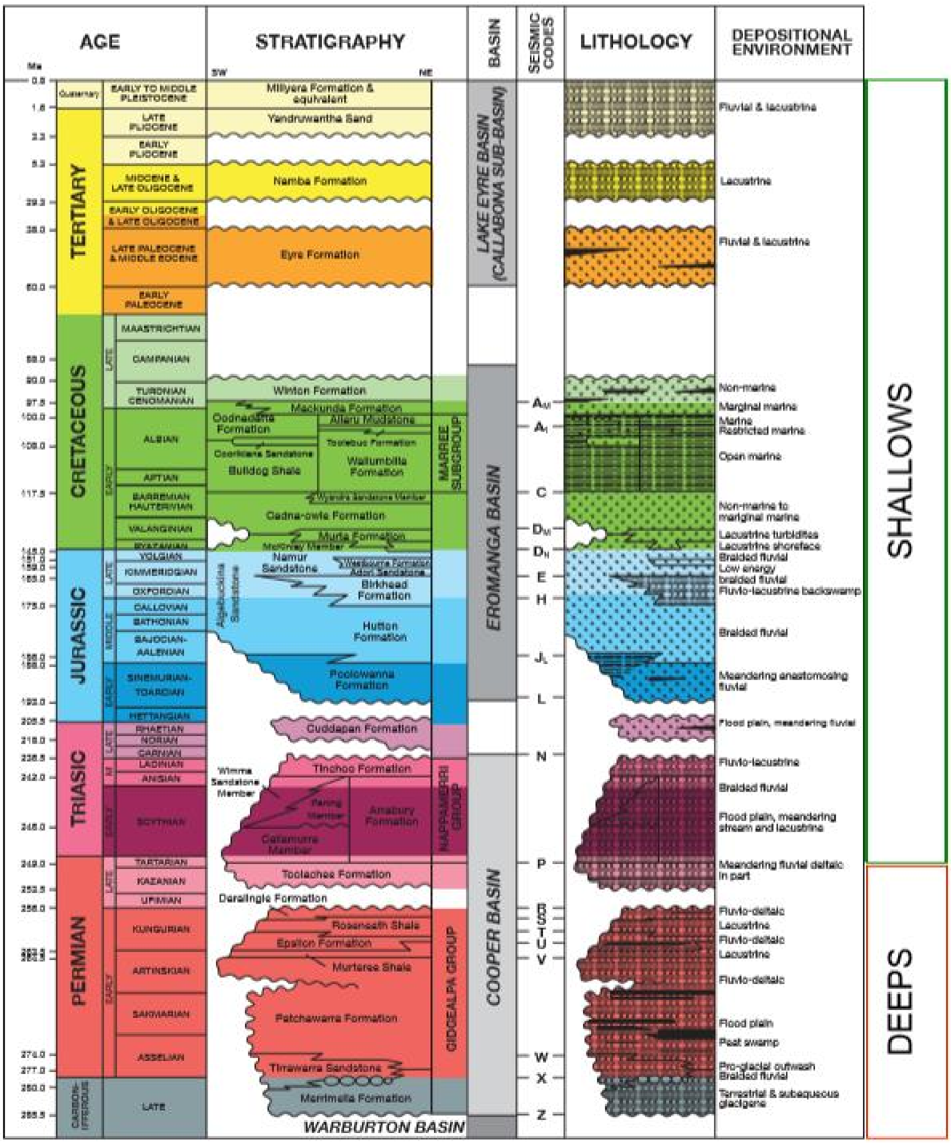
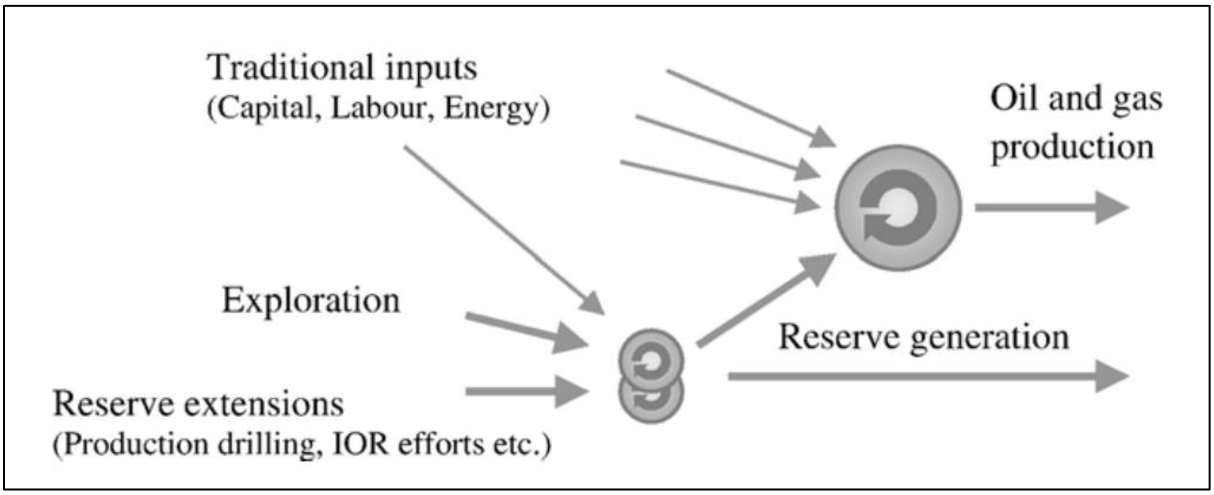


Figure 4: Stratigraphic column highlighting the Deeps and Shallows of Area B



Appendix 2 – Production structure in an oil and gas company



Source: Mohn & Osmundsen (2008, pp. 307).

Appendix 3 –Example 1: ASX offtake announcement by Carpentaria Resources Limited

Carpentaria RESOURCES | WORLD'S BEST IRON ORE PRODUCT

ASX Announcement

6 August 2018

Japan's Mitsui & Co., Ltd. secures Hawsons off-take providing financial support for BFS

Highlights

- **Blue-chip Japanese trading house Mitsui & Co., Ltd. secures off-take from Carpentaria's Hawsons Iron Project in 2 stage financing package**
- **Mitsui to obtain an option of securing off-take by contributing A$5.4m to Hawsons bankable feasibility study, which cost is estimated to be A$27.0m**
- **Mitsui to exercise the option and to secure 2 million tonnes per annum of Hawsons Supergrade® product off-take for 20 years by contributing US$60 million to Hawsons construction funding**
- **Deal significantly reduces the project's funding risk and is expected to accelerate discussions with other potential off-takers and funding parties**

In a major advance for Broken Hill's next new mine, emerging iron producer Carpentaria Resources Limited (ASX:CAP) announced today an agreement with Mitsui & Co., Ltd. (Mitsui) to drive development of its flagship Hawsons Iron Project (Hawsons).

Under the agreement, the blue-chip Japanese trading house will contribute A$5.4 million towards the cost of the project's bankable feasibility study (BFS) for an option over 2 Mtpa of Hawsons Supergrade® product off-take.

Significantly, the BFS funding A$5.4 million provided is non-dilutive to shareholders and is equivalent to 20% of the estimated BFS funding requirements.

This off-take will be secured by Mitsui subject to Mitsui's option exercise with a US$60 million (at current exchange rates, A$81 million) contribution to the debt funding package for the construction of a new magnetite mine just 60km south-west of "the Silver City."

CAP's Managing Director, Quentin Hill, said Mitsui's financing provided a major vote of confidence in Hawsons as the world's leading high-quality iron ore concentrate/pellet feed project.

"We are delighted to welcome Mitsui to the project, given its status as one of the largest international investors in Australia's resources industry, including major iron ore developments. This investment confirms Hawsons' position as the world's leading undeveloped high quality iron ore project and supports our view that the Hawsons can satisfy the demand from customers in the high quality, high-value and high-growth iron ore markets of direct reduction iron (DRI) and pellet feed," Mr Hill said.

Carpentaria Resources Limited
ABN : 63 095 117 981
ASX : CAP

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Brisbane Qld 4000

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"Importantly, the financing reduces the project's financing risk and enhances its bankability, combining binding investment grade off-take with funding support. This model is highly beneficial to CAP shareholders, as it avoids dilution, addresses key project delivery risks and adds significant value to the project. We have a clear plan for development that is on track and we will continue to pursue non dilutive arrangments where possible.

"We now expect our current discussions with blue-chip off-takers and fund managers to accelerate ahead of securing the remaining BFS funding and develop Hawsons into a major new mine. "

The Hawsons BFS is targeted to be completed within the next 12-15 months.

Deal summary

- Binding A$5.4m payment to the Hawsons joint venture directed to BFS works, available once the balance of BFS funding is secured by the joint venture
- Mitsui gains option to secure 2.0 million tonnes per annum (Mtpa) of Hawsons Supergrade® pellet feed off-take for a 20-year period and exclusivity to sell the pellet feed product in Japan
- Product price to be in line with market practice at the time, which today is consistent with CAP's pricing formula in its PFS and based on the 65% Fe index, plus additional value for extra iron units and then adjusted for chemical and physical properties, which are subject to negotiation (refer ASX announcement 28 July 2017)
- Option exercise condition is for Mitsui to commit a US$60m mezzanine debt facility for Hawsons construction following the BFS

Mr Hill said: "CAP has previously secured 120% demand for Hawsons' initial planned production of 10 Mtpa from steelmakers and trading houses across Asia and the Middle East. Mitsui is the first-mover with a funding commitment, and the additional competition for the product is expected to drive development, raising the stakes for those seeking to secure Hawsons off-take.

"Today's announcement demonstrates that Hawsons is capable of winning international investment. From our successful PFS announced last year, to our recent award of Major Project Status by the Federal Government, and the recent appointment of a highly-credentialled resources industry Director, CAP and Hawsons are building significant momentum towards development.

"This is another well planned step in our off-take led strategy that exploits the global long term flight to high quality iron ore. For Broken Hill, the new investment and creation of jobs would be a real boost this heritage-listed mining city, and we look forward to securing additonal strategic partners," he added.

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About Mitsui & Co., Ltd.

Founded in 1947, Tokyo-based Mitsui & Co., Ltd. is one of the world's most diversified trading, investment and services enterprises. The company is a leading exporter of natural resources and agricultural commodities from Australia, accounting for around $8 billion in total exports annually as the nation's fourth largest exporter.

In the past decade, Mitsui group companies have invested around $15 billion in Australia, backed by its network of 137 offices in 66 countries/regions.

For more information on Mitsui & Co. (Australia), see:
https://www.mitsui.com/au/en/company/profile/index.html

About Hawsons Iron Project

The Hawsons joint venture (CAP 68.69%, Pure Metals Pty Ltd 31.31%) is currently undertaking development studies based on the low cost, long-term supply of a high grade, ultra-low impurity iron concentrate to a growing premium iron market, including the direct reduction (DR) market.

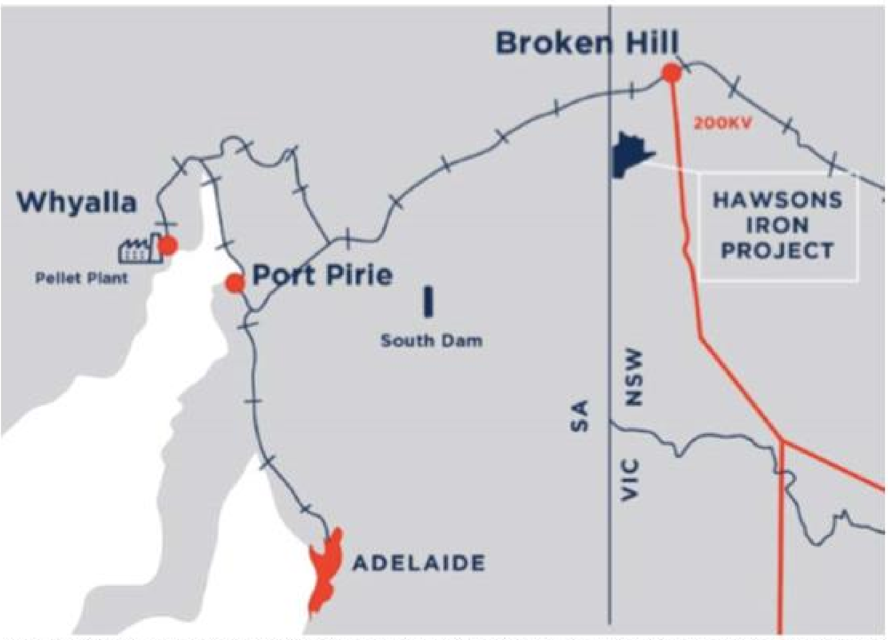
The project has a clear technical and permitting pathway. It is located 60km south-west of Broken Hill, an ideal position for mining operations with existing power, port, rail and road infrastructure sufficient for a 10 Mtpa start-up operation. A mining lease application has been lodged with the NSW Government.

The project's soft rock is different from traditional hard rock magnetite and allows a very different approach to the typical magnetite mining and processing challenges (both technical and cost-related). The soft rock enables simple liberation of a product of rare quality without complex and expensive processing methods.

The Company is targeting the growing premium high-grade product market, both pellets and pellet feed, which is separate to the bulk fines market and its prefeasibility study has shown its targeted cost structure is very profitable at consensus long-term price forecasts for this sector.

CAP has secured off-take intent from blue-chip companies comprising Taiwan's Formosa Plastics; China's Shagang Steel; Japan's Mitsubishi Corporation RtM; Bahrain Steel, Emirates Steel and Kuwait Steel from the Middle East; and trading house Gunvor Group.

In April 2018, the Hawsons was awarded Major Project Status by the Federal Government, one of only 14 projects nationwide to receive such recognition, in a move expected to expedite regulatory approvals and increase investor confidence.



The Hawsons Iron Project is located 60km south-west of Broken Hill, NSW, an ideal position for mining operations with existing port, power, rail and road infrastructure suitable for a 10 Mtpa start-up operation

Appendix 3 –Example 2: ASX offtake announcement by Kidman Resources Limited

KIDMAN RESOURCES

ASX RELEASE

Offtake Agreement with Tesla

17 May 2018

- **Kidman enters binding lithium hydroxide offtake agreement with Tesla**
- **3-year fixed-price take-or-pay agreement with two 3-year term options**
- **Significantly enhances post refinery commissioning cash flow profile**
- **In discussions with other strategic, globally significant parties**
- **Further validates Kidman's strategy of being an integrated ASX-listed manufacturer of battery-grade refined lithium**

Kidman Resources Limited (Kidman) (ASX: **KDR**) is pleased to announce it has entered into a binding agreement with Tesla, Inc. (Tesla) to supply lithium hydroxide (Agreement). This follows the 4 May 2018 announcement that Western Australia Lithium (WAL), its 50:50 joint venture with Sociedad Quimica y Minera de Chile (SQM), had entered into an exclusive option to lease a premier site in the Kwinana Strategic Industrial Area in Western Australia.

The Agreement is for an initial term of three years on a fixed-price take-or-pay basis from the delivery of first product, and contains two 3-year term options. The other commercial terms of the Agreement are strictly confidential.

The Agreement equates to less than 25% of Kidman's portion of initial nameplate production for the first three years from the refinery.

Other Offtake Discussions

In addition to the Agreement with Tesla, Kidman is in discussions with other strategic, globally significant parties also seeking refined lithium offtake. To date, expressions of interest from these parties have materially exceeded Kidman's portion of initial refinery nameplate production. Kidman is currently targeting to enter into a limited number of offtake agreements, while leaving a minority portion of future supply uncontracted.

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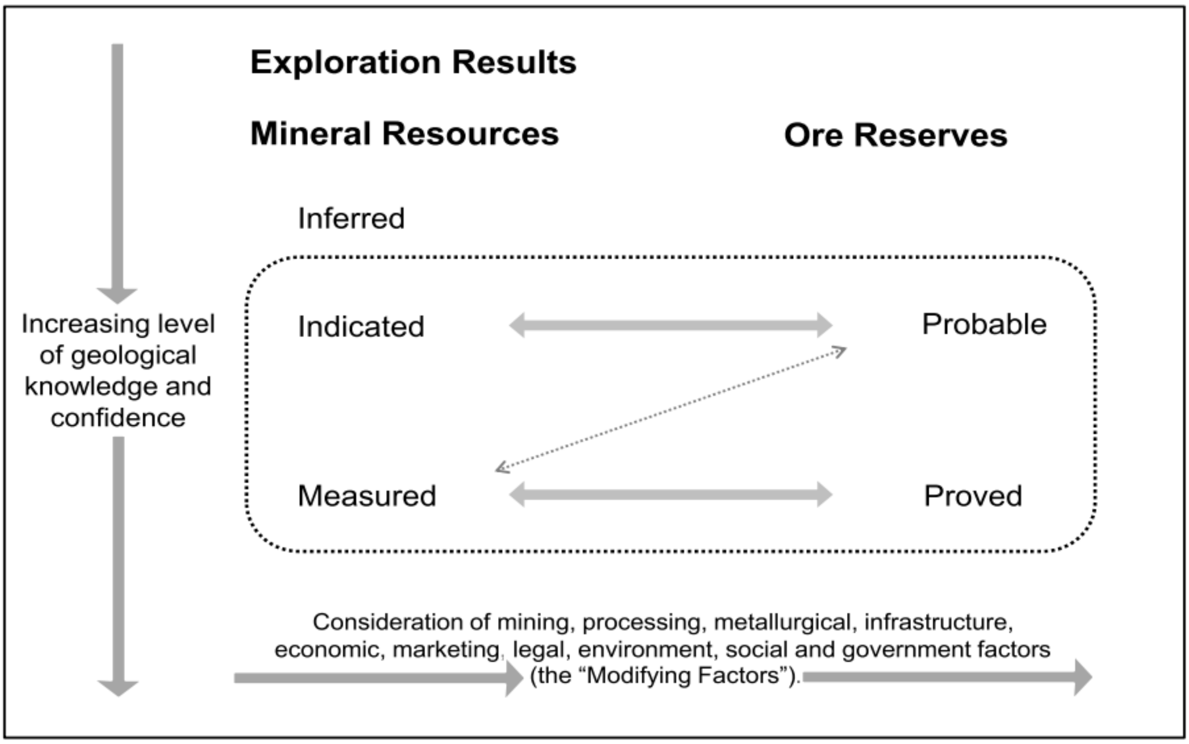
Appendix 4 – General relation between mineral resources and ore reserves



Source: JORC Code (2012, pp. 9)

Appendix 5 – Example of the life-cycle of a mine

1. Exploration
Geological desk studies Geophysics and geological mapping Drilling and test programme Evaluation of mineral resources & reserve Pre-feasibility studies
2. Project Development
Bankable feasibility studies Environmental and Social Assessments & Development of Sustainability and Community Programmes Regulatory and Government approvals Project Financing Construction of infrastructure and mine development Training, operations readiness, commissioning and start up
3. Operations
Mine and infrastructure operations and maintenance Capital upgrades Sustainable community and environmental programmes
4. Mine Closure
Mine Closure Rehabilitation Monitoring

Source: Camiron SA (2012).

Appendix 6 – Summary of the alliance literature

Reference	Citations [96]	Research question/objective	Sample description				Event study approach		Hypotheses
			Setting	Period	Size	Data source	Window	CAR	
Amici et al. (2013)	38	Investigate the value creation of alliances and joint-ventures in the banking setting.	Financial industry	1999-2009	208 interfirm arrangements (113 alliances and 106 joint ventures)	Associazione Bancaria Italiana (ABI)	[-1; 0]	0.13%	H1. Joint ventures and alliances have different effects on banks' wealth creation. H2. There is a positive effect of correlated diversification on bank's wealth change. H3. Uncorrelated diversification has a positive influence on the bank's value creation. H4. The presence of foreign partners in the bank's interfirm arrangements influences wealth change.
Ben-Zion et al. (2011)	2	Extension of Chan et al (1997). Also, they investigate whether market reactions surrounding the date of the announcement reflect market overreactions.	Aggregate market	1990-1997	355 interfirm arrangements (293 non-equity alliances and 62 minority equity alliances)	Lexis/Nexis	[-1; 1]	1.69%	H1. Abnormal returns from the announcement of alliances are positive for the exchange partners. H2. Abnormal returns after the announcement of alliances are negative for the exchange partners. H3. Negative abnormal returns predicted in H2 are greater for high-tech firms, smaller firms, firms participating in multinational arrangements, firms collaborating to new product creation for both companies, and firms engaging in short-term alliances.

[96] Citations obtained from Google Scholar on 23/04/2019.

Berg & Friedman (1977)	65	Examine the association between the formation of joint arrangements and the joint venturers' rate of return.	Chemical industry	1964-1973	97 joint ventures	Federal Trade Commission (FTC)	-	-	The hypothesis predicts negative effects on the rate of return from joint ventures consistent with a knowledge-acquisition model, while a positive association is expected from joint ventures focused on yielding market power.
Beshears (2013)	23	Investigate the relation between the organisational form to undertake drilling activities and the project's performance.	Oil and gas industry	1954-1975	1,070 lease auctions (corporate alliances aiming at participating in auction leases to acquire and develop them)	US Department of the Interior	-	-	Overall the main hypothesis indicates that alliances allow partners to achieve better outcomes by combining information and expertise.
Bodnaruk, Massa & Simonov (2013)	44	Analyse corporate governance characteristics of firms and their industrial organisation focusing on the potential association between governance quality and alliance formation.	Aggregate market	1990-2007	17,760 (strategic alliances and joint ventures)	Securities Data Corporation (SDC) Platinum	-	-	H1. Companies with better governance are more likely to form alliances. H2. Alliance creation is more sensitive to governance when agency issues are more severe. H3. Alliance creation is more sensitive to firm governance in less competitive industries. H4. Good-governance firms are more likely to initiate alliances if the cost of alliances is lower.
Boone & Ivanov (2012)	65	Investigate spillover effects from a bankruptcy alliance partner on the other exchange participants.	Aggregate market	1989-2007	366 interfirm arrangements (282 alliances and 84 joint ventures)	Securities Data Corporation (SDC) Platinum	[-1; 1]	Alliance formation: 1.03% Bankruptcy announce	It is predicted spillover effects from the counterparty's bankruptcy on the non-bankrupt alliance party.

								ment: -0.39%	
Brooke & Oliver (2005)	29	Investigate the source of abnormal returns focusing on R&D intensive alliances.	Aggregate market	1994-2001	123 deals (only strategic alliances)	Aspect Financial DatAnalysis	[-1; 1]	1.60%	Maximisation hypothesis predicts a positive market reaction to the alliance announcement. The knowledge hypothesis predicts that alliance involving R&D activities will generate wealth gains. The flexibility hypothesis indicates that high-tech alliances yield higher abnormal returns than low-tech arrangements (according to the interpretation of Brooke&Oliver (2005).
Chan et al (1997)	681	Examine the circumstances for the value creation stemming from the formation of alliances.	Aggregate market	1983-1992	345 deals (only strategic alliances)	Lexis/Nexis and Dow Jones News Retrieval	[0]	0.64%	Alliances involving know-how and sensitive information sharing create more value to the exchange partners.
Das et al (1998)	651	Investigate interfirm arrangements focusing on the scope of the project's activities.	Aggregate market	1987-1991	119 two-party alliances (no joint ventures)	Wall Street Journal and Financial Times (Information Technology Strategic Alliances - ITSA)	[0; +1]	0.50%	H1. Firms entering alliances experience positive abnormal returns; H2. Abnormal returns on the announcement of technology-related alliances are higher than wealth changes of marketing interfirm arrangements; H3a. The profitability of announcing firms is negatively correlated with the abnormal returns on the alliance announcements; H3b. This negative

									correlation is greater for marketing collaborations relative to technological alliances; H4a. Abnormal returns experience by smaller announcing firms are greater than abnormal returns yielded by larger firms; H4b. This relative size effect is greater in technological alliances than in marketing arrangements; H5a. The variance of stock returns decreases with the announcement of alliances; H5b. The variance of stock returns decreases with the announcement of technological arrangements, and h5c. The variance of stock returns increases with the announcement of marketing alliances
Demirkan & Zhou (2016)	5	Investigate the relation between the auditor service pricing and its client's industrial organisation.	Aggregate market	2001-2011	1,286 firms with alliances and 3,188 firms without any alliance	Securities Data Corporation (SDC)	-	-	H1. Auditors will raise their audit fees due to an increased audit complexity for clients engaging in alliances. H2. Auditors will raise their audit fees due to an increased audit complexity for clients engaging more in alliances rather than joint ventures.
Gore et al (2019)	-	Examine the wealth effects of alliance partners with specialist auditors.	Aggregate market	1988-2015	4,071 alliances	Securities Data Corporation (SDC) Platinum	[-1, +1]	1.29%	Alliance expert auditors can be used as a mechanism to mitigate information uncertainty and hold-up problems in alliances,

									yielding positive wealth changes.
Keasler & Denning (2009)	19	Investigate the magnitude of value creation resulting of alliances and the factors that may differentiate alliance activities that are positive to shareholders relatively to those that are not.	Aggregate market	1983-1992 and 1995-2004	10,141 deals (strategic alliances only)	Securities Data Corporation (SDC) Platinum	[-1; 0]	1.47%	H1. The magnitude of alliance formation and its market reaction have changed over time. H2. Past studies suggest that over half of alliances fail. H3. Firms participating in vertical alliances yield higher abnormal returns than firms forming a horizontal alliance. H4. Smaller firms experience different abnormal returns relative to those of larger firms. H5 Technology firms' abnormal returns are different from those of other types of firms. H6. Alliances are expected to be more profitable across international boundaries. H7. Increase in alliance activity is due to technology, globalisation, and the complexity and diversity of markets.
Kim & Palia (2014)	2	Analysis of the reasons underlying acquisitions of target companies via alliance compared to acquisitions of target firms made by solo equity firms.	Aggregate market	1980-2009	68 alliances formed between private equity bidders and 458 deals involving a single private equity bidder	Securities Data Corporation (SDC)	-	-	Absolute risk hypothesis predicts a positive relation between the target firm's risk and alliance formation between bidding companies. Relative risk hypothesis indicates the relative risk rather than the absolute risk is an alliance motivation. Resources

									pooling hypothesis predicts a positive relationship between project size and alliance formation. Two predictions are based on the collusion hypothesis where alliances can be used as a collusion strategy: collusion formation between the bidding firms and target, and collusion between bidders. The specialisation hypothesis indicates synergies from gains to specialisation between exchange partners and target firm. The asymmetric information hypothesis predicts a positive association between sources of information asymmetry (i.e., intensive R&D firms) and the probability of alliance formation. The lemons hypothesis indicates that less profitable projects/firms are subject to alliances.
Koh & Venkatraman (1991)	631	Analysis of the scope and value creation of joint-venture formation in the information technology (IT) industry.	Information technology and related manufacturing industries	1972-1986	175 joint ventures	Wall Street Journal Index	[-1; 0]	0.87%	H1. Wealth changes associated with joint venture formation is positive for the exchange partners. H2. Parent companies forming joint ventures in the identical category yield the highest abnormal returns, and parent firms forming a joint venture in an unrelated

									category report the lowest abnormal returns. H3. The parent company with a higher share of its sales in business related to the business of an equally owned joint venture experience a higher abnormal return than the parent company with the lower sales portion. H4. Firms with related joint venture partners report higher wealth changes than those with joint venture unrelated partners. H5. The abnormal return of the smaller partner in an equally owned joint venture is not different from that of the larger partner, and the dollar change is equal.
Lerner et al (2003)	401	Analysis of the relation between changes in financing availability and firm's industrial organisational.	Biotechnology industry	1980-1995	200 alliance agreements	Recombinant Capital	-	-	Large corporations have specialised knowledge and expertise to financially back younger firms, even in periods of adverse equity market conditions. In periods with favourable equity market conditions, R&D is likely to retain the alliance project's control rights. Interfirm agreements where terms allow the R&D firm to keep the project's rights are more successful, mostly in periods of weak equity market conditions.

McConnell & Nantell (1985)	403	Investigate the source of wealth gains associated with synergies resulting from the formation of joint ventures	Aggregate market	1972-1979	136 joint ventures	Mergers and Acquisitions	[-1; 0]	0.73%	It is predicted that joint venture participants yield wealth changes associated with the formation of interfirm arrangements based on the synergies resulting from resource pooling.
Owen & Yawson (2015)	16	Analyse R&D as a main determinant of cross-border alliances and related value creation.	Aggregate market	2000-2008	4,189 non-equity alliances	Securities Data Corporation (SDC) Platinum	[-2, +2]	1.57%	From an information asymmetry perspective, the study investigates why US firms choose to form an alliance with partners in one location as opposed to options in other countries.
Ozmel et al (2013)	103	Investigation of the role of financing alliances and venture capitalists. Secondly, they examine the effect of start-ups' funding mostly via VC or alliance on their exit outcomes.	Biotechnology industry	1980-2004	1,899 venture-backed biotechnology firms	Thomson Financial's VentureXpert database	-	-	The authors predict that increasing funding via venture capitalists received by a biotechnology firm increases the probability of this firm to go public; Increased alliance activity has negative effects on the participation of venture capitalists and on the biotech's probability to have an IPO; Alliance can improve the biotech's prospects for future funding via venture capital sources and also the biotech's success of a successful exit.
Palia et al (2008)	62	Analysis of the choice determinants to undertake a movie project either internally or via an interfirm arrangement	Movie industry	1994-2000	275 film projects	Project-level data is gathered from Compustat, Institutional	-	-	Risk-reduction hypothesis supports a positive relationship between project risk and alliance formation (or from an internal capital market perspective, low-

						Brokers Estimate System (I/B/E/S), press search and public sources with complementary data obtained directly from film studios			risk projects are more likely to be executed internally). Alliance formation is positively associated with the efficiency of managerial contribution according to the managerial bargaining power hypothesis. Market structure hypothesis indicates that alliance formation is positively related to industry concentration. Resource pooling theory supports that companies engage in alliance to combine complementary resources, the authors predict the larger the project, the higher the probability of alliance formation. The specialisation hypothesis indicates that more profitable movies are made under co-financing arrangements. This prediction contrasts to the lemon hypothesis where less profitable projects ('lemons') are more likely to be executed via an interfirm arrangement.
Pisano (1989)	854	Examine the reasons of companies forming arrangements with equity ties instead of using non-equity interfirm collaborations	Biotechnology industry	-	195 collaborative deals (contractual deals, joint ventures and	Californian proprietary database	-	-	H1. Collaborative arrangements are more likely to have equity ties when R&D is one of the activities to be undertaken through the arrangement. H2. Interfirm arrangements

					direct equity investments)				involving multiple projects are more likely to have equity ties. H3. Equity arrangements are less likely when there are many potential exchange partners.
Robinson (2007)	204	Investigate governance issues in alliance contracting. Comparison of alliance contracts with other financial contractual collaborations such as venture capital contracts.	Biotechnology industry	1990-1998	125 deals	Recombinant Capital	-	-	No hypotheses are tested given the goal of the study is to focus on the contract design of strategic alliances.
Robinson (2008)	191	To develop and test a model to explain the firm's choice to undertake a project internally or via alliances.	Aggregate market	1985-2001	90,417 alliances	Securities Data Corporation (SDC)	-	-	H1. Longshot projects should be organised through alliances, while less-risky projects should be executed internally.
Stuart et al (1999)	2807	Investigate the association between firm's inter-organisational networks and its ability to acquire resources.	Biotechnology industry	1978-1991	301 biotechnology firms	Recombinant Capital	-	-	H1. The greater the prominence of the alliance partner, the better the performance of the new venture. H2. The greater the prominence of firms acquiring equity stages of the partner, the better the performance of the new venture. H3. The greater the prominence of the investment bank, the better the performance of the new venture. H4. The greater the uncertainty about the quality of the company, the larger the impact of the prominence of the firm's exchange partners on its performance.

Appendix 7 – Offtaker's industry classification for the certification-related proxies

Certification related proxies			ASX company's industry	Offtaker's industry	Freq.	%
Horizontal			Metals and mining	Metals and mining	143	36.1%
			Oil, gas and consumable fuels	Oil, gas and consumable fuels	13	3.3%
			Chemicals	Chemicals	4	1.0%
Non-horizontal	End-user		Metals and mining	Chemicals	30	7.6%
				Oil, gas and consumable fuels	4	1.0%
			Oil, gas and consumable fuels	Metals and mining	9	2.3%
				Energy, equipment and services	1	0.3%
			Energy, equipment and services	Metals and mining	1	0.3%
			Any	Aerospace and defence	1	0.3%
				Automobiles	3	0.8%
				Construction Materials	8	2.0%
				Construction and engineering	4	1.0%
				Diversified consumer services	2	0.5%
				Electric utilities	6	1.5%
				Electrical equipment	12	3.0%
				Electronic equipment, instruments and components	11	2.8%
				Food products	1	0.3%
				Household durables	2	0.5%
				Independent Power and Renewable Electricity Producers	4	1.0%
				Industrial conglomerate	7	1.8%
				Multi-utilities	6	1.5%
				Paper and forest products	1	0.3%
				Technology hardware, storage and peripherals	1	0.3%
	Intermediary	Non-trader	Any	Banks	2	0.5%
				Capital markets	11	2.8%
				Commercial services and supplies	1	0.3%
				Distributors	1	0.3%
				Diversified financial services	3	0.8%
				Media	1	0.3%
		Trader		Trading companies and distributors	79	19.9%
Subtotal					372	93.9%
Missing observations					24	6.10%
Total					**396**	**100.0%**

Appendix 8 – Part A: Variable definitions for farmout agreements

Variable name	Type	Definition
ACREAGE	Continuous	Farmout area surface measured in acres.
CAR	Continuous	Cumulative market-adjusted abnormal return.
CONFOUND3DAY	Counting	Announcing firm's number of market-sensitive announcements on ASX over a three-day window centred on the farmout agreement.
CRISK	Continuous	Political risk based on the International Country Risk Guide obtained from The PRS Group.
FINCOM	Indicator	Coded '1' for the disclosure of financial commitment terms in the farmout announcement.
FIRMAGE	Continuous	Age of the announcing firm based on its listing tenure on the ASX.
FIRSTFARM	Indicator	Coded '1' for projects (exploration permits) farmed out for the first time based on the sample period.
FOREIPART	Indicator	Coded '1' for farmout announcements involving at least one overseas (non-Australian) counterparty.
LACRES	Continuous	Natural logarithm of *ACREAGE*.
LFIRMAGE	Continuous	Natural logarithm of *FIRMAGE*.
LMCAP	Continuous	Natural logarithm of *MCAP*.
MAJORPART	Indicator	Coded '1' for farmouts involving at least one major oil and gas company (for the major classification, see Figure 2 – List of major oil and gas companies).
MCAP	Continuous	Firm size based on its market capitalisation in $ million.
NFIRMS	Counting	Number of firms participating in the farmout agreement.
OFFSHORE	Indicator	Coded '1' for the presence of areas subject to offshore exploration.
OILPVOL	Continuous	Volatility based on the daily price change of the WTI crude futures contract over the month of the farmout announcement.
OPERCHANG	Indicator	Coded '1' for farmouts indicating the change of the project's day-to-day exploration management to the farminee.
POTENRES	Indicator	Coded '1' for the disclosure of potential reserve targets in the permit area.
PROJLOC	Indicator	Coded '1' for the farmouts of overseas projects (not located in Australia).

TOP20	Continuous	Announcing firm's equity stake held by the twenty largest shareholders at the fiscal year end prior to the farmout announcement date.
UNCONV	Indicator	Coded '1' for farmout announcements disclosing projects located in areas prone to unconventional resources.

Appendix 8 – Part B: Variable definitions for offtake agreements

Variable name	Type	Definition
BINDING	Indicator	Coded '1' for offtake agreements indicating binding mutual commitments between the agreeing parties.
CAR	Continuous	Cumulative market-adjusted abnormal return.
CRISK	Continuous	Political risk based on the International Country Risk Guide obtained from The PRS Group.
END_USER	Indicator	Coded '1' if the offtaker's industry classification indicates the use offtake-committed-resources as an input in its manufacturing process
DEVELOPER	Indicator	Coded '1' if the announcing firms is in the early-stage of its life cycle (developer) based on the sales of resources (SALESREV=0). Coded '0' if the announcing firms are considered producers based on their sales of resources (SALESREV>0).
FUNDING	Indicator	Coded '1' for the disclosure of the offtaker's funding commitment either via equity or debt.
FINCF	Continuous	Announcing firm's financing cash flow in $ million at the fiscal year prior to the offtake announcement.
FIRMAGE	Continuous	Age of the announcing firm based on its listing tenure on the ASX.
INTERMEDIARY	Indicator	Coded '1' if the offtaker operates as a middle-man.
INVCF	Continuous	Announcing firm's investing cash flow in $ million at the fiscal year prior to the offtake announcement
LFIRMAGE	Continuous	Natural logarithm of *FIRMAGE*.
LIFEMINE	Indicator	Coded '1' if the offtaker is committed to the announcing firm over the life of project.
LMCAP	Continuous	Natural logarithm of *MCAP*.
LPAGE	Continuous	Natural logarithm of *PAGE*.
MCAP	Continuous	Firm size based on its market capitalisation in $ million.
MINING	Indicator	Coded '1' if the announcing firm's GICS classification is 'Materials'. Coded '0' if the announcing firm's GICS classification is 'Energy'.
NFIRMS	Counting	Number of firms participating in the offtake agreement.
NCOMM	Counting	Number of commodities in the offtake agreement.
NON_HORIZ	Indicator	Coded '1' if there is at least one counterparty (offtaker) operating in an industry different from the announcing firm's (project sponsor's). Coded '0' (horizontal) if the

		counterparty(ies) share the same industry classification of the announcing firm (project sponsor).
OFFTKTIME	Continuous	Duration of the agreement as per the offtake agreement.
OFFTKVAL	Continuous	Offtaker's total purchase commitment of resources in $ million.
OFFTYRVO	Continuous	Offtaker's total purchase commitment of resources in volume.
OILPVOL	Continuous	Volatility based on the daily price change of the WTI crude futures contract over the month of the farmout announcement.
OPCF	Continuous	Announcing firm's operating cash flow in $ million at the fiscal year prior to the offtake announcement.
PAGE	Counting	Number of pages of the offtake announcement.
PROJLOC	Indicator	Coded '1' for the farmouts of overseas projects (not located in Australia).
SALESREV	Continuous	Announcing firm's total revenue in $ million from the sales of natural resources at the fiscal year prior to the offtake announcement
TOP20	Continuous	Announcing firm's equity stake held by the twenty largest shareholders at the fiscal year end prior to the farmout announcement date.
TRADER	Indicator	Coded '1' if the offtaker is a trading house.
VCRB	Continuous	Volatility based on the daily price change of the Core Commodity CRB index (*CRBSPMTPI*) retrieved from Datastream over the month of the offtake announcement.
VCRBEXEN	Continuous	Volatility based on the daily price change of the Core Commodity CRB index (*TRJCENT*) retrieved from Datastream over the month of the offtake announcement.

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