Essays in Financial Economics

by

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ABSTRACT

This thesis consists of three essays that empirically and theoretically explore the implications of financial frictions on firm financial and investment policy.

In the first chapter, I examine how financial constraints affect asset allocation, and consequently productivity and asset values. Using a unique dataset of agricultural outcomes, I explore how farmers respond to exogenous cash inflows that are caused by an expansion of hydraulic fracturing (fracking) leases. Farmers who receive positive cash flow shocks increase their purchases of land, which results in a reallocation effect. Examining cross-county purchases, I find that farmers in high-productivity counties who receive cash flow shocks buy farmland in low-productivity counties. In contrast, when farmers in low-productivity counties receive positive cash flow shocks, they do not engage in similar behavior. Moreover, farmers increase their purchases of vacant (undeveloped) land. Average output, productivity, and profits all increase following these positive cash flow shocks, and farmland prices rise significantly. These effects are broadly consistent with an efficient reallocation of land towards more productive users. Finally, I show that farmers borrow relatively less following the cash flow shock.

In the second chapter, I develop and empirically test a dynamic sequential equilibrium model of corporate cash payout policy that endogenizes a firm's dividend initiation decision, and its extreme reluctance to subsequently cut dividends in a sequential equilibrium. After payment of dividends, all excess cash is disgorged via stock repurchases that elicit no price reactions. The theoretical model generates results consistent with many stylized facts related to dividend initiations, including: a positive dividend-initiation announcement effect; a larger (in absolute value) negative announcement effect for a dividend cut/omission than for an initiation; and a probability of dividend initiation that is increasing in the firm's profitability and assets in place, and decreasing in the personal tax rate on dividends relative to capital gains. The model also generates additional novel predictions: (i) the probability of dividend initiation is decreasing in managerial ownership of the firm, and this effect is stronger the weaker is (external) corporate governance; (ii) the dividend initiation probability is decreasing in the potential loss in value from the "two-audience-signaling" information disclosure costs associated with secondary equity issues. These new predictions are tested empirically using panel data through a predictive logit model of dividend initiations, and additional empirical support for the information-disclosure result is found using a regression discontinuity design.

In the third chapter, I develop a theory in which the owners of firms pursue short-termism in project choice to limit managerial rent-seeking behavior. Unlike in previous theories, a short-term bias in investment horizons maximizes firm value in the second-best case, whereas managers themselves prefer long-horizon projects. Short-termism benefits the firm in two ways: it limits managerial rent extraction by preventing investments in bad projects that delay information revelation about project quality and managerial ability, and it enables faster learning about managerial ability which allows more efficient subsequent decisions. This result does not depend on any stock mispricing or managerial desire to use earnings management in order to manipulate stock prices. The likelihood of short-termism is higher when corporate governance is stronger, and at lower levels of the corporate hierarchy. Numerous testable predictions of the analysis are discussed.

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Contents

Chapter 1
Financial Constraints and Asset Reallocation: Evidence from Farming and Fracking

1.1 Introduction

In an industry without significant frictions, assets will be allocated to the most efficient users of those assets. However, in the presence of frictions, assets may be allocated to less-efficient users, resulting in a misallocation of assets. Financial constraints represent an important friction that is at the heart of finance and economics (e.g. Bolton and Scharfstein (1990) and Campello, Graham, and Harvey (2010)). In the presence of financial constraints, the most productive users of assets may not be able to obtain financing in order to invest in those assets, leaving the assets in the hands of less-productive users. This resulting misallocation may lead to depressed aggregate outcomes, such as a loss in productivity and lower asset values, as the cash flows generated from the asset are not as high as those generated by the most efficient users.[1] If this is the case, relaxing these financial constraints may result in an efficient *reallocation* of assets. Alternatively, it is also possible that financial constraints induce firms to conserve resources and avoid wasteful spending, i.e., these constraints may discipline managers in the way debt contracts might (e.g. Hart and Moore (1994)). In this case, relaxing these constraints may worsen economic outcomes. Thus, these conjectures about the consequences of financial constraints need to be confronted with the data, particularly to understand the size and signficance of the effects.

The goal of this paper is to empirically examine how financial constraints affect asset allocation and aggregate economic outcomes. A major challenge in such an empirical analysis is that a shock that relaxes financial constraints will typically also affect the firm's fundamentals, making it difficult to isolate the effect of relaxing financial constraints. In order to overcome these difficulties, I focus on a setting in which there is a shock that relaxes the financial constraints of firms, but does not affect their future investment opportunities. I empirically examine whether relaxing the financial constraints of firms leads to a reallocation of assets, and the effect this has on productivity, output, profitability, and asset values.

[1] A large literature has argued that such asset misallocation may account for differences in total factor productivity (TFP) and wealth across nations. Banerjee and Duflo (2005) and Restuccia and Rogerson (2013) summarize the macroeconomic evidence on this. While these effects may be potentially mitigated through contracting, frictions that lead to incomplete contracts often play an important role in sustaining financial constraints and their effects. Why firms are financially constrained and why creditors do not lift these constraints are issues that have been explored in various theories. For example, Holmstrom and Tirole (2011), who view financial constraints as ubiquitous, show that a single deviation from the Arrow-Debreu paradigm, namely limited pledgeability of future income, can generate financial constraints.

The setting I use to study this question is the market for agricultural land in Oklahoma. For identification, I exploit the exogenous cash windfalls that farmers in Oklahoma received starting in the mid-2000s from signing hydraulic fracturing (fracking) leases. I use these cash flow shocks in conjunction with a unique institutional feature that helps to overcome the empirical challenge of disentangling the effect of liquidity shocks from changes in the fundamental value of the asset. By law, there is a separation of ownership between the "surface land rights" (i.e. farmland) and subsurface "mineral rights" in Oklahoma—the two are traded as distinct assets. Surface rights give the owner the ability to use the land for farming. However, a fracking lease can only be entered into with the owner of the *mineral* rights of a parcel of land. This feature means that the productivity and value of *farmland* will be directly unaffected by the discovery of oil underneath the ground, as the owner of *only* the surface rights cannot capture the cash flows from the oil beneath that land.[2]

As some farmers own the mineral rights underneath their land and others do not, this creates heterogeneity that I exploit in my empirical tests, relying on the idea that any effect on asset transfers, productivity, and prices should be driven by a liquidity effect operating through a lessening of financial constraints.[3] I use a differences-in-differences methodology to examine areas where many farmers received cash payments following the arrival of fracking—due to their ownership of both the surface and mineral rights to the land—to areas where there was substantial fracking activity but farmers did not receive cash payments, as they did not own the mineral rights to their land.

I find that farmers who enter into fracking leases (and thus receive large cash windfalls) subsequently purchase more land on average than farmers who do not enter into these leases. While these results are consistent with an efficient reallocation of assets when financial constraints are relaxed, it could also be driven by farmers who receive cash windfalls and buy farmland as a means to "park" the cash (similar to "overinvestment" behavior, as described by Stein (2003)). These two motivations for land purchases have very different implications for economic efficiency.

To further understand the mechanism at play, I examine in detail the reallocation of farmland. Specifically, following the arrival of fracking in high-farm-productivity areas, farmers who receive lease-related cash flow shocks from fracking leases in these areas purchase more farmland from farmers in low-farm-productivity areas. However, when fracking arrives in low-productivity counties, similarly-affected farmers do not exhibit the same purchasing behavior. This is inconsistent with an empire-building effect, since that would require *all* farmers who received cash windfalls to buy land. It is, however, consistent with a reallocation of farmland from less-productive to more-productive farmers. I also find that there is no significant increase in farmland purchases in the areas where relatively few farmers have mineral rights, and thus few experience fracking-related cash windfalls. This means that the effects that I document are driven by heterogeneity in the pattern of mineral rights ownership, an essential feature of my identification strategy.

In addition to this reallocation of land between farmers, I provide evidence of a second

[2]It may be the case that fracking *adversely* affects farmland values through channels such as earthquakes, pollution or groundwater contamination. These types of channels would bias me *against* finding an effect. I address these more fully in Section 1.A.4 of the Appendix.

[3]This pattern of mineral rights ownership amongst farmers was established well before the sample period that I examine. See the discussion on the selection issue later in Section 1.2.2.

reallocation channel—a reallocation of land from non-farm users to farmers. In particular, farmers who receive cash flow shocks following the arrival of fracking also increase their purchases of non-farm vacant (undeveloped) land. Since this vacant land was previously not put to productive use, and is transferred to a user who is able to extract higher cash flows from the land through its conversion into farmland, this effect also suggests a reallocation of land from "outside" users to "expert" users.[4]

I then turn to how this reallocation affects farm output, productivity, and profitability. I find that areas where farmers enter into a large number of fracking leases experience an increase in their crop area under cultivation and in crop production, and also enjoy greater crop-growing productivity enhancements than do other areas, leading to higher farm profits. The results suggest that these outcomes are also economically significant, with areas where many farmers enter into fracking leases experiencing increases of roughly 18% in crop production, 7-10% in productivity, and 12-15% in farm profits compared to other areas. Broadly speaking, these effects are more consistent with the hypothesis that there is an efficient reallocation of assets from less-productive to more-productive users than with alternative hypotheses.

Next, I examine the effect of the reallocation on land prices. I find larger farmland price increases in areas where many farmers own mineral rights and enter into fracking leases, compared to areas where only a few farmers enter into fracking leases. These price increases are large in magnitude—areas where many farmers entered into fracking leases experienced increases in farmland prices of roughly 20-40% more than other areas. This effect is again in line with the reallocation of land to more-efficient users whose valuation of the asset is higher, since they are able to extract a higher surplus from it.[5]

Finally, I explore the effects on equipment capital expenditures and farm leverage. I show that farmers also use these cash windfalls to increase their purchases of farm equipment, which is in line with farmers investing in additional capital in order to farm the land that they purchased.[6] Additionally, farmers reduce the amount of debt they hold relative to farmers who do not experience the cash windfalls. The leverage result is consistent with the liquidity-shocked farmers further relaxing their borrowing constraints for future investment.

I run a number of robustness checks in order to rule out alternative channels that may drive the results. First, I examine whether the results may be due to a wealth effect. If agents hold an "idiosyncratic" asset—one whose value depends on user-specific skills—then a large positive shock to wealth could cause these agents to purchase more of the asset. To check

[4]In a sense, this is the reverse of the effect in Shleifer and Vishny (1992), where a fire sale leads to a reallocation of the asset from "expert" to "outside" users.

[5]These prices only reflect the value of surface rights, and so are not a result of the discovery of oil underneath the land. This effect can also be interpreted as evidence of a "cash-in-the-market" pricing effect (e.g. Allen and Gale (1994, 2005)). One possible reason why farmland prices rose so much more than productivity and output is that prior to the liquidity shock, land prices were depressed due to binding financial constraints. For example, if farmers were only willing to pay an amount well below the value of farmland even in the hands of less-productive users, then that lower amount would represent the pre-fracking land price and only farmers with a significant liquidity need or desire to get out of farming would sell at that price (similar to a fire sales setting).

[6]This result is consistent with the theory and evidence in Garmaise (2007), who shows that financially-constrained firms use relatively more labor than physical capital. Hence, when financial constraints are relaxed, farmers invest more in equipment.

this channel, I conduct a placebo test using non-farm vacant landholders. If a wealth effect is driving the results, then *both* farmers and non-farm vacant landholders should purchase additional land. I find, however, that the non-farm landholders do not purchase additional land, consistent with the reallocation effect.

Second, I examine whether the results are driven by a long-term trend in the relationships between the outcome variables in the high- and low-mineral-rights counties. This involves a falsification test in which I examine farm output, productivity, and land prices during the sample period, falsely specifying the year of fracking arrival as 1995. I find that there is no statistical difference between the high-mineral-rights and low-mineral-rights counties based on the diff-in-diff estimator, thereby ruling out the long-term trend hypothesis.

Finally, I check whether the results are driven by a boost in local economic activity due to the arrival of fracking. For example, an increase in local economic activity could increase farmland values and output through demand channels that are unrelated to a reallocation effect. If this effect is indeed at work, then counties with the most oil and fracking should experience the largest effects, irrespective of the mineral rights ownership patterns of farmers. I find, however, that this is not the case—conditioning simply on fracking activity does not deliver my results. Rather, what matters is the pattern of mineral rights ownership, which is inconsistent with local economic activity driving the effects.

My paper is most directly connected to the economics literature that explores how frictions lead to capital misallocation, and lower productivity as a result—see Restuccia and Rogerson (2013) for a review. These papers focus mainly on empirically identifying a misallocation of resources and the resulting heterogeneity in total factor productivity, often by calibrating equilibrium models or using data across countries or industries. For example, Hsieh and Klenow (2009) provide evidence from manufacturing establishments in China and India compared to the U.S., and show how resource misallocation can lower aggregate productivity. Gilchrist, Sim, and Zakrajsek (2013) propose an empirical framework to estimate how resource misallocation, caused by financial frictions, creates a loss in productivity. Adamopoulos and Restuccia (2014) provide evidence of how the misallocation of resources across farms can explain productivity and farm size differences between rich and poor countries. Along these lines, a number of papers have also argued that a well-functioning financial system, through alleviating financial frictions that cause a misallocation of resources, is important for economic growth (e.g. Levine (1997) and Rajan and Zingales (1998)).[7] While my results are also consistent with the existence of a misallocation caused by financial frictions, in contrast to this literature I focus on providing direct evidence of how *alleviating* the constraints generated by these frictions can lead to a reallocation of assets between users that improves efficiency, and examining the various channels through which this reallocation operates.

Also related are papers that examine how factors other than financial constraints could

[7]A connected paper is Butler and Cornaggia (2011), which explores the effect of access to financing on productivity. They show that corn farmers experienced larger increases in productivity in areas with greater access to local finance, following an increase in demand for corn. Similarly, Krishnan, Nandy, and Puri (2015) show that interstate banking deregulation in the U.S. increased access to bank financing for borrowers and led to higher total factor productivity (TFP) for these borrowers. In contrast to these papers, I show evidence of reallocation effects as an important extensive-margin channel through which financial constraints (isolated from other channels such as product demand or credit supply) can affect real outcomes.

drive a reallocation of assets in an industry. Maksimovic and Philips (2001) analyze reallocations arising from M&A activity and asset sales, and provide evidence of productivity gains. Eisfeldt and Rampini (2006) examine reallocation during the business cycle using data on capital flows, and show that capital reallocation is procyclical. Bertrand, Schoar, and Thesmar (2007) study how banking deregulation in France can improve banking efficiency, leading to an improvement in allocative efficiency across firms (borrowers) through an effect on credit supply.[8] Almeida and Wolfenzon (2005) develop a model in which limited pledgeability (driven by low investor protection) creates a misallocation of capital, but high external financing needs can create an efficient reallocation by forcing the liquidation of low-productivity projects; they also provide empirical evidence using cross-country data.[9]

I contribute to this literature by showing that the relaxation of the financial constraints of small firms (i.e. farms), independently of any changes in credit supply or product demand, can lead to real effects through a reallocation of capital that improves productivity and profitability.[10] In contrast to the approach in previous papers, I examine an exogenous shock to financial constraints that is *unrelated* to the future productivity or prospects of the business. As a result, I am able to provide direct evidence of reallocation effects at a more micro level and for particular assets in a market, permitting an assessment of some of the specific channels through which the effects arise. Moreover, I provide additional evidence that such a reallocation effect also significantly affects asset prices, which also has not been previously shown.

A second literature that my paper contributes to is the vast literature on the effect of financial constraints and liquidity on investment (e.g. Fazzari, Hubbard, and Petersen (1988)).[11] While my analysis also adds to this literature by showing the effect of an exogenous cash flow shock on investment via agricultural land investment by small firms (farms), I

[8]This paper focuses on a different phenomenon from what I focus on in this paper, in that they are concerned with constraints on the supply of credit due to factors that affect lenders. My focus is therefore distinct from how shocks to bank capital can reduce lending (e.g. Peek and Rosengren (2000)).

[9]Other papers show how different frictions can affect asset reallocation. Giroud and Mueller (2015) examine how a positive shock to a plant at a financially-constrained firm can induce a reallocation of labor and capital from low-TFP to high-TFP plants. Khanna, Slezak, and Bradley (1994) theoretically examine resource allocation by managers within firms, who make use of both private information and outsiders' information, and the implications for insider trading. There is also an accounting literature which examines how financial reporting quality can facilitate efficient capital allocation and investment (e.g. Shroff (2015)).

[10]A change in credit supply often has fairly broad effects and will affect both financially-constrained firms as well as unconstrained firms, even though constrained firms may be affected more. Lemmon and Roberts (2010) examine how exogenous shocks to the supply of credit affected the investment behavior of firms, by examining events that reduced the supply of below-investment-grade credit after 1989. They document that net investments by firms declined as a result, indicating limited ability to switch to other sources of financing. My analysis is able to empirically sharply delineate the effect on financially-constrained firms when their constraints are relaxed.

[11]See also Blanchard, Lopez de Silanes, and Shleifer (1994), Kaplan and Zingales (1997), Lamont (1997), Almeida, Campello, and Weisbach (2004), Rauh (2006), Almeida and Campello (2007), Fee, Hadlock, and Pierce (2009), Hadlock and Pierce (2010), and others. These and other papers show that financial constraints are ubiquitous at the household as well as firm levels. See Agarwal, Liu, and Souleles (2007) for evidence of the importance of these constraints for households based on an analysis of credit card borrowers who receive tax rebates. A more recent related paper is Karlan et. al. (2014), which conducts a field experiment with farmers in Ghana to explore how cash and insurance grants relax constraints, leading to increased agricultural investment and production.

additionally show how this investment behavior affects other real outcomes such as output, productivity, and asset prices. Importantly, I provide new evidence of a specific channel through which financial constraints affect these outcomes, via an efficient reallocation of assets.

A third literature that this paper is connected to is the large literature on the effect of financial constraints and liquidity on asset prices. A number of theoretical models have asserted how the amount of liquidity held by market participants may affect the prices of assets purchased by those participants (e.g. Allen and Gale (1994, 2004), Holmstrom and Tirole (2001), and Shleifer and Vishny (1992, 1997)).[12] My empirical results are consistent with the predictions of these theories, and also provide support for some of the underlying mechanisms that drive the results.[13]

The remainder of this paper is organized as follows. Section 1.2 provides a discussion of the institutional background on farming in Oklahoma, the financial constraints of farmers, and fracking and mineral rights. It also contains a description of the empirical strategy, data sources, and summary statistics. Section 1.3 contains the main results of the analysis. Section 1.4 conducts numerous robustness tests of the main results. Section 1.5 discusses the external validity of the results, and concludes.

1.2 Institutional Background, Empirical Methodology and Data

In this section, I describe the institutional setting in Oklahoma and empirical methodology. I also describe the dataset that I construct and provide summary statistics.

1.2.1 Institutional Background: Farmers in Oklahoma

The agricultural sector provides an ideal setting for testing the interaction between financial constraints, market asset allocation, and prices for a number of reasons.

First, farmers can be viewed as small business owners who own and invest in a specialized asset which they are the expert (most-efficient) users of: farmland. In particular, the market for farmland is localized, with local farmers being the most knowledgeable in terms of cultivating the land and understanding its properties, such as soil quality. As a result, local farmers are typically the most productive users of farmland, and this land will be more valuable to farmers than to "outside" users.

[12]In frictionless, complete markets, agents are able to replicate any claim in the economy, so there should be no misallocation of resources and the amount of cash held by market participants should not affect equilibrium prices. However, when agents are liquidity-constrained, they may not be able to fully participate in the marketplace for an asset (e.g. Allen and Gale (1994, 2004), Holmstrom and Tirole (2001), and Huang and Wang (2010), among others; see Allen and Gale (2005) for a review). This can push the price of the asset below its fundamental level, especially if outside agents (i.e. ones that value the asset less than the normal users) are the ones that step in to purchase the asset in place of the first-best, most efficient users. This latter effect is the channel through which fire sales have an impact on prices, as argued by Shleifer and Vishny (1992, 1997). Consequently, when the financial constraints of agents are loosened, prices should rise.

[13]Tirole (2008) provides a review. My analysis is also related to the empirical literature on how prices respond to liquidity; see Amihud, Mendelson, and Pedersen (2006) for a review.

Second, farmers are generally financially constrained—they are unable to access equity markets, and have operating profit margins on the order of 6% and frequently negative.[14] For example, Hartarska and Nadolnyak (2012) use survey data and provide evidence that farmers in Alabama are financially constrained. Hartarska and Mai (2008) show that farmers use off-farm income for investments in farm assets, and that farm investment is sensitive to off-farm income, which they note is consistent with binding financial constraints. Internationally, O'Toole and Hennessy (2013) use Irish data and quantify the extent of financial constraints using a neoclassical Q model.[15] As further evidence that farmers are financially constrained, I obtained interview data of directors and senior executives of lending institutions (many of whom are farmers themselves) providing credit to U.S. farmers.[16] The participants noted that the majority of farmers are cash-constrained, and they unanimously stated that these constraints are a first-order factor affecting farm investment. As a result, a cash infusion to a farmer can be interpreted, on average, as a relaxation of a binding financial constraint.[17] One advantage of focusing on farmers, therefore, is that it allows one to abstract away from relying on particular measures of financial constraints, of which there is substantial disagreement about in the literature (e.g. Farre-Mensa and Ljundqvist (2016). However, as additional empirical evidence of the presence of financial constraints in my sample, I show in the Appendix that my results are stronger for areas with more binding financial constraints ex ante.

Finally, the agricultural sector provides an ideal empirical setting for my purposes because farmers experienced exogenous liquidity shocks in the 2000s due to the entry of a new technology of oil drilling: hydraulic fracturing. Hydraulic fracturing (referred to as fracking henceforth) is the process of extracting oil from deep underground shale rock formations, which consists of injecting high-pressure liquid agents into rock formations to create cracks and extract oil and gas. While fracking has existed as a technology since the 1950s, a technological innovation in the early- to mid-2000s combined fracking with horizontal drilling, to make fracking much more economical. This, combined with a reduction in legal uncertainty provided by a law change in 2005, allowed a flood of oil producers to enter into oil-rich states (particularly Texas, Oklahoma, and North Dakota) and set up fracking drills.

[14]From the USDA Economic Research Service and the USDA Economic information bulletin, May 2006.

[15]Along similar lines, Karlan et. al. (2014) provide evidence that is consistent with farmers having binding constraints; they do this through a field experiment in Ghana, where farmers increased their investments after receiving insurance and cash grants.

[16]I obtained interview data for 26 directors and senior executives of lending associations of the Farm Credit System—a $248 billion nationwide network of agricultural lending institutions in the United States. This credit system serves as one of the most important sources of credit to farmers, providing more than one third of total agricultural credit in the U.S.

[17]An alternative way to relax this cash constraint would be through borrowing more funds (as most farmers are small private businesses that cannot raise equity financing). However, this constraint can be interpreted as a binding borrowing constraint—that farmers are unable to borrow more funds because they are at their debt capacity (and are unable to service additional debt due to their low profit margins). Additionally, farmers may face a borrowing limit due to their inability to pledge their future human capital (e.g. Hart and Moore (1994)). The children of many family farmers show a lack of interest in continuing to work on the farm, and moreover farmers have long enjoyed substantial protection under U.S. bankruptcy law which limits what can be pledged to creditors (see Tremper (1988) for a review).

1.2.2 Institutional Background: Fracking and Mineral Rights

In order to drill underneath land, fracking operators must sign a lease agreement. This lease agreement involves a large upfront payment to the mineral rights owner as well as subsequent royalties that depend on the amount of oil produced. For farmers in oil-rich states in particular, this cash payment represents a significant source of income—the average upfront payment typically ranges from $500 to $10,000 per acre in Oklahoma.[18] With an average farm size in Oklahoma of roughly 450 acres, these payments can range from tens of thousands of dollars to a few million dollars; given a median U.S. farm household income of roughly $52,000 in the late 2000s, these payments represent a very large cash infusion on average for farmers.[19]

However, importantly for my purposes, not every farmer is able to receive these payments even if there is oil underneath the farmer's land. In certain states there is a "split-estate" law system—the ownership of the surface land and the ownership of the mineral rights underneath that land are legally separated, and thus the two are separate assets. By law, the mineral rights have legal superiority, and so fracking operators must sign a lease agreement with the owners of the *mineral rights* in order to drill on a parcel of land. This is crucial to my empirical analysis for two reasons. First, the fact that the *mineral* rights are the asset which confers drilling rights means that oil drilling in a given area will not directly affect the value of the *surface* land rights, since the owner of just the surface rights is not able to capture any of the cash flows from oil payments.[20] This allows me to isolate and identify the channel through which liquidity affects the price of the farmland. Second, this ownership split means that some farmers own the mineral rights underneath their land as a result of inheritance within their families over the years, while other farmers do not—the mineral rights to their land had been sold off generations ago.[21] Furthermore, this pattern of mineral rights ownership was established well before my sample period, and can be taken as exogenous.[22] This fact means that there is heterogeneity amongst farmers in terms of who owns mineral rights, and therefore who can enter into a fracking lease and reap the cash flows. I exploit this heterogeneity in my empirical tests, to compare farmland purchases by farmers who own mineral rights and enter fracking leases to farmers who do not.

[18] This is based upon conversations with farmers in Oklahoma. These numbers are consistent with those in other studies. For example, Andrews (2010) reports that the average upfront payments in Texas can reach up to $10,000 to $20,000 per acre.

[19] Data are taken from the USDA Economic Research Service. This large cash infusion related to fracking leases is also in line with the results of Gilje, Loutskina, and Strahan (2013) and Plosser (2014), who use fracking discoveries in a different context, as an instrument for exogenous deposit inflows to banks.

[20] There are potentially negative externalities to fracking moving into an area, such as wellwater pollution or disruption of farm operations, which may affect productivity and farmland values. However, these potential externalities will negatively affect production and farmland values, and thus bias me *against* finding positive effects. This issue is discussed further in the Appendix.

[21] For example, in the late 19th and early 20th centuries, railroad companies actively bought much of the mineral rights of the land that they laid tracks over.

[22] As further evidence of this fact, I show that the market for mineral rights is thin, with very few sales and transferences. The initial split between mineral rights and surface rights occurred as a result of Homestead Acts in the late 1800s and early 1900s, with some parcels of mineral rights sold to individuals interested in mining for precious minerals such as gold. Mineral rights that were not sold off during this time tended to be transferred across generations of farmers, along with the surface rights (and thus the farmland).

In Appendix 1.A, I provide further institutional details on how fracking in conducted. There are two key takeaways from these details. First, the actual fracking on a farm occupies very little of the farm's surface area, so farming can proceed more or less as usual once the infrastructure for fracking is set up. Second, due to "forced pooling" laws in Oklahoma, an individual farmer with mineral rights has virtually no ability to hold out and refuse to permit fracking on his land.

1.2.3 Empirical Specification

I now describe my empirical strategy. I focus my tests on the state of Oklahoma for a number of reasons. First, agricultural production is significant in Oklahoma, and data on farmers and agricultural land are available at a detailed level. Second, Oklahoma is an oil-rich state due to a number of shale oil formations, which attracted companies interested in drilling to the state, resulting in a large spike in oil production (see Covert (2014)). Finally, Oklahoma has a split-estate law system, as described earlier, where the surface rights and mineral rights are separate assets. It is also a state with "forced pooling", which also has some advantages for my empirical analysis, as will be explained later.

I employ a differences-in-differences (diff-in-diff) methodology in order to examine the impact of fracking on the outcome variables of interest. The ideal strategy involves comparing areas where farmers own both land and mineral rights to areas where farmers do not own mineral rights, and examining the differential impact between the areas after fracking operators enter and sign leases with mineral owners. As the actual mineral rights ownership pattern is not observable in my data, I identify these ownership patterns through an examination of whether a farm landowner signed a mineral lease over my sample period (and therefore owns the mineral rights underneath the land).[23] By doing so, I am able to infer which areas have a large number of farmers who own both surface and mineral rights, and which areas have relatively few farmers who own both. The logic behind this strategy is that the opportunity for a farmer to enter into a mineral lease is exogenous—it depends on whether the farmer owns the mineral rights to the farmland, and whether there is oil underneath the land. There are two potential endogeneity concerns with this assumption. First, a farmer may decide to strategically buy or sell mineral rights in anticipation of fracking operators entering an area, thus raising the possibility of self-selection into the treatment or control groups. Second, the decision to enter into a fracking lease may be endogenous for the farmer; the farmer may decide to turn down a fracking lease when approached by an oil company.

The setting specific to Oklahoma suggests that these endogeneity concerns are not an issue for my analysis. Regarding the first concern, I am able to examine the number of mineral deed transferences during my sample period. The data show that the number of mineral deed transferences amongst farmers is extremely low for all counties during my

[23]For an agent to sign a mineral lease, it must be the case that the agent owns some portion of the mineral rights underneath a plot of land (even if he or she does not own the land itself). The reason why actual mineral rights ownership is not observable in my data is because mineral rights, in many cases, were transferred to farm families when the farm was originally established generations ago. While in some cases mineral rights may have been sold or transferred over time, the timeframe of the original granting of rights or tranference of rights pre-dates the courthouse data that I have access to.

sample period, indicating that mineral rights are illiquid assets with sparse trading on the part of farmers.[24] In addition, following the arrival of fracking, there is no significant change in terms of mineral deed transferences between areas with many farmers who own mineral rights compared to other areas—this indicates that farmers who own mineral rights did not strategically buy/sell them following the arrival of fracking. [25] Regarding the second concern, while there is no formal dataset on the number of farmers who turn down fracking leases, I interviewed a director of a Farm Credit Association in Oklahoma. The director noted that the percentage of farmers who own mineral rights but turn down fracking leases when offered is essentially zero. The reasons for this are twofold. First, the amount of money offered by oil companies for mineral leases is typically very substantial for farmers, and thus attractive. Second, the "forced pooling" law in Oklahoma that was discussed earlier makes it very difficult for farmers to hold out or refuse to lease minerals that they own. The law stipulates that recalcitrant farmers can be forced into signing mineral leases when the majority of mineral acreage around them has already been leased. As a result, practically no farmer in Oklahoma refuses to enter into a fracking lease when approached by an oil company.

For the diff-in-diff specification, I use the year 2005 to denote when fracking entered Oklahoma.[26] Fracking operators flooded Oklahoma starting in 2005, thereby dramatically increasing oil production from that point in time, for two reasons. First, a new technique developed by oil operators in Texas in 2003 combined fracking with horizontal drilling. This allowed drill operators to penetrate shale deposits that were previously difficult to access, and made fracking wells much more economical to develop; the technology became more widely adopted in the next few years. Second, the Energy Policy Act of 2005 exempted fluids used in fracking from federal clean water laws, thereby greatly reducing regulatory uncertainty for well operators. This Act is often cited as a key contributing factor to the surge of fracking after 2005 (see, for example, Krauss and Lipton (2012)).

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[24]Panel A of *Figure 1-B1* of the Appendix shows the total proportion of farmers over time who either transfer their mineral deed to a different owner or who take ownership of a mineral deed. The proportion of farmers who transfer mineral deeds is extremely low, and there is no significant change in the pattern of transferences after the arrival of fracking. Moreover, this proportion is likely overstated in the graph since a number of these transferences are not due to buying/selling, but rather due to estate inheritance transfers within the family. The reason why mineral rights are illiquid is because purchasing them in the marketplace is usually not optimal. For oil companies, leasing the right to drill for the minerals is typically more efficient than taking ownership of the mineral rights. For farmers, the minerals underneath their farmland serve no purpose that is useful to farming, and thus they have no desire to purchase the mineral rights. While a farmer may want to purchase mineral rights in anticipation of being approached by an oil company for a lease, the farmer's lack of expertise in assessing the likelihood and profitability of a future lease (these depend on the oil potential of the minerals) makes such a purchase expensive and risky purchase for the farmer. After the arrival of fracking, when mineral rights increase in value, a farmer may choose to sell his mineral rights instead of entering into a fracking lease. In that case, the farmer would receive a cash inflow from the sale, but would not be identified as a mineral rights owner since he never entered into a lease. However, such a situation would bias me against finding an effect, since these farmers would contribute towards an effect for the control group.

[25]Panel B of *Figure 1-B1* graphs transferences of mineral deeds for counties with a high proportion of farm mineral ownership, compared to counties with a low proportion of farm mineral ownership, following the arrival of fracking. *Table 1-B1* of the Appendix shows, through a differences-in-differences regression, that the difference between the two groups does not significantly change when fracking arrives.

[26]This is the same period identified by Covert (2014) for the entry of fracking operators into North Dakota.

Figure 1-1 and *Figure 1-2* depict the entry of fracking into Oklahoma in the 2000s, and the large influx subsequent to 2005. *Figure 1-1* shows that the number of Underground Injection Control wells (UIC), which fracking wells are classified as, increased exponentially after 2005.[27] *Figure 1-2* shows the number of oil and gas wells in Oklahoma that were active prior to the arrival of fracking (on the left), compared with the number of wells that are currently active. As can be seen from the figures, while there were oil and gas wells prior to the entry of fracking, most counties in Oklahoma were subsequently inundated with a massive increase in the number of wells. This increase in activity caused by the arrival of fracking allowed mineral owners to sign leases with drilling companies, and thus receive large cash payments.

[Figure 1-1 Here]

[Figure 1-2 Here]

More specifically, I run the following main regression specification:

$$\begin{aligned} Y_{i,t} &= \beta_0 + \beta_1 \left(High\,Farm\,Minerals_i \times Fracking\,Entry_t \right) \\ &\quad + (Controls)_{i,t} + \gamma_i + \eta_t + \varepsilon_{i,t}. \end{aligned} \tag{1}$$

Regression (1) is estimated for the period from 2000 to 2010, and is at the county-year-level for the main specifications (thus, i indexes counties and t indexes years).[28] $Y_{i,t}$ is the outcome variable of interest, which includes land purchases in area i at time t, production and productivity measures, the value of farmland, and debt. $High\,Farm\,Minerals_i$ is an indicator variable which takes a value of 1 for the treatment group, which is defined as counties in Oklahoma where many agricultural landowners own mineral rights, and a value of 0 otherwise. I infer this mineral rights ownership through the number of farmers who signed mineral leases (and therefore both own mineral rights to their land and have oil underneath their land). This is specifically defined as a county i where the percentage of farmers over all years that sign into a mineral lease is high (above the median for the sample).[29] The control group consists of areas where few farmers own mineral rights (below the median for the sample). In order to make the treatment and control groups more comparable, I exclude counties with Oklahoma that have little oil potential underground, although the results are robust to including these counties.[30] $Fracking\,Entry_t$ is a dummy variable which takes a value of 1 if the year is 2005 and onwards, and 0 otherwise. The coefficient on $High\,Farm\,Minerals_i \times Fracking\,Entry_t$ is therefore the differences-in-differences estimator, which examines whether oil-rich areas where many farmers own mineral rights

[27] The number of wells starts to increase after 2006, a delay which represents the fact that the figure depicts wells that have actually been constructed. However, mineral owners are compensated with upfront payments when they first sign leases.

[28] The regression is also run at the zip-code level for robustness.

[29] Since all farmers who enter into mineral leases own mineral rights, and there are very few transferences of mineral rights, this measure will give the closest approximation to the true number of mineral rights owners in the county. *Table 1-B2* of the Appendix shows that, using this classification, the percentage of farmers entering into a mineral lease increased for the treatment group relative to the control group.

[30] This is defined as counties with fewer than 20 discovered oil fields, which corresponds to roughly the bottom 20th percentile of the sample.

differed from other areas after fracking arrived in Oklahoma. County fixed effects (given by γ_i) are included to control for unobservable time-invariant heterogeneity between counties, such as differences in soil quality. Year fixed effects (given by η_t) are included to control for time trends over the sample period. *Controls* is a vector of county-level control variables which are included to control for observable differences between counties that may create differential trends.[31]

1.2.4 Dataset Construction

I construct a novel dataset of agricultural outcomes for counties in Oklahoma from a variety of sources.

I first identify farm landowners using data taken from County Assessor offices in Oklahoma.[32] For each county, I obtain ownership information for agricultural land, as well as prior sales information, including the sales price, date of purchase, seller of the land, and the size of the parcel of land. Using this information over the period from 2000 to 2010, I am able to identify individual farmers who own land, when those farmers purchased their land, and the price each paid for the land. In addition, I obtain this information for vacant (undeveloped) land holders.[33]

I next obtain Oil, Gas, and Mineral Lease data from County Courthouse records for each county in Oklahoma for the period from 1990 to 2014.[34] These data include the identity of each person who grants a mineral lease (and thus owns mineral rights to a plot of land) in each year and each county. By merging these data with the data on farm landowners, I am able to construct a dataset that identifies which farmer in each county owns land and has signed a mineral lease to that land, indicating that this farmer has ownership of both the land and the mineral rights underneath the land. The overall dataset contains information for 22,909 individual farmers. Of these, 8,962 entered into mineral leases over my sample period. Using this, I identify which counties in Oklahoma contain numerous farmers who own both land and the mineral rights to the land, and which counties contain relatively few such farmers.

In order to examine changes in output, I collect data from the USDA Economic Research Service (ERS) on county-level crop production, acreage, and productivity (measured through crop yields). To examine changes in debt related to this purchasing behavior, I obtain agricultural real estate loan data from the Federal Reserve Commercial Bank Call Reports from 2000 to 2010. This includes the sum total of all real estate loans secured by farmland for banks located in each county in Oklahoma.[35] I obtain data on county-level farm income, total farm expenditures, farm acreage, and government payments from the Bureau of Economic Analysis (BEA), for use as control variables and to construct a measure of farm profits. I also

[31]These include county income per capita, amount of cropland, total farm income, total farm production expenditures, and government subsidy receipts.

[32]I access the data through OkAssessor.com, which electronically allows access to each individual county's Assessor office land ownership rolls.

[33]A potential disadvantage of this dataset is that it includes only currently active farmers, and thus contains survivorship bias.

[34]This data is electronically accessible from Okcountyrecords.com.

[35]The disadvantage of this data is that it includes only commercial banks which are headquartered in a given county, and thus may suffer from mis-measurement.

use data on purchases of farm machinery via EDA, in order to explore further investment behavior by farmers.

Finally, I also obtain a measure of the oil potential of the different counties in my sample from the Oklahoma Corporation Commission. These data consist of information on exploratory drilling wells that were spudded long before my sample period, and which identify discovered oil fields. I use these data to identify and exclude counties with little oil potential from my dataset, leaving a total of 60 (out of an original 77) counties of data in Oklahoma for the various items described above. I also use this data to construct a measure of oil-rich counties, which I use in robustness checks.

1.2.5 Summary Statistics

[Insert Table 1-1 Here]

Table 1-1 presents summary statistics for the main variables. For the average county in a given year in my sample, about 33% of farmers sign mineral leases to their land, and thus own the mineral rights to their land. However, there is a significant amount of heterogeneity between counties in terms of the proportion of farmers who sign mineral leases. I exploit this heterogeneity in my empirical tests. The average price of farmland is roughly $1,100 to $1,200 per acre over the sample period. Since farmers may receive fracking lease payments that are up to a few thousand dollars per acre, entering into a fracking lease affords a farmer the opportunity to purchase a significant amount of farmland. Consistent with this, the total amount of land purchased at the county-level is about 3,302 acres on average in any given year.

Wheat is the main production crop in Oklahoma, and the average county devotes 102,096 acres to growing wheat, producing roughly 2.185 million bushels of wheat. Wheat yield, a standard measure of crop productivity in the agricultural sector, also shows considerable variation across counties—ranging from roughly 25 bushels/acre in the 25th percentile to about 35.5 bushels/acre in the 75th percentile.

A potential concern in this diff-in-diff setting is that the control group and the treatment group are not comparable—in other words, that my measure of mineral ownership is not randomly assigned, but rather is correlated with some other outcome. To investigate this, I examine observable characteristics of counties with high farm mineral ownership and low farm mineral ownership, and test whether these characteristics differ significantly in my pre-period. *Table 1-2* provides this comparison, showing the difference between the two groups of counties, and whether the difference is significant.[36] In terms of total farm acreage, cropland, farm production expenditures, government payments, number of farms, and average farm size, there is *no* significant difference between counties in the high farm mineral rights groups compared to counties in the low farm mineral rights group. I also examine two proxies for financial constraints—county-level net income per acre of farmland and loan-to-value (LTV)—to test whether the financial constraints of both groups are roughly the same prior to the arrival of fracking. There is no significant difference between these two measures

[36]This is accomplished by running a regression at the county-year level, with the characteristic of interest as the dependent variable and $High Farm Minerals_i$ as the independent variable. Year fixed effects are included in the regression.

as well, which suggests that the treatment and control groups are comparable based on observable characteristics.

[Insert Table 1-2 Here]

1.3 Empirical Results

This section contains the main empirical results. I begin by showing that counties where farmers enter into mineral leases from fracking, and thus receive large cash inflows, subsequently purchase more land relative to other counties. I then show that this purchasing behavior drives a reallocation of land in these counties from less-efficient to more-efficient users, and productivity increases as a result. I finally show how this affects the price of farmland, farm equipment purchases, and the amount of farm debt in the local area.

1.3.1 Purchasing Behavior by Farmers

When a farmer enters into a mineral lease with a fracking operator, the farmer receives a large upfront cash payment. Such a liquidity inflow relaxes the farmer's cash constraints, thus allowing the farmer to invest more by purchasing more farmland. *Figure 1-3* graphically demonstrates this purchasing behavior, and also examines whether the outcome variables exhibit parallel trends prior to the entry of fracking, which is a crucial assumption of the diff-in-diff framework. The top graph compares the total number of purchases of land (both vacant land and farmland) in counties where numerous farmers own mineral rights (and entered into fracking leases) compared to counties where relatively few farmers own mineral rights. Before the arrival of fracking, the number of purchases for both sets of counties moved in similar ways (apart from a one-time jump from 1999 to 2000), suggesting that the parallel trends assumption for the diff-in-diff holds in this situation. Following the arrival of fracking in Oklahoma in 2005, farmers in the counties with a high proportion of farm mineral leases (given by the solid blue line) engaged in more land purchases than farmers in counties with a low proportion of farm mineral leases (given by the dashed red line). In a similar vein, the bottom graph compares the total number of acres purchased by farmers in each type of county. Once again, before the entry of fracking, the acreage purchased by farmers in both types of counties run in parallel. Following the arrival of fracking, the farmers in counties with high mineral ownership purchased more land than farmers in other counties.

[Figure 1-3 Here]

The corresponding regression results are given in *Table 1-3*. Columns (1) and (2) show the results for the number of land purchased by farmers, while columns (3) and (4) show the results for the total number of acres purchased by farmers. In the specifications both with and without fixed effects, the coefficients on the diff-in-diff estimators $High\,Farm\,Minerals_i \times Fracking\,Entry_t$ are positive and significant. This indicates that farmers in counties with high farm mineral rights ownership significantly increased both their number of purchases and acres purchased relative to farmers in other counties. The interpretation of the coefficients is that farmers in counties with high farm mineral ownership engaged in roughly 18% more purchases, on average, following the entry of fracking than farmers in counties with low farm mineral ownership. Similarly, farmers in counties with high farm mineral ownership purchased about 50% more acres of land following the entry of fracking than farmers in counties with low farm mineral ownership. Overall, these results are consistent with farmers using their cash payments to invest in more farmland.[37]

[Table 1-3 Here]

1.3.2 Reallocation Effects

I now more closely examine this purchasing behavior by farmers, and show that it generates a reallocation of land from less-efficient to more-efficient users. I show that the reallocation effect operates via two different channels: a reallocation of farmland between farmers located in areas of differing productivity, and a reallocation of undeveloped land from other "outside" users to farmers.

1.3.2.1 Cross-county Purchases by Farmers in High- and Low-Yield Counties

I first examine purchases of land between farmers, to provide evidence of a reallocation of farmland from low-productivity to high-productivity farming areas. The intuition behind this effect is that higher-productivity farmers, when they experience a relaxation of their financial constraints, will seek out additional farmland to purchase. Since these farmers place a higher value on farmland than lower-productivity farmers (as they are able to extract higher cash flows from the land), it is expected that higher-productivity farmers will purchase farmland from lower-productivity farmers.

In order to explore this, I examine cross-county purchases of farmland in low-productivity counties by farmers residing in either high- or low-productivity counties.[38] If the reallocation channel holds, then farmers residing in high-yield counties (with high farm mineral ownership) should be expected to increase their purchases of farmland from farmers residing in low-yield counties, relative to other counties. Specifically, I run the following triple differences (diff-in-diff-in-diff) regression:

$$\begin{aligned} \log\left(Purchases_{i,t}\right) &= \beta_0 + \beta_1\left(High\,Farm\,Minerals_i \times High\,Yield_i \times Fracking\,Entry_t\right) \\ &\quad + \beta_2\left(High\,Farm\,Minerals_i \times Fracking\,Entry_t\right) \\ &\quad + \beta_3\left(High\,Yield_i \times Fracking\,Entry_t\right) \\ &\quad + \left(Controls\right)_{i,t} + \gamma_i + \eta_t + \varepsilon_{i,t}. \end{aligned} \tag{2}$$

In (2), $High\,Yield_i$ is a dummy variable which takes a value of 1 if the buyer's county has an average yield in the period from 1990 to 1999 that is above the median across all

[37]The data allow the analysis to also be run at the individual farm level, comparing farmers who own mineral rights to farmers who do not own mineral rights. *Figure 1-B2* and *Table 1-B3* of the Appendix examine the difference between these groups of farmers before and after the arrival of fracking. The results are consistent with the county-level results.

[38]This analysis must be done at the county-level, since production and productivity data are not available at a more granular level.

counties, and 0 otherwise. $Purchases_{i,t}$ represents the total acreage of cross-county farmland purchases in low-productivity counties (defined as counties where $HighYield_i = 0$). $High\,Farm\,Minerals_i$ is defined as before. β_1 is therefore the diff-in-diff-in-diff estimator, which gives by how much more farmers in high-yield counties (with substantial farm mineral ownership) increased purchases in other low-yield counties. If the reallocation channel holds, then β_1 should be positive and significant.

Figure 1-4 shows cross-county purchases in low-yield counties over time by farmers in high-yield versus low-yield counties.[39] The top graph shows purchases by farmers in counties with high farm-mineral-ownership, while the bottom graph shows purchases by counties with low farm-mineral-ownership. In the top graph for counties with high farm-mineral-ownership, purchases of low-yield farmland by farmers in high-yield and low-yield counties run in parallel prior to the entry of fracking, but then the purchases of high-yield counties increase while the purchases of the low-yield counties stay flat. In the bottom graph, for counties in low farm mineral counties, there does not appear to be any significant difference between high-yield and low-yield counties. These graphs suggest that the parallel trends assumption holds for (2), and the trends after the entry of fracking are also consistent with the reallocation channel—farmers in high-yield counties increase their purchases from farmers in low-yield counties (where the farmland is, on average, lower-productivity) when they receive money from mineral leases, while farmers who do not receive mineral leases do not change their behavior.

[Figure 1-4 Here]

Table 1-4 estimates the regression results corresponding to the figure. Columns (1) through (4) run the diff-in-diff conditional on counties with high or low farm mineral ownership, and show that $HighYield_i \times Fracking\,Entry_t$ is significant only for counties with high mineral ownership. Columns (5) and (6) run the triple differences regression. β_1 is positive in both columns, and while it is insignificant in column (6), it is significant in column (5).[40]

[Insert Table 1-4 Here]

Overall, these findings are consistent with a reallocation effect from less-efficient to more-efficient farmers. Moreover, these results suggest that the effects are not being driven by an agency problem, such as empire building (e.g. Jensen (1986)). For example, farmers may derive utility from simply expanding their farms using the excess money they receive, even though such investment may not be productively efficient. If farmers do simply expand their operations due to agency problems, then both high-yield and low-yield farmers who receive mineral leases should increase their purchases (purchasing whatever land they are able to). However, if the purchasing behavior is part of an efficient reallocation effect, then high-yield farmers (those who are able to utilize farmland more efficiently) should be expected to purchase from low-yield farmers, which is what I find.[41]

[39]For the low-yield counties, only purchases in other low-yield counties outside the buyer's county are included.

[40]The results in *Table 1-4* only consider county-year observations with positive purchases in low-productivity counties. Alternatively, when including observations with zero purchases, the triple-diff estimator is positive and significant with fixed effects.

[41]Another question that arises is whether the counties are high- or low-productivity because of skill-based

1.3.2.2 Purchases of Vacant Land

A second reallocation channel is a reallocation of land from non-farm users to farmers. More specifically, farmers who are interested in purchasing additional land primarily demand open land that is suitable for either crop production or livestock grazing. While farmers may specifically purchase land that is already used as farmland, they may also purchase vacant (undeveloped) land. Such a purchase can be viewed as a transfer from a less-efficient user of the land to a more-efficient user—the vacant land, previously not put to any productive use in the hands of an "outside" user, is transferred to an "expert" user (in a Shleifer and Vishny (1992) sense) who is able to extract cash flows from the land by converting it into farmland. Indeed, since most farmers live in remote or rural areas, farming is often the most efficient use of land in that area (as it has little alternative commercial applicability).

Figure 1-5 examines total acres of vacant land purchased by farmers. Before the arrival of fracking, the amount of vacant land purchased by farmers in high-farm-mineral-ownership counties runs in parallel to the amount of vacant land purchased by farmers in low-farm-mineral-ownership counties. However, subsequent to the arrival of fracking, the purchases by the high-farm-mineral-ownership counties increase by substantially more than the purchases by the low-farm-mineral-ownership counties. *Table 1-5* confirms this statistically, showing the diff-in-diff estimation results. The coefficient on the diff-in-diff estimator without fixed effects is positive and significant. While the coefficient on the estimator with fixed effects is marginally insignificant, it is also positive. This confirms that farmers in high-farm-mineral-ownership counties increased their purchases of vacant land by significantly more than farmers in other counties (roughly 47% more) following the arrival of fracking, indicating a reallocation of land to the users who are able to extract a better, more productive use of the land.

[Figure 1-5 Here]

[Table 1-5 Here]

1.3.2.3 Crop Production, Productivity, and Profits

An important implication of this reallocation of assets is that it should be reflected in agricultural crop production and productivity. In other words, given that land is transferred from vacant landholders (who do not have a productive use of the asset) to farmers (who are able to use the asset for farming), areas that experience more of these transfers should also show expanded agricultural crop acreage under cultivation, production, and productivity. Moreover, to the extent that farmland is reallocated from lower-productivity farmers to higher-productivity farmers within counties when farmers are given a cash flow shock that relaxes their constraints, this effect is likely to be amplified.

differences on the part of farmers, or due to characteristics of the land itself (such as soil quality). The results are consistent with skill-based differences between farmers driving the results, thus facilitating the interpretation as an efficient reallocation effect. In particular, if innate characterstics of the land were the main driver behind the differences in productivity, then one would expect that farmers in low-productivity counties to purchase land from farmers in high-productivity counties (which would have better soil quality), which is not what I observe in the data.

Figure 1-6 examines crop production, acres under cultivation, and productivity before and after the arrival of fracking. I examine these outcomes for wheat, as it is the primary crop grown in Oklahoma. Average wheat production for high- and low-farm-mineral-ownership counties follow parallel trends before the arrival of fracking, with high-farm-mineral-ownership counties having lower production on average. However, after the arrival of fracking, the gap between the two types of counties disappears, and from 2008 and onward the production of the high farm mineral ownership counties overtakes the low farm mineral ownership counties. For wheat acres under cultivation, counties with high-farm-mineral-ownership grow fewer acres of wheat than other counties (but move in parallel) before the entry of fracking, but then surpass the other counties by dramatically increase their acreage under cultivation following the entry of fracking. The net effect is that the productivity gap between the types of counties shrinks—the average wheat yield for the high farm mineral ownership counties is below that for other counties prior to the entry of fracking, but then increases subsequently to the same level as the other counties.

[Figure 1-6 Here]

Table 1-6 provides the diff-in-diff regression results. The diff-in-diff estimator for wheat production is positive and significant both with and without fixed effects. The coefficient indicates that counties with high farm mineral ownership increased their production by about 18% compared to other counties after the entry of fracking. The diff-in-diff estimator for wheat acres is positive both with and without fixed effects, although it is significant only without fixed effects. The magnitude indicates that counties with high farm mineral ownership increased their wheat acres under cultivation by 7.7% compared to other counties after the entry of fracking. Finally, the diff-in-diff estimator for wheat yields is positive and significant both with and without fixed effects. The magnitude indicates that counties with high farm mineral ownership experienced an increase in yield of about 2.1-2.5 bushels/acre after the arrival of fracking compared to other counties; when compared to a mean yield of roughly 30 bushels/acre over the sample period, this corresponds to a relative productivity increase of about 7-10%.

[Insert Table 1-6 Here]

Finally, these effects for production and productivity should also translate into higher profits, a hypothesis that I now examine. Columns (7) and (8) in *Table 1-6* show the diff-in-diff regression results for farm profitability, which is defined as the sum of the two types of revenue minus production expenses and government subsidy payments, scaled by the number of acres of farmland in the county.[42] The diff-in-diff estimator is positive and significant for both columns, showing that profits per acre increased for counties with high farm mineral ownership relative to other counties following the arrival of fracking. The magnitude indicates that profits per acre increased by about $16/acre more for the treatment group relative to the control group after fracking arrived, which represents a roughly 12-15% increase in profits relative to the control group based on the average.

[42]Production expenses are inclusive of machinery purchase and lease expenses, as well as depreciation.

Overall, these increases in production, acreage under cultivation, productivity, and profitability are consistent with an efficient reallocation of assets following the relaxation of financial constraints.[43]

1.3.3 Effect on Land Prices

I now explore how the relaxing of financial constraints due to the positive liquidity shock provided by fracking affects asset prices, by estimating regression (1) using county farmland values as the dependent variable. Farmland values are measured in terms of the dollar price per acre of farmland, a standard scaling in the agricultural economics literature, and only include the value of *surface* rights. As a result, these values do *not* include any of the expected cashflows from fracking lease payments. *Figure 1-7* explores graphical evidence of the effect at two different geographical levels—the top graph depicts the effect for at the county-level, while the bottom graph depicts the effect at the zip-code-level.[44] Overall, until 2004, the price of farmland for both counties where numerous farmers own mineral rights runs parallel to the price of farmland for counties where relatively few farmers own mineral rights. However, starting in 2005, the price of farmland for counties with numerous farm mineral leases increases by more than for the other counties. This is also the case when the effect is examined at the zip-code-level. These results graphically confirm that the parallel trends assumption is likely to hold in this situation, and demonstrate the price impact related to the arrival of fracking.

[Figure 1-7 Here]

Table 1-7 provides the regression results for (1). Columns (1) and (2) contain county-level estimates, while columns (3) and (4) contain zip-code-level estimates. Overall, across all specifications, the diff-in-diff estimator is positive and significant. The magnitudes of the coefficients indicate that the land prices of areas with high farm mineral ownership increased by about \$220 to \$435 more per acre on average (depending on the level on analysis) after the arrival of fracking than did the land prices in other areas. With a mean sales price across the sample of roughly \$1,200, this represents a significant price impact of roughly 20-40% compared to the control group.

This price effect is consistent with the mechanisms of a reallocation effect following a relaxation of financial constraints. In particular, land is being transferred from less-efficient users to more-efficient users, who are able to extract higher cash flows from the land. Given the fact that the market for farmland is localized and farmers have expertise on local growing conditions as well as a network of local relationships that may enhance farm productivity, the price of farmland is driven up once financial constraints are relaxed. And to the extent that

[43] *Table 1-B4* of the Appendix additionally shows that these effects for production, acreage under cultivation, and productivity are stronger for counties that were more financially constrained before the arrival of fracking (when using net income as a proxy for financial constraints), using a triple-diff specification. This provides additional empirical evidence that financial constraints are driving the effects I observe.

[44] For constructing these averages, in order to omit the bias of extreme values, I exclude farmland purchases that are less than 30 acres and also have a sales price of greater than \$6,000 per acre. This is consistent with the methodology of agricultural land price surveys (see Oklahoma State University Agricultural Land Values, for example).

the pre-liquidity-shock farmland prices were depressed due to binding financial constraints, these prices rise by a greater percentage than the productivity gain from asset reallocation, as explained earlier. This effect is also consistent with a "cash-in-the-market" pricing effect (e.g. Allen and Gale (1994)), as well as the underlying mechanisms of fire sales (e.g. Shleifer and Vishny (1992, 1997)).[45]

[Table 1-7 Here]

1.3.4 Other Investment: Farm Equipment

I next look at farm machinery purchases, in order to examine other farm investments that farmers may undertake following the relaxation of their financial constraints. *Figure 1-8* graphs the number of new farm equipment purchases for counties where many farmers own mineral rights compared to counties where few farmers own mineral rights, around the arrival of fracking. The figure shows that, prior to the arrival of fracking, the farmers in the high-farm-mineral-ownership counties purchased less farm equipment than farmers in the low-farm-mineral-ownership counties (and the purchases of the two groups ran in parallel). Following the arrival of fracking, the purchases of farmers in the high-farm-mineral-ownership counties increases relative to the purchases of farmers in the low-farm-mineral-ownership counties, reducing the gap between the two groups.

[Figure 1-8 Here]

Table 1-8 provides diff-in-diff regression results that confirm that this difference is significant. In particular, the coefficients indicate that counties with high farm mineral ownership increased their number of farm equipment purchases by roughly 16% compared to other counties after the entry of fracking. These results indicate that farmers whose financial constraints are relaxed due to the fracking shock subsequently invest in additional new farm machinery. This is consistent with the results on land purchases previously shown. In particular, since farmers are expanding their land holdings, it is economically intuitive that they are also investing more in farm equipment in order to farm the new land.

[Table 1-8 Here]

1.3.5 Effect on Farm Debt

I now explore how farmers adjust their borrowing behavior in response to relaxed financial constraints. Ex antė the theoretically-predicted effect is not clear-cut. On the one hand, farmers may be predicted to increase the amount of debt that they hold. In particular, if the tradeoff theory of capital structure holds, then a cash infusion that increases the farmer's net

[45]This result is also consistent with Weber and Hitaj (2014), who document that self-reported farmland value estimates increased in areas with fracking in Texas and Pennsylvania. My analysis differs as I use yearly farmland sales data, rather than self-reported Agricultural Census data (which are only available at 5-year intervals), and I also exploit cross-sectional variation in mineral rights ownership. In addition, my results a specific rationale for the increase in farmland value related to the reallocation of farmland across users of different efficiency.

worth should cause him to borrow more to return to his target leverage ratio. Put differently, an increase in liquidity and net worth will lead to a higher debt capacity, and thus farmers may be able to optimally take on more debt. On the other hand, farmers may reduce their borrowing if they are financially constrained and view themselves as being over-leveraged. They may also want to reduce their debt due to debt overhang problems (i.e. Myers (1977)). With large liquidity injections, farmers may be able to get rid of some costly external funding and still have money left over for desired investments. Another possible reason why farmers may want to reduce their debt now is due to the anticipation of future fire sales—if fire sales are expected in the future that farms would want to take advantage of to buy assets at cheap prices, and they believe that debt overhang may prevent them from raising capital later, then farmers may want to reduce their debt now (see Shleifer and Vishny (2011)).

Figure 1-9 examines farm real estate debt around the entry of fracking. Debt is measured as debt per acre of farmland in order to scale for size, as a typical measure of total assets is not readily available for farms.[46] As can be seen from the figure, counties with high farm mineral ownership maintain roughly flat debt after the arrival of fracking, while other counties increase their debt. However, it should be noted from the figure that the parallel trends assumption may not hold very well for farm debt, so some caution should be taken in interpreting these debt results. *Table 1-8* presents the corresponding regression results. In columns (1) and (2), the diff-in-diff estimator is negative, and it is significant in column (1) though marginally insignificant in column (2). This suggests that farmers use the liquidity they receive from mineral leases to partly reduce the amount that they need to borrow compared to other farmers.[47]

[Figure 1-9 Here]

[Table 1-9 Here]

In addition, the fact that debt does not increase for the counties with high farm mineral ownership prior to the arrival of fracking indicates that farmers did not seem to anticipate the boost in their income from fracking. In particular, had farmers anticipated the income from fracking leases, they would be predicted to borrow more before the arrival of fracking (with the knowledge that they would be able to pay off the debt after receiving the additional liquidity shock).

1.4 Robustness

In this section, I present a number of robustness checks for the main results.

[46] The results are similar when examining aggregate debt instead of debt per acre of farmland.

[47] This is also consistent with Bertrand and Morse (2009), who show that payday borrowers—who are among the most financially constrained—significantly reduced their borrowing after receiving tax rebates in 2008.

1.4.1 Effects Amongst Non-farm Vacant Landholders: Checking for Wealth Effects

While the results that have been presented are consistent with an efficient reallocation of assets following the reduction of financial constraints, it could also possibly be driven by a wealth effect. In particular, a wealth effect would predict that, if agents hold some sort of idiosyncratic asset, a large shock to wealth would induce agents to purchase more of the asset because they are richer. While the output and productivity results presented earlier are inconsistent with this effect being the driving force, I attempt to explicitly rule this channel out by examining the effects for non-farm vacant landholders as a placebo test.

More specifically, while farmers are the specialist, most efficient users of farmland (and thus there is a participation cost to entering the agricultural marketplace), vacant landholders (who are not farmers) are simply the holders of an asset which is currently not in productive use. As a result, while a wealth effect would predict that *both* farmers and non-farm vacant landholders will purchase additional land following a cash flow shock, a reallocation effect would predict that the effects documented for farmers should *not* apply to vacant landholders.

In order to test this channel, I examine purchases of land by non-farm vacant landholders, as well as the sales prices of these transactions. *Figure 1-10* graphically shows purchases of vacant land by non-farm vacant landholders (the left two figures) and the sales prices of these transactions (the right figure). In this case, I identify counties based on whether many non-farm *vacant landholders* own mineral rights, as opposed to whether many farmers own mineral rights. The solid blue lines represent counties where the proportion of vacant landholders who own mineral rights is above the median, while the red dashed lines represent counties where the proportion of vacant landholders who own mineral rights is below the median. For both sets of counties in Panel A, the number of vacant land purchases and total acres of vacant land purchased by vacant landholders run in parallel, with no noticeable change after the entry of fracking. Similarly, in Panel B, there is no significant difference between the two sets of counties in terms of sales price per acre.

[Figure 1-10 Here]

Table 1-10 shows the corresponding regression results, and confirms that the diff-in-diff estimator is insignificant for all three variables across all specifications. These results provide evidence that the effects I document are not driven by a wealth effect.

[Table 1-10 Here]

1.4.2 Falsification Test

Another concern is that the results are driven by some sort of long-term trend in the relationships between the variables of interest in the counties with high farm mineral rights ownership and those variables in the counties with low mineral rights ownership. If this is the case, then the effects on productivity and prices that I document are not unique to the sample period I consider (i.e. not caused by the entry of fracking). In order to rule out this possibility, I run a falsification test. The test involves examining acres purchased by farmers, wheat production, acres under cultivation, wheat yield, and farmland sales prices during the period from 1990 to 2000, while falsely specifying the year of the entry of fracking as 1995.

Figure 1-11 graphically shows these outcomes for counties with high and low farm-mineral-rights ownership. The two groups follow a parallel pattern in terms of acres purchased, wheat production, acres under cultivation, and yield for the entire sample period. For farmland sales prices, while there appears to be a difference between the two groups in 1990 and 1991, starting in 1992 the two groups follow a very similar pattern with no substantial change after 1996. *Table 1-11* confirms this statistically, as the diff-in-diff estimator for each outcome is insignificant. Thus, these results suggest that the reallocation effect is a result of the entry of fracking around 2005, and not due to some trends over time between the counties.

[Figure 1-11 Here]

[Table 1-11 Here]

1.4.3 High versus Low Oil Counties: Possible Effects of Local Economic Activity

Another possible channel which may be driving my results is local economic activity which is generally related to the entry of fracking. More specifically, when fracking arrives in an area, the local economy may improve (see Currie, Deutch, Greenstone, and Bartik (2014) and Feyrer, Mansur, and Sacerdote (2015), for example). This can affect labor costs, which may in turn affect production and productivity. In addition, there may be more of a demand for land from real estate developers, looking to build housing for oil drill workers and others who may move in due to the fracking boom, and this could increase the price of farmland through a channel distinct from reallocation.

If this channel is driving my results, then counties with the greatest amount of oil beneath the land (and therefore experiencing the highest fracking activity) should experience the largest effects. In other words, the mineral rights ownership of farmers should not matter, and any effect of farm mineral rights ownership should be driven by an incidental correlation with general fracking activity. In order to examine this, I run the following diff-in-diff regression:

$$\begin{aligned} Y_{i,t} &= \beta_0 + \beta_1 \left(High\,Oil_i \times Fracking\,Entry_t \right) \\ &\quad + \left(Controls \right)_{i,t} + \gamma_i + \eta_t + \varepsilon_{i,t}. \end{aligned} \tag{3}$$

In (3), $High\,Oil_i$ is a dummy variable which takes a value of 1 if the county has high oil potential, defined as a county that is above-median in terms of discovered oil fields, and a value of 0 otherwise. The local economic activity channel implies that the diff-in-diff estimator β_1 should be positive and significant.

Table 1-12 gives the results for acres of land purchased by farmers, wheat production, acres under cultivation, yields, and farmland prices. For each variable, the diff-in-diff estimator is insignificant.[48] Overall, this provides evidence against the channel of local economic

[48]The results are unchanged if I use a measure of the number of total fracking leases in a county instead of oil potential.

activity, and suggests that conditioning specifically on farm mineral rights ownership (rather than simply fracking intensity) is critical for my results.

[Table 1-12 Here]

1.5 Conclusion

The misallocation of assets across firms that differ in the productivity with which they deploy assets can lead to distortions in investment. Such misallocation may be due to financial constraints. A positive liquidity shock for some producers can relax their financial constraints, allowing them to increase their investment and reduce misallocation. I examine the effect of such a shock by exploiting a quasi-natural experiment: the entry of hydraulic fracturing (fracking) into Oklahoma in the mid-2000s, and its effect on farmers. Since farmers who own the mineral rights to their land receive exogenous cash windfalls as a result of fracking leases while others do not, this creates a unique heterogeneity which allows me to conduct a clean empirical test.

My main results are that areas with numerous farmers who receive such liquidity shocks increase their investment in farmland compared to areas with relatively few such farmers. These purchases of farmland generate a reallocation effect that operates through two channels. The first channel is a reallocation between farmers, whereby farmers in high-productivity areas purchase more from farmers in low-productivity areas when they receive such a liquidity shock. The second channel is a reallocation from non-farm users to farmers—farmers increase their purchases of vacant (undeveloped) land. Both of these channels are consistent with a reallocation of assets from less-productive to more-productive users. In line with this, I find that crop production, acreage under cultivation, crop growing productivity, and farm profits increase in areas where numerous farmers receive liquidity shocks compared to other areas. In addition, I show that the price of farmland goes up in these areas, in line with various theories and a "cash-in-the-market" pricing effect. Finally, there are also capital expenditure and leverage effects. Farmers in these areas also use the extra liquidity to increase equipment purchases and borrow less compared to other farmers. I rule out a number of alternative channels that may drive the results.[49]

My paper adds to the literature on the importance of financial constraints, and how alleviating them may improve productivity and raise asset prices in an area, which in turn has broader implications for economic growth. While focusing on a particular sector (agriculture) allows for a cleaner empirical test, it also raises a question about external validity. On this issue, I note that the agricultural sector is also appealing because farms can be viewed as small firms, each with business operations that are analogous to more "traditional" firms that most papers examine. Indeed, U.S. farmers have many characteristics that make the lessons learned from studying them generalizable to a variety of other small (privately-held) businesses and even households. First, they operate in an industry in which there is a

[49]Taken together, my results can be sensibly interpreted only in the context of pre-liquidity-shock financial constraints. Note that absent financial constraints, liquidity shocks are unlikely to have real effects. For example, Mian and Sufi (2012) show that the "cash for clunkers" fiscal stimulus program has a very short-lived effect on automobile purchases, and no effect on employment and house prices.

non-trivial difference in productivity between expert users (local farmers) and non-expert (outside-of-the-industry) users (owners of vacant land). Many industries have this feature (e.g. biotechnology), and indeed this feature corresponds to a key assumption in the fire sales model of Shleifer and Vishny (2011). Second, farmers can raise external financing principally by borrowing—they have traditionally not been issuers of (private) equity. This is a ubiquitous feature of private firms and households. Third, there is cross-sectional heterogeneity in productivity across farmers, as well as financial constraints that cause a misallocation of resources. This is quite common in many other industries, including those in other countries (e.g. Hsieh and Klenow (2009)), so it is also relevant for international comparisons. As a result, my results can be viewed as having external validity beyond just the agricultural sector.

References

[1] Agarwal, Sumit, Chunlin Liu, and Nicholas S. Souleles. "The Reaction of Consumer Spending and Debt to Tax Rebates—Evidence from Consumer Credit Data." *Journal of Political Economy* 115, no. 6 (2007).

[2] Allen, Franklin, and Douglas Gale. "Limited Market Participation and Volatility of Asset Prices." *American Economic Review* 84, no. 4 (1994): 933-955.

[3] Allen, Franklin, and Douglas Gale. "Financial Fragility, Liquidity, and Asset Prices." *Journal of the European Economic Association* 2, no. 6 (2004): 1015-1048.

[4] Allen, Franklin, and Douglas Gale. "From Cash-In-The-Market Pricing To Financial Fragility." *Journal of the European Economic Association* 3, no. 2-3 (2005): 535-546.

[5] Almeida, Heitor, and Murillo Campello. "Financial constraints, asset tangibility, and corporate investment." *Review of Financial Studies* 20, no. 5 (2007): 1429-1460.

[6] Almeida, Heitor, Murillo Campello, and Michael S. Weisbach. "The cash flow sensitivity of cash." *The Journal of Finance* 59, no. 4 (2004): 1777-1804.

[7] Almeida, Heitor, and Daniel Wolfenzon. "The effect of external finance on the equilibrium allocation of capital." *Journal of Financial Economics* 75, no. 1 (2005): 133-164.

[8] Amihud, Yakov, Haim Mendelson, and Lasse Heje Pedersen. "Liquidity and Asset Prices." *Foundations and Trends in Finance* 1, no. 4 (2006): 269-364.

[9] Andrews, Anthony. *Unconventional gas shales: development, technology, and policy issues.* Diane Publishing, 2010.

[10] Bartik, Alexander W., Janet Currie, Michael Greenstone, and Christopher Knittel. "The Local Welfare Consequences of Hydraulic Fracturing". Working paper, 2014.

[11] Bertrand, Marianne, and Adair Morse. "What Do High-Interest Borrowers Do with Their Tax Rebate?." *American Economic Review* 99, no. 2 (2009): 418-23.

[12] Bertrand, Marianne, Antoinette Schoar, and David Thesmar. "Banking deregulation and industry structure: Evidence from the French banking reforms of 1985." *The Journal of Finance* 62, no. 2 (2007): 597-628.

[13] Blanchard, Olivier Jean, Florencio Lopez-de-Silanes, and Andrei Shleifer. "What do firms do with cash windfalls?." *Journal of Financial Economics* 36, no. 3 (1994): 337-360.

[14] Bolton, Patrick, and David S. Scharfstein. "A Theory of Predation Based on Agency Problems in Financial Contracting." *The American Economic Review* 80, no. 1 (1990): 93-106.

[15] Butler, Alexander W., and Jess Cornaggia. "Does access to external finance improve productivity? Evidence from a natural experiment." *Journal of Financial Economics* 99, no. 1 (2011): 184-203.

[16] Campello, Murillo, John R. Graham, and Campbell R. Harvey. "The real effects of financial constraints: Evidence from a financial crisis." *Journal of Financial Economics* 97, no. 3 (2010): 470-487.

[17] Covert, Thomas. "Experiential and social learning in firms: the case of hydraulic fracturing in the Bakken Shale." Available at SSRN 2481321 (2014).

[18] Bartik, Alexander, Janet Currie, John Deutch, and Michael Greenstone (2014). "The Effects of Fracking on Welfare: Evidence from Property Values." Work in progress.

[19] Eisfeldt, Andrea L., and Adriano A. Rampini. "Capital reallocation and liquidity." *Journal of Monetary Economics* 53, no. 3 (2006): 369-399.

[20] Farre-Mensa, Joan, and Alexander Ljungqvist. "Do measures of financial constraints measure financial constraints?." *Review of Financial Studies* 29, no. 2 (2016): 271-308.

[21] Fazzari, Steven M., Robert G. Hubbard, and Bruce C. Petersen. "Financing Constraints and Corporate Investment." *Brookings Papers on Economic Activity* 1988, no. 1 (1988): 141-195.

[22] Fee, C. Edward, Charles J. Hadlock, and Joshua R. Pierce. "Investment, financing constraints, and internal capital markets: Evidence from the advertising expenditures of multinational firms." *Review of Financial Studies* 22, no. 6 (2009): 2361-2392.

[23] Feyrer, James, Erin T. Mansur, and Bruce Sacerdote. "Geographic Dispersion of Economic Shocks: Evidence from the Fracking Revolution." NBER Working Paper No. 21624, 2015.

[24] Garmaise, Mark J. "Production in entrepreneurial firms: The effects of financial constraints on labor and capital." *Review of Financial Studies* 21, no. 2 (2008): 543-577.

[25] Gilchrist, Simon, Jae W. Sim, and Egon Zakrajšek. "Misallocation and financial market frictions: Some direct evidence from the dispersion in borrowing costs." *Review of Economic Dynamics* 16, no. 1 (2013): 159-176.

[26] Gilje, Erik, Elena Loutskina, and Philip E. Strahan. "Exporting liquidity: Branch banking and financial integration." No. w19403. National Bureau of Economic Research, 2013.

[27] Giroud, Xavier, and Holger M. Mueller. "Capital and labor reallocation within firms." *The Journal of Finance* (2015).

[28] Hadlock, Charles J., and Joshua R. Pierce. "New evidence on measuring financial constraints: Moving beyond the KZ index." *Review of Financial Studies* 23, no. 5 (2010): 1909-1940.

[29] Hart, Oliver, and J. Moore. "A Theory of Debt Based on the Inalienability of Human Capital." *The Quarterly Journal of Economics* 109, no. 4 (1994).

[30] Hartarska, Valentina M., and Chi Mai. "Financing Constraints and the Family Farm: How do Families React?." No. 6861. Southern Agricultural Economics Association, 2008.

[31] Hartarska, Valentina, and Dennis Nadolnyak. "Financing Constraints and Access to Credit in a Postcrisis Environment: Evidence from New Farmers in Alabama." *Journal of Agricultural and Applied Economics* 44, no. 04 (2012): 607-621.

[32] Holmström, Bengt, and Jean Tirole. "LAPM: A Liquidity-Based Asset Pricing Model." *The Journal of Finance* 56, no. 5 (2001): 1837-1867.

[33] Holmström, Bengt, and Jean Tirole. *Inside and outside liquidity.* MIT Press, 2011.

[34] Hsieh, Chang-Tai, and Peter J. Klenow. "Misallocation and Manufacturing TFP in China and India." *The Quarterly Journal of Economics* 124, no. 4 (2009): 1403-1448.

[35] Huang, Jennifer, and Jiang Wang. "Market Liquidity, Asset Prices, and Welfare." *Journal of Financial Economics* 95, no. 1 (2010): 107-127.

[36] Jensen, Michael C. "Agency cost of free cash flow, corporate finance, and takeovers." Corporate Finance, and Takeovers. *American Economic Review* 76, no. 2 (1986).

[37] Kaplan, Steven N., and Luigi Zingales. "Do Investment-Cash Flow Sensitivities Provide Useful Measures of Financing Constraints?." *The Quarterly Journal of Economics* 112, no. 1 (1997): 169-215.

[38] Karlan, Dean, Robert Osei, Isaac Osei-Akoto, and Christopher Udry. "Agricultural Decisions after Relaxing Credit and Risk Constraints." *The Quarterly Journal of Economics* 129, no. 2 (2014).

[39] Khanna, Naveen, Steve L. Slezak, and Michael Bradley. "Insider trading, outside search, and resource allocation: why firms and society may disagree on insider trading restrictions." *Review of Financial Studies* 7, no. 3 (1994): 575-608.

[40] Krauss, Clifford, and Eric Lipton. "U.S. Inches Toward Goal of Energy Independence". *The New York Times*, March 22, 2012.

[41] Krishnan, Karthik, Debarshi K. Nandy, and Manju Puri. "Does Financing Spur Small Business Productivity? Evidence from a Natural Experiment." *Review of Financial Studies* 28, no. 6 (2015): 1768-1809.

[42] Lamont, Owen. "Cash Flow and Investment: Evidence from Internal Capital Markets." *The Journal of Finance* 52, no. 1 (1997): 83-109.

[43] Lemmon, Michael, and Michael R. Roberts. "The Response of Corporate Financing and Investment to Changes in the Supply of Credit." *Journal of Financial and Quantitative Analysis* 45, no. 03 (2010): 555-587.

[44] Levine, Ross. "Financial Development and Economic Growth: views and Agenda." *Journal of Economic Literature* 35, no. 2 (1997): 688-726.

[45] Maksimovic, Vojislav, and Gordon Phillips. "The Market for Corporate Assets: Who Engages in Mergers and Asset Sales and Are There Efficiency Gains?." *The Journal of Finance* 56, no. 6 (2001): 2019-2065.

[46] Mian, Atif, and Amir Sufi. "The Effects of Fiscal Stimulus: Evidence from the 2009 'Cash for Clunkers' Program." *The Quarterly Journal of Economics* 127, no. 3 (2012).

[47] Myers, Stewart C. "Determinants of corporate borrowing." *Journal of Financial Economics* 5, no. 2 (1977): 147-175.

[48] Peek, Joe, and Eric S. Rosengren. "Collateral Damage: Effects of the Japanese Bank Crisis on Real Activity in the United States." *The American Economic Review* 90, no. 1 (2000): 30-45.

[49] Plosser, Matthew C. "Bank Heterogeneity and Capital Allocation: Evidence from 'Fracking' Shocks." Available at SSRN 2362499 (2014).

[50] Rajan, Raghuram G., and Luigi Zingales. "Financial dependence and growth." *The American Economic Review* 88, no. 3 (1998): 559.

[51] Rauh, Joshua D. "Investment and financing constraints: Evidence from the funding of corporate pension plans." *The Journal of Finance* 61, no. 1 (2006): 33-71.

[52] Restuccia, Diego, and Richard Rogerson. "Misallocation and productivity." *Review of Economic Dynamics* 16, no. 1 (2013): 1-10.

[53] Shleifer, Andrei, and Robert W. Vishny. "Liquidation Values and Debt Capacity: A Market Equilibrium Approach." *The Journal of Finance* 47, no. 4 (1992): 1343-1366.

[54] Shleifer, Andrei, and Robert W. Vishny. "The limits of arbitrage." *The Journal of Finance* 52, no. 1 (1997): 35-55.

[55] Shleifer, Andrei, and Robert Vishny. "Fire Sales in Finance and Macroeconomics." *Journal of Economic Perspectives* 25, no. 1 (2011): 29-48.

[56] Shroff, Nemit. "Real Effects of Financial Reporting Quality and Credibility: Evidence from the PCAOB Regulatory Regime." Available at SSRN (2015).

[57] Stein, Jeremy C. "Agency, information and corporate investment." Handbook of the Economics of Finance 1 (2003): 111-165.

[58] Tirole, Jean. "Liquidity shortages: theoretical underpinnings." *Banque de France Financial Stability Review: Special Issue on Liquidity* 11 (2008): 53-63.

[59] Tremper, Barbara Dockery. "The Montana Family Farmer under Chapter 12 Bankruptcy." *Montana Law Review* 49 (1988): 40.

[60] United States Environmental Protection Agency. "Assessment of the Potential Impacts of Hydraulic Fracturing for Oil and Gas on Drinking Water Resources". Office of Research and Development, Washington DC (2015).

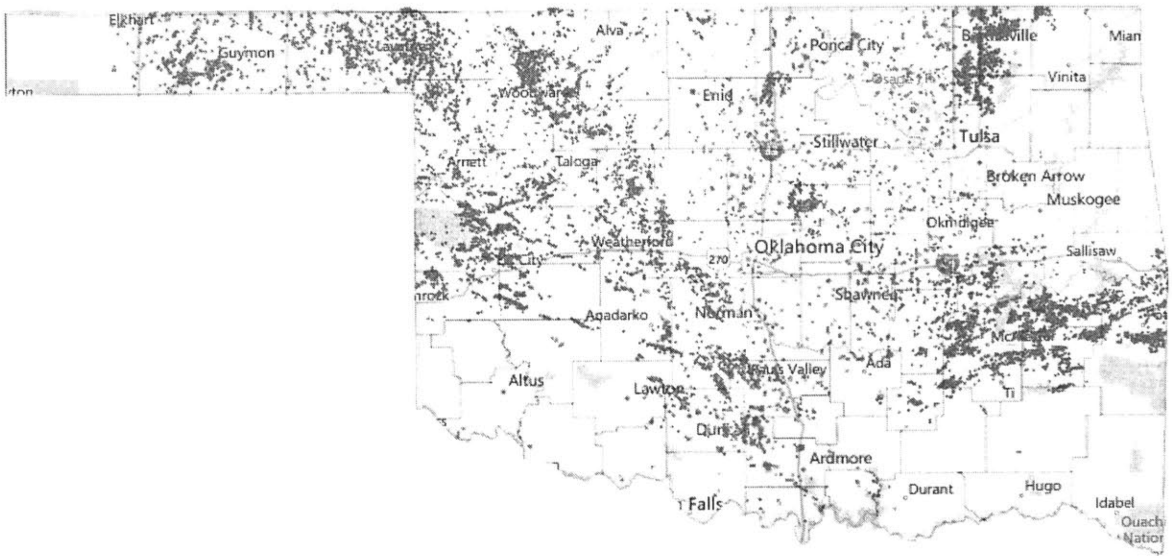
[61] Weber, Jeremy, and Claudia Hitaj. "Shale Gas Drilling and Farm Real Estate Values." National Agricultural & Rural Development Policy Center. *Policy Brief* 25, June 2014.

Figure 1-1: Entry of Fracking into Oklahoma in the 2000s: New Fracking Wells
This figure depicts the entry of fracking into Oklahoma around 2005. The graph shows the number of new Underground Injection Control (UIC) wells, which represents the type of well that a hydraulic fractured well is classified as, for each year in Oklahoma. The data is taken from the Oklahoma Corporation Commission, Oil and Gas Division.

Figure 1-2: Entry of Fracking into Oklahoma in the 2000s—Active Wells Before and After

This figure shows the active oil and gas wells across Oklahoma, during the period 1995–2004 (panel A) and in 2015 (panel B). Panel A is constructed using data from Drillinginfo.com, and panel B is generated from fractracker.org. Each red dot represents an oil and gas well.

Panel A: Active Wells During 1995–2004



Panel B: Current Active Wells in 2015

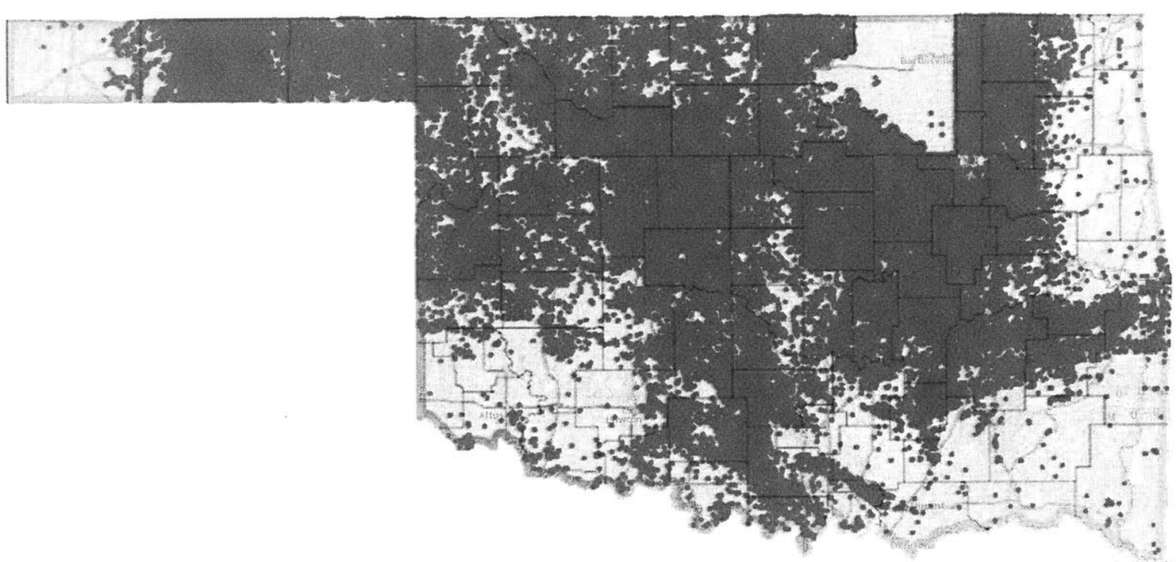


Figure 1-3: Purchases of Land by Farmers

This figure depicts total purchases of land by farmers. The top graph shows the number of purchases by farmers, and the bottom graph shows total acres purchased. In all graphs, counties with low oil potential are excluded. The solid blue line represents counties where a large portion of farmers own mineral rights, and the dashed red line represents counties where a small portion of farmers own mineral rights.

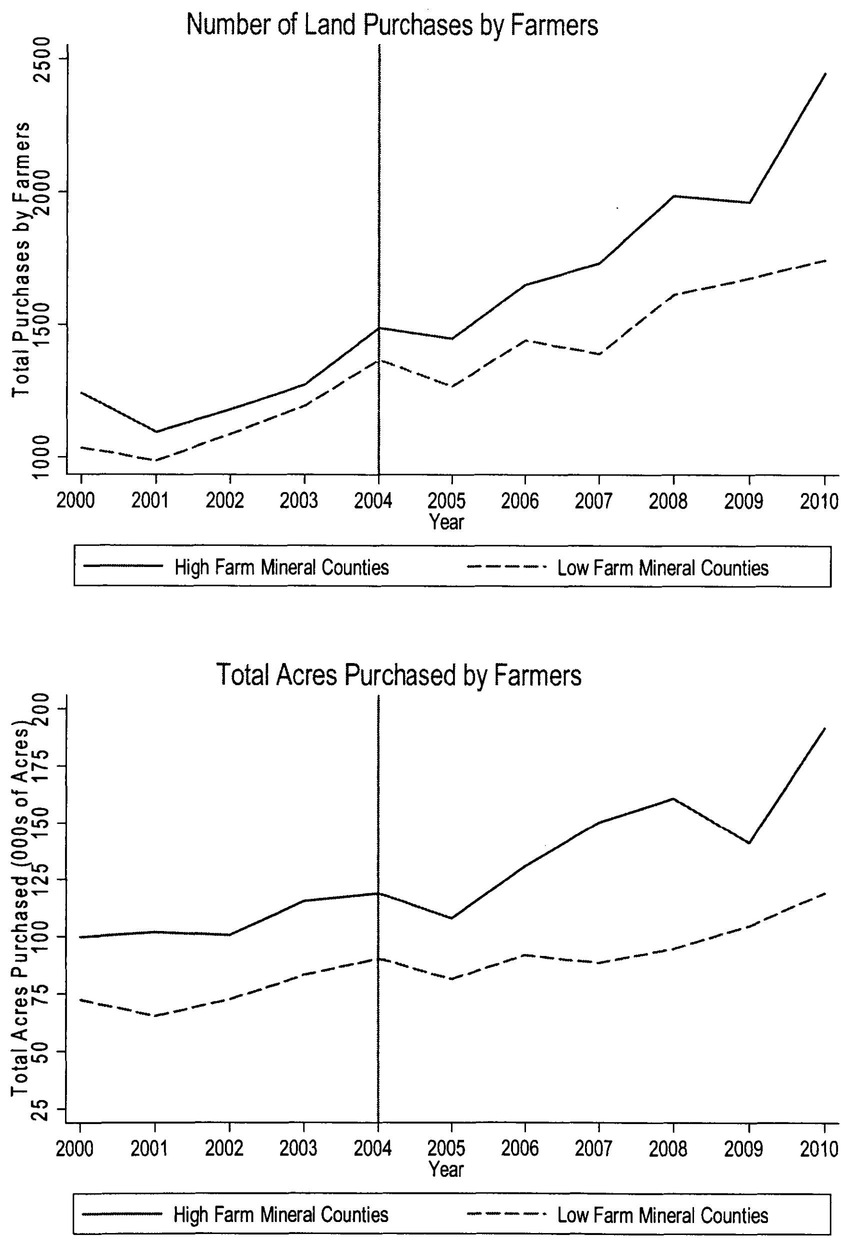
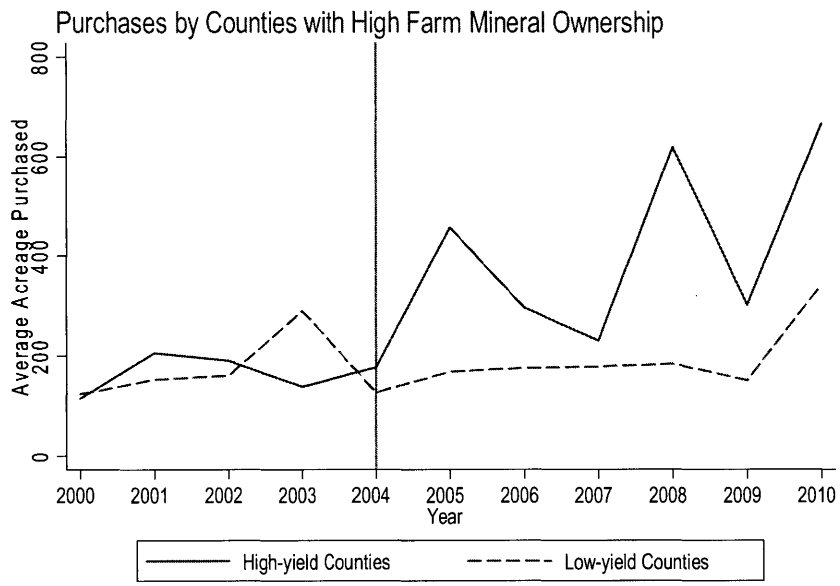


Figure 1-4: Reallocation of Farmland—Overall Purchases in Low-productivity Counties

This figure depicts cross-county acres purchased in low-productivity counties, defined as counties whose average yields from 1990 to 1999 are below median, by farmers in high-yield/low-yield counties. The solid blue lines represent the average county-level amount of acreage purchased in low-productivity counties by farmers residing in high-productivity counties. The dashed red lines represent the average county-level amount of acreage purchased in other low-productivity counties by farmers residing in low-productivity counties. The top graph shows the average acreage purchases in low-productivity counties by farmers in counties with high farmer mineral rights ownership, while the bottom graph shows purchases in counties with low farmer mineral rights ownership. Results exclude counties with low oil potential.



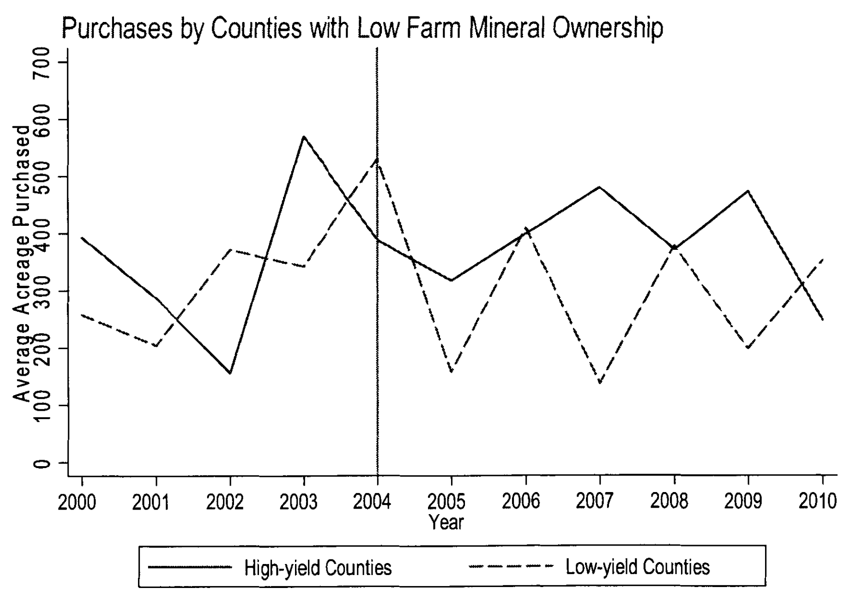


Figure 1-5: Reallocation of Farmland—Purchases of Vacant Land

This figure shows purchasing behavior of vacant (undeveloped) land by farmers. The graph depicts total purchases of vacant land by farmers, divided between counties where a large portion of farmers own mineral rights (solid blue line), and counties where a small portion of farmers own mineral rights (dashed red line). Results exclude counties with low oil potential.

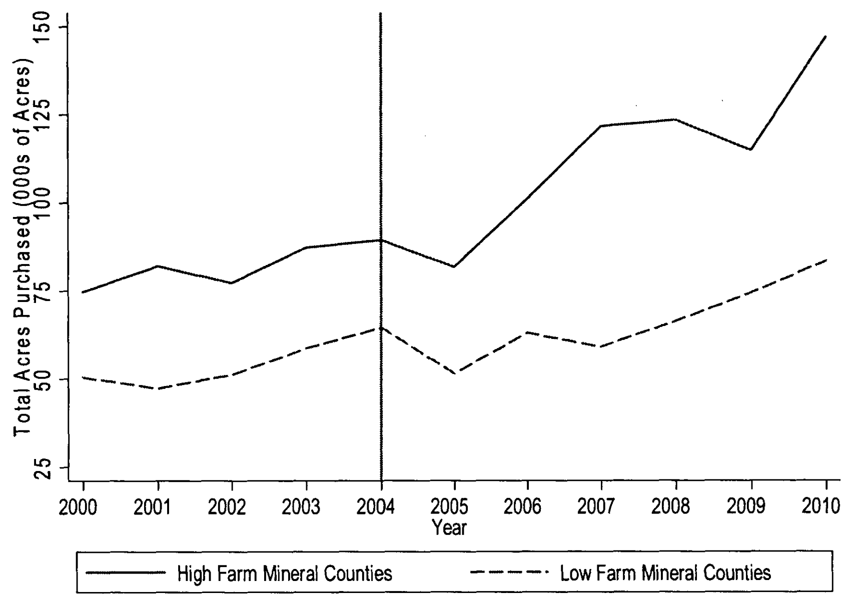


Figure 1-6: Reallocation—Wheat Production, Wheat Acres Cultivated, and Productivity

This figure depicts wheat production, area under cultivation, and productivity. The top left figure shows total wheat production, the top right figure shows total wheat acres under cultivation, and the bottom figure shows the average wheat growing productivity, for counties with high farmer mineral rights ownership (solid blue lines) or low farmer mineral rights ownership (dashed red lines). Wheat Production is the total amount of wheat produced in a given year, in bushels. Wheat Acres is the total number of planted acres of wheat in a given year. Wheat productivity is measured by wheat yield, defined as wheat production per acre harvested (measured in bushels per acre). Counties with low oil potential are excluded.

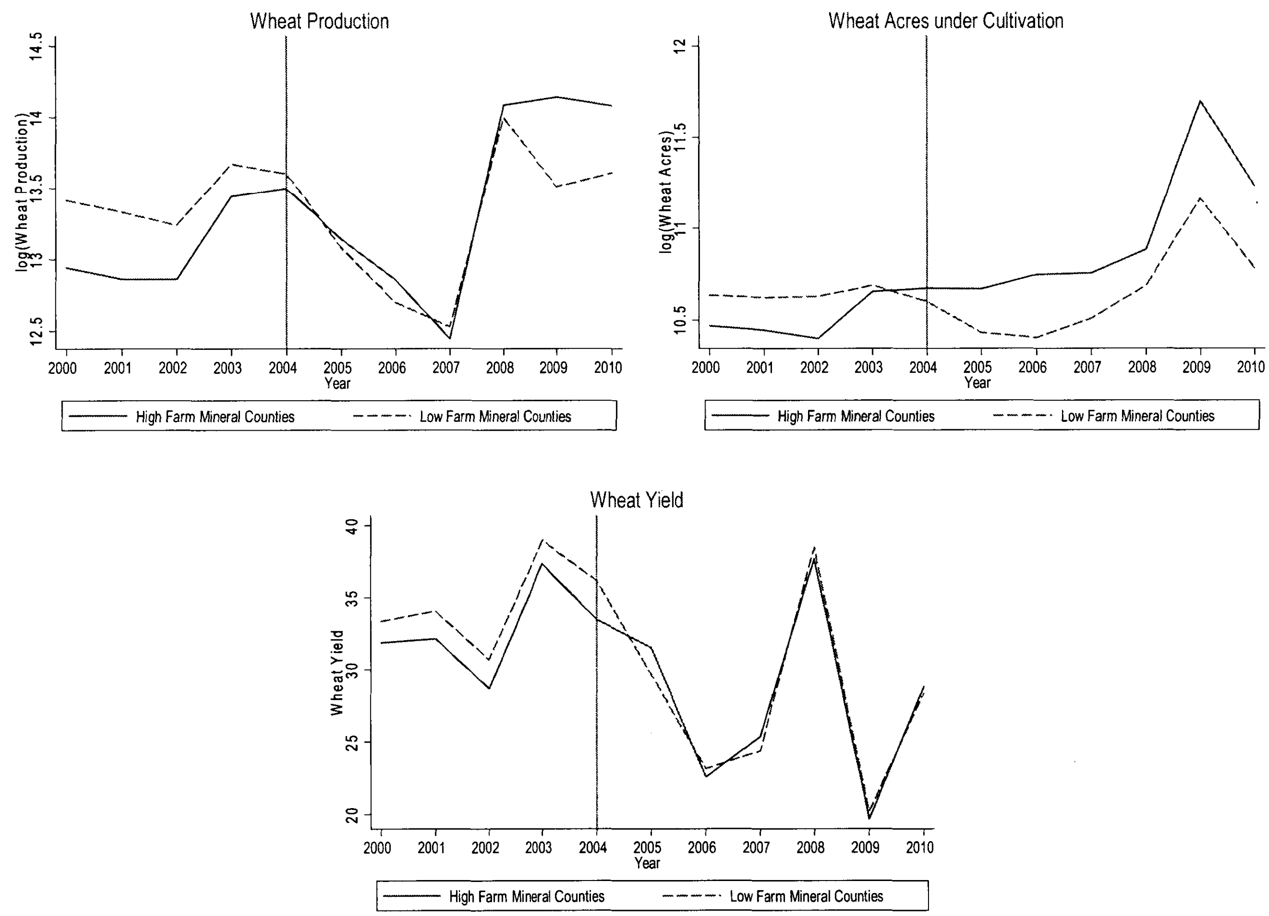
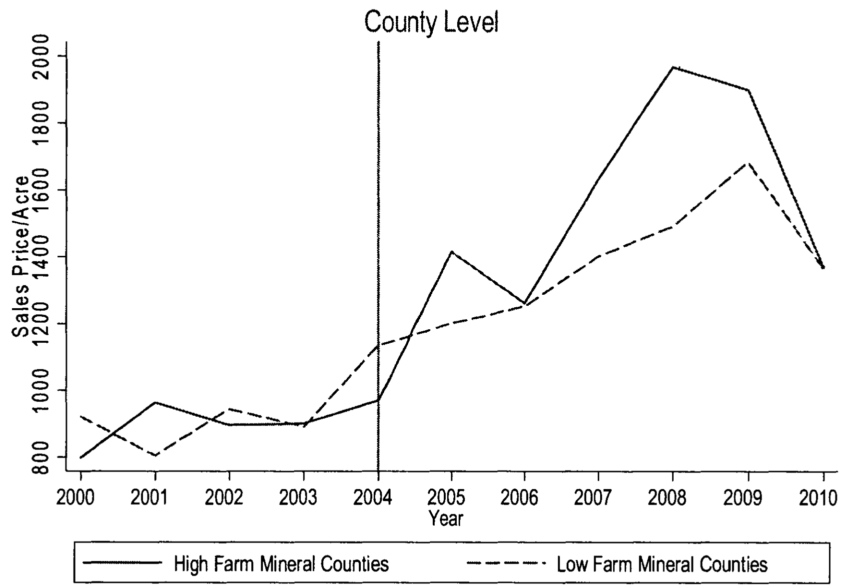


Figure 1-7: Effect on Farmland Prices

This figure shows the effect on farmland prices. The top figure averages sales prices at the county-level, while the bottom figure shows averages sales prices at the zip-code level. The solid blue lines represents counties or zip codes where a large portion of farmers own mineral rights, and the dashed red lines represent counties or zip codes where a small portion of farmers own mineral rights. Results exclude counties with low oil potential.



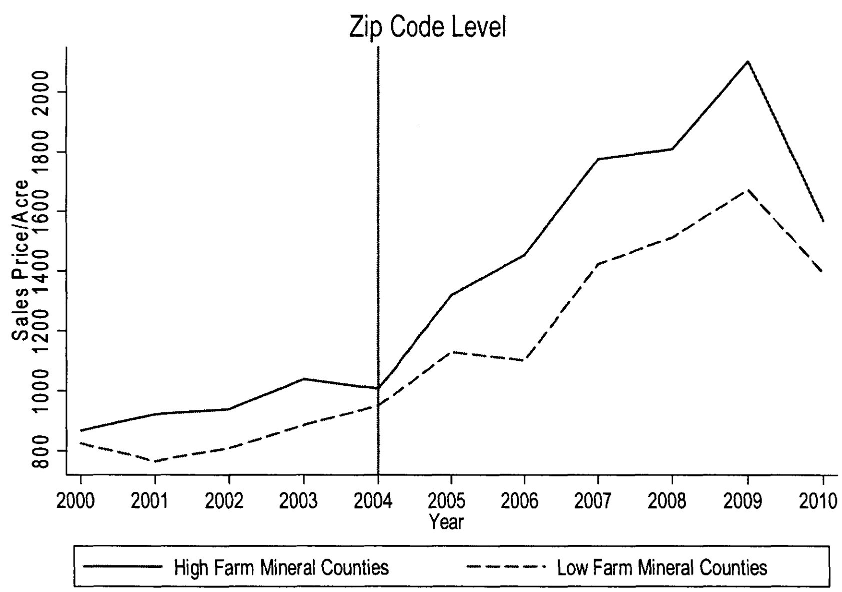


Figure 1-8: Investment in Farm Machinery

This figure shows the total number of purchases of new farm machinery, divided between counties where a large portion of farmers own mineral rights (solid blue line), and counties where a small portion of farmers own mineral rights (dashed red line). Results exclude counties with low oil potential.

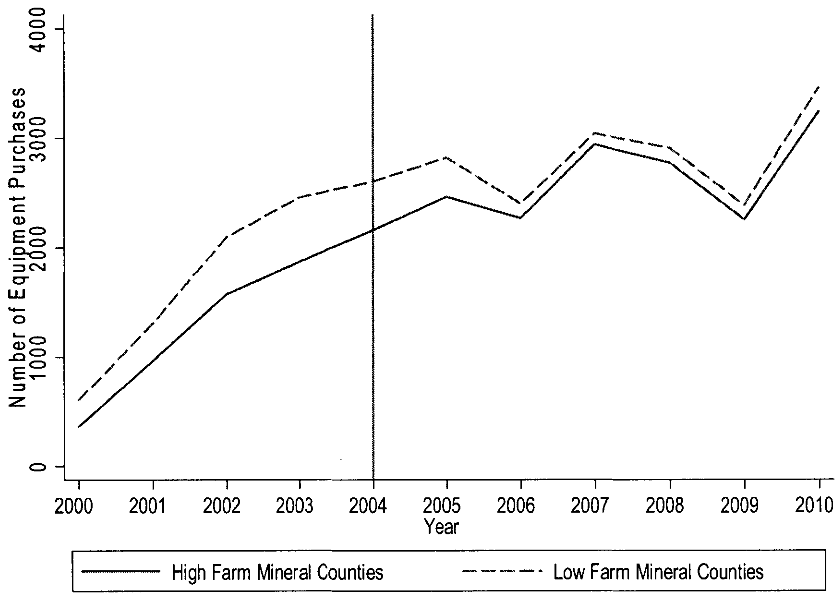


Figure 1-9: Effect on Farm Debt

This figure shows total debt secured by farmland, divided between counties where a large portion of farmers own mineral rights (solid blue line), and counties where a small portion of farmers own mineral rights (dashed red line). Farm debt is shown as the total amount of farm debt scaled by the number of acres of farmland. Results exclude counties with low oil potential.

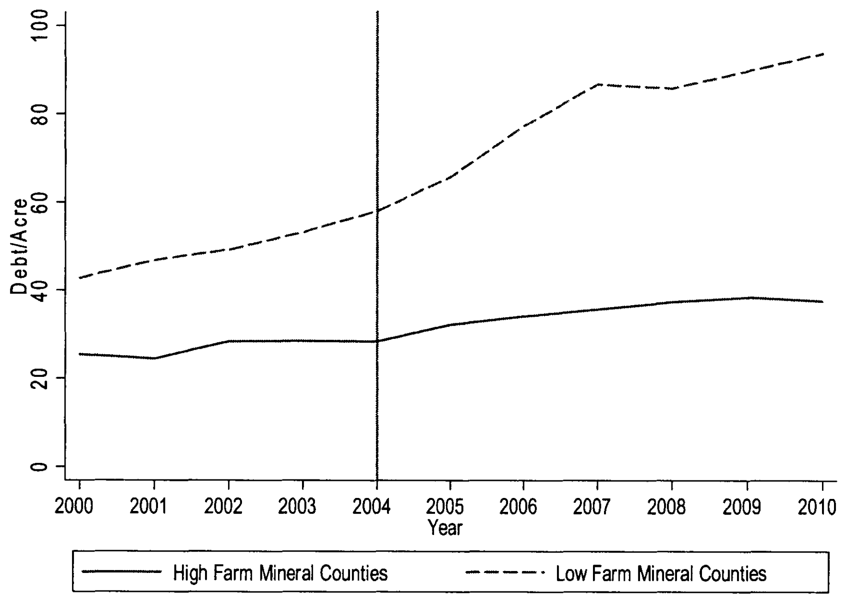
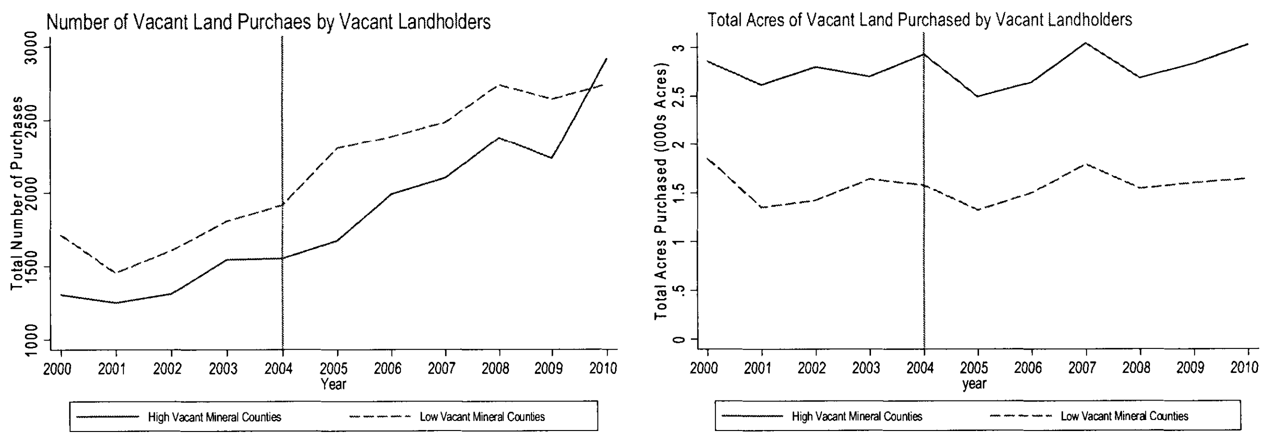


Figure 1-10: Placebo Test—Purchasing Behavior and Price Effect for Vacant Land Holders

Panel A of this figure shows purchases of vacant land by non-farmer vacant landholders. The left figure shows the number of purchases of vacant land by vacant landholders, and the right figure shows the total number of acres of vacant land purchased by non-farm vacant landholders. Panel B shows the sales price of vacant land transactions between vacant landholders. Each graph is divided between counties where a large portion of non-farm vacant landholders own mineral rights (solid blue line), and counties where a small portion of non-farm vacant landholders own mineral rights (dashed red line). Results exclude counties with low oil potential.

Panel A: Purchases of Vacant Land by Vacant Landholders



Panel B: Price of Vacant Land Sales Between Vacant Landholders

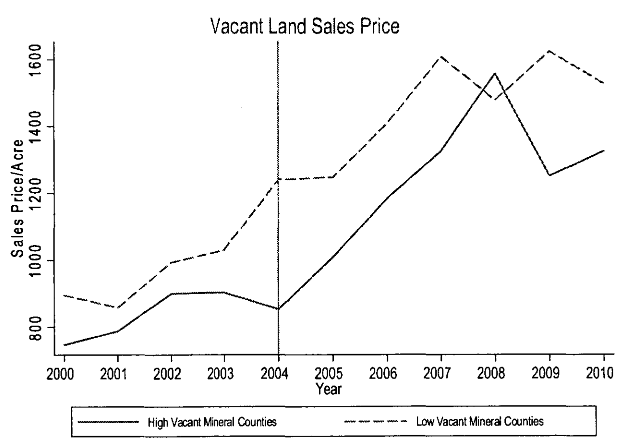


Figure 1-11: Falsification Test

This figure provides graphs for acres purchased by farmers, wheat production, acres under cultivation, yields, and farmland values for the years between 1990 and 2000, falsely specifying the entry of fracking as being 1995. Variables are shown for counties with high farmer mineral rights ownership (solid blue line) or low farmer mineral rights ownership (dashed red line). The top graph depicts total purchases of land by farmers. Wheat Production is the total amount of wheat produced in a given year, in bushels. Wheat Acres is the total number of harvested acres of wheat in a given year. Wheat Yield is the average wheat growing productivity, defined as wheat production per acre harvested (measured in bushels per acre). Farmland Values is the average farmland sales price, in thousands of dollars per acre. Counties with low oil potential are excluded.

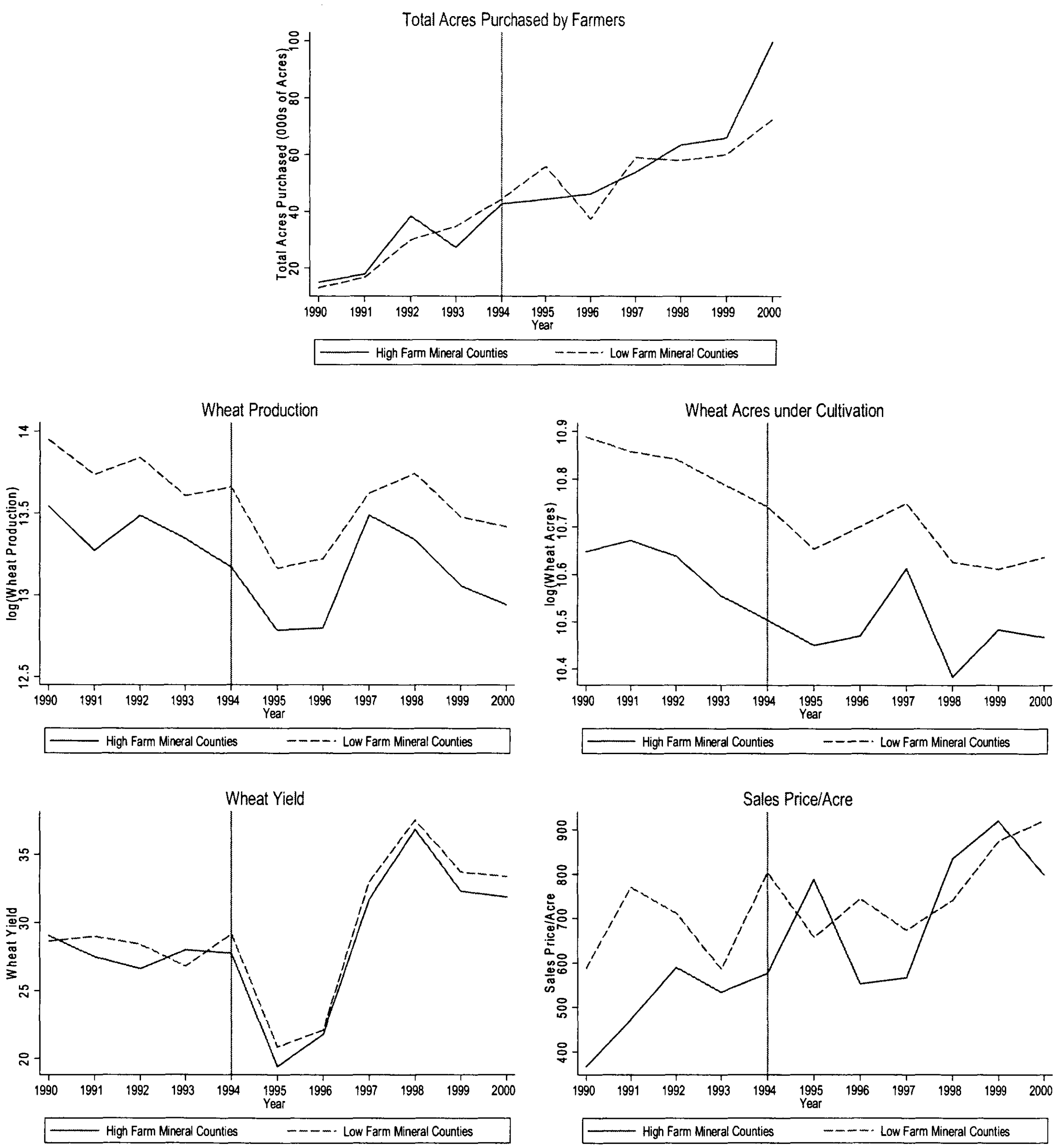


Table 1-1: Summary Statistics

This table provides summary statistics for the key variables. All variables are defined at either the county-year level. *Mineral Lease* is the percentage of farmers in a given county that enter into a mineral lease. Farmland Value is the average value of agricultural land, in dollars per acre. *Wheat Yield* is wheat crop growing productivity, measured in bushels of wheat produced per acre harvested. *Wheat Production* is the total amount of wheat produced in a county for a given year, in millions of bushels. *Wheat Acres* is the total number of cultivated acres of wheat in a county for a given year, in thousands of acres. *Farm RE Debt* is the total amount of real estate debt secured by farmland for banks located in a given county, per acre of farmland. *Farmland Sale Price* is the sales price of agricultural land, measured in dollars per acre. *Number Land Purchases* is the total number of land purchases by farmers. *Acres Purchased* is the total number of acres of land purchased by farmers. All variables are averages from 2000 to 2010.

	#Obs	Mean	Std. Dev.	p25	Median	p75
Mineral Lease %	635	0.547	0.319	0.244	0.628	0.839
Wheat Yield	559	30.515	7.588	25.0	30.8	35.5
Wheat Production	563	2.185	2.802	0.120	0.770	3.620
Wheat Acres	559	102.096	101.404	11.000	70.000	190.000
Farm RE Debt	635	47.343	96.179	10.853	21.516	40.241
Farmland Sale Price	448	1,223.762	700.672	687.759	1,065.741	1,580.48
Acres Purchased	658	3,301.772	5,309.244	0.000	922.875	4,350.447

Table 1-2: Treatment/Control Group Comparison

This table compares the treatment and control groups in terms of observable variables. It presents the results of a regression with the indicated variable as the dependent variable, and *High Farm Minerals* as the independent variable, which is a dummy variable which takes a value of 1 if the county is above-median in terms of mineral rights ownership and 0 otherwise. Year fixed effects are included, and robust standard errors clustered at the county level are in parentheses. All independent variables are county-level totals. *Cropland Acres* is the total number of acres of cropland planted, and *Farmland Acres* is the total number of acres of all types of farmland. *Farm Prod Expense* is the total amount of money per acre of farmland spent by farmers on production expenses. *Govt Payments* is the total amount of payments per acre of farmland by the government to farmers. *Number Farms* is the total number of farms. *Avg Farmsize* is the average size of a farm, in acres. *Net Income* is total revenues minus expenditures per acre of farmland. *LTV* is loan-to-value, calculated as the total amount of farm real estate debt divided by the total value of farmland. Regressions are run from 2000 to 2004. *, **, and *** indicate significance at the 10%, 5%, and 1% level, respectively.

Independent Variable: $High\,Farm\,Minerals_i$	
Dependent Variable	Difference (Treatment – Control)
$\log(Cropland\,Acres)_{i,t}$	0.002
	(0.159)
$\log(Farmland\,Acres)_{i,t}$	0.101
	(0.132)
Farm Prod Expense	−0.030
	(0.021)
Govt Payments	−0.003
	(0.002)
Number Farms	−48.583
	(105.614)
Avg Farmsize	21.393
	(35.182)
Net Income	−0.007
	(0.008)
LTV	−0.001
	(0.013)

Table 1-3: Purchases of Land by Farmers

This table provides the estimation results for purchases of land by farmers. *Num Land Purchases* is the total number of land purchases by farmers, at the county-level. *Total Acres Purchased* is the total number of acres purchased by farmers, at the county-level. *High Farm Minerals* is a dummy variable which takes a value of 1 if the county is above-median in terms of mineral rights ownership, and 0 otherwise. *Fracking Entry* is a dummy variable which takes a value of 1 if the year is 2005 or later. Control variables include county income per capita, amount of cropland, total farm income, and total farm expenditures. Regressions are run from 2000 to 2010, and all regressions exclude counties with low oil potential. Robust standard errors are in parentheses, and are clustered at the county level. *, **, and *** indicate significance at the 10%, 5%, and 1% level, respectively.

Dependent Variable:	log(*Num Land Purchases*)		log(*Total Acres Purchased*)	
	(1)	(2)	(3)	(4)
$High\,Farm\,Minerals_i \times Fracking\,Entry_t$	0.191*	0.184*	0.552*	0.468
	(0.112)	(0.108)	(0.313)	(0.295)
$High\,Farm\,Minerals_i$	−0.122		−0.601	
	(0.381)		(1.031)	
$Fracking\,Entry_t$	0.265***		0.213*	
	(0.072)		(0.111)	
Controls	No	Yes	No	Yes
Year Fixed Effects	No	Yes	No	Yes
County Fixed Effects	No	Yes	No	Yes
Observations	660	654	660	654
R^2	0.018	0.914	0.007	0.863

Table 1-4: Reallocation—Purchases of Land in Low Productivity Counties

This table presents the total amount of cross-county farmland purchases in low-productivity counties. The dependent variable is the log total acreage of purchases in low-yield counties (defined as counties with below-median average yields from 1990 to 1999) by farmers in high-yield/low-yield counties. $High\,Farm\,Minerals$ is a dummy variable which takes a value of 1 if the county is above-median in terms of mineral rights ownership, and 0 otherwise. $High\,Yield_i$ is a dummy variable which takes a value of 1 if the purchasing county has an above-median average yield (defined between 1990 and 1999), and 0 otherwise. $Fracking\,Entry$ is a dummy variable which takes a value of 1 if the year is 2005 or later. Columns (1) and (2) are run conditionally for counties where $High\,Farm\,Minerals_i = 1$, while columns (3) and (4) are run conditionally for counties where $High\,Farm\,Minerals_i = 0$. Control variables include county income per capita, amount of cropland, total farm income, and total farm expenditures. Regressions are run from 2000 to 2010, and exclude counties with low oil potential. Robust standard errors are in parentheses, and are clustered at the county level. *, **, and *** indicate significance at the 10%, 5%, and 1% level, respectively.

Dependent Variable: log(*Acres Purchased of Farmland in Low-yield Counties*)

	High Farm Minerals		Low Farm Minerals		Overall	
	(1)	(2)	(3)	(4)	(5)	(6)
$High\,Farm\,Minerals_i \times High\,Yield_i \times Fracking\,Entry_t$					1.196*	0.829
					(0.704)	(0.682)
$High\,Farm\,Minerals_i \times Fracking\,Entry_t$					−0.196	−0.207
					(0.510)	(0.554)
$High\,Yield_i \times Fracking\,Entry_t$	1.371**	1.421*	0.175	0.361	0.175	0.424
	(0.552)	(0.712)	(0.446)	(0.501)	(0.441)	(0.390)
$High\,Yield_i$	−0.271		−0.432		−0.432	
	(0.562)		(0.441)		(0.436)	
$Fracking\,Entry_t$	−0.509		−0.313		−0.313	
	(0.373)		(0.354)		(0.349)	
$High\,Farm\,Minerals_i$					−1.289***	
					(0.415)	
$High\,Farm\,Minerals_i \times High\,Yield_i$					0.161	
					(0.709)	
Controls	No	Yes	No	Yes	No	Yes
County Fixed Effects	No	Yes	No	Yes	No	Yes
Year Fixed Effects	No	Yes	No	Yes	No	Yes
Observations	148	148	150	150	298	298
R^2	0.035	0.520	0.012	0.426	0.103	0.444

Table 1-5: Reallocation—Purchases of Vacant Land by Farmers

This table provides the estimation results for purchases of vacant land by farmers. *Total Vacant Acres Purchased* is the total number of vacant acres purchased by farmers, at the county-level. *High Farm Minerals* is a dummy variable which takes a value of 1 if the county is above-median in terms of mineral rights ownership, and 0 otherwise. *Fracking Entry* is a dummy variable which takes a value of 1 if the year is 2005 or later. Control variables include county income per capita, amount of cropland, total farm income, and total farm expenditures. Regressions are run from 2000 to 2010, and all regressions exclude counties with low oil potential. Robust standard errors are in parentheses, and are clustered at the county level. *, **, and *** indicate significance at the 10%, 5%, and 1% level, respectively.

Dependent Variable:	log(*Total Vacant Acres Purchased*)	
	(1)	(2)
$High\,Farm\,Minerals_i \times Fracking\,Entry_t$	0.491*	0.469*
	(0.251)	(0.236)
$High\,Farm\,Minerals_i$	1.150	
	(0.811)	
$Fracking\,Entry_t$	0.122	
	(0.128)	
Controls	No	Yes
Year Fixed Effects	No	Yes
County Fixed Effects	No	Yes
Observations	660	654
R^2	0.059	0.903

Table 1-6: Reallocation—Wheat Production, Wheat Acres under Cultivation, Productivity, and Profits

This table provides the estimation results for wheat production, wheat acres under cultivation, crop productivity, and profits. *Wheat Production* is the total amount of wheat produced in the county in a given year, in bushels. *Wheat Acres* is the total number of acres of wheat under cultivation in the county. *Wheat Yield* is wheat growing productivity, defined as wheat production per acre harvested (measured in bushels per acre). *Profits/Acre* is profits per acre of farmland, defined as the sum of crop and livestock revenue less production expenses and government payments, scaled by acres of farmland. *High Farm Minerals* is a dummy variable which takes a value of 1 if the county is above-median in terms of mineral rights ownership, and 0 otherwise. *Fracking Entry* is a dummy variable which takes a value of 1 if the year is 2005 or later. Control variables include county income per capita, amount of cropland (except in columns (3)-(4)), total farm income, and total farm expenditures. Regressions are run from 2000 to 2010, and exclude counties with no oil potential. Robust standard errors are in parentheses, and are clustered at the county level. *, **, and *** indicate significance at the 10%, 5%, and 1% level, respectively.

Dependent Variable:	log(*Wheat Production*)		log(*Wheat Acres*)		*Wheat Yield*		*Profits/Acre*	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
$High\,Farm\,Minerals_i \times Fracking\,Entry_t$	0.488**	0.182*	0.420**	0.077	2.525**	2.147*	0.017*	0.016*
	(0.209)	(0.108)	(0.191)	(0.061)	(1.082)	(1.116)	(0.009)	(0.009)
$High\,Farm\,Minerals_i$	−0.342		−0.111		−2.018**		−0.035	
	(0.515)		(0.412)		(0.909)		(0.050)	
$Fracking\,Entry_t$	−0.307*		−0.015		−7.636***		0.022***	
	(0.150)		(0.106)		(0.821)		(0.007)	
Controls	No	Yes	No	Yes	No	Yes	No	Yes
County Fixed Effects	No	Yes	No	Yes	No	Yes	No	Yes
Year Fixed Effects	No	Yes	No	Yes	No	Yes	No	Yes
Observations	563	563	559	559	559	559	656	656
R^2	0.004	0.961	0.010	0.986	0.177	0.630	0.014	0.966

Table 1-7: Effect on Farmland Prices

This table provides regression estimates for the effect on farmland prices. *Farmland Price/Acre* is the average sales price of farmland per acre, in thousands of dollars. *High Farm Minerals* is a dummy variable which takes a value of 1 if the county is above-median in terms of mineral rights ownership, and 0 otherwise. *Fracking Entry* is a dummy variable which takes a value of 1 if the year is 2005 or later. Columns (1)–(2) are estimated at the county-level, while columns (3)–(4) are estimated at the zip code-level. Control variables include county income per capita, amount of cropland, total farm income, and total farm expenditures. Regressions are run from 2000 to 2010, and exclude counties with low oil potential. Robust standard errors are in parentheses, and are clustered at the county or zip code level. *, **, and *** indicate significance at the 10%, 5%, and 1% level, respectively.

Dependent Variable: *Farmland Price/Acre*

	(1)	(2)	(3)	(4)	(5)
$High\,Farm\,Minerals_i \times Fracking\,Entry_t$	0.225**	0.221*	0.180*	0.338**	0.435*
	(0.110)	(0.124)	(0.110)	(0.143)	(0.254)
$High\,Farm\,Minerals_i$	−0.033		0.109		
	(0.094)		(0.072)		
$Fracking\,Entry_t$	0.457***		0.518***		
	(0.077)		(0.084)		
Level of Analysis	County	County	Zip Code	Zip Code	Zip Code
Controls	No	Yes	No	No	No
Year Fixed Effects	No	Yes	No	Yes	No
County Fixed Effects	No	Yes			
County × Year Fixed Effects				No	Yes
Zip Code Fixed Effects			No	Yes	Yes
Observations	448	445	1,194	1,194	1,194
R^2	0.175	0.454	0.112	0.477	0.683

Table 1-8: Investment in Farm Machinery

This table provides regression estimates for investment in farm machinery. The dependent variable is $\log(Machine\,Purchases)$, which is the logarithm of the total number of new farm equipment purchases in the county. $High\,Farm\,Minerals$ is a dummy variable which takes a value of 1 if the county is above-median in terms of mineral rights ownership, and 0 otherwise. $Fracking\,Entry$ is a dummy variable which takes a value of 1 if the year is 2005 or later. Control variables include county income per capita, amount of cropland, total farm income, and total farm expenditures. Regressions are run from 2000 to 2010, and exclude counties with no oil potential. Robust standard errors are in parentheses, and are clustered at the county level. *, **, and *** indicate significance at the 10%, 5%, and 1% level, respectively.

Dependent Variable: $\log(Machine\,Purchases)$

	(1)	(2)
$High\,Farm\,Minerals_i \times Fracking\,Entry_t$	0.174***	0.158**
	(0.058)	(0.062)
$High\,Farm\,Minerals_i$	−0.475**	
	(0.190)	
$Fracking\,Entry_t$	0.646***	
	(0.045)	
Controls	No	Yes
Year Fixed Effects	No	Yes
County Fixed Effects	No	Yes
Observations	649	645
R^2	0.204	0.941

Table 1-9: Effect on Farm Debt

This table provides regression estimates for the effect of on farm debt. The dependent variable is *Farmland Debt/Acre*, which is the total amount of real estate debt secured by farmland scaled by the total acres of farmland in the county. *High Farm Minerals* is a dummy variable which takes a value of 1 if the county is above-median in terms of mineral rights ownership, and 0 otherwise. *Fracking Entry* is a dummy variable which takes a value of 1 if the year is 2005 or later. Control variables include county income per capita, amount of cropland, total farm income, and total farm expenditures. Regressions are run from 2000 to 2010, and exclude counties with no oil potential. Robust standard errors are in parentheses, and are clustered at the county level. *, **, and *** indicate significance at the 10%, 5%, and 1% level, respectively.

Dependent Variable: *Farmland Debt/Acre*

	(1)	(2)
$High\,Farm\,Minerals_i \times Fracking\,Entry_t$	−24.135*	−25.064
	(14.517)	(15.197)
$High\,Farm\,Minerals_i$	−23.024	
	(20.133)	
$Fracking\,Entry_t$	33.051**	
	(13.996)	
Controls	No	Yes
Year Fixed Effects	No	Yes
County Fixed Effects	No	Yes
Observations	635	631
R^2	0.048	0.920

Table 1-10: Placebo Test—Purchasing Behavior and Price Effect for Vacant Land Holders

This table conducts a placebo test for the effect on purchasing behavior and land prices, by examining the effect on vacant land holders. *Number Purchases* is the number of purchases by non-farm vacant landholders from other vacant landholders. *Acres Purchased* is the total number of acres of vacant land purchased by vacant landholders. *Land Sales Price/Acre* is the average sales price for vacant land sales amongst vacant landholders, in thousands of dollars per acre. *High Vacant Minerals* is a dummy variable which takes a value of 1 if the county is above-median in terms of mineral rights ownership, and 0 otherwise. *Fracking Entry* is a dummy variable which takes a value of 1 if the year is 2005 or later. Control variables include county income per capita, amount of cropland, total farm income, and total farm expenditures. Regressions are run from 2000 to 2010, and counties with no oil potential are excluded. Robust standard errors are in parentheses, and are clustered at the county level. *, **, and *** indicate significance at the 10%, 5%, and 1% level, respectively.

Dependent Variable:	log(*Number Purchases*)		log(*Acres Purchased*)		*Land Sales Price/Acre*	
	(1)	(2)	(3)	(4)	(5)	(6)
$High\,Vacant\,Minerals_i \times Fracking\,Entry_t$	0.075	0.074	0.061	0.049	−0.300	−0.263
	(0.073)	(0.078)	(0.126)	(0.159)	(1.858)	(2.081)
$High\,Vacant\,Minerals_i$	−0.311		0.067		−6.306***	
	(0.281)		(0.347)		(2.223)	
$Fracking\,Entry_t$	0.333***		0.352***		5.341***	
	(0.055)		(0.102)		(1.337)	
Controls	No	Yes	No	Yes	No	Yes
County Fixed Effects	No	Yes	No	Yes	No	Yes
Year Fixed Effects	No	Yes	No	Yes	No	Yes
Observations	647	643	647	643	639	635
R^2	0.043	0.925	0.020	0.803	0.079	0.486

Table 1-11: Robustness—Falsification Test

This table provides regression results for land purchases, wheat production, acres under cultivation, yields, and farmland values for the years between 1990 and 2000, falsely specifying the entry of fracking as being 1995. *Total Acres Purchased* is the total number of acres purchased by farmers, at the county-level. *Wheat Production* is the total amount of wheat produced in a given year, in bushels. *Wheat Acres* is the total number of harvested acres of wheat in a given year. *Wheat Yield* is the average wheat growing productivity, defined as wheat production per acre harvested (measured in bushels per acre). *Farmland Value* is the average farmland sales price, in thousands of dollars per acre. *Farm High Minerals* is a dummy variable which takes a value of 1 if the county is above-median in terms of mineral rights ownership, and 0 otherwise. $Entry'$ is a dummy variable which takes a value of 1 if the year is 1995 or later. Control variables include county income per capita. Regressions are run from 1990 to 2000, and counties with no low potential are excluded. Robust standard errors are in parentheses, and are clustered at the county level. *, **, and *** indicate significance at the 10%, 5%, and 1% level, respectively.

Dependent Variable:	log(*Total Acres Purchased*)	log(*Wheat Production*)	log(*Wheat Acres*)	*Wheat Yield*	*Farmland Price/Acre*
	(1)	(2)	(3)	(4)	(5)
$Farm\,High\,Minerals_i \times Entry'_t$	0.439	0.015	0.018	−0.084	0.150
	(0.428)	(0.093)	(0.074)	(0.808)	(0.118)
County Fixed Effects	Yes	Yes	Yes	Yes	Yes
Year Fixed Effects	Yes	Yes	Yes	Yes	Yes
Observations	660	647	646	646	341
R^2	0.820	0.971	0.982	0.555	0.295

Table 1-12: Placebo Test—High vs. Low Oil

This table provides a placebo test for land purchases, wheat production, acres under cultivation, yields, and farmland values, by identifying counties using oil potential rather than mineral rights. *Total Acres Purchased* is the total number of acres purchased by farmers, at the county-level. *Wheat Production* is the total amount of wheat produced in a given year, in bushels. *Wheat Acres* is the total number of harvested acres of wheat in a given year. *Wheat Yield* is the average wheat growing productivity, defined as wheat production per acre harvested (measured in bushels per acre). *Farmland Value* is the average value of farmland, in dollars per acre. *High Oil* is a dummy variable which takes a value of 1 if the county is above-median in terms of the number of oil fields, and 0 otherwise. *Fracking Entry* is a dummy variable which takes a value of 1 if the year is 2005 or later. Control variables include county income per capita, amount of cropland, total farm income, and total farm expenditures. Regressions are run from 2000 to 2010. Robust standard errors are in parentheses, and are clustered at the county level. *, **, and *** indicate significance at the 10%, 5%, and 1% level, respectively.

Dependent Variable:	log(*Total Acres Purchased*)	log(*Wheat Production*)	log(*Wheat Acres*)	*Wheat Yield*	*Farmland Price/Acre*
	(1)	(2)	(3)	(4)	(5)
$High\,Oil_i \times Fracking\,Entry_t$	−0.320	0.065	0.077	−1.257	0.096
	(0.274)	(0.117)	(0.065)	(1.175)	(0.116)
Controls	Yes	Yes	Yes	Yes	Yes
County Fixed Effects	Yes	Yes	Yes	Yes	Yes
Year Fixed Effects	Yes	Yes	Yes	Yes	Yes
Observations	836	704	699	699	563
R^2	0.871	0.953	0.984	0.595	0.480

Appendix 1.A: Institutional Details of Fracking

In this appendix, I provide some useful institutional details related to fracking in Oklahoma. These are gathered from various data sources, including public websites as well as interviews with and surveys of directors and executives of the farm credit system, most of whom are farmers.

1.A.1 Entering into a Fracking Lease

When an oil company has targeted an area for drilling, it hires an intermediary to locate and contact all owners of mineral rights in that area. The intermediaries then negotiate with the mineral owners, and enter them into a mineral lease with the oil company. The mineral rights owner receives an up-front bonus of \$500–\$10,000 per acre, in additional to royalties which are contingent on the production of oil and gas. The range in the bonuses reflects the fact that oil potential may vary across areas, and also that farmers can opt for a smaller upfront payment in exchange for higher royalties.

There is considerable heterogeneity across farmers in terms of ownership of mineral rights. Some farmers own much of the mineral rights underneath their land, while other farmers own none. While there is a range in terms of the up-front payment, even at the lower end this represents a significant cash inflow to farmers. The average farm size in Oklahoma is roughly 450 acres. Thus, the average farmer that owns even a small portion of the mineral rights underneath his/her land will enjoy an upfront payment of at least tens of thousands of dollars.

Once the oil companies have entered into a lease with the mineral owners, they then negotiate with the surface owners. While owners of surface rights who do not own mineral rights are not able to reap any of the benefits of these contracts nor able to stop any drilling on their property, the oil companies typically will negotiate with the surface owner regarding where to place the drill. In addition, the surface owner is often offered a small inconvenience payment to offset the lack of use of the land during the well construction, as well as a payment for the use of water utilities while the fracking is going on. However, these payments are orders of magnitude smaller than the payments that mineral owners receive.

1.A.2 Drilling of the Oil Well

Once payments and negotiations have been completed, the oil company then proceeds to build the well. The well is typically constructed at the edge of the property, as illustrated in Panel A of *Figure 1-A1*. It is part of a drilling pad that is 400 feet by 400 feet (or 3.67 acres). Thus, the area of land that the drilling pad takes up is less than 1% of the total acreage of an average farm. After constructing the drilling pad, the drill then drills down to 6,000–7,000 feet beneath the surface. After drilling down to that depth, horizontal drilling begins. Once the drilling has been completed, the drilling company brings in a rig and additional equipment that involves roughly 50–100 trucks. At that point, workers then inject chemical fluids at high pressures into the horizontal portion of the drilled minerals, fracturing the rock underground to allow access to stored oil and gas. Panel B of *Figure 1-A1* depicts the the setup of the drilling rig. Once the well is constructed and the infrastructure put in place, the drilling rig is removed and only a small well head that is a few feet tall remains. Oil or gas is then transferred automatically away from the area via constructed pipelines. Thus, once the initial fracking injection and well rig construction is completed, much of the heavy equipment is removed and the used area of the surface land is reduced and able to be restored.

1.A.3 Forced Pooling

An endogeneity concern in my analysis is that farmers may refuse to sign into fracking leases even if they own mineral rights. While in principle they could, as a practical matter it is virtually impossible for a farmer to do so in the state of Oklahoma. It is one of 40 states that have "compulsory pooling", also known as "forced pooling". With this law, the owner of the mineral rights on a piece of land cannot hold out as a non-consenting landowner if a majority of the other mineral rights owners in a given area have agreed to sign leases with the drilling company. All that is required is a "fair and reasonable offer", and there are pre-determined rules to determine this based on the leases signed by other mineral rights owners. With forced pooling, the percentage of farmers with mineral rights who do *not* sign leases once approached is basically zero. The legal environment in Oklahoma is very favorable to mineral rights owners and drilling companies, and farmers who refuse to sign leases run the risk of protracted and costly legal battles.

1.A.4 Negative Effects of Fracking

There has been much concern over the negative effects of fracking. These effects may manifest themselves in a few different ways for farmers. It is important to note that all of these channels would have a *negative* effect on productivity for a farm, and thus would bias me *against* finding the positive effects that I do in my analysis.

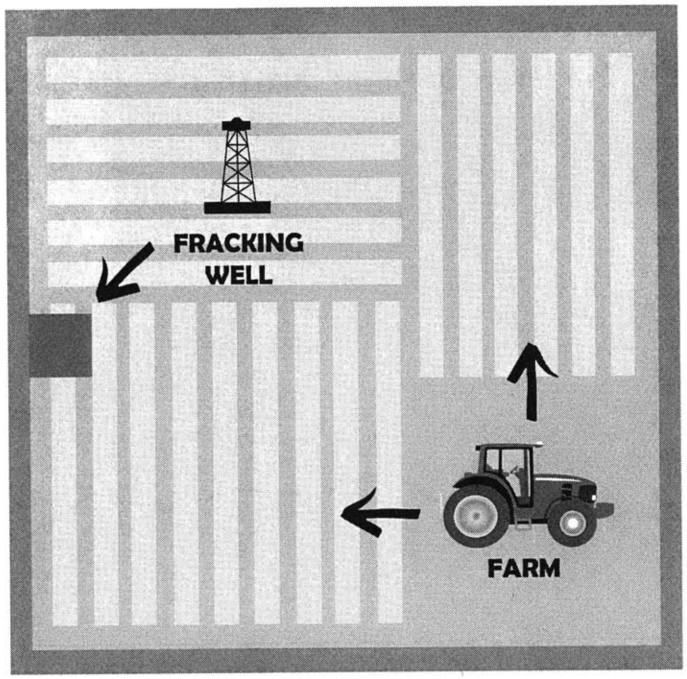
A first potential negative effect of fracking is the possibility of water contamination. Fracking involves the use of toxic chemicals, and so any spillage of such chemicals may adversely affect either livestock of crops on a farm through their use of water. A recent report by the Environmental Protection Agency (EPA, 2015) found no systematic evidence of water contamination by fracking, and concluded that the process does not adversely affect water supplies if undertaken with proper safety measures. Furthermore, conversations with Farm Credit executives revealed that they know of very few instances of farmers being affected by water contamination as a result of fracking.

A second negative effect of fracking is the disruption of farm operations due to the heavy equipment and trucks needed for fracking. Moreover, the land used for drilling may significantly disrupt farm operations and prevent a farmer from farming. These are of minimal concern for a few reasons. First, oil companies typically drill wells at the edge of any farm property, in order to minimize disruption. Second, the portion of land that is used for fracking is less than 4 acres, which is less than 1% of the acreage of the average farm. Third, once the initial oil drilling rig has been removed, the wellhead that remains is only a few feet tall, and the land around it can be restored for farming.

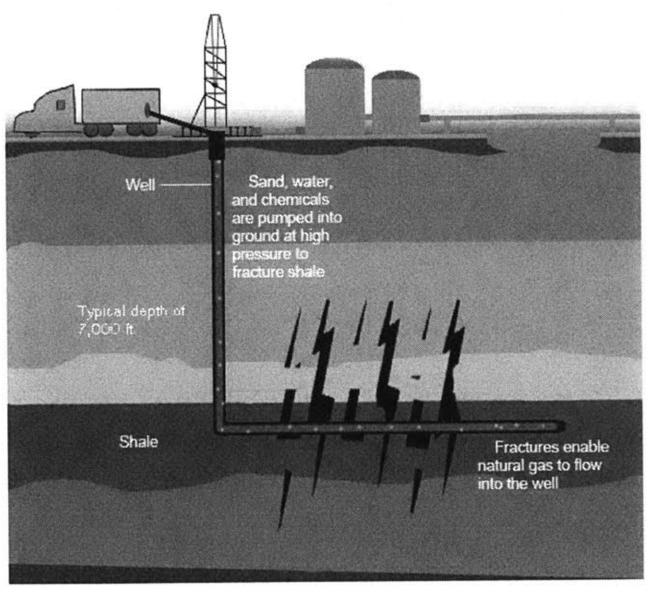
Figure 1-A1: Placement of Oil Wells and Diagram of Drilling Rig

Panel A shows the relative placement of an oil well on a farm. Panel B gives a diagram of a fracking drilling rig (graphic edited from newsarchive.medill.northwestern.edu/news-198624.html).

Panel A: Relative Placement of Oil Well on a Farm



Panel B: Diagram of Drilling Rig

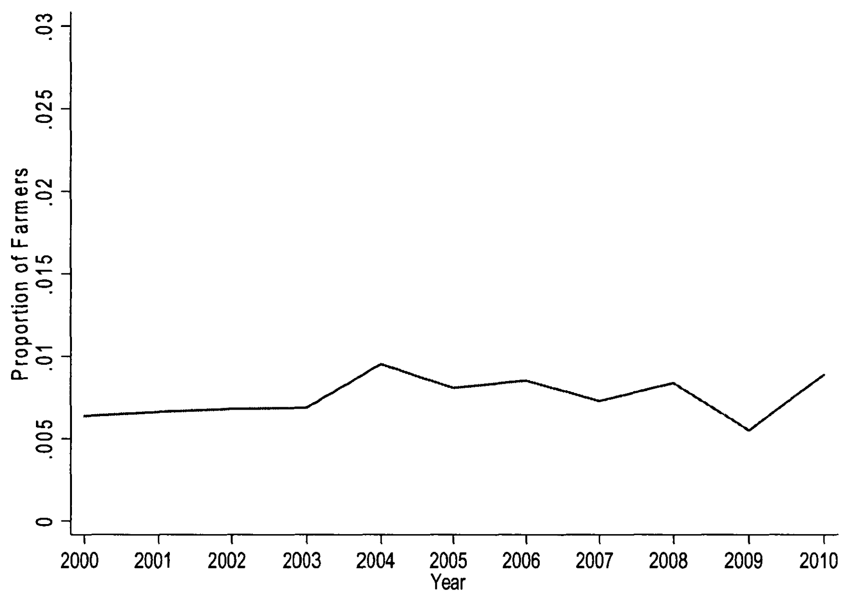


Appendix 1.B: Additional Figures and Tables

Figure 1-B1: Mineral Rights Transfers by Farmers

Panel A provides the total proportion of farms that engage in transferences of mineral deeds. These transferences include taking ownership of mineral rights, as well as granting ownership of mineral rights. Panel B shows the average proportion of farms that engage in mineral deed transfers, for counties where many farmers own mineral rights (solid blue line) compared to other counties (dashed red line).

Panel A: Proportion of Farms that Transfer Mineral Deeds



Panel B: Farm Mineral Deed Transfers, High vs. Low Mineral Ownership Counties

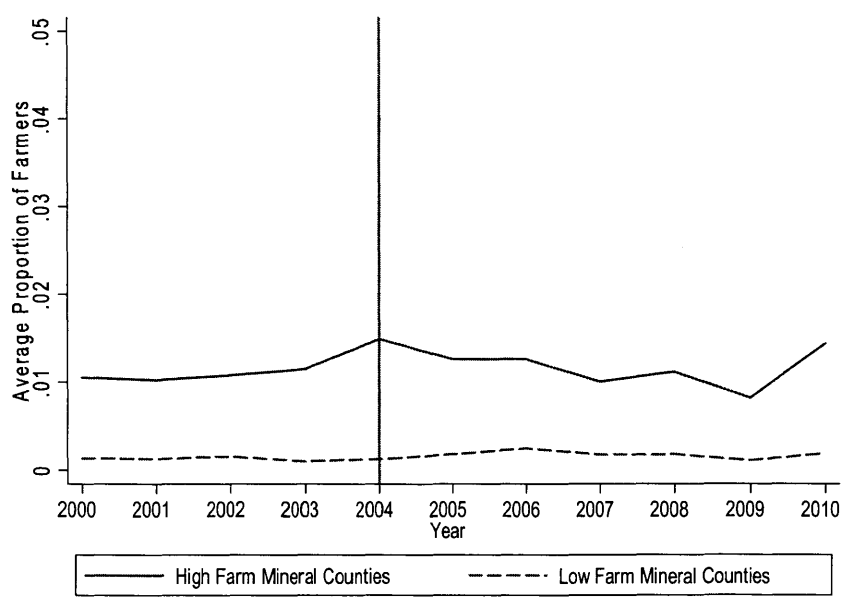


Figure 1-B2: Purchases of Land by Farmers

This figure depicts the total number of acres of land purchased by farmers, for the group of farmers who own mineral rights compared to the group of farmers who do not own mineral rights. The solid blue line represents farmers who own mineral rights, while the dashed red line represents farmers who do not own mineral rights.

Table 1-B1: Farm Mineral Deed Transfers

This table estimates the change in the proportion of farms engaging in mineral deed transfers following the arrival of fracking, for counties with high farm mineral ownership compared to counties with low farm mineral ownership. The dependent variable is the proportion of farms that transfer mineral rights. *High Farm Minerals* is a dummy variable which takes a value of 1 if the county is above-median in terms of mineral rights ownership, and 0 otherwise. *Fracking Entry* is a dummy variable which takes a value of 1 if the year is 2005 or later. Regressions are run from 2000 to 2010, and all regressions exclude counties with no oil potential. Robust standard errors are in parentheses, and are clustered at the county level. *, **, and *** indicate significance at the 10%, 5%, and 1% level, respectively.

Dependent Variable: *Percentage of Farms Transferring Mineral Deeds*

	(1)	(2)
$High\,Farm\,Minerals_i \times Fracking\,Entry_t$	−0.001	−0.001
	(0.002)	(0.002)
$High\,Farm\,Minerals_i$	0.010***	
	(0.003)	
$Fracking\,Entry_t$	0.001	
	(0.0004)	
Year Fixed Effects	No	Yes
County Fixed Effects	No	Yes
Observations	660	660
R^2	0.097	0.819

Table B2: Farmers Entering into Mineral Leases

This table estimates the change in the percentage of farms entering into mineral leases. The dependent variable is the number of farmers signing new mineral leases divided by the number of farms. *High Farm Minerals* is a dummy variable which takes a value of 1 if the county is above-median in terms of the maximum percentage of farmers that enter into a mineral lease, and 0 otherwise. *Fracking Entry* is a dummy variable which takes a value of 1 if the year is 2005 or later. Regressions are run from 1999 to 2011, and all regressions exclude counties with no oil potential. Robust standard errors are in parentheses, and are clustered at the county level. *, **, and *** indicate significance at the 10%, 5%, and 1% level, respectively.

Dependent Variable: *Percentage of Farms Entering into Mineral Leases*

	(1)	(2)
$High\,Farm\,Minerals_i \times Fracking\,Entry_t$	0.083**	0.080**
	(0.035)	(0.036)
$High\,Farm\,Minerals_i$	0.116***	
	(0.033)	
$Fracking\,Entry_t$	0.024*	
	(0.013)	
Year Fixed Effects	No	Yes
County Fixed Effects	No	Yes
Observations	758	758
R^2	0.125	0.660

Table B3: Purchases of Land by Farmers

This table provides the estimation results for purchases of land by farmers, run at the farm-level. *Acres Purchased* is the total number of acres purchased by a farmer in a given year. *Mineral Own* is a dummy variable which takes a value of 1 if the given farmer owns mineral rights, and 0 otherwise. *Fracking Entry* is a dummy variable which takes a value of 1 if the year is 2005 or later. Regressions are run from 2000 to 2010, and all regressions exclude counties with low oil potential. Robust standard errors are in parentheses, and are clustered at the farm level. *, **, and *** indicate significance at the 10%, 5%, and 1% level, respectively.

Dependent Variable: log(*Acres Purchased*)

	(1)	(2)	(3)
$Mineral\,Own_i \times Fracking\,Entry_t$	0.042***	0.062***	0.062***
	(0.011)	(0.013)	(0.013)
$Mineral\,Own_i$	0.176***	0.247***	
	(0.010)	(0.011)	
$Fracking\,Entry_t$	0.067***		
	(0.006)		
County Fixed Effects	No	No	No
Year Fixed Effects	No	No	No
County×Year Fixed Effects	No	Yes	Yes
Farm Fixed Effects	No	No	Yes
Observations	198,847	198,847	198,847
R^2	0.008	0.029	0.227

Table 1-B4: Difference in Effects Based on Ex Ante Constraints

This table shows how the effects of fracking differ based on ex ante financial constraints, for production, acres under cultivation, and productivity. *Wheat Production* is the total amount of wheat produced in a given year, in bushels. *Wheat Acres* is the total number of harvested acres of wheat in a given year. *Wheat Yield* is the average wheat growing productivity, defined as wheat production per acre harvested (measured in bushels per acre). *Farmland Value* is the average farmland sales price, in thousands of dollars per acre. *Farm High Minerals* is a dummy variable which takes a value of 1 if the county is above-median in terms of mineral rights ownership, and 0 otherwise. *Farm Constrained* is a dummy variable which takes a value of 1 if the county has below-median farm net income prior to the arrival of fracking, and 0 otherwise. *Fracking Entry* is a dummy variable which takes a value of 1 if the year is 2005 or later. Control variables include county income per capita, amount of cropland, total farm income, and total farm expenditures.. Regressions are run from 2000 to 2010, and counties with no low potential are excluded. Robust standard errors are in parentheses, and are clustered at the county level. *, **, and *** indicate significance at the 10%, 5%, and 1% level, respectively.

Dependent Variable:	log(*Wheat Production*)	log(*Wheat Acres*)	*Wheat Yield*
	(1)	(2)	(3)
$Farm\,High\,Minerals_i \times Farm\,Constrained_i \times Fracking\,Entry_t$	0.447**	0.235**	3.177*
	(0.183)	(0.107)	(1.762)
$Farm\,High\,Minerals_i \times Fracking\,Entry_t$	−0.008	−0.025	0.802
	(0.092)	(0.034)	(1.234)
$Farm\,Constrained_i \times Fracking\,Entry_t$	−0.804	−0.431***	−4.619***
	(0.149)	(0.092)	(1.377)
Controls	Yes	Yes	Yes
County Fixed Effects	Yes	Yes	Yes
Year Fixed Effects	Yes	Yes	Yes
Observations	563	559	559
R^2	0.964	0.987	0.637

Chapter 2
The Dividend Initiation Decision: Theory and Evidence

2.1 Introduction

When and why does a firm decide to initiate dividend payments? And why are firms so reluctant to cut a dividend, once it is initiated? These are important questions about firm financial policy that are addressed in this paper, both theoretically and empirically. The theory produces results that rationalize existing stylized facts and also generates new predictions with respect to the interactive impact of managerial ownership and corporate governance on the dividend initiation probability, and the effect of proprietary-information-disclosure costs on the likelihood of initiating a dividend. I find strong empirical support for the novel predictions.

There are some prominent stylized facts about dividend policy. First, firms smooth dividends (Lintner (1956)) and are reluctant to cut dividends (Brav, Graham, Harvey, and Michaely (2005)). Second, managers view dividends as less flexible than repurchases and initiate dividends only when they can be maintained (Brav et. al. (2005)). Third, dividend initiations/increases have positive announcement effects (+3.4% to +3.7% for initiations according to Asquith and Mullins (1983) and +0.4% for increases from Allen and Michaely (1994)), but associated dividend omissions/cuts have larger negative effects (-7% for omissions according to Michaely, Thaler, and Womack (1995) and -1.3% for cuts from Allen and Michaely (1994)). And finally, there is a life-cycle effect—firms initiate dividends when they are mature enough to be consistently profitable.

There is no existing theory that *simultaneously* explains all of these empirical regularities. In this paper, I develop a dynamic model of corporate payout policy that generates results consistent with these stylized facts, as well as new predictions. The model has three key elements. One is that there is an agency problem—the manager may make investments that yield him private benefits at the expense of shareholder value (e.g. as in Aghion and Bolton (1992)), and that this agency problem can be controlled with the market discipline provided by the (mandatory) information disclosure that accompanies secondary equity issues. A second feature is that this market discipline comes at a cost because of the "two-audience" signaling problem—any information disclosed to the financial market is also unavoidably disclosed to product-market competitors, creating real cash-flow/value losses (e.g. Bhattacharya and Ritter (1983), and Gertner, Gibbons, and Scharfstein (1988)). The third feature is that there are two kinds of asymmetric information problems. One problem is that "fly-by-night" operators may be observationally indistinguishable from viable firms at the outset; these lemons are sorted from the viable firms on the basis of realized cash flows over time.[50] The other problem is unobservable heterogeneity among viable firms based on

[50]For example, it has been recently reported that numerous Chinese firms have become publicly listed on U.S. exchanges through "reverse mergers", wherein a Chinese firm acquires a financially-distressed U.S.

expected future cash flows. The firm's manager knows whether his firm is viable and what its future expected cash flows are, but outsiders do not. The firm must decide in the first period whether to repurchase stock, initiate a dividend, what project to invest in, and whether to finance it internally or with an equity issue. Then in the second period, the manager has another project-choice decision, financing decision and also whether to initiate a dividend or continue/cut a previously-initiated dividend.

The main results are as follows. First, initiating a dividend signals high expected future cash flows and will generate a positive announcement effect, whereas an open market repurchase is used only to disgorge excess cash, so it will elicit no price reaction.[51] Second, there is a negative price reaction in response to a dividend cut, and it is larger in absolute magnitude than the positive announcement effect of a dividend initiation. In equilibrium, the viable firms never cut dividends, which also rationalizes dividend smoothing (e.g. Lintner (1956)). Lemons, however, do cut dividends, so cuts will be observed in equilibrium as well. But I show in an extension of the model that the highly negative price reaction to a dividend cut will be observed even if a dividend cut is only an out-of-equilibrium phenomenon. Third, the probability of initiating a dividend is increasing in the firm's profitability, retained earnings, assets in place, and magnitude of agency problems (for empirical evidence, see Fama and French (2001) and DeAngelo, DeAngelo, and Stulz (2006)), and decreasing in the personal effective dividend tax relative to the capital gains tax (for empirical evidence, see Chetty and Saez (2005), and Brown, Liang, and Weisbenner (2007)). Fourth, the probability of initiating a dividend is decreasing in the manager's stock ownership in the firm, and this effect is weaker when corporate governance is stronger. Fifth, the dividend initiation probability is decreasing in the potential loss in value from the information disclosure associated with secondary equity issues. The fourth and fifth predictions of the model are novel, with no existing empirical support. These novel predictions will be the focus of my empirical tests.

The core intuition of the model can be seen as follows. Suppose the firm's manager can unobservably choose between an efficient project and an inefficient project that gives him private benefits. The board of directors, acting in the shareholders' interest, has cannot *directly* control the manager's project choice. If the board decides not to initiate a dividend, the initial pool of liquidity can be used to invest in a project. This allows the firm to avoid the disclosure costs of external finance. But the downside is that the manager may choose the inefficient project, with the probability of this moral hazard being smaller the larger the manager's ownership in the firm. To drive this probability down for any given level of managerial ownership, the board can authorize a dividend initiation that uses up the initial pool of liquidity and forces the firm to raise external (equity) financing. The benefit of this is

public firm, merges its Chinese operations with the U.S. firm, and then takes on the name of the U.S. firm. In some cases, the financials of these firms—including revenue figures—have been found to be fraudulent or hard to verify. See Hansen and Oqvist (2012) who discuss the difficulty investors have in distinguishing between fraudulent and legitimate U.S.-listed Chinese firms.

[51]The notion that open-market stock repurchases do not convey any private information (and hence should elicit no price reactions) has been around for some time, e.g. Comment and Jarrell (1991) show that open-market repurchases are substantially weaker information signals than tender-offer repurchases. The survey evidence in Brav, Graham, Harvey, and Michaely (2005) suggests that managers do not use open-market repurchases to signal. Further support is provided by Grullon and Michaely (2004) who find *no* evidence of the post-repurchase operational improvement that one would expect if an open-market repurchase was conveying positive private information.

that the information disclosure that accompanies this financing forces the manager's hand, creating a form of market discipline that compels choice of the efficient (value-maximizing) project. The cost is that the disclosed information also dribbles out to the firm's competitors, causing a decline in real cash flows. The shareholders and the board thus prefer to avoid two-audience signaling costs by not initiating a dividend when the manager's ownership in the firm is high and moral hazard is low; otherwise, a dividend is initiated.

The model is dynamic, so the dividend decision is made in two consecutive periods. This enables an examination of the firm's decision to either cut or maintain a dividend decision made earlier. Market discipline is more valuable for the viable firms with higher values of expected future cash flows and assets in place because there is more in these firms for the manager to expropriate for private gain. Thus, holding fixed managerial ownership, these firms are more likely to initiate dividends. This generates positive announcement effects for dividend initiations.

The lemons pool with the viable firms they are the most observationally similar to in order to escape detection. Thus, there are lemons being pooled with dividend initiators as well as non-initiators. But the lemons are less capable of *sustaining* dividends than viable firms, and thus more likely to cut dividends in the second period. The market therefore interprets a dividend cut as very bad news. This generates highly adverse price reactions to dividend cuts and an endogenous reluctance of viable firms to cut dividends.[52]

This paper then empirically tests the two novel predictions of the theory through a predictive logit model of dividend initiations. The empirical results strongly support the predictions, and are robust to alternative specifications. To provide evidence of the causal relation between disclosure costs and dividend initiations, a regression discontinuity approach, which exploits an information-reporting-requirement discontinuity introduced by the Sarbanes-Oxley Act, is used. The results survive various robustness checks, including potential threshold manipulation and the impact of earnings management, as well as a falsification test that mis-specifies the disclosure threshold.

The structure of the paper is as follows. Section 2.2 reviews the related literature and the marginal contributions of this paper. Section 2.3 presents the theoretical model. Section 2.4 analyzes the results of the model and discusses the empirical predictions. Section 2.5 contains the empirical analysis. Section 2.6 concludes. All proofs are included in the Appendix.

[52]One might wonder whether one could replace "dividends" by "repurchases" throughout the theoretical analysis. After all, a repurchase disgorges cash and forces a future reliance on equity issuance, just the way a dividend does. The answer is no, primarily because of the institutional features of dividends and repurchases, which I take as a given in my analysis. What I specifically have in mind is that a promise to pay a dividend, as well as the payment (or non-payment) of a dividend at a known, pre-determined time is *visible* to the market. The market thus reacts to what it observes with respect to a dividend initiation as well as the subsequent continuation/discontinuation *when these events actually occur*. This institutional feature is essential to my theory. In contrast, with open-market repurchases, all that the market knows is the aggregate amount of repurchase approved by the board of directors, with neither the exact timing of the repurchase nor the volume being repurchased at a given point in time being known. Moreover, the completion rates of approved open-market repurchase programs vary substantially in the cross-section. See, for example, Stephens and Weisbach (1998).

2.2 Related Literature

This section briefly surveys first the various theories and then the empirical studies that are most relevant, using the discussion to point out the main contribution of this paper to the literature.

2.2.1 Theoretical Explanations for Dividends

In light of the Miller and Modigliani (1961) dividend irrelevance theorem, explanations of dividend policy relevance based on signaling, agency costs, and behavioral considerations have had the lion's share of the theoretical literature.

The central insight of dividend signaling is that firms with private information about higher expected future earnings will pay higher dividends. Bhattacharya (1979) was the first to make this point,[53] and was followed by Miller and Rock (1985), John and Williams (1985), Marsh and Merton (1986), Ofer and Thakor (1987), and Lucas and McDonald (1998).[54] Guttman, Kadan, and Kandel (2010) develop an extension of Miller and Rock (1985) in which dividend signaling equilibria that partially pool across subsets of earnings realizations dominate perfectly separating signaling equilibria because they involve less underinvestment; such pooling is interpreted as "dividend stickiness".

Agency explanations for dividends involve firms paying dividends in order to disgorge cash that would otherwise be used inefficiently by managers. (e.g. Jensen (1986) and Zweibel (1996)). Related to this, Myers (2000) builds a model of how outside equity financing works, where dividends are set to represent a sufficient payment to ensure outside investor participation.

Behavioral explanations include Baker and Wurgler (2004), who argue that managers cater to investors by initiating dividends when investors put a premium on the stocks of dividend payers versus non-payers (see also Allen, Bernardo, and Welch (2000)). In Lambrecht and Myers (2012), habit formation leads to the kind of target-adjustment behavior posited by Lintner (1956).

While existing theories have enhanced our understanding of different aspects of dividend policy, it is a challenge to build a theory that is consistent with the majority of stylized facts on dividends and open-market repurchases. From this perspective, the marginal contribution of this paper can be described as follows. First, unlike static dividend signaling models (e.g. Bhattacharya (1979), Miller and Rock (1985), and John and Williams (1985)), this is a *dynamic* sequential equilibrium model. Thus, this model *endogenizes* the stock market's extremely negative reaction to a dividend cut and the firm's consequent reluctance to cut

[53] This follows an earlier contribution by Ross (1977), that debt could serve as a signal of firm value.

[54] Ofer and Thakor (1987) develop a model in which both dividends and *tender-offer* repurchases act as potential signals and firms choose an optimal combination. The paper explains the relative announcement effects of dividends and tender-offer repurchases. Brennan and Thakor (1990) provide a non-signaling information-based explanation for dividends and *open-market* repurchases, and show theoretically that large shareholders who find it privately-optimal to invest in information production, will prefer cash distribution via repurchases, whereas smaller shareholders, who choose to remain uninformed, prefer dividends. Corporate payout policy is then determined by whether small or large shareholders hold the majority of shares. Lucas and McDonald (1998) show that, in an environment with adverse selection and heterogeneous shareholder preferences, a certain mix of dividends and repurchases will be used to signal firm quality.

dividends, and provides an economic rationale for a dividend omission/cut generating a larger price decline than the positive price reaction to a dividend initiation. This is something that static signaling models cannot explain. In these models, the promised dividend payment is an ex ante efficient binding precommitment that is honored even in states in which it is ex post inefficient to do so because distress financing costs must be incurred. The decision to actually make the promised dividend is *not* endogenized. Moreover, because these are static models, one cannot talk about "cutting" dividends or price reactions to such moves.[55] There is only one dividend payment that is promised and made. By contrast, in my model there are two dividend payments, so one can endogenize the dividend initiation decision, the subsequent (subgame perfect) dividend omission/continuation decision, and the price reactions to dividend cuts.

Second, as a consequence of the result that a viable firm will not cut its dividend in equilibrium, the model also implies downward rigidity of dividends and smoothing.

Third, static signaling models imply that the likelihood of a dividend initiation is higher when information asymmetry is greater, since this is when dividend signaling has a higher "bang for the buck" (see Bernheim and Wantz (1995)). My theory predicts the opposite—when information asymmetry is high, so the costs of information disclosure with external equity issues are also high, the probability of dividend initiation is low. This permits an empirical horse race between the two approaches.

Fourth, unlike static signaling models, my theory implies that firms that initiate dividends will subsequently be more reliant on equity issues. Brav et. al. (2005) also note in their paper that firms will generally prefer equity issuance to make dividend payments rather than cut dividends; see Gan and Wang (2012) for recent empirical evidence. Fama and French (2005) document that most firms issue equity every year and that these issuances are material.

Finally, the predicted dependence of the dividend initiation decision on managerial ownership, the inverse relationship between the strength of this relationship and the strength of corporate governance, and the dependence of the dividend initiation decision on the potential firm-value loss resulting from the incremental information disclosure associated with external financing are novel aspects of my theory, and are all new results that have not been formalized in the signaling, agency, or behavioral theoretical models of dividends thus far.[56]

These results also point to the two new empirical contributions of this paper: (i) the dividend initiation decision depends on managerial ownership, but only when governance is poor enough, and (ii) empirical evidence provided for the relevance of information disclosure costs associated with secondary equity issues.

2.2.2 Empirical Evidence on Dividends

In a classic study, Asquith and Mullins (1983) documented large positive excess returns for firms initiating dividend payments, consistent with signaling. Similarly, Healy and Palepu (1988), Michaely, Thaler, and Womack (1995), and Petit (1972) show significant negative

[55]This includes Gutman, Kadan, and Kandel (2010).

[56]While Rozeff (1982) and Easterbrook (1984) argue informally that dividend payments may be used to reduce agency costs through subsequent external financing, they do not focus on two-audience signaling costs due to proprietary information disclosure and do not present a formal theory as this paper does.

excess returns and negative earnings changes for firms that omit dividend payments. Moreover, the evidence shows that the excess returns are asymmetric for initiations relative to omissions—on average, excess returns are around +3% for initiations and -7% for omissions (Allen and Michaely (1994)). Bernheim and Wantz (1995) provide strong evidence in support of dividend signaling. The theoretical model developed in this paper is consistent with these empirical regularities.[57]

Lintner (1956) provides survey and empirical evidence that managers smooth dividends. Brav, Graham, Harvey, and Michaely (2005) provide similar evidence based on a survey of CFOs. In addition, they present evidence that managers view repurchases as more flexible, and will only start to pay or increase dividends when they are reasonably sure that they will be able to maintain them permanently at the new level. In more comprehensive tests of the Lintner (1956) model, Fama and Babiak (1968) also find that the model performs well empirically, and Skinner (2008) shows that the target adjustment model still holds for total payout.[58] Michaely and Roberts (2012) provide evidence that private firms smooth dividends less than comparable (propensity-score-matched) public firms and also pay lower dividends. This evidence is consistent with my model on two counts. First, to the extent that ownership and management are closer in private firms—in one group of firms labeled as "private" by Michaely and Roberts (2012), the main owner is also the manager—than in public firms, there is a lesser need for dividends to resolve an agency problem. Second, there is usually less information disclosure by private firms. So, they face higher *incremental* two-audience disclosure costs and find dividends less attractive than public firms.[59]

Other empirical work has tested some of the predictive implications of my model. Consistent with my theory, Fama and French (2001) and Bulan, Subramanian, and Tanlu (2007) showed that greater size and profitability imply a higher probability of dividend initiation.

In terms of taxes and dividend policy, a number of papers have shown that a lower tax rate on dividend income (relative to capital gains income) implies a higher likelihood of dividend payments—a pattern that is also generated by my model. For example, Chetty and Saez (2005) examine the effect of the large tax cut enacted in 2003 on individual dividend income, and find a large increase in dividend payments and in the number of firms initiating dividend payments.

Empirical papers linking managerial stock ownership to payout policy include Brown, Liang, and Weisbenner (2007), who show that, after the reduction in personal dividend tax

[57]Grullon, Michaely, and Swaminathan (2002) document that firms that increase dividends experience subsequent declines in earnings, casting doubt on the signaling hypothesis. They find that dividend increases are followed by significant declines in systematic risk, so the positive dividend announcement effect may be due to a decline in the firm's cost of capital. This raises an interesting possibility that I leave for future research. It may be that as firms mature they decide to reduce their R&D investments (e.g. the way IBM did when Lou Gerstner took over as CEO in the 1990s) and thus they have less proprietary information to protect, which encourages a dividend initiation/increase, as predicted by my theory. It is also possible that reduced R&D means less systematic risk, e.g. R&D generates proprietary knowledge about products that represent highly discretionary spending for the firm's customers, and this spending covaries positively with the state of the economy—information technology spending by firms is a good example of this.

[58]Specifically, Skinner (2008) shows that the Lintner model works when payout is defined as dividends + repurchases – issues for mature firms.

[59]The lower smoothing in private firms is clearly consistent with my model since these firms are not deterred by an adverse stock price reaction when they consider cutting dividends.

rates in 2003, there is a positive relationship between executive stock holdings and rates of dividend initiation.[60] They suggest that managers with high levels of stock ownership find it less costly to initiate dividends after the tax cut. In contrast, my model predicts that managerial stock ownership and the probability of dividend initiation should be negatively related, especially when governance is poor. I do not know of any paper that has specifically tested this prediction.[61]

Finally, the empirical prediction of my model connecting payout policy to information disclosure costs is also novel, and has not been tested empirically. In addition to using a proxy for information disclosure costs in my logit model, I also attempt to isolate the effects of disclosure costs related to external financing on the dividend initiation decision, by employing a regression discontinuity approach that relies on a discontinuous change in reporting requirements for firms based on public float values that was introduced by the Sarbanes-Oxley Act of 2002.

2.3 The Model

In this section, I develop the theoretical model. Consider a five-date model, $t = 0, 1, 2, 3, 4$, with two consecutive time periods: Period 1 starting at $t = 0$ and ending at $t = 2$, and period 2 starting at $t = 2$ and ending at $t = 4$. In each period, there is a board of directors, representing the shareholders, who instruct the firm's manager about whether to initiate a dividend and whether to repurchase stock. The manager makes a visible project choice whose quality is unobservable to all except the manager himself. Dividends serve both an information-communication role and an agency-costs-reduction role. The details are described below.

2.3.1 Preferences, Types of Firms and Projects, and Strategy Spaces

Preferences: All agents are risk-neutral and the riskless rate is zero. Firms operate in a competitive capital market in which securities are priced to give investors an expected return of 0. Each firm has initial non-managing shareholders who collectively own a fraction $\alpha_0 \in (0, 1)$ of the firm, and a manager who owns $1 - \alpha_0$ of the firm. These ownership fractions are publicly observable. Firms are all-equity financed. Each firm starts out with a total of $C + I$ in cash (with $C < I$) at $t = 0$. This cash position is publicly observable. Of this, I can be used to invest in a project at an interim date $t = 1$ in the first period; this project will yield its only payoff at date $t = 2$, the end of the first period. The amount C is "excess cash" that is not needed for investment. If kept within the firm, its value at a future date

[60] They find a negative relationship between executive option holdings and dividend initiations and increases, which they relate to the fact that options lose value when cash dividends are paid as a result in the decline in share price.

[61] Fenn and Liang (2001) find a negative relationship between managerial ownership of stock and stock options (as a percentage of total shares outstanding) and dividend *payout*. Hu and Kumar (2004) show a strong negative relationship between managerial stock ownership and the likelihood of dividend payment in a logit analysis. However, neither of these papers focuses specifically on dividend *initiations* or on the interactive effect of managerial ownership and corporate governance on the dividend initiation decision.

(either $t = 1$ or $t = 2$) will be δC, with $\delta \in (0, 1)$. This assumption is meant to capture the idea that idle cash is prone to inefficient use (e.g. Jensen (1986)).[62]

Firms Types and Projects: There are *two types of firms*: "normal" (N) firms and "lemons" (L). Only the firm's manager knows at $t = 0$ whether his firm is a type N or type L. What is common knowledge is that the prior probability is $g \in (0, 1)$ that a randomly-chosen firm is type N and $1 - g$ that it is type L. A firm's type is intertemporally unchanging.

A type-N firm can choose between two mutually-exclusive projects at $t = 1$ with identical initial investment needs: a good (G) project and a private-benefit or empire-building (P) project. The G project yields an observable payoff of $V \in (0, 2I)$ with probability $\theta \in (0, 1)$ and 0 with probability $1 - \theta$ at $t = 2$. There are two possible values of θ: θ^- and θ^+, with $1 > \theta^+ > \theta^- > 0$. The manager as well as the board of directors (who represent the interests of the initial shareholders)—called "insiders"—know whether $\theta = \theta^-$ or $\theta = \theta^+$, conditional on the firm being type N; others do not and have a prior belief that $\Pr(\theta = \theta^+) = r \in (0, 1)$ and $\Pr(\theta = \theta^-) = 1 - r$. The P project yields a commonly-observed payoff of 0 with probability 1 and a random private benefit of $\tilde{B}$ to the manager at $t = 2$. Viewed at $t = 0$, $\tilde{B}$ is uniformly distributed with support $(0, B_{max}] \subset \mathbb{R}_+$, with $B_{max} < I$, so P is inefficient.[63] The probability distribution of $\tilde{B}$ is common knowledge, and will depend on a variety of factors, including the quality of corporate governance in the firm. Suppose ξ indicates the quality of (commonly-known) corporate governance in the firm, with high values of ξ indicating stronger governance being exercised on the manager. Then $\partial B_{max}/\partial \xi < 0$, $\inf B_{max}(\xi) = 0$, and assume that $\sup B_{max}(\xi) < I$. The manager privately observes the realization of $\tilde{B}$ before deciding whether to invest in G or P. No one but the manager can observe this project choice. A type-L firm has access to *only* project P. To the market, type-L firms appear observationally identical to type-N firms.

The type-N firms also exhibit another form of *ex ante* unobservable *intra-group* heterogeneity. The type-N firms with $\theta = \theta^+$—call them type-N^+—have assets in place worth A if carried until $t = 4$. If these assets are liquidated prior to $t = 4$, then they are worth $0 < A_l = I < A$. Moreover, these assets in place represent another source of private benefits for the manager. Thus, if he invests in the P project, it also enables him to consume perquisites out of the assets in place (he cannot do this with the G project). This means that investing in P yields the manager a total private benefit of $\tilde{B} + A$. The idea is that the more resource-rich the firm, the greater the opportunity for the manager to consume perks. The type-N firms with $\theta = \theta^-$—call them type-N^-—have assets in place that are observationally identical to the assets in place of the firms with $\theta = \theta^+$, but these assets essentially get exhausted in helping produce project cash flows and are thus worthless at $t = 4$, with zero liquidation value at prior dates. Similarly, the type-L firms have assets in place that are observationally identical to those of the type-N firms, but are worthless at any date.

[62]This value dissipation from "storage" does not apply to the investment needed for the project.

[63]P can be thought of as an empire-building or perquisites-consumption project. For example, it could be a poor acquisition that expands firm size and the CEO's social prestige and compensation, or a "castle-in-the-sky" new product investment that has little change of success. The assumption that the success probability is zero can be easily relaxed to allow a small success probability.

Although the manager is privately informed about whether the firm is type N or type L, he can credibly communicate the information to the board of directors, but not to investors at large, at a personal cost of $K > 0$. Moreover, the initial ($t = 0$) shareholders *cannot* provide the firm financing beyond their initial investment, due to limited personal resources, diversification motives, etc.

Information Structure: The manager is the most informed party here. He knows whether his firm is type N or type L, whether $\theta = \theta^+$ or $\theta = \theta^-$ conditional on the firm being type N, and the project chosen if the firm is type N. The firm's board of directors (acting on the initial shareholders' behalf) represent the second-most informed party. The board does *not* know whether the firm is type N or L, but knows whether the firm has $\theta = \theta^+$ or $\theta = \theta^-$ if it is type N. That is, mixed in with type-N^- firms, there are type-L firms—call them type-L^-—that appear to the board of directors of any type-N^- firm to be observationally identical to a type-N^- firms, so that the board's prior probability that its own firm is type N^- is g. Similarly, mixed in with the type-N^+ firms, there are type-L firms—call them type-L^+—that appear to the board of directors to be observationally identical to a type-N^+ firm, so that the board's prior probability that its own firm is type N^+ is g. The stock market (represented by other investors) knows the least. The market cannot distinguish between type-L and type-N firms, does not know the type-N firm's θ, and does not observe the manager's project choice.

Second-period Events: After the project payoff is observed at $t = 2$, the second period begins. The project payoff becomes common knowledge when realized at $t = 2$. Whether the firm will have the necessary funds at $t = 2$ to invest in a project at $t = 3$ (the interim date of the second period) depends on whether the first period project paid off. At $t = 3$, the manager has the same choice of one of two mutually-exclusive projects that he did in the first period. The payoffs on the first-period and second-period P projects are identical and independently distributed (i.i.d.). However, the second-period G project pays off $\hat{V} > V$ with probability θ and 0 with probability $1 - \theta$.[64] The value of θ for the second period is the same as that for the first period for any firm. The second-period project, regardless of type, pays off at $t = 4$, at which date the world ends.

Strategy Spaces: The *strategy spaces* are as follows. At the start of each period, *shareholders* delegate to the board of directors the authority to decide whether to ask the manager to initiate a dividend payment (if no dividends were paid in earlier periods) or to continue/discontinue a previous dividend. The manager could also go to the board with a dividend policy proposal of his own, but the authority for approval rests with the board; in a part of the analysis the manager takes the lead in proposing a dividend policy for board

[64] This means that the second-period project has higher value than the first-period project, conditional on the *same* beliefs about the firm's type. First-period projects can be feasibly externally financed at prior beliefs. But if there is first-period project failure, then it may not be possible to externally finance the second-period project at the now-lower posterior belief that the firm is type N, if the type G project has the same value across the two periods conditional on the same beliefs. Giving the second-project a higher value eases the parametric restrictions for the firm to get external finance in the second period after project failure (but is not necessary).

approval. The assumption that approval authority rests with the board is in line with practice.[65] Similarly, the board also decides on behalf of the shareholders whether to instruct the manager to repurchase stock. I restrict attention to open-market stock repurchases.[66] The assumption that shareholders (via the board) must authorize any open-market repurchase is also in line with practice. All repurchases are strictly proportional in that all shareholders (including the manager) participate in direct proportion to their ownership shares.

2.3.2 Objective Functions, Payout and Financing Choices, and Parametric Restrictions

At the start of each period, the board makes the dividend/repurchase decision to maximize the expected value at that date of the shareholders' wealth over the remaining time. The manager makes his project choice to maximize the sum of the value of this stock ownership in the firm at different dates and his private benefit. For simplicity, it is assumed that if the firm pays a dividend, it is $d \in \{0, I\}$.[67] It is also assumed that dividend payments are subject to personal taxation at the rate of $\tau \in (0,1)$. Stock repurchases are not subject to taxes.[68]

Since $C < I$, a dividend payment by the firm at $t = 0$ means that it will have to seek external financing at $t = 1$ for its first-period project. External financing typically involves information disclosure, and this can generate a real loss in the value of the project. This loss can be due to a variety of reasons: the transaction cost of raising financing,[69] and a decline in project cash flows due to the "two-audience signaling" problem wherein any project-related information that is communicated to investors is also unavoidably communicated to the firm's product-market competitors.[70] The focus is on the information disclosure costs related to the two-audience signaling problem, so transaction costs are ignored, and it is assumed that this loss in firm value due to external financing is proportional to the observable value of the project: λV, with $\lambda \in (0,1)$.[71] Thus, the G project's payoff distribution with external

[65]This is consistent with evidence provided by La Porta, Lopez de Silanes, Shleifer, and Vishny (2000), who show that firms around the world (in countries with good legal systems) pay dividends because minority shareholders pressure insiders to disgorge cash.

[66]Tender-offer repurchases, whereby the board authorizes the firm to repurchases a certain number of shares at a pre-determiend price above the current stock price, serve a different purpose (signaling firm value) and are beyond the scope of this paper. See Ofer and Thakor (1987) and Vermaelen (1981).

[67]Allowing the size of the dividend to be endogenously determined from a continuum introduces complexity without yielding additional insight.

[68]This is not a restrictive assumption. In practice, investors are only taxed on their capital gains resulting from selling their shares to the firm, and that too at the capital gains rate, which is lower than the personal income tax rate for most investors.

[69]The costs of raising external capital are large, and investment banking fees constitute a significant portion of these costs. For example, Lee, Lochhead, Ritter, and Zhao (1996) find that the average firm pays about 7% of the total proceeds to raise capital through a seasoned equity offering, and investment banking fees represent 76% of total flotation costs.

[70]See Bhattacharya and Ritter (1983), for example. The idea that dividends create market discipline due to the increased need to raise costly outside equity in the future is also advanced by Rozeff (1982) and Easterbrook (1984).

[71]Thus, it is clear that these are not intended to be just floation costs of a seasoned equity issue—which would be proportional to I—but rather information-disclosure costs that dissipate firm value.

financing becomes $[1-\lambda]V$ with probability θ and 0 with probability $1-\theta$ if it is a first-period project, and it becomes $[1-\lambda]\hat{V}$ with probability θ and 0 with probability $1-\theta$ if it is a second-period project. In the second period, external financing may become necessary because the first-period project fails to produce a visible payoff.

While external financing involves a cost, it also has a benefit. Because the information disclosure accompanying external financing allows investors to detect the manager's project choice with probability $q \in (0,1)$. If the manager is discovered to have chosen P, financing is denied and the firm is extinguished. This disciplining role of external financing to reduce agency costs is familiar from the previous literature on "outside equity".[72] This also means that the manager *cannot* raise outside financing and then not invest in the project.

I impose some restrictions on the exogenous parameters of the model in order to confine attention to the case of most interest to this analysis. These are listed and discussed below.

1. *Project NPV*: It is assumed that the first-period project has positive NPV regardless of whether it is internally or externally financed:

$$\min\left\{\theta^{-}(1-\lambda)V,\ [\theta^{-}V]^2\left[1-\alpha_0\right]\left[B_{max}\right]^{-1}\right\} > I, \tag{1}$$

   It is next assumed that the second-period project of a type-N^{-} firm if externally financed has a sufficiently high NPV to make it worthwhile for the firm to raise financing for the project, but not high enough to also pay a dividend should it choose to do so:

$$g_f\theta^{-}[1-\lambda]\hat{V} \in (I, 2I), \tag{2}$$

2. *Incentive Compatibility for the Manager*: These restrictions establish that the detection probability associated with external financing is high enough to guarantee incentive compatibility—the manager will not choose project P when faced with this market discipline:

$$q > 1-[1-\alpha_0]\left\{[1-\lambda]\theta^{-}\hat{V}+V-2I\right\}B_{max}^{-1}, \tag{3}$$

   where $g_f \equiv \left[1-\theta^{-}\right]g\left\{\left[1-\theta^{-}\right]g+[1-g]\right\}^{-1}$, and

$$q > 1-[1-\alpha_0]\left\{[1-\lambda]\theta^{+}\hat{V}+V[1-\lambda]-2I+A\right\}\left[B_{max}+A\right]^{-1}. \tag{4}$$

3. *Financing Constraints*: It is assumed that, conditional on first-period project failure, the type-N^{+} firm cannot raise enough financing for both a dividend payment and project financing in the second period, unless there is asset liquidation:

$$g_2\left\{[1-\lambda]\theta^{+}\hat{V}+A\right\} < 2I, \tag{5}$$

[72] See Myers (2000) and Fluck (1999). In Myers (2000), insiders have incentives to capture the cash flows of the firm, but long-lived projects in the firm need funding from outsiders in order to continue. Insiders have an incentive to expend effort and work, and pay dividends, in order to induce the outside investors to contribute capital to the project and thus maximize firm value (which in turn allows insiders to capture more cash flow in the future).

where $g_2 \equiv [1-\theta^+] g_1 \{[1-\theta^+] g_1 + [1-g_1]\}^{-1}$ and $g_1 \equiv g\{g+[1-q][1-g]\}^{-1}$. Thus, it is assumed that when the firm has a failed project, the market responds by no longer allowing it to raise enough financing for both a dividend and another project.

4. *Communication to the Board*: The final restriction guarantees that it will pay for the manager to expend personal effort at cost K to convince the board of the type-N^+ firm to liquidate assets in place to pay a second-period dividend following first-period project failure:

$$[1-\alpha_0]\left\{[1-\lambda]\theta^+\hat{V} + I\tau\right\} > K. \tag{6}$$

2.3.3 Timeline and Summary of Key Events

This section describes the timeline of the model and key events, summarized in *Figure 2-1*.

[Figure 2-1 Here]

At $t=0$, the start of the first period, non-managing shareholders own $\alpha_0 \in (0,1)$ of the unlevered firm and the manager owns $1-\alpha_0$. The firm starts with $C+I$ in cash, of which I can be used for investment at $t=1$ in a project and C is "excess cash" that is not needed to operate the firm. If this cash is kept idle in the firm until $t=1$ or $t=2$, it will be worth only δC, with $\delta \in (0,1)$. The firm can choose to initiate a dividend payment $d \in \{0, I\}$ at $t=0$. The firm can also undertake an open-market repurchase to disgorge any fraction of its available cash $C+I$ at $t=0$. Dividends are taxed at the ordinary income tax rate of $\tau \in (0,1)$ when investors receive them. Repurchases involve no taxation.

At $t=1$, the manager must decide whether to invest in a project and which project to invest in: P or G. The choice depends on the realized value of the manager's private benefit, $\tilde{B}$. If the firm paid a dividend, then it raises this financing by issuing equity. If it decided to not pay a dividend, then the project can be financed with internal funds. External financing leads to reduction in the payoff in the successful state of the G project from V to $(1-\lambda)V$.

The project payoff is realized at $t=2$. After this the second period begins. The firm must decide whether to initiate a dividend (assuming it did not do so at $t=0$), and whether to continue dividend payment if it paid a dividend at $t=0$. It may also repurchase stock at $t=2$.

At $t=3$, the firm must again choose between P and G. The choice depends on the realized value, $\tilde{B}$, of the manager's private benefit with project P. How the project is financed (externally or internally) depends on whether the first period project paid off and whether a dividend was paid at $t=2$. The payoff on G in the second period is $(1-\lambda)\hat{V}$ with probability θ and 0 with probability $1-\theta$ if it is externally financed. If internally financed, the payoff in the successful state is $\hat{V}$. The second-period project pays off at $t=4$. Section 4.6 discusses why all the elements of the model are needed.

2.4 Analysis of the Model

This is a dynamic model in which there is both private information (the firm's manager privately knows whether the firm is type L or type N, and if it is type N then whether $\theta = \theta^+$ or $\theta = \theta^-$, whereas the board of directors only knows whether $\theta = \theta^-$ or $\theta = \theta^+$ conditional on the firm being type N) and moral hazard (the manager can invest in the inefficient empire-building project in an unobservable way). The model will be analyzed in the usual backward induction manner. Formally, this is a game in which the informed board moves first and announces whether the firm will pay a dividend and/or repurchase stock, based on its private information about θ, conditional on the firm being type N. The uninformed market reacts by setting the firm's stock price. The board then determines whether to raise internal or external financing for the project, and subsequently the manager makes his project choice. The strategy set for the board can be written as $\{d_p, r_p, x_p; p \in \{1, 2\}\}$, where d_p is the dividend paid in period p, r_p is the amount repurchased in period p, and $x_p \in \{internal, external\}$ is the decision in period p about whether to finance the project with internal funds or via a new equity issue. Note that the dividend payments and stock repurchases occur at dates $t = 0$ and $t = 2$ in the first and second periods respectively, whereas the project financing decisions in periods 1 and 2 occur at dates $t = 1$ and $t = 3$ respectively.

2.4.1 Structure of the Game

It is useful to begin by establishing that the firm will not keep its excess cash on the books.

Lemma 1: *The firm will use any excess cash not needed for investment in a project at any date to repurchase its stock at the prevailing market price.*

The intuition is straightforward. Excess cash is subject to value dissipation if kept in the firm. Using this cash to pay a dividend means that shareholders incur a personal tax. Thus, the only action that does not result in any value dissipation for the shareholders is a repurchase.

Figure 2-2 shows the strategic choices for the board of directors which is making decisions on behalf of the shareholders. In light of Lemma 1, the repurchase decision is excluded.

[Figure 2-2 Here]

We will see later that there are three possible equilibria, depending on the exogenous parameter values: (1) firms separate at $t = 0$ into two groups, one initating a dividend payment and the other choosing not to do so (see the two sets of outcome nodes in *Figure 2-2*); (2) all firms choose not to initiate a dividend at $t = 0$; and (3) all firms choose to initiate a dividend at $t = 0$.

Initially, the focus will be on the separating equilibrium in (1). The possibility of the equilibria mentioned in (2) and (3) will be discussed later.

2.4.2 Analysis of the Separating Equilibrium: Firm Values in Different States at $t = 2$

Before characterizing the sequential equilibrium (Kreps and Wilson (1982)) in this game, it is useful to begin by computing firm values and the wealth of the shareholders in the eight different numbered nodes at $t = 2$ in *Figure 2-2*. For this, the *conjectured* sequential equilibrium is as follows. The type-N^+ firms choose to initiate a dividend at $t = 0$, while the type-N^- firms choose not to. The type-N firms that do not initiate a dividend at $t = 0$ choose to repurchase stock with their excess cash at $t = 0$. At $t = 1$, they choose G as their first-period project and finance it internally. At $t = 2$, they either initiate a dividend or don't do so. The type-N firm always invests in the G project in the second period and finances it internally if the first-period project pays off and no dividend is paid at $t = 2$; otherwise, it finances the project externally. The type-L firms mimic the strategies of the group of type-N firms (at all dates at which it is possible to do so) that they are observationally identical to in the eyes of their directors.[73] The type-N firms that do initiate a dividend at $t = 0$ also use their excess cash to repurchase stock at $t = 0$. At $t = 1$, they choose the G project in the first period and finance it through an equity issue. At $t = 2$, if the first-period project pays off, they either continue or discontinue the first-period dividend. If they continue the dividend, the project is financed externally. If they discontinue it, the project is financed internally. If the first-period project fails, the dividend is either continued or discontinued at $t = 2$, and the second-period project is externally financed in either case. The out-of-equilibrium belief that a firm that does not initiate a dividend at $t = 0$ but does so at $t = 2$ will be viewed as a type-N^- firm will also be taken as a given here, and formalized in Proposition 2.

Given this conjectured equilibrium (this conjecture will be formally verified later), I now calculate the firm value (market value of equity) in every node.

Node 3: This node arises because the first-period project pays off V and a dividend is initiated at $t = 2$, leaving the firm with $V - I$ in investible cash. Since $V < 2I$, we know that $V - I < I$, implying that external equity financing will be raised for the second-period project. The external financing needed is $I - [V - I] = 2I - V > 0$. Let α_n be the ownership share sold to new shareholders at $t = 2$ to raise this amount. That is, α_n satisfies the competitive market pricing condition:

$$\alpha_n[1 - \lambda]\theta^- \hat{V} = 2I - V, \tag{7}$$

where two facts are recognized. First, because the equilibrium is separating, investors know that the type-N firm that chose not to initiate a dividend is type-N^-. Second, if a firm invests in the G project, then a fraction λ of the value is lost due to disclosure and transaction costs, so the net expected value is $[1 - \lambda]\theta^- \hat{V}$. Moreover, although the type-N^- firms are pooling with lemons at $t = 0$, so that the prior probability that the firm is type-N^- is only g, first-period project success means that the posterior probability of the firm being type N^- is 1; hence the expression in (7).

[73] Although "pooling-in-strategies" across the type-N and type-L firms occurs in the first period at $t = 0$, there are states of the world at $t = 2$ in which it is impossible for the type-L firms to mimic their type-N look-alikes.

The type-N^- firm's manager's ownership now becomes $[1-\alpha_n][1-\alpha_0]$. Thus, substituting from (7), he computes his expected wealth if he invests in project G as:

$$[1-\alpha_n][1-\alpha_0][1-\lambda]\theta^-\hat{V} = [1-\alpha_0]\left\{[1-\lambda]\theta^-\hat{V} - [2I - V]\right\}. \tag{8}$$

If the manager selects the P project, then his expected *maximum* wealth is

$$[1-q]B_{max}, \tag{9}$$

where $1-q$ is the probability that his choice of P will go undetected by investors. We now have:

Lemma 2: *The type-N^- firm's manager will prefer project G over project P when he finances the project externally at $t=2$ having chosen not to initiate a dividend at $t=0$ and after having observed the first-period project pay off.*

Essentially, this result says that the incentive compatibility of project choice is guaranteed because of the market discipline of external financing. Given Lemma 2, the wealth of the initial ($t=0$) shareholders in node 3 is given by

$$W_3^S = \alpha_0\left[(1-\lambda)\theta^-\hat{V} - 2I + V\right], \tag{10}$$

since they assess firm value as g times what the manager assesses it as.

Node 4: This node arises because the first-period project pays off and no dividend is initiated at $t=2$, so the firm has V in investible cash. External financing is unnecessary since the project can be internally financed. Given the absence of market discipline, the manager's choice of G or P project will depend on the realized value of $\tilde{B}$ associated with P. Let B^0 be the maximum value of $\tilde{B}$ such that G is preferred to P for all $\tilde{B} \leq B^0$. That is, B^0 solves

$$[1-\alpha_0]\left[\theta^-\hat{V}\right] = B^0. \tag{11}$$

Thus, the total expected value of an internally-financed project is:

$$\int_0^{B^0} \theta^-\hat{V} f\left(\tilde{B}\right) d\tilde{B}. \tag{12}$$

Given the assumption that $\tilde{B} \sim U(0, B_{max}]$, the wealth of the initial shareholders in node 4 (as assessed by the insiders at $t=0$) can be written as (defining $h(\theta^-) \equiv B^0/B_{max}$):

$$W_4^S = \alpha_0\left[\int_0^{[1-\alpha_0]\theta^-\hat{V}} \theta^-\hat{V}\left[B_{max}\right]^{-1} d\tilde{B}\right] = \alpha_0\left[\theta^-\hat{V}\right] h\left(\theta^-\right). \tag{13}$$

Nodes 5 and 6: Failure of the first-period project means that the posterior probability that the firm is type N (type N^- in this node) is:

$$\Pr(N \mid \text{first period project fails}) = \frac{[1-\theta^-]\,g}{[1-\theta^-]\,g + [1-g]} \equiv g_f < g. \tag{14}$$

Now, it is clear that, given (2), the firm will be unable to raise $2I$. However, given (2), it is also possible to raise enough financing to fund the project. Thus, the second-period project can be externally financed, but a dividend cannot be initiated. The amount of ownership that will need to be sold to new investors in order to raise I will satisfy the competitive pricing condition:

$$\alpha_n g_f [1-\lambda]\theta^- \hat{V} = I. \tag{15}$$

The type-N manager's ownership becomes $(1-\alpha_n)(1-\alpha_0)$ and his wealth at $t=3$ with G is:

$$[1-\alpha_n]\,[1-\alpha_0]\,[1-\lambda]\theta^- \hat{V}. \tag{16}$$

If the manager selects the P project, then his expected maximum wealth is given by (9). It is easy to establish that, given (3), the manager will strictly prefer to invest in the G project. Thus, the wealth of the initial shareholders in node 5 (as assessed by them) is

$$W_5^S = W_6^S = \alpha_0 \left[g_f [1-\lambda]\theta^- \hat{V} - I \right]. \tag{17}$$

Given that no dividend can be paid in node 5, nodes 5 and 6 are identical.

Lemma 3: *In nodes 3-6, the manager will never incur the cost K to credibly communicate the firm's true type to the firm's board.*

The intuition is that the firm never initiates a dividend in nodes 3-6 unless it has internal funds due to first-period project success. Since the manager wants to convince the board that the firm is type N and not type L only when he needs their approval to pay a dividend, he chooses not to do so at a personal cost because the decision of whether to pay a dividend out of internal funds does not depend on the board's knowledge of whether the firm is type N or L. This is because a type-L firm with internal funds will mimic whatever an observationally-identical type-N firm does.

Node 7: This node is reached when an externally-financed project pays off, a dividend is paid and then the project is externally financed again. The analysis mirrors that for node 3. However, in the lower set of nodes, 7 through 10, because the first-period project is externally financed, market discipline screens out some lemons. Thus, at $t=1$, *before* the project outcome is observed, the posterior belief about the firm being type N (type N^+ in this case) is:

$$\Pr(N \mid \text{project externally financed}) \equiv g_1 = \frac{g}{g + [1-q][1-g]} \in (g, 1). \tag{18}$$

Now, if the project pays off at $t=2$, then the posterior belief that the firm is type N is:

$$\Pr(N \mid \text{project financed externally and successful}) = 1. \tag{19}$$

Thus, when the project is externally financed (node 7), the external financing needed is $2I - (1-\lambda)V$, and α_n satisfies the competitive pricing condition:

$$\alpha_n \left\{ [1-\lambda]\theta^+ \hat{V} + A \right\} = 2I - V(1-\lambda). \tag{20}$$

The type-N firm's manager's ownership becomes $[1-\alpha_n][1-\alpha_0]$. Thus, his wealth if he invests in project G at $t = 3$ is:

$$[1-\alpha_n][1-\alpha_0] \left\{ [1-\lambda]\theta^+ \hat{V} + A \right\} = [1-\alpha_0] \left\{ [1-\lambda]\theta^+ \hat{V} + A - [2I - V(1-\lambda)] \right\}. \tag{21}$$

If the manager selects the P project, then his expected *maximum* wealth is calculated as follows. Let B_+^0 be the maximum value of $\tilde{B}$ such that the manager still prefers G to P. That is, B_+^0 solves:

$$[1-\alpha_0] \left[\theta^+ \hat{V} \right] = B_+^0 + A. \tag{22}$$

Thus, if the manager selects the P project, then his maximum expected wealth is:

$$[1-q][B_{max} + A]. \tag{23}$$

For later use, it will be convenient to define $h(\theta^+) \equiv B_+^0 / B_{max}$, where $B_+^0 = [1-\alpha_0] \left[\theta^+ \hat{V} \right] - A$. Note that the wealth of the shareholders if they choose internal financing will be

$$\alpha_0 \int_0^{[1-\alpha_0][\theta^+\hat{V}]-A} \left[\theta^+ \hat{V} \right] B_{max}^{-1} d\tilde{B} = \alpha_0 h(\theta^+) \left[\theta^+ \hat{V} \right]. \tag{24}$$

We now have the following analog of Lemma 3.

Lemma 4: *The type-N^+ firm's manager will prefer project G over project P in the second period when he finances the project externally at $t = 2$ after having chosen to initiate a dividend at $t = 0$ and having observed that the first-period project has paid off.*

We can now write the wealth of the initial shareholders in node 7 as

$$W_7^S = \hat{\alpha}_0 \left[[1-\lambda]\theta^+ \hat{V} + A - 2I + V(1-\lambda) \right]. \tag{25}$$

Node 8: In this node, the project pays off but the dividend is discontinued, so that the project is internally financed. For now it will be assumed that this will *not* be done in equilibrium, and it will be checked later that it will indeed be optimal for any firm to avoid doing this.

Node 9: If the project fails, then

$$\Pr(N \mid \text{externally financed project fails}) = \frac{[1-\theta^+]\, g_1}{[1-\theta^+]\, g_1 + [1-g_1]} \equiv \dot{g}_2 < g_1. \tag{26}$$

To continue the dividend, the firm needs external financing of $2I$. However, given (5), it is impossible for the firm to raise enough financing for both a second-period dividend and second-period project funding. The only way to pay a second-period dividend is to liquidate the firm's assets in place for $A_l = I$. Then, after paying the dividend, the firm could raise I to fund the second-period project by issuing equity at the ex-dividend price. The following result can now be proved.

Proposition 1: *Suppose a firm that cuts its dividend in the second period from what it paid in the first period is viewed by investors as type-L firm. Then, following first-period project failure, the manager of a type-N firm that had paid a first-period dividend will choose to personally incur a cost K to convince the board that the firm is type N and then the firm will liquidate assets in place to pay the same dividend in the second period. The firm will issue equity to raise I to finance the second-period project and invest it in project G. The expected wealth of the initial shareholders in node 9 (as assessed by the shareholders at $t = 2$ before assets in place are liquidated) is:*

$$W_9^S = \alpha_0 g_2 \left\{[1-\lambda]\theta^+\hat{V} - I\tau\right\}. \tag{27}$$

Even though liquidating assets in place prematurely is costly—the manager must incur a personal cost K and then assets can only be liquidated at $A_l < A$—the firm will prefer to do it if not doing it and cutting its dividend leads to the most adverse possible inference about its value. It will be verified that such an inference will indeed arise in equilibrium.

Node 10: It will be proved later that this node will never be reached in equilibrium, except by a type L firm. The next result is straightforward but useful.

Lemma 5: *The firm will always choose to invest in its second-period project.*

2.4.3 Evaluation of the Second-Period Choices

A comparison will now be made of the values in the different nodes.

Nodes 3 and 4: The shareholders' total wealth in node 3 is

$$W_3^S + \alpha_0 I[1-\tau] = \alpha_0 \left\{[1-\lambda]\theta^-\hat{V} + V - I - I\tau\right\}. \tag{28}$$

The wealth in node 4 can be written as $W_4^S + V - I$, which is:

$$\alpha_0 \left\{\left(\theta^-\hat{V}\right)^2 [1-\alpha_0]\left[B_{max}\right]^{-1} + V - I\right\}. \tag{29}$$

Note that, ignoring α_0, (28) and (29) also represent the market values of equity at $t = 2$ corresponding to nodes 3 and 4 respectively prior to raising equity and investing. We now have:

Lemma 6: *Assume that*

$$[1-\alpha_0]\,\theta^{-}\hat{V} > [1-\lambda]B_{max}. \tag{30}$$

Then the shareholders prefer to not initiate a dividend at $t=2$ if they did not initiate it at $t=0$ and the first-period project paid off.

The parametric restriction in (30) ensures that shareholder wealth in node 4 is higher than that in node 3. It will be assumed henceforth that (30) holds.

Nodes 5 and 6: The initial shareholders' wealth in node 5 or node 6 is W_6^S, (see (17)).

Lemma 7: *The shareholder will not initiate a dividend at $t=2$ if they did not initiate it at $t=0$ and the first-period project did not pay off.*

As for the lower nodes 7-10, it has already been stated that nodes 8 and 10 will not be reached in equilibrium. This will be verified as part of the equilibrium.

2.4.4 Analysis of the Separating Equilibrium: Choices and Firm Values at $t = 0$

I will now calculate the firm values at $t=0$ that are associated with the two choices at that date: no dividend initiation and dividend initiation, i.e. nodes 1 and 2.

For a type-N^- firm that chooses not to initiate a dividend at $t=0$, the initial shareholders' wealth in *node 1* can be written as:

$$\begin{aligned} &W_1^S(\theta^-) = \\ &\alpha_0 g\Bigg\{\left\{\Pr\left(\tilde{B}\le[1-\alpha_0]\,\theta^-V\right)[1-\theta^-]+\Pr\left(\tilde{B}>[1-\alpha_0]\,\theta^-V\right)\right\}\left(g_f[1-\lambda]\theta^-\hat{V}-I\right) \\ &\quad+\Pr\left(\tilde{B}\le[1-\alpha_0]\,\theta^-V\right)\theta^-\left[V-I+\left(\theta^-\hat{V}\right)^2(1-\alpha_0)\left(B_{max}\right)^{-1}\right]\Bigg\}. \end{aligned} \tag{31}$$

(31) can be understood as follows. The expression in the large braces in (31) is multiplied with g, the probability the firm is type N. There are two terms being added up inside the large braces in (31). The first term in (31) has two components. The first is the probability that no cash flow will be thrown off by the first-period project. This is the sum of two probabilities: (i) the probability that project G will be chosen and it will fail, which is $\Pr\left(\tilde{B}<[1-\alpha_0]\,\theta^-V\right)[1-\theta^-]$; and (ii) the probability, $\Pr\left(\tilde{B}>[1-\alpha_0]\,\theta^-V\right)$, that the project P is chosen in the first period. The second component is the net value of the externally-financed second-period project in the state in which the first-period project fails. By (2), this quantity is strictly positive.

The second term in (31) is $\Pr\left(\tilde{B}\le[1-\alpha_0]\,\theta^-V\right)\theta^-\left[V-I+\left(\theta^-\hat{V}\right)^2(1-\alpha_0)\left(B_{max}\right)^{-1}\right]$. It consists of: the probability, $\Pr\left(\tilde{B}\le[1-\alpha_0]\,\theta^-V\right)$, that the manager will choose G in the first period if the project is internally financed; the probability, θ^-, that the G project will succeed; and a third part that has the payoff, V, due to the success of the first-period project and the net value of the internally-financed second-period project, which is $\left(\theta^-\hat{V}\right)^2 (1-\alpha_0)(B_{max})^{-1} - I$.

The initial shareholders' wealth in *node 2* is:

$$
\begin{aligned}
W_2^S(\theta^+) \;=\; \alpha_0 \Big\{ & I[1-\tau] - I + \theta^+ g\left[V[1-\lambda] + I(1-\tau) - 2I + A + [1-\lambda]\theta^+\hat{V}\right] \\
& + \left[1-\theta^+\right] g\left[(1-\lambda)\theta^+\hat{V} - I\tau\right]\Big\}
\end{aligned} \tag{32}
$$

In (32), the first term inside the curly brackets, $I[1-\tau]$, is the after-tax dividend in the first period. The second term is I, the expected cost of external financing raised for the first-period project when investors price the security using the same beliefs about the firm's type as the initial shareholders in a separating equilibrium in which the firm signals itself as a type-N^+/L through a dividend at $t=0$. The third term, with θ^+ in it, is the expected payoff along the path that leads to node 7. It includes the first-period project payoff $V(1-\lambda)$, the second-period dividend $I[1-\tau]$, the $-2I$ that corresponds to the cash outflow due to the external financing raised to cover the investment in the second-period project and the second-period dividend, the value of assets in place A, and the expected value of the second-period project $[1-\lambda]\theta^+\hat{V}$. The fourth term contains $1-\theta^+$, the probability that the first-period project will fail, and hence refers to the path that leads to node 9.

2.4.5 The Separating Sequential Equilibrium

This subsection describes the separating equilibrium in this game. It is useful to first impose additional parametric restrictions that are sufficient (but not necessary) for the results:

$$\Psi > \tau > \max\left\{1-\lambda,\ 2\theta^- g\left[\theta^+ - \theta^-\right]\left[\theta^+\right]^{-1}\right\} > 0, \tag{33}$$

where $\Psi \equiv I^{-1}\theta^+ g\left\{V[1-\lambda] + [1-\lambda]\theta^+\hat{V} + A - I - h(\theta^+)[V-I] - [h(\theta^+)]^2\left[\theta^+\hat{V}\right]\right\}$,

$$h(\theta^+) < 1-\lambda < \left[h(\theta^-)\right]^2, \tag{34}$$

$$\theta^+ \text{ is sufficiently large, with } \theta^+ \le 2\theta^-. \tag{35}$$

Restriction (33) guarantees that the value loss from the information disclosure associated with external financing is small relative to the tax disadvantage of dividends, so that using the combination of external financing and dividend payment makes sense for the firm. Restriction (34) bounds the value loss associated with external financing from below by the probability, $h(\theta^+)$, that the manager of a type-N^+ firm will choose a G project and from above by the probability, $h(\theta^-)$, that the manager of a type-N^- firm will choose a good project. The assumption that $h(\theta^+) < h(\theta^-)$ means that it is more likely that the manager of the type-N^+ firm will invest in the P project than it is that the manager of the type-N^- firm will do so. This is because there are more perks to consume in the type-N^+ firm. Finally, restriction (35) ensures that the type-N^+ firm faces a sufficiently low risk of project failure that initiating a dividend is not excessively "risky".

It is also helpful to note the following result as a preamble to the sequential equilibrium.

Lemma 8: *If investors knew as much as the firm's board of directors at the outset, the type-N^- firms would prefer a strategy of not paying dividends at $t = 0$ or $t = 2$ to one of paying dividends at $t = 0$ and $t = 2$, whereas the type-N^+ firms would prefer to pay $d = I$ at $t = 0$ and $t = 2$ rather than setting $d = 0$ at $t = 0$ and $t = 2$. There would be no dividend initiation announcement effect.*

This result establishes that resolving an agency problem is the sole reason for the firm's initial shareholders to use dividends. The intuition is discussed after the next result.

Proposition 2: *Assume $\hat{V}$ is sufficiently high. Then there is a sequential equilibrium (Kreps and Wilson (1982)) in which: (i) the type-N^- firm chooses not to initiate a dividend at $t = 0$ or at any subsequent date and finances its first-period project internally and its second-period project internally (paying out any first-period cash flow in excess of its second-period investment need through a repurchase) if the first-period project succeeds and externally if it fails; and (ii) the type-N^+ firm chooses to initiate a dividend at $t = 0$ and continues with the dividend for the second period at $t = 2$, finances its first-period project externally, its second-period project internally if the first-period project succeeds and externally by selling its assets in place if it fails. The type-L firms mimic and pool at $t = 0$ with the type-N firms they are observationally identical to from the perspective of the board of directors. At $t = 2$, the type-L firms that were able to obtain external financing and initiate dividends at $t = 0$ end up not paying dividends in the second period. The type-L firms that pooled with the type-N^- firms and did not initiate dividends at $t = 0$ continue to mimic the type-N^- firms at $t = 2$. The only out-of-equilibrium move is for a firm to not initiate a dividend at $t = 0$ and then initiate it at $t = 2$. Investors' out-of-equilibrium beliefs are to view such a firm as being type-N^- with probability g and type-L with probability $1 - g$ in the second period.*

The intuition is as follows. The type-N firm has two benefits of initiating a dividend in the first period. First, it leads to external financing of the first-period project and hence market discipline on the manager. Second, it makes mimicry by the lemons impossible in the second period, conditional on first-period project failure, as long as the type-N firm does not cut its dividend. This means that if the type-N firm can continue with a dividend in the second period, it pays a lower "lemons premium" than it did in the first period. The downside of initiating a dividend payment at $t = 0$ is that, if the first-period project fails, raising external financing to finance the second-period project *and* pay a second-period dividend may be costly or impossible. There are two reasons why initiating a dividend makes more sense for the type-N^+ firm. One is that the external-financing-related market discipline associated with dividend initiations has greater value for the type-N^+ firm than for the type-N^- firm, because there are more perquisites to consume in the former. The other reason is that the expected cost of dividend continuation in the second period is lower for the type-N^+ firm because it has a lower likelihood of first-period project failure than the type-N^- firm and also has assets in place for raising second-period financing.

Compared to the type-N^+ firm, the benefit of the market discipline associated with a dividend payment and external financing is lower for the type-N^- firm, and the cost of first-period project failure after having initiated a dividend at $t = 0$ is prohibitive. This is because such a firm cannot raise enough external financing to pay a dividend and finance its second-period project. It would thus be viewed as a lemon in the second period if it cut its dividend, and knowing this it prefers not to initiate a dividend at $t = 0$.

The overall intuition is that the firms with relatively high expected cash flows and substantial assets in place find market discipline especially valuable and thus prefer to initiate dividends and raise external financing that brings with it market discipline. Other firms abstain. As a consequence, the dividend initiation decision has a positive announcement effect.

Note also that investors arrive at an extremely adverse inference if a firm cuts its dividend. This is endogenously derived as part of the equilibrium since the only firms that cut dividends are lemons. This adverse inference deters type-N firms from initiating dividends unless they can be sustained. This is an endogenous rationale for the downward rigidity of dividends.

Proposition 3: *The set of exogenous parameters satisfying restrictions (1)-(6), (30), (33), (34), and (35) is non-empty.*

Corollary 1: *Suppose the inequality in (5) is reversed, and it is impossible for the manager to convince the board that the firm is not type L (i.e., $K = \infty$). Then the sequential equilibrium is the same as in Proposition 2 except that no dividend cuts occur in equilibrium. If the out-of-equilibrium move of a dividend cut is observed, investors form the belief that the firm cutting the dividend is type L, and this belief survives the univeral divinity refinement (Banks and Sobel (1987)) of sequential equilibrium.*

When the inequality in (5) is reversed, it is possible for the firm that initiated a dividend at $t = 0$ and experienced first-period project failure to raise second-period external financing without having to sell assets in place. This enables type-L firms that pooled with type-N^+ firms at $t = 0$ to also pool with them at $t = 2$ and raise external financing, so no dividend cuts are observed in equilibrium. Nonetheless, were a firm to cut its dividend (an out-of-equilibrium move), there would still be a very negative price reaction since the firm would be viewed as a lemon. Thus, the very adverse price reaction to a dividend omission/cut does not depend on the number of lemons or even whether lemons cut dividends in equilibrium. I now turn to the impact of corporate governance.

Lemma 9: *There is a threshold such that if the quality of corporate governance, ξ, is above that threshold, no firm will initiate a dividend for any given positive managerial ownership if $\theta^+ - \theta^-$ and $V^+ - V^-$ are small enough.*

The intuition is straightforward. In the limit, perfect corporate governance eliminates the private-benefit project, making a dividend payment unnecessary to resolve the agency problem. And as long as $\theta^+ - \theta^-$ and $V^+ - V^-$ are small enough, the signaling benefit of dividend initiation to the type-N^+ firm is not enough to overcome the disclosure-related value loss from initiating a dividend. This suggests that managerial ownership and corporate governance are partial substitutes.

2.4.6 Discussion of the Different Elements of the Model

There are a few issues related to how the model is set up that are now discussed.[74]

First, does the proportion of type-L firms in the population matter? The answer is that it does not for the theory. All that is needed is that there be some positive probability of lemons in each group: the dividend initiators and the non-initiators.[75] Empirically, however, since dividend cuts are rare, it would be reasonable to posit that the prior probability of finding a type-L firm in any group is low, but it must be *positive*. Absent lemons, the price reaction to a dividend cut would only lower the price of a type-N^+ firm to that of a type-N^-firm. In this case, there is no cost to the type-N^- firm (other than the disclosure-related cost) to initiate a dividend at $t = 0$ because, its second-period price, conditional on a dividend-cut announcement, is exactly the same as it would be if it had *not* initiated a dividend at $t = 0$. Thus, the firm prefers to get a higher price at $t = 0$ from pooling with the type-N^+ dividend initiators, and all firms initiate dividends. Of course, a deterrent to a dividend initiation is the dislosure-related cost associated with equity issuance. However, this cost is proportional to firm value, so it is higher for the type-N^+ firm that the type-N^- firm. This means if the type-N^+ firm initiates a dividend, so does the type-N^- firm. In other words, the two-layered information asymmetry is essential. Having type-N^-/type-N^+ heterogeneity is necessary for the dividend initiation announcement effect, whereas the type-N/type-L heterogeneity is necessary for both the result that the dividend omission/cut has a negative price effect that is larger than the positive price impact of a dividend initiation and the initial separation of the type-N^+ and type-N^- firms through the dividend initiation decision.

Second, why don't the type-L^+ firms prefer to "hide" with the type-N^-/type-L^- firms (i.e. not initiate a dividend) rather than pool with the type-N^+ firms? The reason is that the board of directors of a type-L^+ firm know that the firm is either type N^+ or type L^+, so if the manager proposes not paying a dividend at $t = 0$, the board will not approve.[76] It would personally cost the manager K to convince the board of the firm's true type, but at $t = 0$ the manager of neither a type-L^+ nor a type-N^+ firm would have an incentive to do so.

Third, the empire-building project is needed to generate the agency problem that a dividend initiation seeks to resolve. Without this, there is no benefit to a dividend initiation, other than signaling. One would get announcement effects and the reluctance to cut dividends from such a model, but all of the unique empirical predictions related to the impact of managerial ownership, corporate governance, and incremental information-disclosure costs would be lost.

Fourth, external financing in this model is with equity. If the firm instead relied upon a *public* debt issue, little would change, since there would be information-disclosure costs with that form of financing as well. Bank (or private) debt would change things since

[74] I thank Stew Myers for encouraging me to think about these issues.

[75] This is similar to the idea of almost any positive amount of uncertainty about players' payoffs generating reputational effects (e.g. Kreps and Wilson (1982)).

[76] Note that even the manager of a type-N^+ firm would want to propose to the board that the firm not pay a dividend, since that would shield the manager from market discipline. So the manager's desire to not pay a dividend does not tell the board whether the firm is type N^+ or type L^+.

it would minimize disclosure costs. Introducing that possibility raises issues related to a choice between (multilateral) capital market financing and (bilateral) bank financing that are beyond the scope of this paper; see Bhattacharya and Chiesa (1995) for such an analysis.

In addition to this, an important feature of the theory is that there is a cost to the firm from issuing equity. This raises the question of whether a standard Myers and Majluf (1984) set-up with dilution costs would generate the same key results. At a theoretical level, any friction (including that in Myers and Majluf (1984)) that creates a dissipative external financing cost will suffice for the main results. In this particular setting, however, the analysis differs from Myers and Majluf (1984), where there is a pooling equilibrium in which overvalued firms also issue equity. The dividend-initiation equilibrium in this paper at date $t = 0$ is *separating*, so there is no asymmetric-information-based dilution cost. Moreover, in contrast to Myers and Majluf (1984), equity issuance *reduces* adverse selection in my model because the accompanying information disclosure allows the market to weed out the lemons more effectively. And because it is a dividend initiation that leads to a secondary equity issue, the future *continuation* of this dividend payment results in a further weeding out of lemons because they cannot sustain the dividend payment, even if they pooled with the dividend initiators at date $t = 0$. Thus, an extrapolation of the Myers and Majluf (1984) model to include dividends would imply that a dividend initiation, which increases the likelihood of a future equity issue with its adverse-selection-induced dilution costs, should reduce current shareholder wealth and have a negative announcement effect.[77] This is the opposite of my result. Moreover, my empirical tests explicitly rely on the information-disclosure aspect of my theory, rather than pooling-related adverse selection costs.

Fifth, a stock repurchase generates no price reaction. However, a small perturbation of the model can yield a positive price effect in response to a completed repurchase. That is, if it is assumed that project payoffs are privately observed, then a second-period repurchase by a firm that did not initiate a dividend at $t = 0$ and does not pay a dividend at $t = 2$ will signal to the market at $t = 2$ that the first-period project was a success (only in this case does a repurchase occur in equilibrium at $t = 2$), generating a positive price reaction.

Finally, the dividend choice in this model is discrete. If d were chosen in a continuum, the analysis would remain qualitatively similar but the parametric restrictions needed for incentive compatibility in Proposition 2 would be eased. This is because the type-N^+ firm is free to choose as high a dividend level at $t = 0$ as is necessary to discourage mimicry by the type-N^- firm. Moreover, even if the inequality in (5) were to be reversed (the case of Corollary 1), the type-N^+ firm would have an incentive to increase its dividend at $t = 2$ until so much external financing is needed following project failure at $t = 2$ that asset sales become essential. This would force the lemons to cut dividends and this would remove adverse selection for the type-N^+ firms.

2.4.7 Other Equilibria

As noted earlier, other pooling equilibria are possible as well, although it is not clear any of them would survive the univeral divinity refinement of sequential equilibrium. For example,

[77]Clearly, this extrapolation goes far outside the structure of the Myers and Majluf (1984) model. It is only meant to make the point that it is an approach that differs from the model developed here.

if managerial ownership is sufficiently low, the value of market discipline may be high enough for most firms to initiate dividends, except for those with excessive information-disclosure costs. Another possibility is that managerial ownership is so high that no firm finds it beneficial to initiate a dividend. This is because the model implies that once managerial ownership goes above a threshold, the manager would never opt for the inefficient private-benefit project, in which case no firm will wish to incur the cost of initiating dividends. Thus, in the empirical tests, the focus will be on the below-average-managerial-ownership firms.

2.4.8 Empirical Implications

The model generates the following testable predictions:

1. The probability of dividend initiation is decreasing in the managerial ownership of the firm, and this effect becomes weaker as corporate governance gets stronger.

2. The probability of dividend initiation is decreasing in the incremental information-disclosure costs associated with secondary equity issues.

3. The probability of dividend initiation is increasing in the firm's profitability, assets in place, and magnitude of agency problems, and decreasing in the personal tax rate on dividends relative to capital gains.

4. A dividend initiation will trigger a positive announcement effect.

5. A dividend cut/omission will trigger a negative announcement effect that is larger in absolute value than the positive announcement effect associated with a dividend initiation.

6. Firms will use stock repurchases to use up excess cash, but with no price reactions.

7. Firms with better governance will repurchase less.

The first two predictions are the novel predictions of the model and have been extensively discussed. The third prediction follows because a reason for initiating a dividend is to control an agency problem, so the bigger this problem, the higher the probability of initiating a dividend. The fourth and fifth predictions are formal results of the model (Proposition 2). The sixth prediction arises from the fact that repurchasing is done merely to get rid of excess cash in the firm, and convey no private information. The seventh prediction is related to the fact that it is the dissipation in value from keeping excess cash on the balance sheet that motivates stock repurchases. Better governance (which would imply higher market values of on-balance-sheet cash; see Dittmar and Mahrt-Smith (2007)) would lower this value dissipation and make stock repurchases less attractive.

2.5 Empirical Results

This section tests the new predictions (Predictions 1 and 2 above) of the theoretical model. All of the other predictions have existing empirical support, so they are not tested here, although the variables identified in Prediction 3 are included as controls. Section 2.5.1 describes the empirical methodology. Section 2.5.2 describes the data sources and summary statistics. Section 2.5.3 gives the results of the predictive empirical model, and tests robustness and alternative specifications. Section 2.5.4 provides the results of the regression discontinuity analysis.

2.5.1 Empirical Methodology

In order to estimate the probability that a firm will initiate a dividend in a given year, a predictive logit model is estimated using the variables predicted by the theoretical model in Sections 3 and 4. The logit specification for analyzing the likelihood of a firm paying a dividend is as follows:

$$\Pr\left\{Init_{i,t} = 1 \mid X_{i,t}, \text{nonpayer}\right\} = M\left(X_{i,t}\beta\right). \tag{36}$$

where $Init_{i,t}$ is a binary variable which takes a value of 1 if firm i initiated a dividend in year t and 0 otherwise, and $M(\cdot)$ is the standard logistic distribution function. (36) estimates the probability that a firm pays a dividend, conditional on it being a non-payer. A firm is classified as being a non-payer if it has not paid a dividend in the 5 years prior to year t, following DeAngelo, DeAngelo, and Stulz (2006). X_i is the vector of lagged explanatory variables that are predicted to influence the dividend initiation decision. The explanatory variables directly related to the predictions in the model are as follows. $Mgr\,Own_{i,t-1}$ is the percentage of total shares outstanding owned by top management in firm i in year $t-1$, taken from Execucomp, included as a measure of managerial ownership in the firm.[78] $Inst\,Own_{i,t-1}$ is the percentage of total shares outstanding owned by the top five institutional blockholders, obtained from Thomson Reuters. It is included as a measure of the quality of corporate governance—the greater the amount of top institutional ownership, the stronger the incentive for institutional investors to monitor the firm, and hence the better the corporate governance.[79] $(R\&D/TA)_{i,t-1}$ is a measure of R&D intensity in the firm, included as a proxy for information disclosure costs; firms with higher R&D intensity have more proprietary product information, and thus stand to lose more when that information is revealed (see Bhattacharya and Ritter (1983)).[80] $\ln(TA)_{i,t-1}$ is the natural logarithm of lagged total book assets of the company, included as a measure of the size of assets in place;

[78] This measure also includes options that are exercisable within 60 days, and unvested stock ownership.

[79] Previous papers that have used institutional ownership as a governance proxy are Berger, Ofek, and Yermack (1997) and John and Litov (2008). Other commonly-used governance proxies are the number of outside directors on the board, the size of the board of directors, and the Gompers-Ishii-Metrick (GIM) governance index, which includes many of these proxies as determinants of governance quality (see Gompers, Ishii, and Metrick (2003)).

[80] Another possible proxy for two-audience signaling costs is the number of patents possessed by the firm. One drawback of this proxy is that it may understate the firm's proprietary knowledge, since portions of such knowledge may be worth protecting even though they are not patented.

recall that the dividend-initiating type-N firm has higher-valued assets in place than the non-initiator in the theoretical model. $Div\,Tax_{t-1}$ is the the personal tax rate on dividend income as of the end of year $t-1$, taken from the Organization for Economic Co-operation and Development (OECD).[81] $ROA_{i,t-1}$ is the lagged return on assets, used as a proxy for profitability and hence the ability to pay dividends, as in Fama and French (2001) and DeAngelo, DeAngelo, and Stulz (2006). In order to examine the interaction of corporate governance and managerial ownership, an interaction term is also added to (36) between $Mgr\,Own_{i,t-1}$ and $Low\,Inst\,Own_{i,t-1}$, which is a dummy variable that takes a value of 1 when institutional ownership is low and 0 otherwise.[82]

My theory predicts that the probability of initiating a dividend in year t is increasing in $\ln(TA)_{i,t-1}$ and $ROA_{i,t-1}$, and decreasing in $Mgr\,Own_{i,t-1}$, $Inst\,Own_{i,t-1}$, $(R\&D/TA)_{i,t-1}$ and $Div\,Tax_{t-1}$. It also predicts that, when managerial ownership is low enough, that the probability of initiating a dividend is decreasing in $Mgr\,Own_{i,t-1}$. Moreover, as the effect of managerial ownership on dividend initiation is predicted to become stronger as corporate governance gets weaker, it is expected that $Mgr\,Own_{i,t-1} \times Low\,Inst\,Own_{i,t-1}$ will have a negative effect.

A number of other control variables, previously shown to be important for dividends, are also included. $(Debt/TA)_{i,t-1}$ is the book value of debt scaled by total assets, as included by Brown et. al. (2007) to control for the need to service debt payments. $(M/B)_{i,t-1}$ is the lagged ratio of the market value of equity to the book value of equity, and is included as a control for investment opportunities. $(RE/TE)_{i,t-1}$ is the ratio of earned equity (retained earnings) to total equity, which DeAngelo et. al. (2006) argue is a proxy for the life-cycle stage of a firm (i.e. a higher earned equity to total equity ratio implies a greater probability of dividend payout). $(Cash/TA)_{i,t-1}$ is the lagged ratio of cash holdings scaled by total assets, included as a measure of ability to pay dividends as in Fenn and Liang (2001), Fama and French (2001), and DeAngelo et. al. (2006). Finally, $Repur_{i,t-1}$ is an indicator variable that takes a value of 1 if firm i repurchases stock in the previous year, and 0 otherwise. Stock repurchases are defined as an increase in treasury stock, as in Fama and French (2001). Bulan et. al. (2007) argue that repurchases reflect firm maturity and stabilizing cash flows—a firm that has repurchased stock is thus more likely to initiate dividends.

2.5.2 Data and Summary Statistics

Dividend payment data come from the CRSP database. Because the model's predictions apply to regular (not one-time special) dividends, dividend payments are restricted to those classified as ordinary cash dividends of non-monthly frequency in CRSP (distribution codes 1222, 1232, 1242, and 1252). Managerial ownership data come from the Execucomp database, and institutional ownership data from Thomson Reuters. Financial data are taken from Compustat. As is standard, I exclude public utility and financial firms (SIC codes 4900-4999

[81]This is the net personal tax on dividend income, calculated from the effective statutory rax rates on distributions of domestic income to a resident individual shareholder. Year fixed effects are excluded in order for this variable to enter into the regressions, although the results are robust to including year fixed effects but excluding this variable.

[82]This is defined as ownership by the top 5 institutional blockholders equal to less than 25% of total shares outstanding, which is roughly the median value of the variable.

and 6000-6999) because of their special regulatory restrictions. Personal dividend tax rate data are taken from the Organization for Economic Co-operation and Development (OECD). As Execucomp data only run from 1992 to 2011, and managerial ownership is a key predictive variable in the model, the data in the sample run from 1992 to 2011. All variables except for $\ln(TA)_{i,t-1}$, $DivTax_{t-1}$, and $Repur_{i,t-1}$ are winsorized at the 1% level. Summary statistics are given in *Table 2-1* below.

[Table 2-1 Here]

The data from 1992 to 2011 encompass a total of 7,319 firm-year observations and 1,003 unique firms, with a sample of 272 dividend initiations. On average, firms had an R&D intensity of 5.6% as a percentage of total assets, and held 21% of debt in their capital structure, as a percentage of total assets. The mean dividend tax rate is roughly 35%, with a maximum of 46.3%. The mean level of top executive ownership is roughly 1.5% of total shares outstanding. The lower median value for this variable indicate that the distribution for ownership is skewed. Finally, the mean level of top institutional ownership for the sample is 26%, while the median level is roughly 25.6%.

2.5.3 Results and Robustness

2.5.3.1 Main Results

The results of regression (36) are included in *Table 2-2* below.

[Table 2-2 Here]

Columns (1) and (2) report the results of regressions run using the entire sample, and columns (3) through (6) run regressions only for firms with levels of managerial ownership that are not high.[83] Columns (1), (3), and (5) include only the main predictive variables, while columns (2), (4), and (6) also include control variables. Overall, the results are supportive of the main predictions of the model. Focusing first on columns (1)–(4), $InstOwn_{i,t-1}$ enters with a negative and significant coefficient, indicating that the worse the corporate governance, the more likely a firm is to initiate a dividend, as predicted by the model. $MgrOwn_{i,t-1}$ is negative and insignificant in specifications (1) and (2), but is negative with signficant coefficients in specifications (3) and (4). This is consistent with the model in that higher levels of managerial ownership predict a higher probability of initiating a dividend in the following year, but only when managerial ownership is low enough.[84] $(R\&D/TA)_{i,t-1}$ also has a negative and significant coefficient in all specifications. This indicates, as predicted by the model, that firms with greater R&D intensity (and therefore a higher marginal cost of information disclosure) have a lower probability of initiating a dividend. Moreover, the coefficients on $\ln(TA)_{i,t-1}$ and $ROA_{i,t-1}$ are positive and highly significant, indicating that

[83] A high level of managerial ownership is defined as one in which the firm's top managers own more than 5% of the total outstanding stock of the firm, which corresponds to roughly the 90th percentile of the data. Thus columns (3)-(6) only include firms with managerial ownership equal to less than 5% of total shares outstanding.

[84] The results are similar when using CEO ownership instead of top managerial ownership.

larger total assets in place and higher profitability predict a higher probability of initiating a dividend in the subsequent year, as predicted by the model. The coefficient on $Div\,Tax_{t-1}$ is negative and significant in all but specification (2), indicating that a drop in the dividend tax rate predicts a higher probability of initiating a dividend in the next year, also consistent with the model.

Columns (5) and (6) examine the interaction between managerial ownership and governance (proxied by institutional ownership), and its effect on dividend initiation. The coefficient for $Mgr\,Own_{i,t-1} \times Low\,Inst\,Own_{i,t-1}$ is negative and significant with a larger magnitude, indicating support for the hypothesis that the effect of managerial ownership on dividend initiation is stronger when governance is weaker. However, as pointed out by Powers (2005), Ai and Norton (2003), and others, the interaction effect in a logit model cannot be interpreted in the same way as an OLS model, since the marginal effect also depends on the levels of the independent variables in a logit model. An analysis of the sign and significance of the interaction effect for various levels of the covariates is given in *Figure 2-3* below.[85] As can be seen, the interaction effect is consistently negative for most observations, and it is statistically signficant on average over these observations and across the range of predicted dividend initiation probabilities. This provides further supporting evidence for the direct interpretation of the interaction effect coefficient.

[Figure 2-3 Here]

Finally, as columns (2), (4), and (6) in *Table 2-2* indicate, the main results are robust to the inclusion of other control variables and industry fixed effects. In all specifications, $(M/B)_{i,t-1}$ and $(Cash/TA)_{i,t-1}$ enter with insignificant coefficients. $(Debt/TA)_{i,t-1}$ enters with a negative and significant coefficient, consistent with existing empirical evidence (e.g. Fenn and Liang (2001)) that firms with higher levels of debt are less likely to pay (here, initiate) dividends. There are two possible (not mutually exclusive) explanations for this. One is that debt service drains cash flow, leaving less for dividends. The other is that having debt is a source of discipline (e.g. Hart and Moore (1994)) and lessens agency problems, reducing the need to rely on dividends to do so. $(RE/TE)_{i,t-1}$, the earned/contributed capital mix, is also insignificant. This result is at odds with DeAngelo, DeAngelo, and Stulz (2006), who argue that the retained earnings ratio is a proxy for the life-cycle of the firm and is important for overall payout. This suggests that there is a difference between overall payputs and dividend *initiations* in terms of the influence of retained earnings on the decision.[86] Finally, the indicator variable for whether a firm has repurchased stock in the previous year, $Repur_{i,t-1}$, is positive and significant, suggesting that firms that repurchase stock in a given year are more likely to initiate a dividend in the following year. This is consistent with the evidence in Bulan et. al. (2007), as well as life-cycle explanations of dividend payout.[87]

[85] All covariates from specification (6), apart from the industry fixed effects, are included.

[86] DeAngelo, DeAngelo, and Stulz (2006) report that they re-run their specification for dividend initiations in untabulated results, and find that the earned/contributed capital mix is still significant. This runs counter to my results.

[87] One possible concern with the analysis is that the results may be partly driven by the financial crisis which began in 2007. In order to mitigate this concern, the logit analysis is re-run in untabulated results

2.5.3.2 Robustness: Hazard Specification

An alternative way to estimate the probability of dividend initation is through survival analysis, which analyzes the time until an event of interest occurs. More specifically, define the initial state or "risk set" to be the set of firms which have not initiated a dividend since their IPO date. Define T to be firm age, or the time that a firm has spent in the initial state, i.e. the amount of time since a firm's IPO until that firm initiates a dividend. A "failure" is then defined as an event which moves a firm out of the "risk set" or initial state—in other words, a dividend initiation. The hazard function is then defined as the instantaneous probability of leaving the initial state at any point of time, i.e., the probability of a firm initiating a dividend at any time t as a function of IPO age T, given that the firm has not previously paid a dividend:

$$\psi(t) \equiv \lim_{\triangle t \to 0} \frac{\Pr\left[t \leq T < t + \triangle t \mid T \geq t\right]}{\triangle t} = \frac{q(t)}{1 - Q(t)}, \tag{37}$$

where $Q(t) = \Pr(T \leq t)$ is the probability that a dividend is initiated at or before t, and $q(t) = Q'(t)$. A Cox Proportional Hazard model allows the hazard function to depend on both IPO time and firm characteristics. It estimates the hazard function as a product of a baseline hazard function which only depends on time since IPO, and another function reflecting firm characteristics:

$$\psi\left(t, x_i\right) = \psi_0(t) \exp\left[X_i' \beta\right]. \tag{38}$$

In (38), $\psi_0(t)$ is the baseline hazard function which describes the risk of initiating a dividend solely as a function of time since the IPO (i.e. with all X_i variables equal to 0), and $\exp\left[X_i' \beta\right]$ is an adjustment factor that depends upon the firm characteristics X_i defined in section 5.1. The Cox proportional hazard model obtains maximum likelihood estimates of the β coefficients in (38), relative to the baseline hazard rate.

Table 2-3 below gives the results of regression (38). It reports hazard ratios, estimates of $\exp(\beta)$, for each variable, which indicate proportional changes relative to the baseline hazard ratio. The interpretation is as follows. Suppose a variable has a hazard ratio of 1.1. This indicates that firm with a one unit higher value for the variable is 10% *more* likely to initate a dividend. Alternatively, suppose the variable has a hazard ratio of 0.90. This indicates that firm with a one unit higher value for the variable is 10% *less* likely to initate a dividend. Thus, a coefficient greater than 1 in *Table 2-3* indicates the probability of dividend initiation is increasing in that variable, while a coefficient less than 1 indicates that the probability of dividend initiation is decreasing in that variable.

[Table 2-3 Here]

As in Section 2.5.3, specifications (1) and (2) include all firms, while specifications (3) through (6) exclude firms with high levels of managerial ownership. Columns (1), (3), and (5) include only the main predictive variables from the theoretical model, while columns (2),

excluding the years of the financial crisis, 2007-2011. The results are qualitatively similar to those in *Table 2-2*.

(4), and (6) include control variables. The overall results are consistent with the pooled logit estimation in Section 5.3. In all specifications, $\ln(TA)_{i,t-1}$ has a hazard ratio that is greater than 1 and significant, indicating that the probability that a firm initiates a dividend is increasing in total assets. $DivTax_{t-1}$ and $(R\&D/TA)_{i,t-1}$ both have statistically significant hazard ratios that are less than 1 in all specifications, indicating that the probability of initiating a dividend is decreasing in R&D intensity, and in the dividend tax rate. $Mgr\,Own_{i,t-1}$ has a hazard ratio that is less than 1 in all specifications, indicating that the probability of initiating a dividend is decreasing in managerial ownership. However, as in Section 2.5.3, it is significant when managerial ownership is low enough (i.e. in columns (3) and (4)). In addition, $Inst\,Own_{i,t-1}$ has a hazard ratio that is less than 1 and significant in all specifications, meaning that the probability of dividend initiation is higher when corporate governance is worse. The interaction effect has a hazard ratio that is less than 1 and significant in both columns (5) and (6), again indicating that the effect of managerial ownership on dividend initiation becomes stronger as corporate governance gets weaker. The results for the various control variables, including their significance, are consistent with the results in Section 2.5.3.[88]

2.5.4 A Test of Information Disclosure Costs and Dividend Initiations

2.5.4.1 Motivation and Graphical Analysis

A central prediction of the model is that the probability of initiating a dividend is decreasing in the potential loss in value from the information disclosure and transaction costs associated with secondary equity issues. In Sections 2.5.3 and 2.5.4, R&D intensity serves as a proxy for these information disclosure costs. However, such a proxy is not clean, as R&D costs may be related to various other characteristics related to the dividend initiation decision. Moreover, the inclusion of R&D in a panel regression does not establish causality with respect to the decision to initiate a dividend. This section attempts to overcome this endogeneity problem by employing a regression discontinuity methodology that relies on a market-value-based change in reporting requirements for firms introduced by the Sarbanes-Oxley Act (SOX) that was passed in July 2002. Compliance with the Act was required by the end of 2004.

Section 404 of the Sarbanes-Oxley Act required firms with a public float (market value of all shares held by outsiders) above \$75 million to disclose additional information to the market in the form of a "management" report, which includes an assessment of the quality of the firm's financial-reporting-related controls and the risks of the firm.[89] Thus, in 2004 and

[88]Another alternative specification is to use a Fama and MacBeth (1973) procedure, which is used in the predictive logit regressions of payout by Fama and French (2001) and DeAngelo, DeAngelo, and Stulz (2006). One drawback of the approach is that, due to the estimation of the equation each year, the dividend tax rate variable cannot be included in the regressions. In untabulated results, I confirm that the Fama-MacBeth approach yields qualitatively similar results.

[89]Section 404 requires all firms subject to the rule to file a "Management Report", in which the manager has to opine on the quality of the firm's "Internal Control over Financial Reporting"—potential risks in the financial reporting that may lead to misrepresentation or fraud. Examples of risks include inaccurate recordings of sales revenues. An independent auditor's report must also be included. The SEC exempted firms with public floats below \$75 million from full compliance with Section 404 (specifically the independent

beyond (when firms were officially required to be in compliance), firms faced a mandatory increase in information disclosure requirements when they reached a public float of $75 million. This means that the *incremental* cost of *discretionary* information disclosure related to the "two-audience" signaling problem of Bhattacharya and Ritter (1983) went down in 2004 for firms reaching the $75 million threshold, since they had to disclose more information anyway. The model developed here predicts that, compared to firms that are just to the left of the $75 million public-float threshold, λ decreases after 2004 for firms that are just to the right of the threshold. So for firms in the immediate neighborhood of the $75 million threshold, dividend initiations should be greater for firms just above $75 million than for those just below $75 million during 2004–2012.

A graphical analysis provides some preliminary evidence consistent with the predictions of my model. *Figure 2-4* shows the percentage of dividend initiations per public-float bucket from 2004 to 2011.[90] In the figure, the focus is on public-float buckets on either side of the $75 million threshold. Overall the graph is supportive of the predictions of the model. In the post-SOX period, the rate of dividend initiations is strikingly higher for the $75-$120 public float bucket than for the adjacent bucket. These effects are consistent with the predictions of the model—as a result of Sarbanes-Oxley, firms immediately to the right of the $75 million public-float threshold experienced a decrease in the marginal cost of information disclosure, and thus a decrease in the cost of initiating dividends. These firms subsequently increased their rates of dividend initiation.

[Figure 2-4 Here]

2.5.4.2 Regression Discontinuity Methodology and Data

The idea behind the regression discontinuity design is that, given that the $75 million public-float threshold is an arbitrary cutoff based on the law, a discontinuous jump in the probability of dividend initiation for firms with public floats immediately to the right of $75 million compared to firms with market values immediately to the left of $75 million can be interpreted as the causal impact of the treatment (the increased information disclosure) on firms.[91]

The mandatory nature of the well-defined $75 million threshold indicates the appropriateness of a sharp regression discontinuity design. Specifically, the following logit regression is estimated from 2004 and onwards:

$$Init_{i,t} = \Phi\left(\alpha + \rho T_{i,t} + f\left(MPFloat_{i,t}\right) + \varepsilon_{i,t}\right). \quad (39)$$

In regression (39), $MPFloat_{i,t}$ is the running maximum public float that firm i has attained from 2004 until year t. The running variable is defined in this way to reflect the fact that

auditor's attestation) until June, 2010; the Dodd-Frank Act then made this exemption permanent. As noted by Iliev (2010) and Cortes (2013), who also exploit this discontinuity in reporting requirements, Section 404 compliance entails significant costs for firms.

[90] Percentage of dividend initiations are defined as the number of dividend initiations in a public float bucket divided by the total number of firms in that bucket in a given year. The graphs are similar if one uses the number of initiations divided by the number of firm-years in each bucket.

[91] This focus on firms around $75 million in public float is also ideal for testing the information-disclosure predictions of the model since these are smaller firms, and thus there is less information about their future prospects (so they are likely to have higher values of λ).

compliance with the law is essentially a one-way door—once a company is required to file a manager's report initially, it then must file one subsequently.[92] f represents a flexible polynomial function—the results are shown for linear (1st-order), 5th-order, and 7th-order polynomial terms. $T_{i,t}$ is an indicator function which takes a value of 1 if $MPFloat_{i,t}$ is greater than or equal to $75 million. $Init_{i,t}$, as before, is a binary variable which takes a value of 1 if firm i initiated a dividend in year t and 0 otherwise. The main specification of regression (39) is estimated for firm-years where the running maximum public floats fall within the bandwidth of $50 million and $100 million during the sample period. This bandwidth is used by Iliev (2010) and Cortes (2013), who also exploit the introduction of Section 404 using a regression discontinuity design. Robustness with respect to alternative bandwidths is discussed later. Regression (39) is a sharp regression discontinuity design—treatment status (i.e. being required to file a manager's report) is a deterministic function of $MPFloat_{i,t}$. It is therefore not necessary to control for covariates in (39). However, for robustness, (39) is also estimated while including industry and year fixed effects, as well as various control variables from Section 2.5.1.[93]

A key assumption of the regression discontinuity design is no self-selection into the treatment group. In other words, firms must not be able to perfectly control passage from the control to the treatment groups. Section 2.5.4.5 verifies that this assumption holds.

For regression (39), I take public float data from Thomson Reuters Datastream and use all firms from the NYSE and NASDAQ for which Datastream contains data for the percentage of shares outstanding that are held by outsiders (free float shares). The public float is then calculated by multiplying this number by the market value of equity of the firm in year t (which in turn is defined by the total number of shares outstanding multiplied by the stock price). As before, I exclude public utility and financial firms (SIC codes 4900-4999 and 6000-6999). The resulting sample runs from 2004 to 2011, and contains 1,371 firm-years of data for 444 different firms when considering a running maximum public float bandwidth of $50 million to $100 million. The sample grows to 6,838 firm-years for 1,424 firms when expanding the bandwidth to $0 million through $150 million.

2.5.4.3 Results and Discussion

The results of regression (39) are given in Panel A of *Table 2-4* below:

[Table 2-4 Here]

Column (1) gives the main specification, with $MPFloat_{i,t}$ falling within a bandwidth of $50 million to $100 million, and including up to 5th degree polynomial terms for $MPFloat_{i,t}$.

[92]As noted by Iliev (2010), if a firm has revenues and a public float of less than $25 million for two consecutive years, it then is no longer required to file a manager's report unless it reaches the $75 million public float threshold once again. This is accounted for in the definition of $MPFloat_{i,t}$ (i.e. $MPFloat_{i,t}$ is reset to be equal to the current public float, rather than the maximum, in years when the public float and revenues of the firm are less than $25 million for two consecutive years). Not accounting for this yields unchanged results.

[93]The controls include: $ROA_{i,t}$, $(Cash/TA)_{i,t}$, $(M/B)_{i,t}$, $(Debt/TA)_{i,t}$, $(RE/TE)_{i,t}$, and $Repur_{i,t}$. Each of these variables is winsorized at the 1% level. Ownership variables are not included because the values are missing for many of the firms in this size range. The results are similar when using a lagged specification instead of a contemporaneous one.

As can be seen in the table, the estimator is positive and significant, indicating that the probability of dividend initiation increases discontinuously immediately to the right of the $75 million public float threshold. *Figure 2-5* below graphically depicts this probability as a function of the maximum running public float, and shows the sharp discontinuous increase at the $75 million threshold. Column (2) includes controls, as well as industry and year fixed effects, while again using a $50 to $100 million bandwidth and up to a 5th-order polynomial.[94] The estimator is robust to the additional controls, and remains positive and significant.

[Figure 2-5 Here]

Regression discontinuity designs are most valid for estimates in a relatively small neighborhood around the cutoff. However, the difficulty here is that the number of firms initiating dividends is relatively low for firms-years within the $50 to $100 million running maximum public float bandwidth. This raises the concern that the estimates do not have sufficient power. To address this concern, columns (3) and (4) in Panel A of *Table 2-4* re-estimate equation (39) using a bandwidth of $0 to $150 million for the running maximum public float, and including up to a 7th-order polynomial for the running variable.[95] Column (3) provides the base estimates, while column (4) includes controls and fixed effects. The results from both columns show that the regression discontinuity estimator is again positive and significant. These results are consistent with the previous estimates and the predictions of the theory.

The regression discontinuity estimates above are parametric, in the sense that they depend on the choice of functional form through the use of polynomials. Thus, these estimates are dependent on the accuracy of the chosen polynomial functional form in fitting the data. An alternative in the literature is the use of nonparametric methods, such as a local linear regression in a narrow bandwidth around the cutoff (e.g. Hahn, Todd, and Van der Klaauw (2001)), which is precluded here due to the small number of dividend initiations in the optimal bandwidth. However, another alternative is the robustness test suggested by Angrist and Pischke (2008)—although the precision of estimates may go down as the bandwidth decreases, the number of polynomial terms needed to model $f\left(MPFloat_{i,t}\right)$ in (39) should also go down, while the effect of $T_{i,t}$ remains. With this in mind, (39) is re-estimated in column (5) in Panel A of *Table 4* using a smaller bandwidth of $65 million to $85 million for the running maximum public float and up to 3rd order polynomial terms.[96] The regression discontinuity estimate remains similar in magnitude and significance, even with fewer polynomial terms. This provides additional evidence on the robustness of the results.

2.5.4.4 Robustness: Falsification Test

A possible concern with the above results is that there is a trend with respect to larger public floats that is not captured by the polynomial functions, and which has nothing to do with the $75 million public float information requirement. To address this concern, I

[94]The use of polynomials is to control for a potentially nonlinear trend relationship between the running variable and outcome variables.

[95]This expands the sample to 6,838 firm-years for 1,424 different firms. The number of dividend initiations increase from 15 to 39 when using this expanded bandwidth.

[96]The results are unchanged when using a linear or quadratic specification with this bandwidth.

provide a falsification test, by re-estimating the results while falsely specifying the public float cutoff to be a value other than \$75 million (while using similar bandwidths to the estimates before). The estimates are provided in Panel B of *Table 2-4*. For each cutoff value for $MPFloat_{i,t}$ and each bandwidth, the regression discontinuity estimator is insignificant. This provides additional evidence that the effect is specific to the \$75 million public float information requirement introduced by Section 404 of the SOX.

2.5.4.5 Robustness: Threshold Manipulation

The validity of the regression discontinuity design rests on the assumption that firms cannot perfectly manipulate their public float to choose the side of the \$75 million cutoff they are on. One way that firms may do so is through changes in investment or payout policy. Another way is through earnings management. It is well documented that firms in general "manage" their earnings (e.g. Dechow, Sloan, and Sweeney (1995), and Kothari, Leone, and Wasley (2005)). It is conceivable that a firm that is close to the \$75 million public float threshold may manage earnings downward in order to avoid hitting the threshold and thus avoid the SOX requirements.[97]

The empirical evidence regarding active manipulation on the part of firms around this \$75 million cutoff is mixed. For example, Iliev (2010) finds significant earnings management amongst firms facing large compliance costs, but focuses only on firms in 2004. In a larger sample from 2005 to 2010, Cortes (2013) finds no evidence of active manipulation by firms in general (through examining bunching around the threshold) and also specifically through changes in capital expenditures or payout policy. He does not specifically examine earnings management, however.

In order to test for whether there is significant earnings management by firms in my sample, I estimate discretionary accruals, a widely used measure for earnings management in the accounting literature, for firms close to the \$75 million public float threshold. Discretionary accruals are calculated using two different measures. The first measure is referred to as Jones Model Discretionary Accruals, and follows Jones (1991). Let $(Total\,Accruals)_{i,t}$ represent total accruals for firm i as of year t, which is defined as the one-year change in current liabilities exceeding current long-term debt, minus depreciation and amortization. Then discretionary accruals are defined as:

$$(Discr\,Accruals)_{i,t} = (Total\,Accruals)_{i,t} - (Non\,Discr\,Accruals)_{i,t}\,, \tag{40}$$

where $(Non\,Discr\,Accruals)_{i,t}$ represents non-discretionary accruals. Non-discretionary accruals are defined by the Jones Model:

$$(Non\,Discr\,Accruals)_{i,t} = \alpha_0/TA_{i,t-1}+\alpha_1\left(\triangle Sales_{i,t}/TA_{i,t-1}\right)+\alpha_2\left(PPE_{i,t}/TA_{i,t-1}\right). \tag{41}$$

The estimates for the parameters in (41) must be estimated econometrically using:

$$(Total\,Accruals)_{i,t} = \tilde{\alpha}_0/TA_{i,t-1}+\tilde{\alpha}_1\left(\triangle Sales_{i,t}/TA_{i,t-1}\right)+\tilde{\alpha}_2\left(PPE_{i,t}/TA_{i,t-1}\right)+\varepsilon_{i,t}, \tag{42}$$

where $TA_{i,t-1}$ is lagged total assets, $\triangle Sales_{i,t}$ is the change in sales, and $PPE_{i,t}$ is property, plant, and equipment. Regression (42) is estimated cross-sectionally for each year, using all

[97] I thank Antoinette Schoar for suggesting that I investigate this.

firm-year observations in the same two-digit SIC industry. Using the parameter estimates obtained from (42), non-discretionary accruals are calculated for each firm-year using the Jones Model, equation (41).

The second measure, a modification of the Jones model, follows from Kothari, Leone, and Wasley (2005), includes $ROA_{i,t-1}$ as a performance measure. Thus, (41) and (42)become:

$$\begin{aligned}(Non\,Discr\,Accruals)_{i,t} &= \beta_0/TA_{i,t-1} + \beta_1\left(\triangle Sales_{i,t}/TA_{i,t-1}\right) + \beta_2\left(PPE_{i,t}/TA_{i,t-1}\right) \\ &\quad + \beta_3 ROA_{i,t-1}, \qquad (43)\end{aligned}$$

$$\begin{aligned}(Total\,Accruals)_{i,t} &= \tilde{\beta}_0/TA_{i,t-1} + \tilde{\beta}_1\left(\triangle Sales_{i,t}/TA_{i,t-1}\right) + \tilde{\beta}_2\left(PPE_{i,t}/TA_{i,t-1}\right) \\ &\quad + \tilde{\beta}_3 ROA_{i,t-1} + \varepsilon_{i,t}. \qquad (44)\end{aligned}$$

The parameters are estimated in the same way as described above, and discretionary accruals are then calculated using (40).

The regression discontinuity methodology of the previous sections is extended to see if there is any significant difference in earnings management between firms with public floats on either side of the $75 million threshold subsequent to 2004. Thus, the following regression is estimated:

$$(Discr\,Accruals)_{i,t} = \alpha + \rho T_{i,t} + f\left(MPFloat_{i,t}\right) + \varepsilon_{i,t}, \qquad (45)$$

where $MPFloat_{i,t}$ is the running maximum public float that firm i has attained from 2004 until year t, $T_{i,t}$ is an indicator function which takes a value of 1 if $MPFloat_{i,t} \geq \$75$ million, and f represents a flexible polynomial function. (45) is estimated for the same bandwidths and using the same polynomial terms as in Section 5.4.3. If firms are using earnings management to manipulate their public float around the $75 million threshold, then the estimate for ρ in (45) should be significant—firms to the immediate left of the threshold would have a stronger incentive to use earnings management to avoid compliance than firms that are already required to comply.

The estimation results for (45) are given in *Table 2-5* below. Panel A of *Table 2-5* gives the results for discretionary accruals estimation using equations (40)–(42), while Panel B gives the results for discretionary accruals estimation using equations (43) and (44).

[Table 2-5 Here]

As can be seen in the table, the coefficients for the regression discontinuity estimator are insignificant in all specifications, using both the Jones Model and the Modified Jones-Performance Model to calculate discretionary accruals. Thus, there seems to be no difference in earnings management between firms on either side of the $75 million public float threshold, suggesting that earnings management is not affecting the results.

2.6 Conclusion

This paper develops a dynamic model of dividend initiation. The key new results of the theory are as follows. First, apart from the effects of previously-documented variables, the probability of dividend initiation is decreasing in the size of the manager's ownership, and this effect is stronger when corporate governance is weaker. Second, the probability of dividend initiation is decreasing in the potential value loss from the two-audience information disclosure costs accompanying the external financing necessitated by dividend payments. Third, there is an endogenously-arising negative price reaction to a dividend cut that is larger in absolute magnitude than the positive announcement effect of a dividend initiation; this rationalizes a reluctance to cut dividends and the consequent downward rigidity of dividends. Additionally, the model produces results consistent with previous theories, such as positive announcment effects of dividend initiations.

The two novel predictions of the theory are then confronted with the data: (i) the probability of dividend initiation is decreasing in managerial ownership, and this effect is stronger when corporate governance is weaker; and (ii) the dividend initiation probability is decreasing in the *incremental* information-disclosure costs associated with external equity financing. Empirical tests using a predictive logit model of dividend initiations provide support for these predictions. The second prediction is also tested by exploiting an information-disclosure-requirement discontinuity (at a public float of $75 million) introduced by SOX. Using a regression discontinuity design, I find that, after SOX passed, firms with public floats just above $75 million were significantly more likely to initiate dividends than firms with public floats below $75 million. The results survive several robustness checks, including differing bandwidths in the regression discontinuity, a falsification test, checking threshold manipulation, and the impact of earnings management.

Future research could examine whether the reduction in systematic risk subsequent to a dividend increase documented by Grullon, Michaely, and Swaminathan (2002) can be explained by the information-disclosure-cost argument. Is it the case that mature firms reduce R&D, which decreases their systematic risk as well as two-audience information disclosure costs, thereby leading to the conditions that are more conducive to a dividend initiation/increase?

Appendix 2.A

Proof of Lemma 1: The proof follows directly from the fact that \$1 in excess cash distributed to the shareholders via a repurchase is worth \$1 to them. If kept on the balance sheet, it is worth $\delta \in (0,1)$ at a future date. ■

Proof of Lemma 2: For the type-N firm's manager to prefer project G over project P, a sufficient condition is that

$$[1-\alpha_0]\left\{[1-\lambda]\theta^{-}\hat{V}-[2I-V]\right\} \geq [1-q]B_{max}. \tag{A.1}$$

Rearranging, this means

$$q \geq 1-[1-\alpha_0]\left\{[1-\lambda]\theta^{-}\hat{V}+V-I-I\right\}B_{max}^{-1}. \tag{A.2}$$

Since $V-I>0$ and $I<Ig_f^{-1}$, we see that (3) guarantees that (A.2) holds. ■

Proof of Lemma 3: In the conjectured equilibrium, only the type-N^{-} firm or an observationally identical type-L firm will find itself in nodes 3-6. The only purpose of expending the personal cost K to credibly communicate to the board that the firm is type N and not type L is to get the board's approval to sell the assets in place to pay a dividend. But since the assets in place of any firm other than the type-N^{+} firm have zero value, it does not pay for the manager to expend K. ■

Proof of Lemma 4: A sufficient condition for the type-N^{+} firm's manager to prefer project G over project P is (using (21) and (23)):

$$[1-\alpha_0]\left\{[1-\lambda]\theta^{+}\hat{V}+A-(2I-V[1-\lambda])\right\} \geq [1-q]\left[B_{max}+A\right]. \tag{A.3}$$

Since $A>I$, upon rearranging it can be seen that (A.3) holds, given (4). ■

Proof of Proposition 1: Given the conjectured investor inferences at $t=2$ in response to a dividend cut, the manager will view his wealth as 0 if the board does not approve a sale of the assets in place in order to pay a dividend. Moreover, the board will not approve this unless the manager can convince them that the firm is type N. If the manager expends K to communicate that the firm is type N, his wealth is:

$$[1-\alpha_0]\left\{[1-\lambda]\theta^{+}\hat{V}+I[1-\tau]-I\right\}, \tag{A.4}$$

where $I[1-\tau]$ is the after-tax dividend received and I is the expected payment out of second-period project cash flow to the new shareholders who provide project funding at $t=2$. For the manager to wish to expend a personal cost of K, it must be true that

$$[1-\alpha_0]\left\{[1-\lambda]\theta^{+}\hat{V}+I[1-\tau]-I\right\} \geq K, \tag{A.5}$$

which is guaranteed by (6). Prior to the assets being liquidated, the shareholders' posterior beliefs that the probability the firm is type N after its first-period project fails is g_2 (see (26)). Given (5), the firm clearly cannot raise enough funding externally to finance the second-period project *and* pay a second-period dividend, necessitating the asset sale. The shareholders assess their (pre-asset liquidation) expected wealth as:

$$\alpha_0 g_2 \left\{[1-\lambda]\theta^+\hat{V} - I\tau\right\}, \tag{A.6}$$

which is (27). ■

Proof of Lemma 5: Since the beliefs of the firm's board of directors, *after* having signaled that the firm is either $\theta = \theta^-$ or $\theta = \theta^+$, conditional on being type N, are identical to the beliefs of other investors in the market, the board views any equity issue as being correctly priced. Hence, it will invest in the project with external financing if

$$\theta^-[1-\lambda]V > I, \tag{A.7}$$

$$\theta^+[1-\lambda]V > I, \tag{A.8}$$

and it will invest in the project with internal financing if

$$\left[\theta^- V\right] h\left(\theta^-\right) > I, \tag{A.9}$$

$$\left[\theta^+ V\right] h\left(\theta^+\right) > I. \tag{A.10}$$

Given (1), we see that (A.6)–(A.9) are satisfied. ■

Proof of Lemma 6: If the shareholders did not initiate a dividend at $t = 0$ and the first-period project paid off, then they can finance the second-period project internally if they wish. The comparison here is between nodes 3 and 4. In node 3, external financing ensures that it is incentive compatible for the manager to choose project G, so the shareholders' expected wealth is:

$$\begin{aligned} & \alpha_0 \left\{[1-\lambda]\theta^-\hat{V} + V - 2I + I[1-\tau]\right\} \\ = \; & \alpha_0 \left\{[1-\lambda]\theta^-\hat{V} + V - I - I\tau\right\} \end{aligned} \tag{A.11}$$

In node 4, the shareholders' expected wealth is:

$$\alpha_0 \left\{h\left(\theta^-\right)\left[\theta^-\hat{V}\right] + V - I\right\}. \tag{A.12}$$

For the shareholders to prefer not to initiate a dividend, it must be true that (A.12) exceeds (A.11). A sufficient condition for this is that:

$$h\left(\theta^-\right)\left[\theta^-\hat{V}\right] > [1-\lambda]\theta^-\hat{V}, \tag{A.13}$$

which holds given (30). ■

Proof of Lemma 7: If the shareholders did not initiate a dividend at $t = 0$, then it is known that in a separating equilibrium the firm is type N^- (or type L). If the first-period project does not pay off, then the only way for the firm to both invest in the second-period project and pay a dividend is to liquidate assets in place, given that Lemma 5 asserts that the firm always chooses to invest in its second-period project. But such a firm has no assets in place of any value. Thus, it does not pay for the shareholders to initiate a dividend. ∎

Proof of Lemma 8: It will be shown that if investors know as much as the firm's board of directors about the firm's type (i.e. whether it is type N^- or type N^+), then the type-N^- firms will prefer the strategy of not paying dividends at $t = 0$ and $t = 2$ to that of paying dividends at both dates, the type-N^+ firms will prefer to pay $d = I$ at $t = 0$ and $t = 2$ rather than set $d = 0$ on both dates. Let $W_1^S(\theta)$ be the expected wealth of the shareholders at $t = 0$ if they choose not to initiate a dividend, and $W_2^S(\theta)$ the expected wealth of the shareholder if they choose to initiate a dividend at $t = 0$.

Then the type-N^- and type-N^+ firms will choose the conjectured strategies if:

$$W_2^S(\theta^+) \geq W_1^S(\theta^+), \tag{A.14}$$

and

$$W_1^S(\theta^-) \geq W_2^S(\theta^-), \tag{A.15}$$

with strict inequality for at least one of the above.

Now

$$\begin{aligned} W_1^S(\theta^+) &= \alpha_0 g\left\{h(\theta^+)\,\theta^+\left[V - I + h(\theta^+)\left[\theta^+\hat{V}\right]\right]\right\} \\ &\quad + \alpha_0 g\left\{\left[h(\theta^+)\left[1-\theta^+\right] + \left[1 - h(\theta^+)\right]\right]\left[g_f[1-\lambda]\theta^+\hat{V} - I\right]\right\}. \end{aligned} \tag{A.16}$$

Let us compare (A.16) to (32). Collect the following terms in (32):

$$D_1 \equiv \frac{-I\tau}{\theta^+ g} + V[1-\lambda] - I\tau + [1-\lambda]\theta^+\hat{V} + A - I, \tag{A.17}$$

Moreover, collect the following terms in (A.16):

$$D_2 \equiv h(\theta^+)\left[V - I + h(\theta^+)\left[\theta^+\hat{V}\right]\right]. \tag{A.18}$$

Now, given (33), we see that

$$D_1 > D_2. \tag{A.19}$$

This implies that

$$\begin{aligned} &\alpha_0\left\{I[1-\tau] - I + \theta^+ g\left[V[1-\lambda] + I[1-\tau] - 2I + A + [1-\lambda]\theta^+\hat{V}\right]\right\} \\ &\qquad > \alpha_0 g\left\{h(\theta^+)\,\theta^+\left[V - I + h(\theta^+)\left[\theta^+\hat{V}\right]\right]\right\}. \end{aligned} \tag{A.20}$$

As for the remaining terms, we have $\alpha_0\left[1-\theta^+\right]g\left[\{1-\lambda\}\theta^+\hat{V} - I\tau\right]$ in (32) and

$\alpha_0 g \{h(\theta^+)[1-\theta^+] + [1-h(\theta^+)]\} \left\{g_f[1-\lambda]\theta^+\hat{V} - I\right\}$ in (A.16). Both of these terms converge to 0 as $\theta^+ \to 1$. Thus, by continuity, for θ^+ high enough, these terms can be ignored. This proves that

$$W_2^S(\theta^+) > W_1^S(\theta^+). \tag{A.21}$$

Now, $W_1^S(\theta^-)$ is given by (31), and

$$W_2^S(\theta^-) = \alpha_0 \left\{I[1-\tau] - I + \theta^- g\left[V[1-\lambda] - I - I\tau + [1-\lambda]\theta^-\hat{V}\right]\right\}. \tag{A.22}$$

We can write (31) as:

$$W_1^S(\theta^-) = \alpha_0 g\left\{h(\theta^-)\theta^-\left[V - I + h(\theta^-)\left[\theta^-\hat{V}\right]\right] + Q\right\}, \tag{A.23}$$

where Q is a positive quantity. Now, comparing (A.22) and (A.23), we see that

$$\begin{aligned}[h(\theta^-)]^2\left[\theta^-\hat{V}\right] &> [1-\lambda]\left[\theta^-\hat{V}\right] \\ &> [1-\lambda]\left[\theta^-\hat{V}\right] - I\tau,\end{aligned} \tag{A.24}$$

where the first inequality follows from (34). Moreover, from (34) and (33), we have

$$\begin{aligned}h(\theta^-)[V-I] &> [1-\lambda][V-I] \\ &= [1-\lambda]V - I + I\lambda \\ &> V[1-\lambda] - I + I[1-\tau] \\ &> \theta^- g\{V[1-\lambda] - I\} + I[1-\tau].\end{aligned} \tag{A.25}$$

From (A.24) and (A.25), it is clear that

$$W_1^S(\theta^-) > W_2^S(\theta^-). \tag{A.26}$$

This establishes that if the investors know as much as the board, the type-N^- firm will not pay any dividend at $t=0$ and $t=2$, whereas the type-N^+ firm will pay $d=I$ at $t=0$ and $t=2$. ■

Proof of Proposition 2: To prove that the type-N^- and type-N^+ firms will play the strategies stipulated in the proposition, it is necessary to first establish incentive compatibility (IC) along the path of play. For this, let $W^S(\bar{\theta} \mid \theta)$ be the wealth of the initial ($t=0$) shareholders of a type-N firm with θ when it adopts the equilibrium strategy of a type-$\bar{\theta}$ firm (i.e. "reports" that it is a type-$\bar{\theta}$ firm). The IC constraints are:

$$W^S(\theta^+ \mid \theta^+) \geq W^S(\theta^- \mid \theta^-), \tag{A.27}$$

$$W^S(\theta^- \mid \theta^-) \geq W^S(\theta^+ \mid \theta^-), \tag{A.28}$$

with at least one strict inequality in a separating sequential equilibrium. Now, from Lemma 8, we know that $W^S(\theta^+ \mid \theta^+) \equiv W_2^S(\theta^+) > W_1^S(\theta^+)$ and since $W_1^S(\theta^+) > W^S(\theta^- \mid \theta^-)$, it is clear that (A.27) holds as a strict inequality. To prove (A.28), note that $W^S(\theta^- \mid \theta^-) \equiv W_1^S(\theta^-)$, and that the amount of ownership that the initial shareholders will have to give up to raise I at $t=0$ if they of the type-N^- mimic the type-N^+ firm and initiate a dividend at $t=0$ is $\alpha_n(\theta^+)$, given by:

$$\alpha_n(\theta^+) = \frac{I}{W(\theta^+)}, \tag{A.29}$$

where

$$\begin{aligned} W(\theta^+) \equiv{}& \theta^+ g\left\{V[1-\lambda] + I[1-\tau] - 2I + A + [1-\lambda]\theta^+\hat{V}\right\} \\ &+ \left[1-\theta^+\right] g\left\{[1-\lambda]\theta^+\hat{V} - I\tau\right\} \end{aligned} \tag{A.30}$$

is the ex-first-period-dividend value investors assign to a firm they believe is type-N^+. Next, one can write:

$$W^S(\theta^+ \mid \theta^-) = \alpha_0 I[1-\tau] + \alpha_0[1-\alpha_n]\theta^- g\left\{I[1-\tau] + [1-\hat{\alpha}_n]\left[[1-\lambda]\theta^-\hat{V}\right]\right\}, \tag{A.31}$$

where α_n is the share of ownership the initial shareholders have to surrender to new shareholders at $t=0$ in exchange for external financing, and $\hat{\alpha}_n$ is the share of ownership that must be surrendered at $t=2$ in order to raise second-period external financing. By the competitive pricing condition,

$$\hat{\alpha}_n[1-\lambda]\theta^+\hat{V} = 2I - V(1-\lambda), \tag{A.32}$$

since external financing sought in the second period, conditional on first-period project success, is $2I - V(1-\lambda)$. Substituting for $\hat{\alpha}_n$ from (A.32) into (A.31) gives:

$$W^S(\theta^+ \mid \theta^-) = \alpha_0 I[1-\tau] + \alpha_0[1-\alpha_n]\theta^- g\left\{I[1-\tau] + \left[1 - \frac{[2I - V[1-\lambda]]}{[1-\lambda]\theta^+\hat{V}}\right][1-\lambda]\theta^-\hat{V}\right\}. \tag{A.33}$$

Upon simplification, we have:

$$\begin{aligned} W^S(\theta^+ \mid \theta^-) <{}& \alpha_0 I[1-\tau] \\ &+ \alpha_0\theta^- g\left[V[1-\lambda] - I\tau - I + [1-\lambda]\theta^-\hat{V} + I - I\left\{\frac{2\theta^- - \theta^+}{\theta^+}\right\} - \alpha_n\triangle\right], \end{aligned} \tag{A.34}$$

where $\triangle \equiv I[1-\tau] + \left[1 - \frac{2I - V[1-\lambda]}{[1-\lambda]\theta^+\hat{V}}\right][1-\lambda]\theta^-\hat{V}$.

Let us now compare (A.23), which gives us $W^S(\theta^- \mid \theta^-)$, and (A.34). It was shown in the proof of Lemma 8 that $[h(\theta^-)]^2\left[\theta^-\hat{V}\right] > [1-\lambda]\theta^-\hat{V} > [1-\lambda]\theta^-\hat{V} - I\tau$, and $h(\theta^-)[V-I] > \theta^- g[V[1-\lambda] - I] + I[1-\tau]$. Thus, to prove that $W^S(\theta^- \mid \theta^-) > W^S(\theta^+ \mid \theta^-)$, it is useful to begin by noting that in (A.23),

$$\begin{aligned} Q ={}& \left\{h(\theta^-)\left[1-\theta^-\right] + \left[1 - h(\theta^-)\right]\right\}\left\{g_f[1-\lambda]\theta^-\hat{V} - I\right\} \\ ={}& \left\{1 - h(\theta^-)\theta^-\right\}\left\{g_f[1-\lambda]\theta^-\hat{V} - I\right\}. \end{aligned} \tag{A.35}$$

Now the restriction on $g_f[1-\lambda]\theta^-\hat{V}$ is that it belong to $(I, 2I)$. Thus, $\sup_{\hat{V}} g_f[1-\lambda]\theta^-\hat{V} = 2I$ when $g_f[1-\lambda]\theta^-\hat{V}$ is restricted to lie within $(I, 2I)$. Thus, $\sup_{\hat{V}} Q = [(1 - h(\theta^-))\theta^-] I$ and $\hat{V}$ can be chosen to be large enough to insure that (A.23) can be written as approximately

$$W_1^S(\theta^-) \simeq \alpha_0 g \left\{ h(\theta^-)\theta^- \left[V - I + h(\theta^-) \left[\theta^-\hat{V}\right] - I \right] + I \right\}. \tag{A.36}$$

Let us now compare (A.34) and (A.36). Note first that since $\tau > 2\theta^- g[\theta^+ - \theta^-]/\theta^+$, in (A.34) the quantity

$$I[1-\tau] - \theta^- g - \left\{ \frac{2\theta^- - \theta^+}{\theta^+} \right\} < 0. \tag{A.37}$$

Next, take the quantity $V[1-\lambda] - I\tau$ from (A.34) and note that:

$$\begin{aligned} V[1-\lambda] - I\tau &< V[1-\tau] - I[1-\lambda] \\ &= [1-\lambda][V-I] \\ &< h(\theta^-)[V-I], \end{aligned} \tag{A.38}$$

where the first inequality follows since $1 - \lambda < \tau$, and the second inequality follows since $1 - \lambda < h(\theta^-)$. Moreover, take the quantity $[1-\lambda]\theta^-\hat{V} - I$ from (A.34) and note that:

$$\begin{aligned} [1-\lambda]\theta^-\hat{V} - I &< \left[h(\theta^-)\right]^2 \theta^-\hat{V} - I \\ &< \left[h(\theta^-)\right]^2 \theta^-\hat{V} - h(\theta^-) I, \end{aligned} \tag{A.39}$$

where the first inequality follows from (34), and the second since $h(\theta^-)$ is a probability. Combining (A.37), (A.38), and (A.39), and noting that $I > \theta^- g[I - \alpha_n \triangle]$, it follows by comparing (A.34) and (A.36) that

$$W^S(\theta^+ \mid \theta^-) < W_1^S(\theta^-). \tag{A.40}$$

Thus, incentive compatibility along the path of play has been established. From earlier results, the optimality of the strategies at $t = 2$ along the path of play has also been established. It is also apparent that a type-L firm that is observationally identical to a type-N firm from the board's perspective will find it privately optimal to pool with that type-N firm.

All that remains to be proved is that no firm will wish to defect from the equilibrium path. There are no out-of-equilibrium moves at $t = 0$, so no (observable) defection from the equilibrium is possible. Defection is possible only at $t = 2$. Consider now a firm that initiated a dividend at $t = 0$, experienced project failure in the first period, and cut its dividend. In equilibrium, if, given the strategies of different types of firms, investors believe with probability 1 that it is type-L, the shareholders' wealth at $t = 2$ is zero, so it is better for the manager of the type-N firms with $\theta = \theta^+$ to invest K to convince the board the firm is type N and then sell assets to continue the dividend initiated at $t = 0$, as shown earlier. So there will be no defection by a type-N firm. However, no type-L firm that initiated a dividend at $t = 0$ will be in a position to continue the dividend payment. Given these strategies, the Bayesian posterior belief of investors about the firm's type is indeed that it is type-N if it continues its dividend and type-L if it does not, and the market's reaction of pricing firms that cut dividends as if they were type-L is a best response. Further, given the out-of-equilibrium belief that any firm that initiates a dividend at $t = 2$ after not having initiated it at $t = 0$ is either type-N^- or type-L^- (using the prior beliefs across the two types), it is clear that no firm will wish to defect from the equilibrium by doing so.

To prove that the equilibrium is sequential, it needs to be verified that the equilibrium beliefs (including out-of-equilibrium beliefs) and strategies are the limit of some sequence of Bayesian rational beliefs and strategies. Let $\sigma_i\left(\tilde{d}\right)$ be the probability with which a firm of type i chooses a dividend $\tilde{d} \in \{0, I\}$ in the second period after having set a dividend payment of $d = 0$ in the first period. Note that, conditional on having observed $d = 0$ in the first period, the market's belief is that the firm is type N^- with probability g and type L with probability $1 - g$. Define a sequence of strategies $\left\{\sigma_i^n\left(\tilde{d}\right), n = 1, 2, ..., \infty\right\}$ as follows:

$$\sigma_N^n\left(\tilde{d}\right) = \begin{cases} 1/n & \text{if } \tilde{d} = d = I \\ 1 - (1/n) & \text{if } \tilde{d} = 0 \end{cases}, \tag{A.41}$$

$$\sigma_L^n\left(\tilde{d}\right) = \begin{cases} 1/n & \text{if } \tilde{d} = d = I \\ 1 - (1/n) & \text{if } \tilde{d} = 0 \end{cases}. \tag{A.42}$$

Then, the posterior beliefs are:

$$\Pr{}^n\left(\text{firm is type } L \mid \tilde{d} = 0\right) = \frac{[1 - (1/n)][1 - g_p]}{[1 - (1/n)][1 - g_p] + [1 + (1/n)g_p]}, \tag{A.43}$$

$$\Pr{}^n\left(\text{firm is type } L \mid \tilde{d} = I\right) = \frac{[1/n][1 - g_p]}{\{(1/n)[1 - g_p] + g_p(1/n)\}}, \tag{A.44}$$

$$\Pr{}^n\left(\text{firm is type } N \mid \tilde{d} = I\right) = \frac{(1/n)g_p}{\{(1/n)[1 - g_p] + g_p(1/n)\}}, \tag{A.45}$$

where g_p is the posterior belief that the firm is type N^-, conditional on the project outcome (success/failure). Now, taking limits, we see that $\forall i$:

$$\lim_{n\to\infty} \Pr{}^n\left(i \mid \tilde{d} = 0\right) = \begin{cases} 1 - g_p & \text{if } i = L \\ g_p & \text{if } i = N \end{cases}, \tag{A.46}$$

$$\lim_{n\to\infty} \Pr{}^n\left(i \mid \tilde{d} = I\right) = \begin{cases} g_p & \text{if } i = N \\ 1 - g_p & \text{if } i = L \end{cases}. \tag{A.47}$$

Thus, the sequence of Bayesian rational beliefs associated with the assumed sequence of strategies converges to the equilibrium beliefs. This completes the proof that this is a sequential equilibrium. ■

Proof of Corollary 1: The proof of sequential equilibrium is similar to that of the proof of Proposition 2 except that a dividend cut is now also an out-of-equilibrium move. It is clear that a type-L firm gains by pooling with type-N^+ firms at $t = 2$ and continuing the dividend payment after a project failure. So no dividend cuts occur in equilibrium.

The proof that the equilibrium is sequential proceeds in exactly the same way as in the proof of Proposition 2, and so is omitted here. I now prove that the out-of-equilibrium belief on the part of investors in response to the out-of-equilibrium move of a dividend cut survives the universal divinity refinement of sequential equilibrium. Let the best reponse of the uninformed investors/market to a dividend cut be described by a probability $\mu \in [0, 1]$ with which the investors believe the firm is type N. Let μ_L be the value of this probability such that a type-L firm is indifferent between a dividend cut and paying a dividend. For any $\mu > \mu_L$, the firm strictly prefers to cut its dividend. Now, since the type L firm simply cannot liquidate its assets in place at a value high enough to pay a dividend, it follows that $\mu_L = 0$. Define

$$\Omega_L = \{\mu > \mu_L = 0 \mid \mu \in [0, 1], \text{type-}L \text{ firm cuts its dividend}\} \tag{A.48}$$

as the set of best responses for which the type-L firm strictly wishes to cut its dividend, and

$$\Omega_L^0 = \{\mu = \mu_L = 0 \mid \mu \in [0, 1], \text{type-}L \text{ firm cuts its dividend}\} \tag{A.49}$$

as the set of best responses for which the type-L firm is indifferent between cutting its dividend and not cutting it.

Similarly, let μ_N be the value of μ such that the type-N^+ firm is indifferent between a dividend cut and paying a dividend. Now, since the board can decide whether or not to authorize the manager to pay a dividend only after it has been convinced by the manager that the firm is type N, the situation considered is one in which the manager has already done that. Thus, if the board authorizes liquidation of assets in place to pay a dividend, the expected value of the shareholders' wealth based on the stock price at $t = 2$ will be $\alpha_0 \left\{[1 - \lambda]\theta^+\hat{V} - I_T\right\}$ (recalling (27)). If the board decides to not liquidate its assets and cut the dividend (to zero), then with a posterior belief of μ_N on the part of investors, the competitive pricing condition dictates that the firm will need to sell ownership $\alpha_n \in (0, 1)$ to raise I:

$$\alpha_n \mu_N \left\{[1 - \lambda]\theta^+\hat{V} + A\right\} = I. \tag{A.50}$$

The market value of the original shareholders' ownership claim will be

$$[1 - \alpha_n]\, \alpha_0 \mu_N \left\{[1 - \lambda]\theta^+\hat{V} + A\right\}. \tag{A.51}$$

Substituting (A.50) in (A.51) and simplifying allows (A.37) to be written as:

$$\alpha_0 \left[\mu_N \left\{[1 - \lambda]\theta^+\hat{V} + A\right\} - I\right]. \tag{A.52}$$

Thus, we see that μ_N is the solution to:

$$\alpha_0 \left\{[1 - \lambda]\theta^+\hat{V} - I_T\right\} = \alpha_0 \left[\mu_N \left\{[1 - \lambda]\theta^+\hat{V} + A\right\} - I\right], \tag{A.53}$$

which yields

$$\mu_N = \frac{[1-\lambda]\theta^+\hat{V} + I[1-\tau]}{[1-\lambda]\theta^+\hat{V} + A}. \tag{A.54}$$

Note that $A > I[1-\tau]$, so $\mu_N \in (0,1)$.

Define

$$\Omega_N = \{\mu > \mu_N = 0 \mid \mu \in [0,1], \text{type-}N \text{ firm cuts its dividend}\} \tag{A.55}$$

as the set of best responses for which the type-N firm strictly wishes to cut its dividend, and

$$\Omega_N^0 = \{\mu = \mu_N = 0 \mid \mu \in [0,1], \text{type-}N \text{ firm cuts its dividend}\} \tag{A.56}$$

be the set of best responses for which the type-N firm is indifferent between cutting its dividend and no cutting it. From (A.48), (A.49), (A.55), and (A.56), it follows that

$$\Omega_N \cup \Omega_N^0 \subset \Omega_L. \tag{A.57}$$

From the universal divinity criterion, it follows then that investors should assign zero posterior probability to the event that the firm that has cut its dividend is type N, i.e., it assigns probability 1 that the firm is type L. In this caser, the market value of equity is zero. Thus, no type-N firm that has initiated a dividend will cut it. The proof for the case in which the first-period project was a success is similar, but simpler. ■

Proof of Proposition 3: Consider the following exogenous parameter values: $q = 0.67$, $\lambda = 0.36$, $\alpha_0 = 0.55$, $g = 0.93$, $V = 13.8$, $\theta^+ = 0.95$, $\theta^- = 0.8$, $B_{max} = 6.9$, $A = 8$, $I = 7$, $\hat{V} = 19$, and $\tau = 0.65$. These parameter values satisfy all the restrictions on the exogenous parameters: (1)–(6), as well as (30), and (33)–(35). ■

Proof of Lemma 9: Suppose governance is approaching to be perfect. Then $B_{max}(\xi)$ is arbitrarily close to 0. This asymptotically eliminates the private-benefit project from the manager's optimal set for any $\alpha_0 > 0$. Moreover, assume $\theta^+ - \theta^- = V^+ - V^- = \varepsilon > 0$ for ε arbitrarily small. Then the signaling benefit of dividend initiation is arbitrarily small. So suppose both type-N^+ and type-N^- firms pool and do not initiate dividends at $t = 0$. The highest value a firm that defects from this conjectured equilibrium and pays a dividend is that of a type-N^+ firm that does not pay a dividend, call it V^+, minus the disclosure cost D. For $\theta^+ - \theta^- = V^+ - V^- = \varepsilon$, the firm's value in the conjectured pooling equilibrium, call it V_p, will exceed this value, i.e., $V_p > V^+ - D$, since V_p and V^+ will be arbitrarily close to each other. Hence, no firm will defect from the pooling no-dividend equilibrium. ■

Figure 2-1: Sequence of Events

$t = 0$	$t = 1$	$t = 2$	$t = 3$	$t = 4$
▶ Shareholders own α_0 of unlevered firm. Manager owns $1 - \alpha_0$. ▶ Firm has $I + C$ in cash. ▶ Firm can pay a dividend and/or repurchase stock. Shareholders decide what to instruct the manager to do. ▶ There are two observationally indistinguishable types of firms: type L (lemons) and type N (normal). The manager privately knows the firm's type. All other believe that the prior probability the firm is type N is g. ▶ Among the type-N firms, there are those with $\theta = \theta^+$ (type-N^+) and those with $\theta = \theta^-$ (type-N^-) that are observationally identical to investors (outsiders), but whose type is known to the manager and the board.	▶ Manager has a choice between G and P projects. ▶ Manager privately observes realized value of private benefit $\tilde{B}$ associated with P. ▶ The board instructs manager to either raise external financing or use internal funds to finance project. Manager also makes unobservable project choice.	▶ Project payoff is realized. ▶ Dividend payment is either initiated, not initiated, continued, or discontinued by shareholders.	▶ Manager has the same project choice as at $t = 1$. ▶ He observes realized value of $\tilde{B}$ and chooses project. ▶ Project is financed either with internal or external financing.	▶ Second period project payoff is realized ▶ All payments are made

Figure 2-3: Analysis of Logit Interaction Effect
The graph gives z-statistics for the logit interaction effect, $Mgr\,Own_{i,t-1} \times Low\,Inst\,Own_{i,t-1}$, for regression (36). The z-statistics are plotted for various levels of the covariates and predicted initiation probability, following Ai and Norton (2003). The red lines indicate statistical significance at the 10% level.

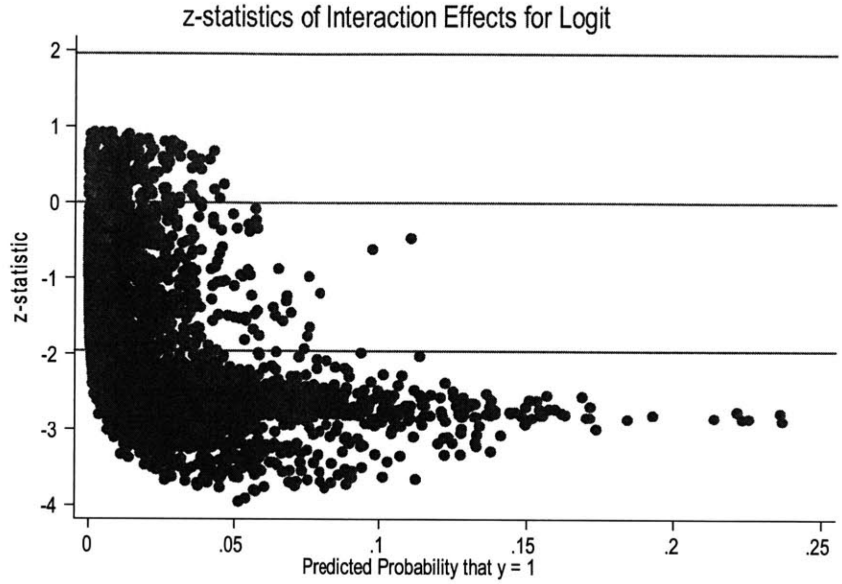


Figure 2-4: Dividend Initiation Rates by Public Float
The graphs give the percentage of dividend initiations per market capitalization bucket, defined as the number of dividend initiations in a market capitalization bucket divided by the total number of firms in that bucket. The period runs from 2004-2011, which is subsequent to the implementation of the Sarbanes-Oxley Act.

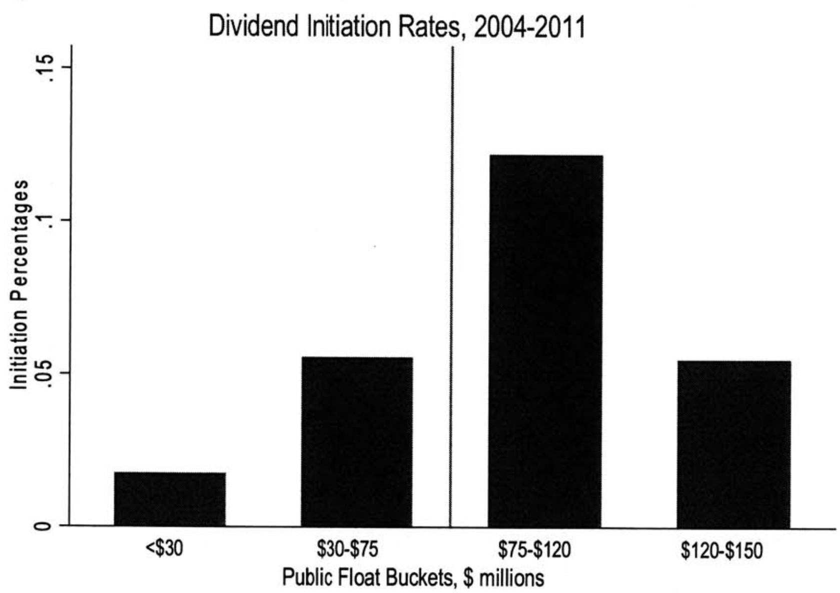


Figure 2-2: Firm's Strategies

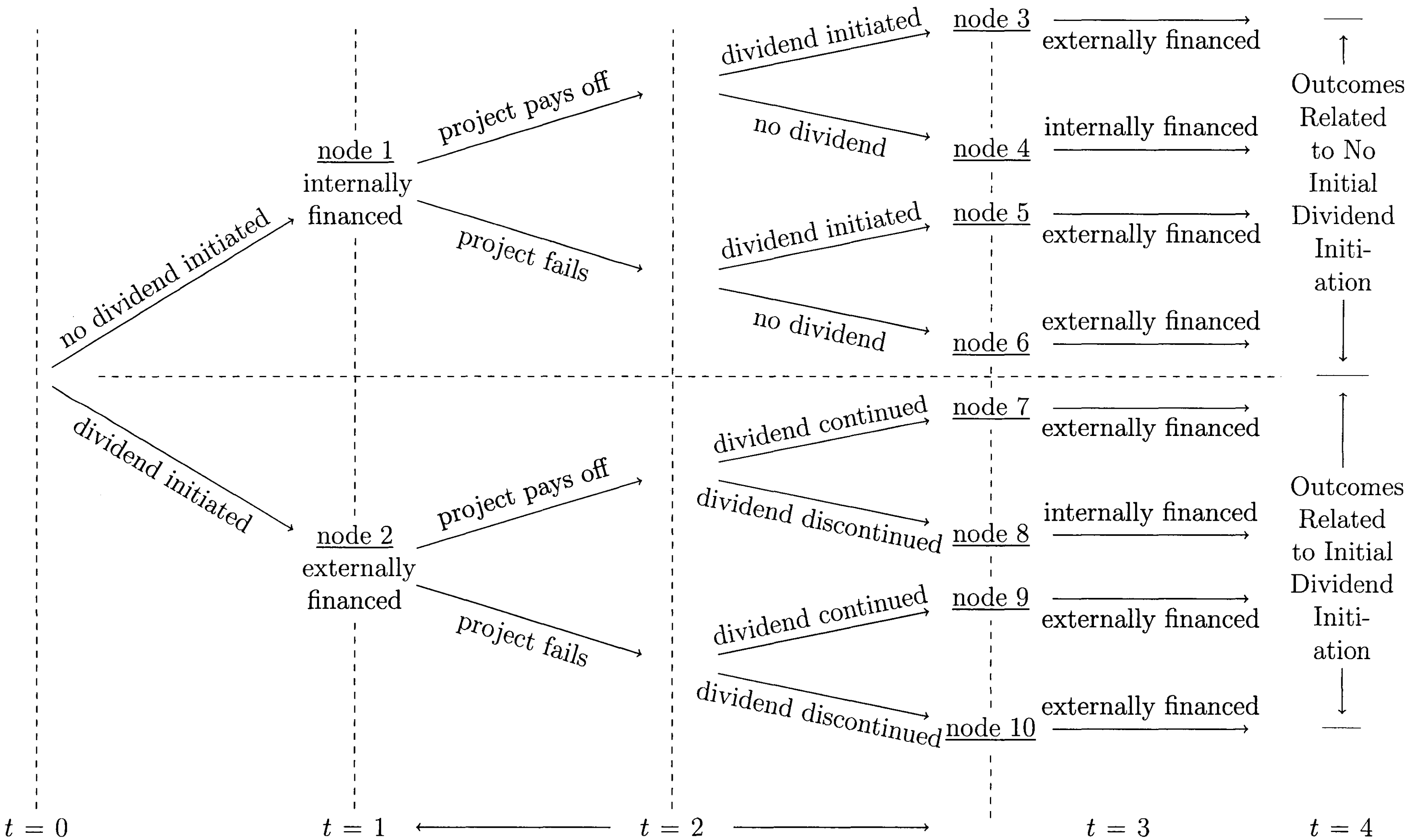


Figure 2-5: Probability of Dividend Initiation Around $75 million Threshold
This graph shows the probability of dividend initiation as a function of the maximum running public float, $MPFloat_{i,t}$. The estimates come from the logit regression (39), for a bandwidth of the running variable between $50 million and $100 million, and including up to 5th-order polynomial terms.

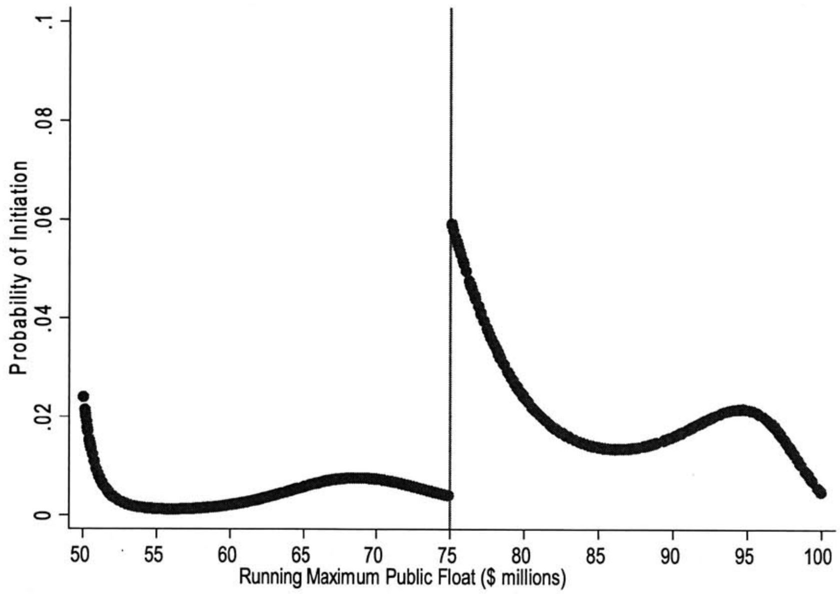


Table 2-1: Summary Statistics

Summary statistics of variables included in regression (36). The variable values run from 1992 to 2011. $Init_{i,t}$, is a binary variable which takes a value of 1 if a firm initiated a dividend in year t and 0 otherwise. $\ln(TA)_{t-1}$ is the natural logarithm of lagged total book assets of the company. $Div\,Tax_{t-1}$ is the personal tax rate on dividend income in year $t-1$. $Mgr\,Own_{t-1}$ is the percentage of total shares outstanding owned by top management in year $t-1$. $Inst\,Own_{t-1}$ is the percentage of total shares outstanding owned by the top 5 institutional blockholders. $(R\&D/TA)_{t-1}$ is a measure of R&D intensity in the firm. ROA_{t-1} is the lagged return on assets. $(Debt/TA)_{t-1}$ is the book value of debt scaled by total assets. $(Cash/TA)_{t-1}$ is the lagged ratio of cash to total assets. $(RE/TE)_{t-1}$ is the ratio of earned equity (retained earnings) to total assets. $Repur_{i,t-1}$ is an indicator variable that takes a value of 1 if a firm repurchases stock in the previous year. All variables except for $\ln(TA)_{i,t-1}$, $Div\,Tax_{i,t-1}$, and $Repur_{i,t-1}$ are winsorized at the 1% level.

Variable	Mean	SD	p25	Median	p75
$Init_{i,t}$	0.0263	0.151	0.000	0.000	0.000
$\ln(TA)_{i,t-1}$	6.961	1.660	5.816	6.827	8.000
$Div\,Tax_{t-1}$	0.349	0.121	0.210	0.447	0.462
$Mgr\,Own_{i,t-1}$	0.016	0.044	0.000	0.0002	0.009
$Inst\,Own_{i,t-1}$	0.260	0.098	0.192	0.256	0.322
$(Cash/TA)_{i,t-1}$	0.156	0.182	0.024	0.082	0.228
$(R\&D/TA)_{i,t-1}$	0.058	0.091	0.005	0.028	0.082
$ROA_{i,t-1}$	0.086	0.164	0.051	0.096	0.146
$(Debt/TA)_{i,t-1}$	0.219	0.209	0.044	0.197	0.330
$(M/B)_{i,t-1}$	3.222	5.013	1.509	2.356	3.798
$(RE/TE)_{i,t-1}$	0.306	4.414	0.154	0.551	0.860
$Repur_{i,t-1}$	0.516	0.500	0.000	1.000	1.000

Table 2-2: Predictive Logit Model of Dividend Initiations

This table presents the results of regression (36), which is a pooled predictive logit model of dividend initiations. Columns (1) and (2) run the regression for the entire sample, while columns (3)–(6) eliminate firms with high managerial ownership (>5% of shares outstanding). All variables are as described in Section 5.1. All variables except for $\ln(TA)_{i,t-1}$, $DivTax_{i,t-1}$, $Low\,Inst\,Own_{t-1}$, and $Repur_{i,t-1}$ are winsorized at the 1% level. Robust standard errors are in parentheses, and standard errors are clustered at the firm level. Industry fixed effects are included as indicated. *, **, and *** indicate signicance at the 10%, 5%, and 1% level, respectively.

	Dependent Variable: $Init_{i,t}$					
	(1)	(2)	(3)	(4)	(5)	(6)
$\ln(TA)_{t-1}$	0.284***	0.331***	0.298***	0.326***	0.314***	0.360***
	(0.055)	(0.067)	(0.059)	(0.071)	(0.061)	(0.072)
$DivTax_{t-1}$	-1.492**	-1.255	-2.177***	-1.939**	-2.072**	-1.806**
	(0.751)	(0.852)	(0.819)	(0.921)	(0.817)	(0.916)
$Mgr\,Own_{t-1}$	-1.657	-2.040	-20.983*	-22.001*	-12.164	-9.877
	(1.931)	(2.142)	(10.979)	(12.179)	(11.945)	(12.598)
$Mgr\,Own_{t-1} \times Low\,Inst\,Own_{t-1}$					-47.799**	-77.579***
					(24.274)	(25.537)
$Low\,Inst\,Own_{t-1}$					0.510**	0.564***
					(0.200)	(0.217)
$Inst\,Own_{t-1}$	-2.354***	-2.840***	-2.904***	-3.172***		
	(0.855)	(0.983)	(0.918)	(1.050)		
$(R\&D/TA)_{t-1}$	-8.450***	-9.294***	-9.779***	-10.742***	-9.670***	-11.325***
	(1.766)	(2.698)	(1.913)	(3.029)	(1.901)	(3.087)
ROA_{t-1}	3.835***	3.067***	4.263***	3.258***	4.341***	3.441***
	(0.785)	(0.912)	(0.855)	(0.985)	(0.875)	(1.006)
$(Cash/TA)_{t-1}$		-0.018		-0.066		-0.010
		(0.580)		(0.652)		(0.653)
$(M/B)_{t-1}$		-0.008		-0.004		-0.005
		(0.021)		(0.023)		(0.023)
$(Debt/TA)_{t-1}$		-1.693***		-1.709**		-1.742***
		(0.578)		(0.632)		(0.625)
$(RE/TE)_{t-1}$		0.001		-0.000		-0.004
		(0.016)		(0.019)		(0.021)
$Repur_{t-1}$		0.569***		0.556***		0.543***
		(0.188)		(0.199)		(0.197)
Constant	-4.522***	-14.319***	-4.171***	-14.570***	-5.318***	-14.662***
	(0.632)	(1.133)	(0.680)	(1.095)	(0.576)	(1.104)
Industry Fixed Effects	No	Yes	No	Yes	No	Yes
Observations	7,270	7,015	6,483	6,267	6,483	6,267
Pseudo-R^2	0.0705	0.106	0.087	0.123	0.086	0.124

Table 2-3: Cox Proportional Hazard Model of Dividend Initiations

This table presents the results of regression (38), which estimates a Cox proportional hazard model for dividend initiations. Time in the model is the time since IPO for each firm. Estimates of the hazard ratio, $\exp(\beta)$, are reported for each variable. Columns (1) and (2) run the regression for the entire sample, while columns (3)–(6) eliminate firms with high managerial ownership (>5% of shares outstanding). All variables are as described in Section 5.1. All variables except for $\ln(TA)_{i,t-1}$, $DivTax_{i,t-1}$, $Low\,Inst\,Own_{t-1}$, and $Repur_{i,t-1}$ are winsorized at the 1% level. Robust standard errors are in parentheses, and standard errors are clustered at the firm level. Industry fixed effects are included as indicated. *, **, and *** indicate signicance at the 10%, 5%, and 1% level, respectively.

	(1)	(2)	(3)	(4)	(5)	(6)
$\ln(TA)_{t-1}$	1.364***	1.513***	1.421***	1.559***	1.463***	1.645***
	(0.098)	(0.142)	(0.110)	(0.158)	(0.114)	(0.169)
$DivTax_{t-1}$	0.088**	0.058**	0.031***	0.030***	0.031***	0.038***
	(0.093)	(0.067)	(0.035)	(0.039)	(0.034)	(0.048)
$Mgr\,Own_{t-1}$	0.056	0.043	0.000**	0.000*	0.000*	0.000
	(0.143)	(0.115)	(0.000)	(0.000)	(0.000)	(0.000)
$Mgr\,Own_{t-1} \times Low\,Inst\,Own_{t-1}$					0.000**	0.000*
					(0.000)	(0.000)
$Low\,Inst\,Own_{t-1}$					1.421	1.546
					(0.351)	(0.427)
$Inst\,Own_{t-1}$	0.142*	0.029***	0.107*	0.017***		
	(0.163)	(0.037)	(0.139)	(0.025)		
$(R\&D/TA)_{t-1}$	0.0001***	0.0002**	0.00002***	0.00001**	0.00002***	0.00004**
	(0.0002)	(0.0008)	(0.0001)	(0.0002)	(0.0001)	(0.0002)
ROA_{t-1}	10.183**	8.215*	12.348**	8.610*	13.318**	10.505**
	(9.528)	(9.263)	(12.507)	(10.312)	(14.001)	(12.597)
$(Cash/TA)_{t-1}$		0.474		0.401		0.460
		(0.295)		(0.278)		(0.318)
$(M/B)_{t-1}$		0.955**		0.956*		0.962
		(0.021)		(0.024)		(0.025)
$(Debt/TA)_{t-1}$		0.087***		0.078***		0.080***
		(0.070)		(0.073)		(0.072)
$(RE/TE)_{t-1}$		0.989		0.983		0.979
		(0.021)		(0.022)		(0.021)
$Repur_{t-1}$		1.808***		1.723**		1.593*
		(0.412)		(0.436)		(0.400)
Industry Fixed Effects	No	Yes	No	Yes	No	Yes
Observations	4,992	4,936	4,405	4,354	4,405	4,354
Log-pseudolikelihood	-520.449	-452.792	-431.771	-381.103	-430.921	-382.908
Prob > chi^2	0.000	0.000	0.000	0.000	0.000	0.000

Table 2-4: Effect of Information Disclosure on Dividend Initiations and Falsification Test

Panel A estimates the main regression discontinuity equation (39) for a public float threshold of $75 million. Panel B contains estimates of the regression discontinuity equation (39) while falsely specifying the cutoff value for $MPFloat_{i,t}$. The sample is from 2004 to 2011, and consists of firms-years with running maximum public floats that fall within the indicated bandwidths (bandwidth is in $ millions). The dependent variable is $Init_{i,t}$, which takes a value of 1 if firm i initiated a dividend in year t and 0 otherwise. $T_{i,t}$ is a dummy variable which takes a value of 1 if $MPFloat_{i,t}$ is greater than or equal to $75 million. Specifications include 3rd- through 7th-order polynomial terms for $MPFloat_{i,t}$, as indicated (coefficient estimates are excluded). Industry and year fixed effects, as well as controls, are included where indicated. Controls variables include $ROA_{i,t}$, $(Cash/TA)_{i,t}$, $(M/B)_{i,t}$, $(Debt/TA)_{i,t}$, $(RE/TE)_{i,t}$, and $Repur_{i,t}$. All controls are winsorized at the 1% level. Robust standard errors are in parentheses, and standard errors are clustered at the firm level. *, **, and *** indicate signicance at the 10%, 5%, and 1% level, respectively.

Panel A: Effect of Information Disclosure on Dividend Initiations

Dependent Variable: $Init_{i,t}$

	(1)	(2)	(3)	(4)	(5)
$T_{i,t}$	2.793***	4.454**	2.319**	2.828**	2.778**
	(0.839)	(1.576)	(1.092)	(1.346)	(1.374)
$MPFloat_{i,t}$ Bandwidth	[50, 100]	[50, 100]	[0, 150]	[0, 150]	[65, 85]
$MPFloat_{i,t}$ Polynomial Order	5	5	7	7	3
Controls	No	Yes	No	Yes	No
Industry Fixed Effects	No	Yes	No	Yes	No
Year Fixed Effects	No	Yes	No	Yes	No
Observations	1,371	738	6,838	5,741	582
Pseudo-R^2	0.064	0.379	0.067	0.284	0.080

Panel B: Falsification Test

Dependent Variable: $Init_{i,t}$

	(1)	(2)	(3)	(4)	(5)
$T_{i,t}$	0.866	0.300	1.507	0.537	-1.277
	(2.130)	(1.909)	(1.011)	(1.073)	(1.583)
Cutoff Value	25	25	150	150	85
$MPFloat_{i,t}$ Bandwidth	[0, 50]	[0, 50]	[75, 225]	[75, 225]	[75, 95]
$MPFloat_{i,t}$ Polynomial Order	5	5	7	7	3
Controls	No	Yes	No	Yes	No
Industry Fixed Effects	No	Yes	No	Yes	No
Year Fixed Effects	No	Yes	No	Yes	No
Observations	4,487	1,160	2,573	1,987	475
Pseudo-R^2	0.062	0.295	0.015	0.312	0.036

Table 2-5: Earnings Management Analysis

This table estimates regression (45) to test for earnings management by firms. The dependent variable in both panels is $(Discr\,Accruals)_{i,t}$, which is described in Section 5.4.5. Panel A estimates the regression discontinuity equation (45) by calculating the dependent variable using the "Jones Model", as in Jones (1991). Panel B estimates the regression discontinuity equation (45) by calculating the dependent variable using the "Modified-Jones Performance" model, as in Kothari, Leone, and Wasley (2005). The sample is from 2004 to 2011, and consists of firms-years with running maximum public floats that fall within the indicated bandwidths (bandwidth is in $ millions). $T_{i,t}$ is a dummy variable which takes a value of 1 if $MPFloat_{i,t}$ is greater than or equal to $75 million. Specifications include 3rd- through 7th-order polynomial terms for $MPFloat_{i,t}$, as indicated (coefficient estimates are excluded). Industry and year fixed effects, as well as controls, are included where indicated. Controls variables include $ROA_{i,t}$, $(Cash/TA)_{i,t}$, $(M/B)_{i,t}$, $(Debt/TA)_{i,t}$, $(RE/TE)_{i,t}$, and $Repur_{i,t}$. All controls are winsorized at the 1% level. Robust standard errors are in parentheses, and standard errors are clustered at the firm level. *, **, and *** indicate signicance at the 10%, 5%, and 1% level, respectively.

Panel A: Estimation Using Jones Model Discretionary Accruals

Dependent Variable: $(Discr\,Accruals)_{i,t}$

	(1)	(2)	(3)	(4)	(5)
$T_{i,t}$	-1.996	-1.615	-1.782	-1.970	-5.372
	(4.805)	(5.119)	(2.399)	(2.417)	(6.212)
$MPFloat_{i,t}$ Bandwidth	[50, 100]	[50, 100]	[0, 150]	[0, 150]	[65, 85]
$MPFloat_{i,t}$ Polynomial Order	5	5	7	7	3
Controls	No	Yes	No	Yes	No
Industry Fixed Effects	No	Yes	No	Yes	No
Year Fixed Effects	No	Yes	No	Yes	No
Observations	1,832	1,822	8,386	8,322	738
R^2	0.001	0.012	0.001	0.003	0.003

Panel B: Estimation Using Modified Jones-Performance Model Discretionary Accruals

Dependent Variable: $(Discr\,Accruals)_{i,t}$

	(1)	(2)	(3)	(4)	(5)
$T_{i,t}$	-0.276	-0.008	-0.211	-0.343	-1.353
	(1.774)	(1.873)	(0.965)	(0.942)	(2.261)
$MPFloat_{i,t}$ Bandwidth	[50, 100]	[50, 100]	[0, 150]	[0, 150]	[65, 85]
$MPFloat_{i,t}$ Polynomial Order	5	5	7	7	3
Controls	No	Yes	No	Yes	No
Industry Fixed Effects	No	Yes	No	Yes	No
Year Fixed Effects	No	Yes	No	Yes	No
Observations	1,830	1,820	8,378	8,315	737
R^2	0.000	0.010	0.002	0.007	0.001

References

[1] Aghion, Phillipe, and Patrick Bolton, 1992, "An Incomplete Contracts Approach to Financial Contracting". *The Review of Economic Studies* 59 (3), 473-494.

[2] Ai, Chunrong, and Edward C. Norton, 2003, "Interaction Terms in Logit and Probit Models". *Economics Letters* 80 (1), 123-129.

[3] Allen, Franklin, Bernardo, Antonio, and Ivo Welch, 2000, "A Theory of Dividends Based on Tax Clienteles". *The Journal of Finance* (55) 6, 2499-2536.

[4] Allen, Franklin, and Roni Michaely. *Dividend Policy.* Rodney L. White Center for Financial Research, 1994.

[5] Angrist, Joshua D., and Jorn-Steffen Pischke. *Mostly Harmless Econometrics: An Empiricist's Companion.* Princeton University Press, 2008.

[6] Asquith, Paul, and David W. Mullins Jr., 1983, "The Impact of Initiating Dividend Payments on Shareholders' Wealth". *The Journal of Business* 56 (1), 77-96.

[7] Baker, Malcolm, and Jeffrey Wurgler, 2004, "Appearing and Disappearing Dividends: the Link to Catering Incentives". *Journal of Financial Economics* 73 (2), 271-288.

[8] Banks, Jeffrey, and Joel Sobel, 1987, "Equilibrium Selection in Signaling Games". *Econometrica* 55 (3), 647-661.

[9] Berger, Philip, Ofek, Eli, and David Yermack, 1997, "Managerial Entrenchment and Capital Structure Decisions". *The Journal of Finance* 52 (4), 1411-1438

[10] Bernheim, B. Douglas, and Adam Wantz, 1995, "A Tax-Based Test of the Dividend Signaling Hypothesis". *The American Economic Review* 85 (3), 532-551.

[11] Bertrand, Marianne, and Sendhil Mullainathan, 2003, "Enjoying the Quiet Life? Corporate Governance and Managerial Preferences". *The Journal of Political Economy* 111 (5), 1043-1075.

[12] Bhattacharya, Sudipto, 1979, "Imperfect Information, Dividend Policy, and 'The Bird in the Hand' Fallacy". *Bell Journal of Economics* 10 (1), 259-270.

[13] Bhattacharya, Sudipto, and Gabriela Chiesa, 1995, "Financial Intermediation with Proprietary Information". *Journal of Financial Intermediation* 4 (4), 328-357.

[14] Bhattacharya, Sudipto, and Jay Ritter, 1983, "Innovation and Communication: Signalling with Partial Disclosure". *Review of Economic Studies* 50 (2), 331-346.

[15] Brav, Alon, Graham, John R., Harvey, Campbell R., and Roni Michaely, 2005, "Payout Policy in the 21st Century". *Journal of Financial Economics* 77 (3), 483-527.

[16] Brennan, Michael J., and Anjan V. Thakor, 1990, "Shareholder Preferences and Dividend Policy". *The Journal of Finance* 45 (4), 993-1018.

[17] Brown, Jeffrey, Liang, Nellie, and Scott Weisbenner, 2007, "Executive Financial Incentives and Payout Policy: Firm Responses to the 2003 Dividend Tax Cut". *The Journal of Finance* 62 (4), 1935-1965.

[18] Bulan, Laarni T., Subramanian, Narayanan, and Lloyd Tanlu, 2007, "On the Timing of Dividend Initiations". *Financial Management* 36 (4), 31-65.

[19] Chetty, Raj, and Emmanuel Saez, 2005, "Dividend Taxes and Corporate Behavior: Evidence from the 2003 Dividend Tax Cut". *The Quarterly Journal of Economics* 120 (3), 791-833.

[20] Comment, Robert, and Gregg A. Jarrell, 1991, "The Relative Signalling Power of Dutch-Auction and Fixed-Price Self-Tender Offers and Open-Market Share Repurchases". *The Journal of Finance* 46 (4), 1243-1271.

[21] Cortes, Felipe, 2013, "Firms' Opaqueness and Corporate Cash Holdings". Working Paper, Washington University in St. Louis.

[22] DeAngelo, Harry, DeAngelo, Linda, and Rene M. Stulz, 2006, "Dividend Policy and the Earned/Contributed Capital Mix: a Test of the Life-Cycle Theory". *Journal of Financial Economics* 81 (2), 227-254.

[23] Dechow, Patricia M., Sloan, Richard G., and Amy P. Sweeney, 1995, "Detecting Earnings Management". *The Accounting Review* 70 (2), 193-225.

[24] Dittmar, Amy, and Jan Mahrt-Smith, 2007, "Corporate Governance and the Value of Cash Holdings". *Journal of Financial Economics* 83 (3), 599-634.

[25] Easterbrook, Frank H., "Two Agency-Cost Explanations of Dividends". *The American Economic Review* 74 (4), 650-659.

[26] Fama, Eugene F., and Kenneth French, 2001, "Disappearing Dividends: Changing Firm Characteristics or Lower Propensity to Pay?" *Journal of Financial Economics* 60 (1), 3-43.

[27] Fama, Eugene F., and Kenneth French, 2005, "Financing decisions: who issues stock?." *Journal of Financial Economics* 76 (3), 549-582.

[28] Fama, Eugene F., and Harvey Babiak, 1968, "Dividend Policy: An Empirical Analysis". *Journal of the American Statistical Association* 63 (324), 1132-1161.

[29] Fama, Eugene F., and James D. MacBeth, 1973, "Risk, Return, and Equilibrium: Empirical Tests". *Journal of Political Economy* 81 (3), 607-636.

[30] Fenn, George W., and Nellie Liang, 2001, "Corporate Payout Policy and Managerial Stock Incentives". *Journal of Financial Economics* 60 (1), 45-72.

[31] Fluck, Zsuzsanna, 1999, "The Dynamics of the Management-Shareholder Conflict". *Review of Financial Studies* 12 (2), 379-404.

[32] Gan, Jie, and Ziyang (Martin) Wang, 2012, "Can Firms Build Capital-Market Reputation to Compensate for Poor Investor Protection? Evidence from Dividend Policies". SSRN Working Paper, September 2012. http://papers.ssrn.com/sol3/papers.cfm?abstract_id=2194309

[33] Gertner, Robert, Gibbons, Robert, and David Scharfstein, 1988, "Simultaneous Signalling to the Capital and Product Markets." *RAND Journal of Economics* 19 (2), 173-190.

[34] Gompers, Paul, Ishii, Joy, and Andrew Metrick, 2003, "Corporate Governance and Equity Prices". *The Quarterly Journal of Economics* 118 (1), 107-155.

[35] Grullon, Gustavo, Michaely, Roni, and Bhaskaran Swaminathan, 2002, "Are Dividend Changes a Sign of Firm Maturity?" *Journal of Business* 75 (3), 387-424.

[36] Guttman, Ilan, Kadan, Ohad, and Eugene Kandel, 2010, "Dividend Stickiness and Strategic Pooling". *Review of Financial Studies* 23 (12), 4455-4495.

[37] Hahn, Jinyong, Todd, Petra, and Wilbert Van der Klauuw, 2001, "Identification and Estimation of Treatment Effects with a Regression-Discontinuity Design". *Econometrica* 69 (1), 201-209.

[38] Hansen, Jens Ording, Fredrik Oqvist, "Why Do U.S.-Listed Chinese Firms Go Private?" SSRN Working Paper, December 2012. http://ssrn.com/abstract=2186683

[39] Hart, Oliver, and John Moore, 1994, "A Theory of Debt Based on the Inalienability of Human Capital". *The Quarterly Journal of Economics* 109 (4). 841-879.

[40] Healy, Paul M., and Krishna G. Palepu, 1988, "Earnings Information Conveyed by Dividend Initiations and Omissions". *Journal of Financial Economics* 21 (2), 149-175.

[41] Hu, Aidong, and Praveen Kumar, 2004, "Managerial Entrenchment and Payout Policy". *Journal of Financial and Quantitative Analysis* 39 (4), 759-790.

[42] Iliev, Peter, 2010, "The Effect of SOX Section 404: Costs, Earnings Quality, and Stock Prices." *The Journal of Finance* 65 (3), 1163-1196.

[43] Jensen, Michael, 1986, "Agency Cost of Free Cash Flow, Corporate Finance, and Takeovers". *American Economic Review* 76 (2), 323-329.

[44] John, Kose, and Lubromir Litov, 2010, "Corporate Governance and Financing Policy: New Evidence". SSRN Working Paper, February 2010. http://papers.ssrn.com/sol3/papers.cfm?abstract_id=637341

[45] John, Kose, and Joseph Williams, 1985, "Dividends, Dilution, and Taxes: A Signalling Equilibrium". *The Journal of Finance* 40 (4), 1053-1070.

[46] Kothari, S.P., Leone, Andrew J., and Charles E. Wasley, 2005, "Performance Matched Discretionary Accrual Measures". *Journal of Accounting and Economics* 39 (1), 163-197.

[47] Kreps, David, and Robert Wilson, 1982, "Sequential Equilibria". *Econometrica* 50 (4), 863-894.

[48] Kreps, David, and Robert Wilson, 1982, "Reputation and Imperfect Information". *Journal of Economic Theory* 27 (2), 253-279.

[49] La Porta, Rafael, Lopez de Silanes, Florencio, Shleifer, Andrei, and Robert Vishny, 2000, "Agency Problems and Dividend Policies Around the World". *The Journal of Finance* 55 (1), 1-33.

[50] Lambrecht, Bart M., and Stewart C. Myers, 2012, "A Lintner Model of Payout and Managerial Rents". *The Journal of Finance* 67 (5), 1761-1810.

[51] Lee, Inmoo, Lochhead, Scott, Ritter, Jay, and Quanshi Zhao, 1996, "The Costs of Raising Capital". *The Journal of Financial Research* 19 (1), 59-74.

[52] Lintner, John, 1956, "Distribution of Incomes of Corporations Among Dividends, Retained Earnings, and Taxes". *The American Economic Review* 46 (2), 97-113.

[53] Lucas, Deborah J., and Robert L. McDonald, 1998, "Shareholder heterogeneity, adverse selection, and payout policy." *Journal of Financial and Quantitative Analysis* 33 (2), 233-253.

[54] Jones, Jennifer J., 1991, "Earnings Management During Import Relief Investigations". *Journal of Accounting Research* 29 (2), 193-228.

[55] Marsh, Terry A., and Robert C. Merton, 1986, "Dividend variability and variance bounds tests for the rationality of stock market prices." *The American Economic Review* 76, (3), 483-498.

[56] Michaely, Roni, and Michael R. Roberts, 2012, "Corporate Dividend Policies: Lessons from Private Firms". *Review of Financial Studies* 25 (3), 711-746.

[57] Michaely, Roni, Thaler, Richard H., and Kent L. Womack, 1995, "Price Reactions to Dividend Initiations and Omissions: Overreaction or Drift?" *The Journal of Finance* 50 (2), 573-608.

[58] Miller, Merton H., and Franco Modigliani, 1961, "Dividend Policy, Growth, and the Valuation of Shares". *The Journal of Business* 34, 411-433.

[59] Miller, Merton H., and Kevin Rock, 1985, "Dividend Policy Under Information Asymmetry". *The Journal of Finance* 40 (4), 1031-1051.

[60] Myers, Stewart C., 2000, "Outside Equity". The Journal of Finance 55 (3), 1005-1037.

[61] Newey, W., and K. West, 1987, "A Simple, Positive Definite, Heteroskedasticity and Autocorrelation Consistent Covariance Matrix". *Econometrica* 55, 703-708.

[62] Ofer, Aharon R., and Anjan V. Thakor, 1987, "A Theory of Stock Price Responses to Alternative Corporate Cash Disbursement Methods: Stock Repurchases and Dividends". *The Journal of Finance* 42 (2), 365-394.

[63] Petit, R. Richardson, 1972, "Dividend Announcements, Security Performance, and Capital Market Efficiency". *The Journal of Finance* 27 (5), 993-1007.

[64] Powers, Eric A., 2005, "Interpreting Logit Regressions with Interaction Terms: an Application to the Management Turnover Literature". *Journal of Corporate Finance* 11 (3), 504-522.

[65] Ross, Stephen A., 1977, "The Determination of Financial Structure: the Incentive-Signalling Approach". *The Bell Journal of Economics* 8 (1), 23-40.

[66] Rozeff, Michael S., 1982, "Growth, Beta and Agency Costs as Determinants of Dividend Payout Ratios". *Journal of Financial Research* 5 (3), 249-259.

[67] Skinner, Douglas J., 2008, "The Evolving Relation Between Earnings, Dividends, and Stock Repurchases". *Journal of Financial Economics* 87 (3), 582-609.

[68] Stephens, C.P., and Michael S. Weisbach, 1998, "Actual Share Repurchase Reacquisition in Open-Market Repurchase Programs". *The Journal of Finance* 53 (1), 313-333.

[69] Vermaelen, Theo, 1981, "Common Stock Repurchases and Market Signaling". *Journal of Financial Economics* 9 (2), 139-183.

[70] Zwiebel, Jeffrey, 1996, "Dynamic Capital Structure Under Managerial Entrenchment". *The American Economic Review* 86 (5), 1197-1215.

Chapter 3
A Theory of Efficient Short-termism

3.1 Introduction

As has been well documented, managers engage in both accounting and real earnings management in order to smooth reported earnings. Accounting earnings management involves the use of discretionary accruals, whereas real earnings management involves actual investment and financing decisions that are intended to boost short-term earnings at the expense of long-term value (e.g. Chen (2009)).[98] While much of the literature deals with accounting earnings management, evidence of the use of real earnings management has been documented in many papers (e.g. Burgstahler and Dichev (1997), Burgstahler and Eames (2006), and Zang (2011)). A prominent example of real earnings management is "corporate investment myopia", which is the practice of preferring lower-valued short-term projects over higher-valued long-term projects.[99] It has been argued that even inefficient short-term projects boost short-term earnings and lead to higher stock prices.[100] In this view, investment myopia is linked to the pressure that the stock market puts on managers to deliver immediate results, a practice that has been blamed for many ills, even being referred to as a danger to capitalism itself (e.g. Rappaport and Bogle (2011)). Many have suggested that reforming executive compensation can help to "curb" short-termism and thereby improve outcomes (e.g. Pozen (2014)). Yet, short-termism continues to be widely practiced (e.g. Narayanan (1985a), Lefley (1996), Pike (1996), and Chen (2009)).[101] Moreover, short-termism exhibits no correlation with firm performance, and does not appear to be used only by incompetent or unsophisticated managers (e.g. Graham and Harvey (2001)).[102]

[98]There is an extensive literature on earnings management. See, e.g., Beyer, Guttman, and Marinovic (2014), Fudenberg and Tirole (1995), Collins and Kothari (1989), Dechow, Ge, and Schrand (2010), and Dichev, Graham, Harvey, and Rajgopal (2013).

[99]In Dell's recent decision to go private, one of the reasons provided by some observers was that Dell could pursue more long-term-oriented investment strategies if it did not face the pressure from the stock market to deliver short-term results. Such concerns about the value-depleting pressure on public firms to deliver short-term results have been voiced in other contexts too. See, for example, in the spirit of the Bolton, Scheinkman, and Xiong (2006a) model, Polsky and Lund (2013) state: "First, short-termism could be the result of myopic shareholder preferences for current results...Second, short-termism could be the result of poorly-designed compensation arrangements." Bebchuk and Fried (2010) state: "...standard executive pay arrangements were leading executives to focus on the short term, motivating them to boost short-term results at the expense of long-term value. The crisis of 2008-09 has led to widespread recognition that pay arrangements that reward executives for short-term results can produce incentives to take excessive risks."

[100]For example, Stein (1989) states: "In an effort to mislead the market about their firms' worth, managers forsake good investments so as to boost current earnings." It has been suggested that firms also manipulate earnings to boost their stock prices through practices such as accounting gimmicks (e.g. Peng and Roell (2008)) or inefficient mergers (e.g. Graham, Harvey, and Rajgopal (2005)).

[101]Recently, evidence of short-termism has even been provided for private investments in cancer research—Budish, Roin, and Williams (2015) document that these investments are distored away from long-term projects.

[102]An example of short-termism is the frequent use of the payback criterion in capital budgeting. A project's payback period is the length of time it takes for project cash flows to add up to the initial investment. Graham

This paper challenges the notion that short-termism is inherently a misguided practice, and asks whether there is something economically valuable about short-termism in project choice that transcends the desire to engage in real earnings management to manipulate investor beliefs. In other words, can we expect short-termism to rationally be a robust (value-maximizing) practice in a wide range of circumstances? I highlight two main findings related to this question. First, there are circumstances in which the *owners* of the firm prefer short-term projects in the (constrained) second-best case, even though long-term projects have higher first-best values. There are other circumstances in which the firm's owners prefer long-term projects in the second best. Moreover, this is completely independent of any stock market inefficiencies or pressures. Thus, even though short-termism results in what appears to be real earnings management, this result stands in sharp contrast to earlier research in which short-termism incentives emanate from stock market frictions (e.g. Bolton, Scheinkman, and Xiong (2006a) and von Thadden (1995)). Second, it is the managers with career concerns who dislike short-term projects, even when the firm's owners prefer them. This is the *opposite* of the results in Narayanan (1985a,b) and Stein (1989), that managers like short-term projects even though the firm's owners prefer long-term projects. In this paper, managerial career concerns distort outcomes by inefficiently inclining them towards *long-term* horizons, and short-termism is a way to reduce this distortion.[103]

These results are derived in the context of a simple two-period model of internal governance and project choice in firms, with career concerns and moral hazard distorting managerial project choices in firms. There is a top executive (called a "CEO"). In the base version of the model, the CEO maximizes firm value.[104] Reporting to the CEO is a lower-level, divisional manager (referred to as "manager" henceforth) who requests funding for (and manages) projects in two time periods. The manager receives ideas for projects in each period with variable quality—they can be good (positive NPV) projects or bad (negative NPV) projects. The manager knows project quality, but the CEO does not. Regardless of quality, the project can be (observably) chosen to be short-term or long-term, and a long-term project has higher intrinsic value than the short-term project.[105] The probability of

and Harvey (2001) found that 56.7% of the firms in their survey almost always used payback; they note: "This is surprising given that financial textbooks have lamented the shortcomings of the payback criterion for decades". Pike's (1996) evidence that, during 1975-1992, 4-14% of companies in the U.K. used payback as their *only* capital budgeting criterion suggests that payback is decision-relevant. Anecdotal evidence, in the form of examples of CEOs making statements that they have well-understood guidelines in their firms about the maximum permissible project payback periods, are also consistent with this.

[103]Moreover, unlike in Holmstrom (1999), where career concerns reduce agency costs, in my model they increase agency costs.

[104]The idea here is that executive compensation is designed to align the CEO's interest with that of the shareholders. In a generalized version of this preference function, the CEO also cares about the utility of a manager who reports to her, which introduces an additional agency problem.

[105]One can think about the long-term and short-term projects concretely through examples. Within each firm, there are typically both short-term and long-term projects. For example, for an appliance manufacturer, investing in modifying some feature of an existing appliance, say the size of the freezer section in a refrigerator, would be a short-term project. By contrast, building a plant to make an entirely new product—say a high-technology blender that does not exist in the company's existing product portfolio—would be a long-term project. The long-term project will have a longer gestation period, with not only a longer time to recover the initial investment through project cash flows, but also a longer time to resolve the uncertainty about whether the project has positive NPV in an *ex post* sense. There may also be industry differences that

success for any good project depends on the manager's ability, which is *ex ante* unknown to everybody.

In the first-best case, the manager requests funding only for the long-term version of a good project. However, when the manager has private information about project quality that the CEO does not have, the manager may request funding for a bad project by misrepresenting it as a good project because he enjoys private benefits from investing in projects.[106] These private benefits can be thought of as quasi-rents earned by the manager in the perquisites-consumption framework of Jensen and Meckling (1976).

Now consider the manager's choice problem. In the second period, the manager always proposes a short-term project because no long-term projects are available with only one period left. In the first period, the manager does have a choice. But if he gets a bad project, he prefers to nonetheless request funding, and do this for the long-term version of the project. If such a project is approved, then the manager enjoys the private benefit from investing in the first period. Moreover, because nothing is revealed about his ability at the end of the first period, he is also able to obtain funding for his second-period project and enjoy that private benefit too. So, even a manager who invests in a bad first-period project can enjoy private benefits in both periods, as long as the project is long-term.[107] Put differently, by investing in a short-term project that reveals early information about managerial ability, the manager gives the firm (top management) the *option* of whether or not to give him a second-period project with managerial private benefits linked to it, whereas with the long-term project the manager keeps this option for himself. The option has value to the firm and to the divisional manager. Thus, the manager prefers to retain the option rather than surrendering it to the firm. I call this the "incentive problem".

The CEO recognizes the manager's incentive, and thus realizes that bad projects may get funded in the first period. The CEO may thus impose a requirement that any project that is funded in the first period must be a *short-term* project. This "institutionalizes" real earnings management and makes investing in a bad project in the first period more costly for the manager because adverse information is more likely to be revealed early about the project and hence about managerial ability, with a loss of his second-period private benefit. The manager's response may be to not request first-period funding if he has only a bad project. Such short-termism generates another benefit to the firm in that it speeds up learning about the manager's *a priori* unknown ability, permitting the firm to condition its second-period investment on this learning. I refer to this as the "learning problem".

I show that there are circumstances in which, because of the benefit of short-termism in resolving the incentive and learning problems, the firm's owners will wish to insist on projects whose cash flows reveal information early rather than late, and a CEO may stipulate that only short-term projects will be approved. In a practical sense, one way for a firm to practice this type of real earnings management is by stipulating a maximum acceptable payback period

determine project duration. For example, long-distance telecom companies (e.g. AT&T) will typically have long-duration projects, whereas consumer electronics firms will have short-duration projects.

[106]There are many papers that assume managers enjoy private benefits from certain projects, and have an incentive to over-invest because of the private benefits. For example, see Aghion and Bolton (1992), Harris and Raviv (1996), and Stulz (1990). Stein (2003) provides an excellent review.

[107]Of course, a long-term bad project will convey unfavorable information about managerial ability at the end of the second period, but the manager does not care about that because it is the end of the game.

for project approval. This results in only short-term good projects being selected in the first period, and firm value goes up even though the short-term good project has lower value (in the first-best case) than the long-term good project. The analysis also implies that not all firms will practice short-termism. With general preferences, firms in which CEOs care about both firm value and managerial utility but put relatively low weights on firm value, or firms in which the gap in value between the long-term and short-term project is very large, will prefer long-term project, so not all firms will display short-termism. Even though such firms will suffer from larger agency problems, their long-term projects may be sufficiently more valuable than the short-term projects of firms that practice short-termism, and thus there may be little correlation between short-termism and firm value in the cross-section. By the same token, it is possible to find short-termism being associated with either better or worse firm performance. Thus, tests of the predictions of the theory developed here need to focus on dimensions other than cross-sectional differences in firm performance; these issues are discussed in Section 3.4.

I compare capital budgeting short-termism to contracting on managerial private benefits as a solution to the incentive problem. Because wage contracting can resolve the incentive problem (at a cost), but does not produce the learning benefit of short-termism, the analysis reveals insights about when firms will rely on short-termism and when they will rely on contracting on private benefits. Since *both* the learning and incentive problems are resolved by short-termism, firms may choose short-termism if *either* of these two problems is present. Thus, even in well-performing firms known to have high-ability managers—where the learning problem is of minimal importance—short-termism will be used to resolve incentive problems.

Since short-termism is intended to prevent lower-level managers from investing in bad projects, its use should be greater for managers who typically propose "routine" or less important projects and less for top managers (like the CEO) who would typically be involved in strategic projects.[108] Although the analysis is conducted with managerial risk neutrality and private benefits, I discuss the effect of replacing private benefits with managerial risk aversion and the limitations of this approach in explaining the collection of stylized facts the model explains.

The analysis assumes that the manager's wage in any period is paid at the start of the period. I examine what would happen if payoff-contingent wage contracting was permitted. I characterize the conditions under which one would still encounter short-termism, but observe that payoff-contingent contracting reduces the attractiveness of short-termism. I then extend the model to allow for the influences of other employees (besides the manager) on the performance of the project, and assume that the CEO observes these influences but the manager does not. This kind of ex post asymmetric information makes payoff-contingent wages for the manager infeasible because the CEO has an incentive to act strategically.

[108]By "routine" projects, I mean projects that are less strategic and are on a smaller scale—essentially projects that would affect overall firm value less than strategic projects that influence the firm's business portfolio mix. Some might argue that learning about managerial ability is not much of a concern for routine projects, so one should expect little need for payback. However, routine projects are typically analyzed by managers who subsequently get promoted and are replaced by managers with unknown abilities, and even routine projects may have payoff distributions that depend on managerial ability. Moreover, even if the learning benefit of payback was absent, the firm may still want to use a payback constraint to deal with the incentive problem.

Short-termism thus resurfaces as a result. Since the problem of isolating an individual employee's impact on a project payoff is greater at lower levels of the hierarchy, this suggests that the firm is more likely to impose a short-termism constraint on lower-level managers.

Overall, the most robust result from this analysis is that informational frictions bias the investment horizons of firms without any discounting-related time horizon effects (e.g. such as those in Laibson (1997)), and that the bias towards short-termism may, in fact, be value-maximizing in the presence of such frictions. This means that the shareholders may demand real earnings management because it increases the value of the firm, so the castigating of short-termism as well as the rush to regulate CEO compensation to reduce its emphasis on the short term may be worth re-examining. Indeed, *not* engaging in short-termism may signal an inability or unwillingness on the CEO's part to resolve intrafirm agency problems and thus adversely affect the firm's stock price. This is not to suggest that short-termism is necessarily always a value-maximizing practice, since some of it may be undertaken only to boost the firm's stock price. The point of this paper is simply that some short-termism reduces agency costs and benefits the shareholders.

The remainder of the paper is organized as follows. Section 3.2 develops the model. Section 3.3 contains the analysis. Section 3.4 discusses the robustness of the results to relaxing key assumptions, including allowing payoff-contingent wage contracting, and the addition of more time periods which may generate a potential "horizon effect" in project choice. This section also discusses empirical implications. The related literature is discussed in Section 3.5. The paper is concluded in Section 3.6. All proofs are included in the Appendix.

3.2 The Model

In this section, the model is described. This section begins by describing the main players in the game and their preferences. It then describes the projects and the order in which events occur. This is followed by a description of who knows and does what, and when. The nature of the moral hazard and internal governance are described next. The section ends with a summary of the main assumptions and the time line.

3.2.1 Agents and Preferences

Consider a publicly-traded firm with a manager at the top, called the Chief Executive Officer (the "CEO") and a lower-level divisional manager (the "manager") reporting to him. There may be, say, $n > 1$ such managers who all report to the CEO, but the analysis will focus on a representative manager. For simplicity, the firm is financed entirely with equity.

All players are assumed to be risk neutral, and for simplicity the risk-free interest rate is normalized to zero. The CEO's job is to design the capital budgeting system, which includes the rules by which capital is allocated for projects. The manager's job is to search for project ideas and request capital from the CEO for positive net present value (NPV) projects. The manager enjoys private benefits from investing in projects, i.e., he likes "empire building".[109]

[109] This is related to the "free cash flow" problem proposed by Jensen (1986), and it has been studied

Let $\beta \in (0, 1)$ be the additional utility that the manager derives from investing in any project. This is a private benefit that does not produce any benefit for the firm's shareholders.[110] The preferences of the CEO and the manager are described later. For now, it is useful to note that the manager cares about his wages and private benefits, and the CEO cares about firm value and the manager's welfare (utility). It is also assumed that the manager is penniless, i.e., lacks the financial resources to buy out the firm or the project from the shareholders. This ensures separation of ownership and control.

The manager has some skill that is unknown to all at the beginning. However, because this skill can affect project cash flows (this is described later in this section), beliefs about the manager's skill will be revised on the basis of observed cash flows. It is assumed that there are two types of managers: Talented (T) and Untalented (U). Let θ_t be the commonly-assigned probability at date t that the manager is type T. Then, the prior probabilities attached to the manager's skill (talent) at $t = 0$, which are common knowledge, and represented by: $\Pr(\text{type} = T) = \theta_0 \in (0, 1)$, and $\Pr(\text{type} = U) = 1 - \theta_0$. That is, it is assumed that the manager does not know his own type and there are common prior beliefs about this type.[111]

3.2.2 Sequence of Events and Projects

There are three dates in the model ($t = 0$, $t = 1$, and $t = 2$) and thus two time periods, the first period ($t = 0$ to $t = 1$) and the second period ($t = 1$ to $t = 2$). Projects available to the manager differ in two dimensions: their value (NPV) and their cash-flow duration (or payback). This produces four types of projects that will be described below. A project in any period needs an initial \$1 investment that the manager must request from the CEO, so the firm will need \$2 if it invests in projects in both period. This investment will be financed by the firm with an equity issue at $t = 0$. The firm has assets in place that will yield a sure payoff of $A = \bar{A} > 0$ at $t = 2$.

On the value dimension, a project can be good (G) or bad (B). A G project has positive NPV, and a B project has negative NPV. On the duration dimension, a project can be long-term (L) or short-term (S). An L project requires an investment at $t = 0$ and delivers its cash flow at $t = 2$. An S project requires an investment at $t = 0$ and delivers its cash flow at $t = 1$ (or alternatively it may require an investment at $t = 1$, and deliver its cash flow at $t = 2$). This means that in the first period the manager can invest in either an L or an S project, but in the second period only S projects are available.

A good, long-term project (call it L_G) pays off $R_L > 1$ with probability 1 at $t = 2$ if the manager is of type T, but it pays off R_L with probability $q \in (0, 1)$ and 0 with probability

in various contexts in many papers, e.g. Aghion and Bolton (1992), and Harris and Raviv (1996). One interpretation of this assumption is in the spirit of the perquisites-consumption assumption in Jensen and Meckling (1976). Being in control of a bigger asset base allows the manager to consume more perquisites. This is also similar to "managerial entrenchment", as described by Shleifer and Vishny (1989).

[110] In other words, the shareholders do not adjust the manager's wage downward when he invests to account for the private benefit he enjoys from investing. While this is not formally justified within the analysis, there are many reasons why real-world wage contracts may not have such features. The main reason is that it can create strong incentives to not invest (e.g. Holmstrom and Ricart i Costa (1986)).

[111] This is similar to Holmstrom and Ricart i Costa (1986) and it avoids signaling complications that can arise if the manager knows more about his own type than do others.

$1-q$ at $t=2$ if the manager is of type U. If investment occurs at $t=0$, a good, short-term project (call it S_G) pays off $R_S > 1$ with probability 1 at $t=1$ if the manager is of type T, but it pays off R_S with probability q and 0 with probability $1-q$ at $t=1$ if the manager is of type U. The short-term project has the same type-dependent payoff distribution at $t=2$ if investment occurs at $t=1$.

A bad, long-term project (call it L_B) pays off 0 with probability 1, regardless of the manager's type. Similarly, a bad, short-term project (call it S_B) pays off 0 with probability 1, irrespective of the manager's type.

Table 3-1 summarizes the type-dependent payoff distributions of projects:

[Table 3-1 Here]

Regardless of project type, the manager enjoys a utility of β if investment occurs in any period. Project availability is stochastic. It is assumed that, regardless of the manager's type, the probability that the manager will receive a G project idea in any period is $p \in (0,1)$. The manager almost surely (with probability 1) has access to a B project in any period. Moreover, once he receives a project idea, it can be structured as either a long-payback (L) project or a short-payback (S) project.

Some restrictions on the exogenous parameters are now presented so that the analysis can focus on the main cases of interest:

$$R_L > 1. \tag{1}$$

This means that L_G is a positive-NPV (socially efficient) project when run by a talented (T) manager. Further:

$$\beta + qR_L < 1. \tag{2}$$

This means that an L_G project is both negative-NPV (since $qR_L < 1$) and socially inefficient (since $\beta + qR_L < 1$) when run by a type-U manager. It also follows that:

$$1 < R_S < R_L. \tag{3}$$

This means that the S_G project has positive NPV (and is socially efficient), but it has lower value than the L_G project. Define $\triangle \equiv R_L - R_S$ as the difference in values of the L_G and S_G projects. The expected value of $\triangle$, evaluated at the prior beliefs about the manager's type, is $\bar{\triangle}_0 \equiv \theta_0 [R_L - R_S] + [1-\theta_0]\, q\, [R_L - R_S]$. From (2) and (3), it follows that:

$$\beta + qR_S < 1. \tag{4}$$

So, the S_G project is socially inefficient and has negative NPV when run by a type-U manager. The L_B project gives a total payoff of β (since the payoff of the B project is 0 with probability 1, but the manager also receives a private benefit β) has negative NPV (the project payoff is 0) and is socially inefficient (since $\beta < 1$). It also directly follows that the S_B project also has negative NPV and is socially inefficient. Finally, it is assumed that:

$$\theta_0 R_L + (1-\theta_0) qR_L > 1, \tag{5}$$

$$\theta_0 R_S + (1 - \theta_0) q R_S > 1, \tag{6}$$

and

$$p\{\theta_0 R_S + (1 - \theta_0) q R_S\} > 1. \tag{7}$$

Inequalities (5) and (6) are assumed since, if these did not hold, the CEO would never approve any project that the manager proposed at the beginning (with prior beliefs about type). Inequality (7) is assumed since, without it, a CEO who puts enough weight on firm value would not approve any project at $t = 1$ if an L project was started at $t = 0$ (since with an L project, θ_1, the posterior belief at $t = 1$ that the manager is type T, equals the prior belief at $t = 0$, θ_0).

In the first period, the manager requests \$1 in funding from the CEO if he wishes to invest in a project. If capital is given, then the project yields a (possibly random) payoff at $t = 1$ if it is a short-term project. Based on this, beliefs are revised from θ_0 to θ_1. If it was a long-term project, then nothing is observed at $t = 1$, so $\theta_0 = \theta_1$. The manager then requests funding for his second-period project. The game ends at $t = 2$.

3.2.3 What the Players Know and Do, and When

The manager knows the value of the project (G or B) for which he is requesting funding, as well as whether it is short-term (S) or long-term (L). The CEO can observe whether the project is S or L, but not the value (G or B). As in Holmstrom and Ricart i Costa (1986) and Holmstrom (1999), it is assumed that the manager is paid his wage at the beginning of the period. So he is paid a first-period wage of w_0 at $t = 0$, and a second-period wage of $\tilde{w}_1$(which is random) at $t = 1$. The second-period wage is random because the perception of the manager's skill at $t = 1$ generally depends on the project cash flow at $t = 1$, and this cash flow is random. Let w_1^+ be the manager's wage if the first-period project has a positive cash flow and the posterior belief that he is type T is therefore higher than the prior belief, and let it be w_1^- if the first-period cash flow is zero and this posterior belief is therefore lower than the prior belief. It is thus the case that $w_1^+ > w_1^-$. A wage is paid in any given period regardless of whether there is investment in a project in that period.

Now let w^T be the wage of a manager of type T and w^U be the wage of a manager of type U; also set $w^U \equiv 0$ without loss of generality. As in Holmstrom and Ricart i Costa (1986) and Holmstrom (1999), assume that wages are increasing in perceived managerial talent, and for simplicity assume that wages are linear in perceived managerial talent. Let $\theta_1^+ \equiv \Pr(\text{manager's type is } T \mid \text{success at } t = 1)$ and $\theta_1^- \equiv \Pr(\text{manager's type is } T \mid \text{failure at } t = 1)$. We then have that:

$$w_0 = \theta_0 w^T + (1 - \theta_0) w^U = \theta_0 w^T, \tag{8}$$

$$w_1^+ = \theta_1^+ w^T + (1 - \theta_1^+) w^U = \theta_1^+ w^T, \tag{9}$$

and

$$w_1^- = \theta_1^- w^T + (1 - \theta_1^-) w^U = \theta_1^- w^T. \tag{10}$$

Hence, the actual wage is a convex combination of the wages of the type-T and type-

U managers, and is dependent on the prior and posterior beliefs of the respective types. w^T and w^U can be viewed as the reservation wages of talented and untalented managers, respectively, and similarly w_0, w_1^+, and w_1^- can be viewed as the reservation wages conditional on the labor market's beliefs about the manager's type at $t = 0$ and $t = 1$. All wages, as well as whether the firm has adopted a short-termism restriction on project choice, are publicly observable at $t = 0$ before external financing is raised. Since wages are based on publicly-available outcomes, the CEO effectively has no control over the manager's wage; it is market-determined in the base model in which there is no adverse selection in the labor market.

3.2.4 The Utilities of the Players

For the core results of the model, assume that the CEO maximizes firm value. A more general specification is one in which the CEO maximizes the following utility function:

$$U_{CEO} = \alpha_1(firm\,value) + \alpha_2 U_M, \tag{11}$$

where U_M is the utility of the manager, and α_1 and α_2 are positive exogenous weights. The value-maximizing preference is a special case with $\alpha_2 = 0$. The inclusion of the manager's utility in (11) could reflect a variety of considerations, such as cronyism within the firm, internal politics, and alliances.[112] The idea is that in general a CEO will not necessarily be indifferent to the welfare of subordinates. This concern need not be altruistic—it may simply represent a practical concession to the need to build an effective working relationship.

Let $\omega \equiv \frac{\alpha_2}{\alpha_1}$. The parameter ω has numerous possible interpretations. One is that it represents the degree of ownership of the firm by the CEO—the larger the degree of ownership, the lower is ω. Another interpretation is that the higher the value of ω, the worse the internal governance in the firm, leading to lower firm value.

The manager maximizes the following utility function:

$$U_M = w_0 + \mathbb{E}\left(\tilde{w}_1\right) + \sum_{t=0}^{1} \beta_t \mathbf{1}_{\{x=1\},t}(x), \tag{12}$$

where w_0 is the manager's wage at $t = 0$, $\mathbb{E}\left(\tilde{w}_1\right)$ is the expected value of the manager's wage at $t = 1$, and $\mathbf{1}_{\{x=1\},t}(x)$ is the indicator function at date t, where $x = 1$ if the manager invests and $x = 0$ if the manager does not invest. β_t is the manager's private benefit at time $t = 0$ and $t = 1$, and $\beta_t = \beta$ $\forall t$. Thus, the manager aims to maximize his expected wage at $t = 1$, given that he receives a private benefit for investing in a project.

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[112]It may also reflect a common emotional disposition called "avoidance of unfavorable occasions"; see Elster (1998) for a discussion. It says that human beings have a dislike for getting into situations that they anticipate will trigger negative emotions. Having to say no to a direct report who requests funding for a long-term project and thereby creating a confrontational situation is one example. A simple way to capture the effect of avoidance of unfavorable occasions is to put some weight on the manager's welfare in the CEO's utility. Of course, it is also possible that the reason the CEO puts weight on the manager's utility is her own preferences is that the manager is a protege of the CEO and makes the CEO genuinely care about the well-being of the manager as a fellow employee.

3.2.5 The Nature of Moral Hazard and Internal Governance

The moral hazard in this model arises from the manager's over-investment incentives due to his private benefits, and the fact that the manager has private information regarding the quality of the projects. Since he receives a private benefit β from investing in a project, he has an incentive to invest in *any* project, regardless of its benefit to the firm. This gives the manager an incentive to invest in a negative-NPV project if a good project is unavailable. However, investing in a short-term project carries a danger for the manager: it may produce a poor outcome at $t = 1$, lowering perception of the manager's ability and hence his second-period wage. A longer-term project does not reveal the manager's ability before the terminal date, and therefore insures the manager against a possible downward revision in the perception of his ability. Of course, since beliefs form a martingale (with Bayesian revision), the *expected value* of the manager's posterior ability is the same as the prior value. Hence, possible future upward and downward wage revisions associated with revisions in managerial ability will not affect the risk neutral manager's ex ante choices because his expected future wage will be the same as his current wage (which corresponds to the prior belief about his ability). This is where his private benefits—in addition to his wages—come into play, as will be explained later.

The internal governance mechanism comes from the CEO's ability to approve projects. Given that the CEO knows that the manager has private information regarding project quality and an incentive to invest in long-term projects, even if they are bad projects, the CEO can enforce an internal governance mechanism that conditions project approval on project duration.

3.2.6 Summary of Assumptions and Timeline

The following is a summary of the key assumptions:

A1. (*Private Benefits*) The manager has a private benefit associated with investing in any project, but lacks the financial resources to buy out the project from the firm.

A2. (*Observability*) The project duration (its payback) is observable by both the manager and the CEO, but the project quality is only observable to the manager. Regardless of project quality, the long-term project has higher value than the short-term project.

A3. (*Managerial Types*) The type of the manager (Talented or Untalented) is not known by either the CEO or the manager, and is inferred from project outcomes. This assumption is modified later to permit the manager to know more about his type than others.

A4. (*Non-appropriability*) All of the NPV from a project cannot be given to the manager. The firm always appropriates some of the project rents. In other words, the agency problem (due to the fact that the manager only gets a part of the rent) cannot be eliminated.

Assumption A2 that the long-term project has a higher (first-best) value than the short-term project may not be true in practice for all projects in the firm. If the short-term project has a higher first-best value, then short-termism arises trivially from the specified project technology. The interesting situation is when the long-term project has higher first-best value, so some efficiency is sacrificed in the practice of short-termism. The crucial defining attribute that separates a long-term project from a short-term project is that information about the value of the former is released more slowly over time. In the model, the only signal of project value is its cash flow, so it is the timing of the cash flow that determines the speed of information revelation. This is often the case with real-world projects. It is only when one begins to observe realized cash flows that one is able to update pre-investment beliefs about project value.

Figure 3-1 summarizes the main actions and events that are possible at each point in time:

[Figure 3-1 Here]

3.3 Analysis of the Base Model

In this section, I analyze the base model and its implications. Section 3.3.1 contains an analysis of the first-best case. Section 3.3.2 describes the second-best case. Section 3.3.3 examines whether imposing a short-termism constraint to force early revelation of information can improve firm value. Section 3.3.4 compares the efficiency of approving only short-term projects to that of the contracting regime in which contracts can be explicitly written on managerial private benefits. The section ends with a discussion of how short-termism modeled here may interact with real earnings management.

3.3.1 First-Best Case

In the first-best case, with shareholders and the CEO being able to observe project choice and project payoff, the CEO can observe the manager's project choice. The "first-best" refers to any choice that maximizes the value of the firm because shareholders can dictate this choice. In this case, the manager will request funding from the CEO only if he receives a good project. The CEO will then accept the project, so the manager will receive funding for it.

Whether the first-best project at $t = 0$ is the L or the S version of the G project requires some discussion. On the one hand, L has a higher value since $R_L > R_S$. But on the other hand, by investing S, the firm can make a second-period investment decision at $t = 1$ that is conditional on what is learned about managerial ability based on the first-period outcome. It will be shown that the posterior belief on managerial ability will be high enough conditional on success at $t = 1$ to guarantee second-period funding for the manager, and low enough conditional on failure at $t = 1$ to guarantee denial of second-period funding if the CEO puts sufficiently high weight on firm value (ω is low). Since the prior probability of success for a type G project is $\theta_0 + (1 - \theta_0)q$ (where θ_0 is the probability that the manager is T and succeeds almost surely, and $1 - \theta_0$ is the probability that the manager is U and succeeds with probability q), a conditional investment policy results in second-period investment with probability $\theta_0 + (1 - \theta_0)q$, whereas an unconditional policy (associated with investing in L at $t = 0$) results in second-period investment with probability 1.

This means that, conditional on having a G project at $t = 0$, the condition for L to be the value-maximizing choice in the first-best case is:

$$\bar{\triangle}_0 + p(1 - \theta_0)[1 - q]qR_S \geq p\,[1 - \theta_0]\,[1 - q], \tag{13}$$

recalling that $\bar{\triangle}_0 \equiv \theta_0\,[R_L - R_S] + [1 - \theta_0]\,q\,[R_L - R_S]$. In (13), the left-hand side represents the amount by which the expected value of L exceeds that of S, plus the expected value of the second-period short (S) project, qR_S, that is available with an untalented manager (probability $1 - \theta_0$) who receives a G project idea (probability p) but fails with a short-term project in the first period (probability $1 - q$). This follows since investment in the second period is always available with a long-term investment in the first period (because nothing is revealed about the manager's ability), but *not* with a short-term investment in the first period that fails. The right-hand side is the expected saving in second-period investment due to the conditional (second-period) investment associated with choosing S in the first period rather than the unconditional investment associated with choosing L in the first period, accounting for the probability of receiving a G project. Since only the incentive problem is eliminated in the first-best, the learning benefit of the short-payback project remains, so (13) essentially says that the relative gain in intrinsic value from L exceeds the relative learning benefit of S (the right-hand side of (13)).[113] The following assumption (stronger than (13)) will be assumed to hold throughout:

$$\bar{\triangle}_0 + p(1 - \theta_0)[1 - q]qR_S \geq p\,[1 - \theta_0]\,[1 - q] + 2\beta, \tag{14}$$

which is sufficient for the first-best to be socially efficient. The following result can now be proved.

Lemma 1: *In the first-best case, at* $t = 0$*, the manager requests funding only if a* G *project arrives. In this case, assuming that* (14) *holds, the manager proposes only* L_G *and he receives funding for it.*

Now at $t = 1$, there is only one period left, so the manager can propose only an S project. He will thus only request funding in the first-best case if it is G.

Lemma 2: *In the first-best case, at* $t = 1$ *the manager requests funding only if he finds an* S_G *project.*

[113]The condition for L to be the socially efficient choice is $\{\theta_0 + (1 - \theta_0)q\}(R_L - R_S) + p[(1 - \theta_0)(1 - q)qR_S + p\beta(1 - \theta_0 - (1 - \theta_0)q)] \geq p[1 - \theta_0 - (1 - \theta_0)q]$.

In the next subsection, the second-best case will be analyzed in which the manager's self-interest will affect his project choice.

3.3.2 Second-Best Case

The second-best case refers to the case in which the shareholders delegate project approval to the CEO (because they cannot directly control the internal project choice and approval process) and the CEO can observe whether it is an L or an S version of the project being proposed by the manager, but not whether it is G or B. To analyze the second-best case in the model, I proceed using backward induction from the second period to the first. At $t = 1$, there are two scenarios in the second-best case:

1. The manager receives a G project. He proposes S_G and gains utility $\tilde{w}_1 + \beta$, where $\tilde{w}_1$ is his wage at $t = 1$, which depends on the outcome at $t = 1$.

2. The manager does not receive a G project. If he does not propose a project, his utility is $\tilde{w}_1$. If he proposes an S_B project and it is accepted, his utility is $\tilde{w}_1 + \beta$.

Thus, the manager will propose S_G if it is available, or S_B if it is not (he has no incentive to propose S_B if he has S_G). While the manager will always prefer to seek funding because of the private benefit he receives, whether the manager gets funding or not at $t = 1$ depends on θ_1, the posterior belief about the manager's type, and hence the expected payoff of the project as viewed by the CEO (given that the CEO cannot see whether he received a G project or not). We can thus derive the following result:

Lemma 3: *In the second period (at $t = 1$), the manager will always propose a project as an S project regardless of its quality (G or B). The funding policy that maximizes firm value is as follows. If the manager invests in L at $t = 0$, he gets funding for sure at $t = 1$. Assuming that the manager's equilibrium strategy is to invest in S_G (but never S_B) at $t = 0$ if he chooses S, then the policy that maximizes firm value is to give a manager who invests in S at $t = 0$ the requested additional funding at $t = 1$ if his first period project succeeds but to deny additional funding if his first period project fails (the project payoff is 0). A CEO who maximizes firm value (or with a sufficiently low ω) will follow this policy. A CEO with a sufficiently high ω will provide the manager unconditional funding at $t = 0$ and $t = 1$.*

The economic intuition can be seen as follows. If the manager invests in L at $t = 0$, there is no revelation of information about his type at $t = 1$, so the belief about his type stays at its prior value and the value-maximizing policy is to give the manager additional funding at $t = 1$ (since he received funding at $t = 0$ with prior beliefs about his type). If he invests in S at $t = 0$, then given the equilibrium strategy of choosing S_G, the CEO's posterior probability that the manager is type T is higher than the prior probability if there is success at $t = 1$, and that this posterior is lower than the prior if there is failure at $t = 1$. Thus, the value-maximizing policy is to give the manager additional funding at $t = 1$ following success. Failure lowers the posterior belief about the manager's type so much that the NPV of letting him manage a second-period project is negative, so the value-maximizing policy is to deny him funding. It is straightforward to see that a CEO with a low enough ω will do what maximizes firm value. However, the firm's owners will face moral hazard in the form of a distorted investment policy if the CEO has a high ω that aligns her with what the manager wants.

I now analyze what happens at $t = 0$, and focus on deriving the conditions under which, in the first period, the manager chooses only G. First, suppose the CEO funds both L and S projects. Will the manager propose S or L?

Proposition 1: *At $t = 0$, the manager always proposes an L project, regardless of whether the project is G or B.*

The economic intuition is that with a short-term project, there is a possibility that the project might fail at $t = 1$ even if it is G (since the manager does not know his own type), in which case the manager will not get a second project with its associated private benefit if the CEO has a low ω. If the CEO has a high ω, the manager is guaranteed funding, so he will choose L at $t = 0$ because it has higher value with G and the same values as S with B. Therefore, the manager prefers the long-term project at $t = 0$ in all circumstances.

The manager also prefers proposing a long-term project to proposing no project because of the private benefit associated with running a project. Of course, if the project is B, then proposing S_B is even worse since it would pay off zero with probability one in the next period, and his wage would be revised downward almost surely. This is avoided with the long-term project.

Thus, regardless of the kind of project the manager has at $t = 0$, he will always want to invest and structure the project as a long-term project. Furthermore, from Lemma 3, at $t = 1$, the manager will always request funding for a short-term project regardless of its quality, and he will receive funding since he invested in a long-term project at $t = 0$.

One way to see the combined intuition for these results is to note that the manager cares about both his wages and his private benefits. If we limit the manager to only his wages, then he would be indifferent between structuring a good project as either a short-term (S) or a long-term (L) project because beliefs form a martingale and the expected value of his future wages would be the same regardless of whether the project is short-term or long-term. But the introduction of private benefits creates an asymmetry.[114] An upward revision in managerial ability at the interim date due to revealed project success assures the manager of a private benefit in the second period, but so does *no* revelation of ability at the interim date (which is achieved with the long-term project). By contrast, a short-term project may cause a downward revision of ability and loss of his private benefit. That is, investing in a short-term project is equivalent to the manager writing an option on his human capital and private benefit and giving it to the firm. This option is valuable to the firm because it can allow it to condition its second-period investment decision on revealed managerial ability at the end of the first period, and hence avoid investing in a second-period project with a negative NPV. But giving the firm this option is also costly to the manager because by exercising the option, the firm can deny him his second-period private benefit in one state. Investing in a long-term project denies the firm this option and guarantees second-period private benefit to the manager almost surely. Note that the option is worthless to the firm in

[114]That is, the incentive problem arises because wages form a martingale but investment does not, and managerial private benefits are linked to whether investment occurs.

the first-best case because the manager's ability is known in that case, so nothing is gained by investing in a short-term project to learn about this ability, and the firm would therefore prefer to invest in the higher-valued long-term project in the first period and then a short-term project in the second period. So the real value of the option to the firm and its cost to the manager both come from the same thing—interim learning about managerial ability.

3.3.3 Can the Shareholders Do Better by Imposing a Short-termism Constraint?

Given the self-interested behavior of the manager described in the previous sub-section, an important question that arises is whether firm value can be improved by constraining the manager's choice through the capital budgeting system. Since the inefficiency is created by the manager always choosing a long-term project to defer detection of his choice of a bad project (as well as early revelation of information about his type), a natural capital-budgeting restriction to consider is a requirement that the project duration be no more than one period. This may discipline managers and reduce project-selection inefficiency, as the following analysis confirms.

Lemma 4: *Suppose that L projects are banned, and the second-period funding policy maximizes firm value. Then, the manager will only propose an S project at $t = 0$ if he receives a G project.*

This lemma states that a constraint that no long-term projects be proposed improves project choice efficiency. The next proposition shows that this kind of constraint may be used by the firm. Before getting to that, the following expressions are useful.

If the V firm approves a short-term project proposed by the manager and follows a policy that maximizes firm value, then its total expected (fundamental) value is given by:

$$\begin{aligned} \bar{V}_S &= \bar{A} + p\left\{\theta_0\left[R_S + pR_S\right] + \left[1-\theta_0\right]q\left[R_S + pqR_S\right]\right\} \\ &\quad + [1-p]p\left[\theta_0 + q\left[1-\theta_0\right]\right]R_S + \left\{p\left[1-\theta_0\right]\left[1-q\right] + \left[1-p\right]\right\}\{1\} - 2w_0. \end{aligned} \quad (15)$$

To interpret (15), note that the first term is simply the value of assets in place. Consider the second term: $p\left\{\theta_0\left[R_S + pR_S\right] + \left[1-\theta_0\right]q\left[R_S + pqR_S\right]\right\}$. Here p is the probability that the divisional manager will have a G project. If the manager is type T (probability θ_0), then the first-period project pays off R_S with probability 1, a G project arrives with probability p in the second period and pays off R_S with probability 1. This explains the first term inside the braces, $\theta_0\left[R_S + pR_S\right]$. If the manager is type U (probability $1-\theta_0$), then the probability is q that the first-period project pays off R_S, and second-period funding is available only if the first-period project succeeds (Lemma 3) and investment in G in the second-period occurs in this case only if G arrives (probability p). This explains the term $\left[1-\theta_0\right]q\left[R_S + pqR_S\right]$ in the braces. Now consider the second term $[1-p]p\left[\theta_0 + q\left[1-\theta_0\right]\right]R_S$. When a G project does not arrive in the first period (probability $1-p$), the manager will not request project funding, so there is no first-period cash flow (Lemma 4). But if a G project arrives in the second period (probability p), then the expected payoff is R_S if the manager is type T (probability

θ_0) and qR_S if the manager is type U (probability $1-\theta_0$). The second-last term in (15) is merely the probability that \$1 will remain idle due to no investment in either the first or the second period (note that with a short-term project an investment occurs in the first period only if a G project arrives). With probability p, a G project arrives in the first period and investment occurs, but the manager is type U (probability $1-\theta_0$) and his first-period project fails (probability $1-q$), so there is no second-period funding, resulting in \$1 being idle in the second period; with probability $1-p$ the G project did not arrive in the first period, so the manager did not request first-period funding and \$1 stayed idle in the first-period, but then second-period funding occurred with probability 1. This probability is multiplied with \$1, the amount that stays idle. Note that the probability that the entire \$2 raised at $t=0$ will remain idle is zero, since the second-period project is funded with probability one if no investment occurs in the first period. The last term in (15) is the total expected wage paid to the manager over two periods. The manager's first-period wage is clearly w_0, and since wages are paid regardless of whether investment occurs, we need to calculate his *expected* second-period wage, which is also w_0 because beliefs form a martingale.

Now, if the firm approves a long-term project in the first period and follows a value-maximizing policy, then its total fundamental value is given by:

$$\begin{aligned}\bar{V}_L &= \bar{A}+p\{\theta_0 R_L+[1-\theta_0]\,qR_L\}+p\{\theta_0 R_S+[1-\theta_0]\,qR_S\}-2w_0\\ &= \bar{A}+p\{\theta_0[R_L+R_S]+[1-\theta_0][qR_L+qR_S]\}-2w_0. \end{aligned} \tag{16}$$

Since with a long-term project, the manager is guaranteed funding in both periods with probability 1, the interpretation of (16) is straightforward—observe that $p\{\theta_0 R_L+[1-\theta_0]\,qR_L\}$ is the expected payoff on the first-period project and $p\{\theta_0 R_S+[1-\theta_0]\,qR_S\}$ is the expected payoff on the second-period project.

It will be assumed that p is not too high, so the following condition will be satisfied if $\bar{\triangle}_0>0$ is sufficiently small:

$$2[1-p]p^{-1}>\theta_0[R_L-R_S]+[1-\theta_0]\,q\{R_L-R_S[pq+1-p]\}. \tag{17}$$

This leads to the following result:

Proposition 2 (Short-termism): *Given that the CEO aims to maximize firm value, it may be in the best interests of the CEO to ban L projects and insist on S projects when* (17) *holds. If* (17) *does not hold, the value-maximizing policy may permit L to be funded at* $t=0$*. Only a CEO with a sufficiently low* ω *will ban L projects.*

According to this proposition, provided that the values of the long-term good project and the short-term good project do not diverge significantly ($\bar{\triangle}_0$ is small), firm value is maximized by short-term projects. This rationalizes short-termism in capital budgeting by some firms. When $\bar{\triangle}_0$ is high, however, the long-term project is too valuable to ban and the shareholders and the CEO will both prefer to eschew short-termism. Thus, Proposition 2 identifies circumstances in which CEOs will embrace short-termism—when corporate governance is strong so that the CEO's interests are highly aligned with maximizing firm value and when the value loss from choosing the short-term project is not too large.

Corollary 1: *If the project is being proposed by the CEO rather than the manager, shareholders will have no interest in a no constraint that only an S project can be submitted for approval, as long as ω is low.*

The intuition can be seen as follows. Since a low-ω CEO's interests are aligned with the shareholders' interests, she will never propose a bad project. Moreover, since a long-term good project is worth more than a short-term good project, the CEO should be free to invest in a long-term project. The shareholders or the Board of Directors thus have no reason to insist on short-term projects for proposals being made directly by a low-ω CEO.

This result also has an implication for the firm's decision with respect to the size of its internal capital market. When the board of directors is unsure of whether the CEO will effectively handle the agency problem with respect to the manager (i.e. ω is high), and monitoring the payback periods of projects the CEO approves is too costly for the board, then the board may wish to watch over the firm's cash level, and insist on special repurchases or dividends when that level exceeds what is needed for operating purposes. The reason is that when cash is available internally, the CEO can allow the manager to invest in long-term projects, something that the board and the shareholders do not want. Not having enough cash forces the CEO to seek board approval for external financing, which gives the board an opportunity to ask for information about the projects being funded with that financing, and stop investments in long-term projects. Thus, having a policy of not having excess cash lying around permits the board to engage in selective capital rationing in order to improve internal governance.[115]

One interesting implication of this result is that firms are less likely to practice short-termism or impose a payback constraint for "strategically important" projects that are created by the CEO. Projects may be constrained to be of short duration if they are initiated by lower-level managers.

3.3.4 Using Explicit Wage Contracting Instead of a Short-termism Constraint

In this model, the manager's wage at any date is simply equal to the wage he would receive in an alternative job given the (common) belief about his ability at that date. That is, wages are optimal in the sense that they are the unique outcomes of binding participation constraints at different dates. However, wages have not been explicitly made dependent on private benefits and have not been relied upon to solve the incentive problem of inducing the manager to not invest in the B project at $t = 1$. I now do this to compare the short-termism solution analyzed earlier to a wage contracting solution, focusing on the policy that maximizes firm value. The maintained assumption from the base model is that the manager's wage is paid at the beginning of the period, so the wage cannot be explicitly conditioned on the cash flow realization at the end of the period.

The wage contracting solution has to satisfy the manager's participation constraints at dates $t = 0$ and $t = 1$. That is, the wage, w_t, at date $t \in \{0, 1\}$ must satisfy: $w_0 \geq \theta_0 w^T$ at

[115] See Malenko (2012) for an analysis of how firms can optimally design internal capital markets.

$t = 0$ and $\tilde{w}_1 \geq \tilde{\theta}_1 w^T$ at $t = 1$.[116] Moreover, the wage contract should satisfy the incentive compatibility constraint that the manager will choose G at $t = 0$. That is, a manager who is allowed to choose L must be dissuaded from a B project at $t = 0$. This requires that his expected utility is the same whether he proposes B or rejects it. This can be achieved with a wage contract that pays him w_0 at $t = 0$ if he invests in a project and $w_0 + \beta$ if he does not invest.[117] This means that to achieve incentive compatibility, the manager's participation constraint on the wage at $t = 0$ will have to be slack.

The second-period wage structure is the same as before: the manager gets a wage conditional on the first-period outcome. Given the earlier analysis, it follows that the manager will invest in L (rather than S) if he has a type-G project at $t = 0$. If he has a type-B project, there is no reason for him to invest in L since his first-period payoff, $w_0 + \beta$, is the same whether he invests or not, and he is able to invest in the second-period project at the same wage regardless of whether he invests in the first period. It is also clear that he will not invest in an S project of type B at $t = 0$ since this gives him a first-period utility of $w_0 + \beta$ but a lower second-period utility, i.e., a total utility that is lower than that from not investing.

The value of the firm with this wage contract, net of the wage and the investment, is:

$$p\{\theta_0 R_L + (1-\theta_0)qR_L - 1\} - w_0 + (1-p)(-\beta) + p\{\theta_0 R_S + (1-\theta_0)qR_S\} - w_0 - 1, \quad (18)$$

where p is the probability that the manager will have a type-G project. To understand (18), consider initially the first three terms. The first is $p\{\theta_0 R_L + (1-\theta_0)qR_L - 1\}$, which is the expected NPV of the L project of type G (with the expectation taken over managerial type) multiplied by the probability, p, of having a G project. The second term is the subtraction of the wage w_0 paid to the manager regardless of whether he invests, and the third term is the subtraction of the extra wage β paid to him if he does not invest. Now consider the next three terms, $p\{\theta_0 R_S + (1-\theta_0)qR_S\} - w_0 - 1$, which represent the expected value of the second-period project (which is $\theta_0 R_S + (1-\theta_0)qR_S$ if it is a G project, an event with probability p, and zero if it is a B project) minus wage w_0 and the investment of 1.

The expected value of the firm, net of wages and investments, with short-termism is:

$$p\{\theta_0 R_S + (1-\theta_0)qR_S - 1\} - w_0 + p\{\theta_0 R_S + (1-\theta_0)q^2 R_S\} - [\theta_0 + (1-\theta_0)q]\{w_0 + 1\}. \quad (19)$$

The interpretation of (19) is as follows. $p\{\theta_0 R_S + (1-\theta_0)qR_S - 1\} - w_0$ represents the expected value of the first-period project net of the managerial wage and investment. The term $p\{\theta_0 R_S + (1-\theta_0)q^2 R_S\}$ represents the expected value of the second period project,

[116] The reason why the dynamic individual rationality constraint (IR) becomes a sequence of one-period participation constraints is that in each period, the manager's wage is paid at the start of the period. To see this, note that the dynamic IR constraint at the beginning of the first period is $w_0 + \mathbb{E}[\tilde{w}_1] \geq \theta_0 w^T + \mathbb{E}[\tilde{\theta}_1]w^T$, where w^T is the reservation wage of a type-T manager (see Section 3.2.3). But since beliefs follow a martingale, $\mathbb{E}[\tilde{\theta}_1] = \theta_0$. Moreover, in the second period, the ability of the agent to switch jobs ("quitting constraint") means that $\tilde{w}_1 \geq \tilde{\theta}_1 w^T$ must be honored. This implies $\mathbb{E}[\tilde{w}_1] \geq w^T\theta_0$. The dynamic constraint thus reduces to $2w_0 \geq 2\theta_0 w^T$.

[117] Operationally, this may be achieved by basing the manager's compensation on the free cash flow of his division. By avoiding investment, the manager increases free cash flow and collects a larger bonus for himself, which would be the analog of being paid β to not invest.

recognizing that the manager will be able to invest only if he experiences first-period success, and the term $[\theta_0 + (1-\theta_0)q]\,\{w_0 + 1\}$ represents the expected wage and investment in the second period (which takes into account the fact that the probability of second-period investment is $\theta_0 + (1-\theta_0)q$).

Comparing (18) and (19) leads to the following result:

Proposition 3: *Assume that both the incentive and learning problems matter in the sense that p and θ_0 are both in the interior of $(0, 1)$ and are not too high or too low. Then, if the initial project investment (\$1), the manager's date-0 wage (w_0), and his private benefits (β) are large relative to the difference between the payoffs in the success states of the long and short G projects, $\triangle$, then short-termism leads to a higher firm value than using wages to induce the manager to avoid investing in the bad project at $t = 0$. In addition:*

1. *If the incentive problem is eliminated ($p = 1$), then, assuming that q is low enough, the short-termism restriction is preferred for a sufficiently low value of the prior probability, θ_0, that the manager is type T, and the wage contracting solution is preferred by the shareholders for a sufficiently high value of θ_0.*

2. *If the value of learning is eliminated ($\theta_0 = 1$), then the short-termism restriction is preferred by the shareholders if the probability of getting a G project, p, is sufficiently low, and the wage contracting solution is preferred if p is sufficiently high.*

The intuition for this proposition rests on the fact that the benefit of short-termism relative to the wage contracting resolution is that it allows the firm to learn about the manager's talent by observing the first-period project outcome, so that the cost of paying the manager's second-period wage and investing in the second-period project can be made conditional on this learning. When the required project investment and managerial wage are relatively high, this relative benefit is also high. Moreover, another relative benefit of short-termism is that it enables the firm to avoid paying the manager β in the first period to compensate him for his lost private benefit in the no-investment state. Again, the larger the β, the greater is the relative advantage of short-termism.[118]

This proposition also clearly brings out the intuition related to the two economic functions served by short-termism: resolving the *incentive problem* related to the manager's inclination to invest in the B project, and the *learning* made possible by observing the outcome of a short project at $t = 1$ before deciding whether to invest in another project. When the incentive problem is absent ($p = 1$), the only value of short-termism is learning. Clearly, the value of learning about the manager's talent decreases as θ_0 increases, and in the limit as θ_0 approaches 1 (the manager is almost surely talented), short-termism has no value. Thus, the wage contracting resolution dominates for θ_0 high enough. By contrast, when learning is eliminated entirely ($\theta_0 = 1$) but the incentive problem is resurrected ($p \in (0, 1)$), short-termism is preferred if the incentive problem is severe enough (p is low enough) because in this case the expected cost of compensating the manager in the no-investment state is high.

[118]Note that the incentive benefit of short-termism, namely the elimination of the manager's investment in the bad project in the first period, is symmetrically available with the wage contracting resolution as well, so it does not show up in a comparison of the two approaches.

Thus, short-termism is preferred to the wage contracting resolution either when the value of learning is sufficiently high and/or the incentive problem is sufficiently severe.[119]

All of this presumes that the firm can write wage contracts on private benefits. This is a strong assumption—in practice, it may not be possible. Private benefits may be large and difficult to estimate for contracting purposes. Moreover, paying managers to *not* invest may be inefficient if they also have to be motivated to expend effort to generate project ideas. Thus, there may be numerous reasons why wage contracting as a substitute for short-termism may be infeasible or inefficient. In these circumstances, real earnings management will be prevalent.

3.3.5 Short-termism and Real Earnings Management

By institutionalizing short-termism, the CEO is able to simultaneously achieve two things: resolve an agency problem with the manager, and also manage/boost short-term earnings. Thus, while short-termism may be beneficial in terms of dampening agency problems, it may also be used for the purpose of real earnings management in order to boost a company's stock price.

As noted in Lemma 3, however, it is only a CEO with a sufficiently low ω (i.e. one who puts high enough weight on firm value in her utility function) who practices short-termism. Thus, if ω is unknown to the market and is inferred from observed earnings, a shortfall in interim (date $t = 1$) earnings will cause the market to revise upward its assessment of the CEO's ω, causing the stock price to fall. In other words, shareholders may want to observe high short-term earnings because it reassures them that the CEO is resolving intrafirm agency problems more effectively than if low short-term earnings are observed. Therefore, *not* engaging in real earnings management through short-termism may adversely affect the firm's stock price.

3.4 Model Robustness and Empirical Implications

In this section, two main issues are discussed. The first is the role of the key assumptions and model robustness. The second is the set of empirical implications that emerge from the analysis.

3.4.1 Key Assumptions and Robustness

There are six key assumptions that drive the main results. The first is the assumption in the base model that the manager's type is unknown at the beginning. That is, it is common knowledge that there are two types of managers, talented and untalented, but no one can tell them apart. This leads to career concerns on the part of the manager

[119] Recall that short-termism is predicted to be more likely for routine projects. To interpret Proposition 3, it should be noted that both the value of learning and the severity of the incentive problem can vary in the cross-section. The value of learning can vary cross-sectionally for routine projects due to differences in managerial turnover, and the severity of the incentive problem can vary cross-sectionally due to differences across firms in managerial private benefits.

and leads to inefficiencies in capital budgeting, which then rationalizes value-maximizing short-termism. An alternative assumption that could be made is that the manager knows more about his type than the CEO. In such an asymmetric-information setting, it can be shown that more talented managers have an incentive to separate themselves via the early revelation associated with short-term projects, whereas less talented managers prefer the delayed revelation associated with long-term projects. Thus, asymmetric information will further strengthen the short-termism result.[120]

The second key assumption is that when the manager proposes a project, the CEO knows whether it is a short-duration or long-duration project, but is unaware of its NPV. Asymmetric information about project quality is necessary to make sure that there is a meaningful moral hazard problem involving the manager being able to misrepresent project quality. Symmetry about project-duration information is necessary to enable short-termism to be implemented in capital budgeting. This is a realistic assumption in that the firm should be able to determine with reasonable accuracy whether the manager is proposing a short-term or a long-term project, even though determining project quality may be difficult.

The third key assumption is that the manager enjoys private benefits from investing. This assumption should be viewed quite broadly. It could mean that the manager has a preference for "empire building" as in Harris and Raviv (1996), implying that control of a bigger asset base gives him greater utility. It could also be because increasing investment allows the manager to enjoy greater perquisites consumption.[121] Without this assumption, there is no agency problem between the manager and the CEO/shareholders, so the issues studied in this paper disappear. In the next section, I discuss how the analysis would be affected if managerial private benefits were replaced by risk aversion.

A fourth assumption is that the manager's wage is a fixed amount paid at the start of the period, and is conditioned on all available information about the manager's talent. This precludes payoff-contingent contracting. In Section 3.4.3, I show how the analysis would change if the firm designed a mechanism using the Revelation Principle (e.g. Myerson (1983)) in which the manager reports the type of project he is requesting funding for and receives a payoff-contingent compensation contract from a menu that the firm pre-commits to. I examine a richer information structure in Section 3.4.4 in which this scheme breaks down.

A fifth assumption is that it is assumed that no interim information is available about the long-term project at $t = 1$. In practice, accrual accounting may reveal some information even before project cash flows are realized. This issue is discussed in Section 3.4.5.

The final key assumption has to do with the two-period structure of the model. In Section 4.6, I examine whether short-termism would survive in a richer time-structure.

3.4.2 Managerial Private Benefits versus Risk Aversion

Since the manager's preference for a long-term project in this model arises from his desire to delay revelation of information about his ability, an interesting question is whether managerial risk aversion can replace private benefits in the analysis to generate the same

[120] These details are not provided here, but are available upon request.

[121] For example, investment in a project may mean more purchases from suppliers who may shower the manager with more gifts to get the business.

managerial preferences. The answer is yes. To see this, suppose the divisional manager was risk averse, but there was *no* private benefit associated with investing in a project. In that case, if the manager chooses the short-payback project, his second-period wage is stochastic, either w_1^+ or w_1^-, depending on whether the first-period project succeeds or fails. If he chooses the long-term project, his second-period wage is the expected value of w_1^+ and w_1^-. A risk-averse manager will always strictly prefer the expected value of w_1^+ and w_1^- to a stochastic wage, and hence the long-term project will be preferred to the short-term project.[122]

However, even though the risk-aversion can explain managerial concern with project duration, this assumption has a major limitation relative to the model examined here. Specifically, it cannot explain investment inefficiencies with risk aversion, the manager would not prefer to invest in a (long-term) *bad* project in the first period over not investing at all in that period. This is because he receives the expected value of w_1^+ and w_1^- as his second-period wage in both cases, so he is indifferent between the two choices, and standard convention would choose the no-investment outcome. And if there was any ex-post compensation adjustment associated with ability revelation at $t = 2$, the manager would have a strict preference to not invest (see also Holmstrom and Ricart i Costa (1986)). Absent any investment distortion associated with the manager's preference for a long-term project, the firm would have no reason to adopt short-termism in project selection. Hence, risk aversion can explain why managers would prefer long-term projects, but not why firms would try to prevent them from doing so by imposing a short-termism constraint.[123]

3.4.3 Information-Eliciting Payoff-Contingent Compensation and Short-termism

The model analyzed here has relied on the kind of career concerns model developed by Holmstrom and Ricart i Costa (1986) in which wages are paid at the beginning of each period. However, it is worth exploring the implications of relaxing this assumption. So, following Osband and Reichelstein's (1985) analysis of information-eliciting compensation schemes, suppose we design a revelation game in which the manager is asked to directly report at each date $t \in \{0, 1\}$ to the firm (CEO) his private information about the project and then, conditional on the report r_t at date t, receives an up-front wage $w_t(r_t)$ plus a bonus $c_t\left(\tilde{R}, r_t\right)$ that is a function of the random project payoff $\tilde{R}$. That is, the reporting game is a function $\psi_t : \{G, B\} \to \mathbb{R}^2$, where $\mathbb{R}$ is the real line. The focus of the analysis is on a linear $c_t\left(\tilde{R}\right)$ function:

$$c_t\left(\tilde{R}, r_t\right) = \begin{cases} \gamma_t\left[\tilde{R} - \mu_G\left(\mathbb{E}\left(T_t\right)\right)\right] & \text{if } r_t = G \\ 0 & \text{if } r_t = B \end{cases}, \tag{20}$$

[122]One advantage of the risk aversion assumption is that the manager would prefer the long-term project even if investments were a martingale.

[123]Recall the specification that, despite the learning afforded by the short-payback project, the long-payback project is first-best. This is the only specification that makes sense if "short-termism" is viewed as a distortionary practice, or a deviation from first-best that needs to be explained.

where $\gamma_t > 0$ is a parameter whose value is endogenously determined, $\tilde{R}$ is the actual random payoff on the project, and $\mu_G(\mathbb{E}(T_t))$ is the expected payoff on the G project given the manager's expected talent at date t. Also set

$$w_t(r_t) = w_1 \in \left\{w_1^-, w_1^+\right\} \forall r_t. \tag{21}$$

Now, working backwards, consider the last period. At $t = 1$, only an S project can be chosen. Given a posterior belief of θ_1 about the manager's type, we can write:

$$\mu_G(\mathbb{E}(T_1)) = \theta_1 R_S + [1 - \theta_1] q R_S. \tag{22}$$

Consider a manager who has received a G project at $t = 1$. His expected utility from truthful reporting is:

$$\begin{aligned} U(G \mid G) &= w_1 + \beta + \gamma \left[\mathbb{E}\left(\tilde{R} \mid G, \mathbb{E}(T_1)\right) - \mu_G(\mathbb{E}(T_1))\right] \\ &= w_1 + \beta. \end{aligned} \tag{23}$$

A manager who has a G project at $t = 1$ but reports $r_1 = B$ would get a utility of

$$U(B \mid G) = w_1, \tag{24}$$

since no funding would be provided for a B project, but the manager would still receive a wage of $w_1 = w_1^+$ or w_1^-, depending on the first-period project outcome. Now clearly,

$$U(G \mid G) > U(B \mid G), \tag{25}$$

so a manager with G will always report truthfully.

Suppose the manager has only B at $t = 1$. If he reports truthfully, his utility is

$$U(B \mid B) = w_1, \tag{26}$$

and if he reports $r_1 = G$, his expected utility is

$$U(G \mid B) = w_1 + \gamma_1 [0 - \mu_G(\mathbb{E}[T_t])] + \beta. \tag{27}$$

We need

$$U(B \mid B) \geq U(G \mid B), \tag{28}$$

for incentive compatibility (IC). That is, the IC constraint will be satisfied if:

$$\gamma_1 \geq \frac{\beta}{\theta_1 R_S + [1 - \theta_1] q R_S}. \tag{29}$$

It is straightforward to show that the firm's payoff will be maximized by setting

$$\gamma_1 = \frac{\beta}{\theta_1 R_S + [1 - \theta_1] q R_S}. \tag{30}$$

The following result follows immediately from the above.

Lemma 5: *If the firm can use a reporting game like the one described above in the second period, it will produce a strictly higher second-period firm value than if the firm simply chooses to pay the manager only an up-front wage at the start of the second period.*

The intuition is that, in equilibrium, the manager always reports truthfully, so the expected bonus paid to the manager is zero. Thus, the only wage the firm pays to each manager is the same as that with the policy of only paying the manager an up-front wage that was considered earlier. However, in the previous analysis (see Lemma 3), we saw that the policy of only paying an up-front wage leads to the manager seeking second-period funding even for a B project. This leads to a lower second-period firm value than with the reporting mechanism in which the manager never seeks funding for a B project.

Now consider the firm's choice at $t = 0$. The following lemma can be proved:

Lemma 6: *Taking as given the second-period reporting game, at $t = 0$, the firm can adopt the policy of asking the manager to invest in either the L or the S version of the project the manager has and truthfully report the type (G or B) of the project to the firm. The reporting game involves the manager being paid an up-front wage of w_0 at $t = 0$ regardless of his report. He is denied funding if he reports B. If he reports G, he receives funding and a bonus c_0 that is conditional on the first-period project outcome:*

$$c_0^L = \frac{\beta}{\theta_0 R_L + [1-\theta_0]\, qR_L} \text{ if the manager proposes an } L \text{ project,} \tag{31}$$

$$c_0^S = \frac{\beta[1-p]}{\theta_0 R_S + [1-\theta_0]\, qR_S} \text{ if the manager proposes an } S \text{ project.} \tag{32}$$

This lemma essentially verifies that the direct reporting mechanism can also be used in the first period. The next question that is addressed is whether short-termism should be expected in an environment in which output-contingent wage contracting in a reporting game framework is feasible.

Proposition 4: *Suppose*

$$p\bar{\triangle}_0 + p\,[1-\theta_0]\,[p-q]qR_S > p\,[1-\theta_0]\,[1-q] - [1-p][4p-1]. \tag{33}$$

Then the firm always prefers to instruct the manager to invest in the L version of the project at $t = 0$, i.e., there is no short-termism. If θ_0, $\bar{\triangle}_0$, and q are sufficiently small (so that the inequality in (33) is reversed), then the firm will prefer to practice short-termism.

Given that (14) holds, (33) will hold if p is not too small.[124] Thus, output-contingent contracting reduces the attractiveness of short-termism. The intuitition is as follows. Because output-contingent contracting ensures that the manager avoids proposing B even with

[124] Given (14), it is clear that (33) holds for $p = 1$ and hence by continuity for p high enough.

the L version of the project, one of the *relative* benefits of short-termism—the resolution of the incentive problem—is lost since this problem is resolved with wage contracting. Of course, the learning benefit of short-termism still remains. However, (14) and (33) essentially say that the learning benefit is small compared to the intrinsic-value gain from investing in the L version of G compared to investing in the S version. When this is true, resolving the incentive problem does not suffice for short-termism to be adopted. But when $\bar{\triangle}_0$, the intrinsic-value gain from investing in the L rather than the S version of G, is small and θ_0 and q are small as well, it is possible for the inequality in (33) to be reversed and short-termism to re-emerge. This is intuitive since a reduction in $\bar{\triangle}_0$ makes it possible for the learning benefit of short-termism to overcome the loss in value from eschewing the L version of G.

Corollary 2: *When the value of learning is eliminated ($\theta_0 = 1$), there is no short-termism when output-contingent wage contracting is possible in a contracting framework.*

This result is consistent with a similar result in Proposition 3. Because output-contingent wage contracting resolves the incentive problem, short-termism has no relative advantage if the learning benefit is eliminated.

3.4.4 Ex-post Cash Flow Unobservability and Short-termism

Numerous papers have made the assumption that cash flows may be observable ex post to one of the contracting parties but *not* to others, or that cash flows may be observable to all but not verifiable for contracting purposes. In these circumstances, it is impossible to make wage (or other) contracts contingent on realized profit or cash flow.[125]

In the setting here, it is natural to assume that the CEO can observe the *total* cash flows of the project, but the divisional manager (who requests funding for it) cannot. One reason for this may be that the cash flow of the project is affected by many other employees of the firm, and the actual impact of each employee on the realized cash flow may not be public. That is, each employee may see only his own impact on the cash flow, but not the impact of others, thereby hiding from his view the total realized cash flow. The CEO, however, would have access to information about each component of the total cash flow as well as the total cash flow. It is well known that higher-level executives in most firms have access to more information than lower-level managers, i.e., information access forms an inverted pyramid in which the CEO has the greatest information access. Indeed this differential information access based on the employee's level in the hierarchy is codified in most firms through explicit access rules.[126]

Formally, suppose ν represents the sum of the effects that *other* employees in the firm have on the project cash flow. Let $\nu \in \Lambda$, a subset of the real line. Thus, if x is the impact

[125] For example, Bolton and Scharfstein (1990) assume that the firm's profit is privately observed by the firm, but cannot be observed by its creditors, in which financial constraints emerge endogenously to mitigate incentive problems. Hart and Moore (1998) assume that the ex post cash flows of a project cannot be verified by a court, so the entrepreneur can steal these cash flows. The paper goes on to examine the role of debt in this setting. DeMarzo and Sannikov (2006) develop a continuous-time model of optimal capital structure in which the agent may conceal or (unobservably) divert cash flows for his own consumption.

[126] As another example, it is not uncommon for store managers of a retail corporation to not be able to actively track their own store's profits, since it depends on not only the store's sales, but also the company's overhead costs (which are not directly observable to the manager).

of the manager requesting the funding, then the total project cash flow is:

$$y = x + \nu. \tag{34}$$

We assume that the project-dependent and manager-type-dependent cash flow distribution of x is as it was described earlier. It is assumed that, conditional on G, $\mathbb{E}(x\nu) = \mathbb{E}(x)\mathbb{E}(\nu)$, i.e., x and ν are conditionally orthogonal. Let f be the density function of ν, with $supp(f) = \{\nu \in \Lambda \mid f(\nu) \neq 0\}$ being the support of f, and let g be the density function of y, with $supp(g)$ being the support of g.

Now suppose $supp(f) = [-R_L, R_L]$ for the L version of G, and $supp(f) = [-R_S, R_S]$ for the S version of G. Then $supp(g \mid \tau \in \{T, U\}, L) = [-R_L, 2R_L]$ and $supp(g \mid \tau \in \{T, U\}, S) = [-R_S, 2R_S]$, where τ denotes the manager's type. If we assume that

$$\int_{-R_S}^{R_S} \nu f(\nu)\, d\nu = \int_{-R_L}^{R_L} \nu f(\nu)\, d\nu = 0, \tag{35}$$

then it follows that x is an unbiased predictor of y, i.e.,

$$\int_{-R_L}^{2R_L} y f(y)\, dy = R_L \text{ if } G \text{ is selected,} \tag{36}$$

and

$$\int_{-R_S}^{2R_S} y f(y)\, dy = R_S \text{ if } G \text{ is selected.} \tag{37}$$

Now, suppose only the CEO can observe x and ν individually, and hence y as well.[127] The manager proposing the project can only observe x. None of the cash flows can be verified by a third party (like a court) ex post, i.e., x, ν, and y are unverifiable for contracting. The following result is straightforward, but worth noting as a benchmark.

Lemma 7: *If the CEO can credibly precommit to truthfully revealing y ex post, then the output-contingent wage scheme in the reporting game described in Proposition 4 can be implemented.*

The problem, of course, is that such precommitment will usually be difficult. If we assume that the CEO's utility is given by (11), with $\alpha_2 = 0$, then the CEO will have an incentive to misrepresent y ex post, as indicated in the result below.

Proposition 5: *Suppose the CEO's utility is given by (11) with $\alpha_2 = 0$ and the bonus scheme described in Lemma 6 is used for projects proposed at $t = 0$. Then, regardless of the realized y, the CEO will always report a y ex post that justifies paying the manager an ex post bonus $c_0^L = 0$ at $t = 2$ with the L version of the project. However, if the S version of the G project is sufficiently valuable in the sense that $[\theta_0 + [1 - \theta_0]\, q]\, R_S$ is high enough, the CEO will report y truthfully at $t = 1$ and pay the agreed-upon bonus c_0^S at $t = 1$ if the realized*

[127]The analysis is unchanged if it is assumed that the CEO can only observe y, whereas each employee can observe only his contribution to y, but not y itself.

x warrants it. At $t = 2$, however, the CEO will again report a y ex post that justifies paying the manager an ex post bonus $c_1^S = 0$ on the second-period project chosen at $t = 1$.

The intuition can be understood by examining the CEO's incentive to maximize firm value due to her utility function. Because $0 \in supp(f)$, the CEO can always claim that $y = 0$ regardless of the x that the manager reports observing. The lack of verifiability of the actual realizations of x, ν, and y means that the CEO can claim that she also observed $x = 0$, in which case the manager is not entitled to a bonus. This makes output-contingent contracting infeasible at $t = 0$ for the L version of the project since the manager will anticipate this behavior on the CEO's part at $t = 2$ and the bonus will have no incentive effect.

Interestingly, the CEO does not have the same misrepresentation incentive at $t = 1$ if the S version of the project is funded at $t = 0$. The reason is that observing $x = y = 0$ should rationally lead the CEO to deny any second-period funding for the manager. However, if $x = R_S$ is truly observed by the CEO (or inferred from the realization of y), then it is subgame perfect for the CEO to fund the manager's second-period project request. Of course, this now reveals the CEO's private information, so the manager will have to be paid the bonus $c_0^S > 0$ despite the lack of verifiability of x and y. If $[\theta_0 + [1 - \theta_0] q] R_S$ is high enough, the CEO will not mind paying the manager's bonus in order to capture the value of the sceond-period (short) project. In other words, short-termism emerges once again.

Implications of the Analysis

When the analyses in Sections 3.4.3 and 3.4.4 are combined, one implication that is evident is that short-termism has greater economic value to the firm when the manager's specific contribution to the project is more difficult to verify for contracting purposes. This situation is more likely to be encountered with lower-level managers. As one moves up the management hierarchy, the manager's span of control increases and it becomes easier to assign accountability for verifiable outcomes to the manager. When one gets to the top of the hierarchy, the CEO can be assigned accountability for the entire firm's performance and tying her compensation to the firm's stock price makes sense.

This implication yields the empirical prediction that the short-termism constraint imposed by the firm will weaken as one moves up the corporate hierarchy and compensation contracts become more performance-sensitive. This is a within-firm prediction. A related predictition is that in the cross-section of firms, there will be an inverse relationship between pay-for-performance sensitivity and the use of short-termism.

3.4.5 Accrual Accounting

The key advantage of the short-term project is that it yields at cash flow at $t = 1$ that reveals information about managerial ability, something not possible with the long-term project. In practice, accrual accounting can help the firm to learn something about even the long-term project before it throws off its cash flow. This motivates the question: how would accrual accounting affect the analysis?

This question is important because previous research has shown how accrual accounting can be useful in helping to achieve congruence between the goals of managers and shareholders. For example, Reichelstein (2000) notes that accounting data reflect at each point in time the value currently created by the manager, whereas performance measures based only on realized cash flows are uninformative about value creation at intermediate points in time. In a similar vein, Dutta and Reichelstein (2005) state: "For a range of common production, financing and investment decisions, we argue that private information held by management makes intertemporal matching of revenues and expenses essential". Their analysis focuses on residual income, which is accounting income minus a charge for the cost of capital, and they examine how tying the manager's pay to residual income can serve the shareholders' interests.

A formal analysis of this issue in the context of my model (details available upon request) reveals that, although the restrictions needed on the deep parameters of the model change, the analysis is qualitatively unaffected as long as the (informative) signal about project performance generated by the accrual accounting system at $t = 1$ is more noisy than that produced by the realized cash flow at $t = 2$. With this (natural) assumption about the relative informativeness advantage of the realized cash flow, the short-term project provides a bigger learning benefit than the long-term project. Additionally, absent output-contingent contracting, the short-term project will also have the benefit of resolving the incentive problem at $t = 0$ that wage contracting cannot resolve.

3.4.6 A Richer Time Structure

It is also useful to think about the extent to which the resuts are affected by the two-period time structure. Suppose instead we have an overlapping-generations (OLG) setting in which there are four periods instead of two. At $t = 0$, the situation is the same as in the current model. At $t = 1$, however, it is known that the incumbent manager will leave at $t = 2$ and be replaced by a new one. Thus, it is beneficial for the firm to ask the incumbent manager to invest in an L project. The end-game problem of the current model means that the manager will request funding even if the project is B. But this incentive problem exists regardless of whether the manager is being funded for an L-version or an S-version of the project, so it is optimal for the firm to ask the manager to go for an L project. At $t = 2$, we are back to the situation of the current model, with only two periods left, so short-termism will be encountered in the project choice at $t = 2$. This would imply an initial preference for the long project, followed by a preference for short-termism. This is akin to the "horizon effect", in which the preference of the long-term versus the short-term project depends on the remaining horizon of the manager. The horizon effect typically refers to the phenomenon of intertemporal choice being affected by an exogenous variation in the discount rate (e.g. see the survey by Frederick, Loewenstein, and O'Donoghue (2002)). The evidence on the horizon effect has inspired the development of economic models incorporating hyperbolic or quasi-hyperbolic discount functions (e.g. Laibson (1997), and O'Donoghue and Rabin (1999)).

While the initial experiments conducted in this literature were attempting to assess the shape of an underlying discount function, recent evidence shows that it is unclear that this was indeed achieved. Indeed, the empirical evidence on this is quite mixed, with some papers showing declining discounting, some constant discounting, some increasing discounting (see, for example, Anderhub et. al. (2001), Benhabib et. al. (2010), Dohmen et. al. (2012), and Frederick, Loewenstein, and O'Donoghue (2002)). Thus, it is far from clear whether any discounting model explains the data. A recent paper, however, presents evidence on the horizon effect that is consistent with the choice of L when there is a long time horizon left, and the switch to S when there is a shorter horizon left. Dohmen et. al. (2012) use German socio-economic panel data as one of their datasets and examine how time horizon affects intertemporal choice. One of their results is that people are more impatient for short time horizons than for long time horizons, but are relatively insensitive to *when* the time horizon starts. They view the evidence as being inconsistent with standard discounting models. However, the preference for L when the time horizon is long and the preference for S when it is short is broadly consistent with greater impatience with shorter time horizons.

Have said this, in practice firms may face costs in transferring the management of a project from one manager to another. To the extent that there is firm-specific human capital associated with managing a project, the value of the project with a new manager is likely to be lower than with the incumbent manager who acquired this firm-specific capital through his tenure with the firm. Say this loss in value is $\mathcal{L}$. Then if $\mathcal{L} > \bar{\triangle}_0$, the firm may prefer to have the incumbent invest in S at $t = 1$, and then let the new manager choose another S project at $t = 2$. That is, with sufficient firm-specific human capital, the oscillation between patience and short-termism in an OLG setting would disappear and we would obtain short-termism in both periods.

3.4.7 Empirical Implications

The previous analysis allows one to draw out some empirical implications, which are discussed in this section.

At a broad level, the analysis implies that since short-termism is value-maximizing in the second-best and hence desired by the owners of the firm in some circumstances, we should find that it takes the form of upper management telling divisional managers that the firm will not fund projects with payback periods or project durations exceeding some upper bound. This seems to be consistent with the evidence in Graham and Harvey (2001) and Lefley (1996), and it implies the adoption of capital budgeting rules that mandate short-termism, such as payback period restrictions. What the analysis here adds is that this practice is likely to be encountered only in *specific* circumstances, so that sharper empirical tests can be designed to determine if this is indeed reflected in the data. The predictions below focus on linking empirical tests to these circumstances.

First, given that managers like long-term projects and shareholders like short-term projects, a firm that is run more consistently in the interest of shareholders will place a stronger emphasis on short-termism. This means that firms in which CEOs have greater ownership of the firm will be *more* short-term oriented (see Graham and Harvey's (2001) evidence). Moreover, small firms and private firms also typically have larger ownership stakes held by the CEO, so these firms should also display short-termism.[128] In other words, switching from public to private ownership is *not* necessarily the "solution" for reducing short-termism. Further, if better internal governance means a stronger shareholder-value emphasis and the qualities of external governance (monitoring of the CEO by the Board) and internal governance (mon-

[128]This is what Graham and Harvey (2001) find.

itoring of divisional managers by the CEO) are positively correlated, then the prediction is that there will be a stronger emphasis on short-termism in firms with better (external) corporate governance. A recent paper that provides evidence somewhat consistent with this implication is Gianetti and Yu (2016), which documents that firms with more short-term institutional investors—that are ostensibly more short-term focused—have better long-term performance in dynamic economic environments.

Another way to test the prediction would be to first regress $\triangle S_t$, the change in sales in period t, against $CAPEX_t$ and $CAPEX_{t-1}$, the capital expenditures of the firm in periods t and $t-1$, controlling for industry and firm size for each firm. Taking the slope coefficients from this regression, the estimated value of $\frac{\mathbb{E}(\triangle S_t)+\mathbb{E}(\triangle S_{t+1})}{CAPEX_t}$ can be computed. The higher this asset-turnover ratio, the shorter the payback period of the firm's projects. This ratio can then be regressed on some measure of corporate governance (e.g. the Gompers, Ishi and Metrick (2003) governance index). The prediction is that higher-quality governance should be associated with a higher asset-turnover ratio. To deal with endogeneity issues, on could consider an exogenous shock to governance and examine its effect on short-termism. For example, inclusion of a firm in the S&P 500 can be viewed as a quasi-natural experiment that causes an increase in institutional ownership and an improvement in governance. Appel, Gormley, and Keim (2014) show that an increase in ownership by even passive institutions is associated with an improvement in governance.

Second, short-termism is more likely for routine projects than for strategic projects. This is consistent with the evidence in Lefley (1996), that short payback periods are more likely to be imposed on routine projects (likely to be proposed by lower-level managers) than for more "strategic" projects proposed by senior managers.

Third, within a firm, the short-termism constraint on project choice is more likely to be imposed on lower-level managers, and in the cross-section of firms it will be negatively correlated with managerial pay-for-performance sensitivity.

Fourth, short-termism is likely to be greater in industries in which the loss in value from insisting on short-term projects to discipline managers is not excessive (see condition (20)). Examples are traditional manufacturing firms like appliances and automotive parts. Short-termism should be lower in knowledge-based, R&D-intensive industries like bio-tech and pharmaceuticals. This prediction has yet to be empirically tested.

Finally, to the extent that there is heterogeneity among firms in the efficiency with which they resolve internal governance problems, there will be some firms that invest more in short-term projects and some that invest more in long-term projects. The firm that invests more in long-term projects owns a series of two-year (real) call options, whereas the firm with more short-term projects owns a series of one-year call options. Hence, the stock return volatility of the firm that invests more in long-term projects should be higher.

3.5 Related Literature

This paper is related to three important strands of literature: real earnings management, "myopic" investment behavior by managers, and the role of managerial career concerns in capital budgeting.

There is a substantial literature in real earnings management. The empirical research of Burgstahler and Dichev (1997) and Burgstahler and Eames (2006) documents that both cash flows from operations and discretionary accruals are managed to increase reported earnings. Zang (2011) documents a tradeoff between accounting and real earnings management. Chen (2009) develops and tests a theoretical model in which managers can engage in both accounting and real earnings management and derives the conditions under which firms will rely more on one form of earnings management. Also related are papers that consider how accounting practices aimed at making better information available to investors—so that stock prices more accurately reflect managerial decisions and deter rent-seeking or value-destroying behavior—can encourage earnings management that involves short-termism. For example, Gigler, Kanodia, Sapra, and Venugopalan (2014) develop a model in which the cost of more frequent financial reporting is greater short-termism, whereas Ewert and Wagenhofer (2005) develop a model in which tighter accounting standards put more price pressure on firms, resulting in more earnings management and greater investment myopia.

Papers that examine investment myopia include Stein (1989) and Narayanan (1985a,b). In these papers, managers boost short-term earnings through hidden actions in order to positively influence the stock price or perceptions of managerial ability, and sacrifice long-term earnings in the process.[129] The market is rational and correctly anticipates this signal-jamming behavior, so the earnings inflation is properly "discounted" in the determination of the stock price. But given that the market expects earnings to be inflated, firms are "trapped" in the Nash equilibrium in which not inflating earnings would lead to a lower valuation than what the firm is worth. Darrough (1987) shows that the equilibrium identified by Narayanan (1985a,b) disappears if the shareholders use an appropriate incentive scheme. These issues are relevant because in these models managers like short-term projects but shareholders prefer long-term projects, so it makes sense to examine ways in which shareholders can restore the appropriate incentives. In sharp contrast, in my model, it is the owners of the firm who prefer short-termism.[130] In this sense, my analysis also differs from von Thadden (1995), where myopic firm behavior is caused by the fear of early project termination by outside investors. Since shareholders prefer long-term investments even in the second-best case (with incentive constraints), investor monitoring is shown to be able to overcome investment myopia.

There are also papers where managerial investment myopia is induced by stock mispricing. In Bolton, Scheinkman, and Xiong (2006a,b) current shareholders are willing to sacrifice long-term value in order to take advantage of short-term speculative profits. These profits arise

[129]See also Stein (1988), where the manager faces a takeover threat from a hostile raider and recognizes that temporarily low earnings may cause the firm's stock price to become undervalued. Therefore, the manager may choose to signal by inflating current earnings to reduce the likelihood of a takeover at an unfavorable price.

[130]Models in which external financing is more costly than internal financing predict a preference for a faster generation of internal cash for investments. For example, in Whited (1992), the presence of external financing constraints enhances the shadow value of internal funds. In Thakor (1990), informational frictions open up a wedge between the costs of internal and external financing, which then creates a preference for short-payback projects. While this approach sheds light on payback use in certain kinds of firms, it cannot explain why payback use is not empirically observed to be greater among financially-distressed or capital-constrained firms (Graham and Harvey (2001)). By contrast, the theory in this paper predicts a preference for payback even in the absence of financial constraints.

due to the deviation of stock prices from fundamentals in the presence of the option that current shareholders with short horizons have to sell their stock in the future to potentially overoptimistic investors. The similarity between the Bolton et al (2006a,b) papers and this paper is that, in all three papers, short-termism is due to the wishes of the shareholders rather than to enable rent extraction by the manager. The key difference is that the investment horizon distortion here has nothing to do with stock market inefficiency or even stock market trading. Thus, it can be expected to persist even in private firms and in public firms trading in efficient stock markets. Moreover, a central focus of this paper is linking short-termism to wage dispersion in the labor market is not addressed in these papers. These aspects of my paper also distinguish it from Gumbel (2005), who shows that investors may want managers to trade on short-term information in part because performance observations under long-term informed trading are contaminated by noise in stock prices.

On the issue of managerial career concerns in capital budgeting, an important paper is Holmstrom and Ricart i Costa (1986). The problem there is that risk-averse managers with unknown abilities and career concerns never wish to invest, so they have to be given wage contracts with option-like features.[131] This then causes over-investment, and capital rationing by headquarters becomes necessary. However, unlike in this paper, that paper does not focus on short-termism. Other related capital budgeting papers include Berkovitch and Israel (2004), which shows that the NPV criterion may not work well when managers have private benefits and are privately informed about investment projects, and Hirshleifer, Chordia, and Lim (2001), where it is shown that the firm and the manager may have different preferences over the timing of project uncertainty resolution. More recently, Malenko (2012) examines the optimal design of a capital allocation process in a dynamic setting in which the division manager has private benefits of investing, as in this paper. However, Malenko's (2012) focus is on endogenizing a threshold division of authority for project approval. The allocation of control, which is taken as a given in my paper, is also endogenized in a different setting (involving disagreement) in Van den Steen (2010). Career concerns papers like Holmstrom (1999) argue that the career concerns that arise in dynamic settings can strengthen the agent's effort incentives and reduce agency costs relative to a single-shot game. In contrast, managerial career concerns *distort* outcomes and increase agency costs in my model.

This paper also has something in common with papers on governance that focus on how governance structures influence corporate behavior. For example, Levit and Malenko (2012) examine how the interaction between the labor market for directors and the reputational concerns of directors affects corporate governance. More closely in line with this paper, Acharya, Myers, and Rajan (2010) develop a model of internal governance in which the self-serving behavior of the CEO is limited by the possible reaction of the subordinate. While this paper also focuses on internal governance, the moral hazard problem here is *inverted* compared to Acharya, Myers, and Rajan (2010)—it is the subordinate's self-interested behavior that the

[131] The reason why a risk-averse manager does not want to invest is that beliefs about the manager's ability form a martingale (the expected posterior belief equals the prior belief), so, relative to not investing, the expected wage benefit from investing in a project whose future risky cash flows will noisily reveal ability is zero, which means its incremental expected utility impact is negative. See Holmstrom (1999) for a multiperiod career concerns analysis.

CEO is trying to limit through short-termism.[132]

3.6 Conclusion

Short-termism in corporate behavior has been the subject of much research and public debate. The thrust of the research until now has been that a short-term orientation in project choices sacrifices long-term value and is an undesirable consequence of managerial self-interest or stock market pressure to engage in earnings management, coming perhaps from (impatient) short-horizon investors.

This paper has challenged this idea and argued that short-termism may be good for firm value. Were firms not to insist on short-term results that lead to early revelation of information about project quality and managerial ability, managers would be tempted to choose projects that benefit them personally at the expense of firm value, and firms would learn less efficiently about managerial abilities. Pushing the revelation of information about such activities further into the future is an effective way for managers to protect themselves against the outcome of their rent-seeking being misinterpreted as evidence of low ability, which enables rent extraction to last longer. This makes short-termism a valuable tool of internal governance for top management. Viewed in this light, it is the guardians of firm value, like the shareholders and other investors, who want short-termism, and it is self-interested managers who like long-term projects. This approach produces many empirical predictions, some of which are in line with the existing evidence, and some are new predictions that are yet to be tested.

The theory in this paper does not rely on debt playing a role. In the analysis here, it does not matter whether external financing is raised through debt or equity, as long as debt maturity plays a passive role in the analysis, i.e. it is long-maturity debt. However, short-term debt may create an additional reason for information revelation to occur early rather than late, as bondholders would find this information useful in *repricing* debt. This will reinforce the effect modeled here. But it may also affect the manager's contract in other ways, since conditioning the contract on debt may be optimal (see Bolton, Mehran, and Shapiro (2011), for instance). These interactions may be interesting for future research.

[132] Another related paper is Grenadier and Wang (2005), which examines investment timing and agency conflicts related to contracting problems between managers and owners. Using a real options framework, they find that managers have an incentive to wait longer than owners to invest in projects, since they have a more valuable option to wait than owners. They then generalize their model to allow for greater impatience and "empire building" on the part of managers to explain their preferences for choosing projects with quicker paybacks, consistent with Narayanan (1985a).

Appendix 3.A

This appendix contains proofs of all of the earlier results, in the order in which they were presented.

Proof of Lemma 1: In the first-best case, project choice can be observed by the shareholders, so it maximizes firm value. It will first be shown that the funding will occur only if he has a G project. With a G project, since $1-\theta_0$ is the probability that the manager is type U and thus receives a project payoff of 0 with probability $1-q$, the net expected project payoff across the two types of managers will be $\theta_0 R_T + (1-\theta_0)qR_T - 1$ where $T \in \{L, S\}$ if the manager does not know his type, and the expected social value will be $\theta_0 R_T + (1-\theta_0)qR_T + \beta - 1$. Now, if the manager does not invest, net social surplus and the net expected project payoff are both 0, so the CEO accepts the project in the first-best case. Now if the manager does not receive a G project, then he has a B project which pays off 0 regardless of his type. In the first-best case, there is no investment in the project since the NPV < 0 and also the sum of his private benefit and project NPV is $\beta - 1 < 0$.

Next, it will be established that (13) is a necessary and sufficient condition for L_G to have higher value for the firm than S_G. Suppose the firm invests in L_G in the first period. Its expected net payoff after the first period is $\theta_0 R_L + (1-\theta_0)qR_L - 1$. At the beginning of the second period, no information is revealed about the manager's type since an L project was undertaken at $t = 0$, so $\theta_1 = \theta_0$. The manager receives a G project with probability p, which then gives an expected net payoff of $\theta_0 R_S + (1-\theta_0)qR_S - 1 > 0$. If the manager proposes a B project, the expected net payoff is -1, and if the manager does not invest, the payoff is 0. Thus, the manager will only propose a G project, and its expected net payoff across the two periods is:

$$\{\theta_0 R_L + (1-\theta_0)qR_L - 1\} + p\{\theta_0 R_S + (1-\theta_0)qR_S - 1\} \tag{1}$$

Now, suppose that the firm invests in S_G in the first period. Its expected net payoff after the first period is $\theta_0 R_S + (1-\theta_0)qR_S - 1$. At the beginning of the second period, posterior beliefs about the manager's type are updated from θ_0 to θ_1 via Bayes' Rule, based on the outcome of the first-period project. In the case where the first-period project fails, then beliefs are revised to:

$$\begin{aligned}
\theta_1 &= \Pr(\text{manager's type} = T \mid \text{failure at}\, t = 1) \\
&= \frac{\Pr(\text{failure} \mid \text{type} = T)\Pr(\text{type} = T)}{\{\Pr(\text{failure} \mid \text{type} = T)\Pr(\text{type} = T) + \Pr(\text{failure} \mid \text{type} = U)\Pr(\text{type} = U)\}} \\
&= 0 \equiv \theta_1^-,
\end{aligned} \tag{2}$$

where "failure" means that the first period project payoff is 0, and "success" means that the payoff is R_S. In this case, the expected net payoff of proposing a G project at $t = 1$ is $\theta_1 R_S + (1-\theta_1)qR_S - 1 = qR_S - 1 < 0$ from (4). The net payoff of proposing a B project is -1, and the payoff of not investing is 0. Thus, given failure at $t = 1$, the manager will choose to not invest in the second period in the first-best. In the case where the first-period project succeeds, beliefs are revised to:

$$
\begin{aligned}
\theta_1 &= \Pr(\text{manager's type} = T \mid \text{success at } t = 1) \\
&= \frac{\Pr(\text{success} \mid \text{type} = T)\Pr(\text{type} = T)}{\{\Pr(\text{success} \mid \text{type} = T)\Pr(\text{type} = T) + \Pr(\text{success} \mid \text{type} = U)\Pr(\text{type} = U)\}} \\
&= \frac{\theta_0}{\theta_0 + q(1-\theta_0)} \equiv \theta_1^+, \qquad (3)
\end{aligned}
$$

and

$$
1 - \theta_1 = \Pr(\text{manager's type} = U \mid \text{success at } t = 1) = \frac{q(1-\theta_0)}{\theta_0 + q(1-\theta_0)} \equiv 1 - \theta_1^+. \qquad (4)
$$

In this case, the expected payoff of proposing a G project at $t = 1$ is $\theta_1^+ R_S + (1-\theta_1^+)qR_S - 1$. Since the first-period project succeeds with probability $\theta_0 + (1-\theta_0)q$, the manager receives second-period funding only if he receives a second-period G project and succeeds in the first-period, and the manager receives a G project at $t = 1$ with probability p, the expected net payoff across the two periods when the firm invests in S_G is:

$$
\begin{aligned}
&\{\theta_0 R_S + (1-\theta_0)qR_S - 1\} \\
&+p\left[\theta_0 + (1-\theta_0)q\right]\left\{\left[\frac{\theta_0}{\theta_0 + q(1-\theta_0)}\right]R_S + \left[\frac{q(1-\theta_0)}{\theta_0 + q(1-\theta_0)}\right]qR_S - 1\right\} \\
&= \{\theta_0 R_S + (1-\theta_0)qR_S - 1\} + p\left\{\theta_0 R_S + (1-\theta_0)q^2 R_S - \theta_0 - (1-\theta_0)q\right\}. \qquad (5)
\end{aligned}
$$

Now, for L_G to be value maximizing, the expression in (A.1) should exceed that in (A.5). This comparison yields (13). ■

Proof of Lemma 2: At $t = 1$, only an S project is available. From Lemma 1, the manager at $t = 0$ only requests funding for an L_G project. Then no information is revealed about the manager's type at $t = 1$, so $\theta_1 = \theta_0$ (this will also be the case if no project was proposed at $t = 0$). Since we know that $R_S > 1 > \beta$, it is thus the case that the expected project payoff for a G project is $\theta_0 R_S + (1-\theta_0)qR_S > 1$. If the manager requests funding, then the net social surplus is $\theta_0 R_S + (1-\theta_0)qR_S > 1$. The expected project payoff for a B project is 0, so the net social surplus will be $\beta - 1 < 0$ (and the value to the firm will be -1). If the manager does not invest, net social surplus will be 0. Therefore, in the first best case at $t = 1$, the manager will only propose S_G, and he will receive funding for it. ■

Proof of Lemma 3: First, I show that the manager will always seek funding at $t = 1$. Suppose the manager did not propose a project a $t = 1$. Then his utility at $t = 1$ is $U_{M,t=1}(\varnothing) = \tilde{w}_1$. Now, if the manager does propose a project at $t = 1$, and he gets funding for it, then his utility is $U_{M,t=1}(S_G) = U_{M,t=1}(S_B) = \tilde{w}_1 + \beta$, which does not depend on G or B. Clearly $U_{M,t=1}(S_G) = U_{M,t=1}(S_B) > U_{M,t=1}(\varnothing)$, so the manager will propose a project at $t = 1$.

Now, suppose that a policy of maximizing firm value is in place. Then, at $t = 1$, the manager will get funding if the expected payoff of the project as viewed by the CEO (given that the CEO cannot see whether he received a G project or not) exceeds 1. Thus, the manager gets funding at $t = 1$ if $p\{\theta_1 R_S + (1-\theta_1)qR_S\} + [1-p]0 = p\{\theta_1 R_S + (1-\theta_1)qR_S\} > 1$. The funding decision thus depends on θ_1, the posterior belief at $t = 1$. Now, if the manager invested in an L project at $t = 0$, then $\theta_1 = \theta_0$ (so there is no information revealed about the manager's type at $t = 1$). Since we have that $\theta_0 R_S + (1-\theta_0)qR_S > 1$ from (6), it follows that the manager will get funding at $t = 1$ if he invests in an L project at t . Now suppose that the manager invested in S at $t = 0$. Then there are two possibilities: S fails at $t = 1$ or S succeeds at $t = 1$. Belief revision now depends on what equilibrium choices were made at $t = 0$. Given the equilibrium in which the manager only invests in S_G (not S_B) at $t = 0$, posterior beliefs are obtained using Bayes' Rule as in the proof of Lemma 1. That is, $\Pr(\text{manager's type} = T \mid \text{failure at } t = 1) = \theta_1^- = 0$, and $\Pr(\text{manager's type} = T \mid \text{success at } t = 1) = \theta_1^+ = \theta_0 [\theta_0 + q(1-\theta_0)]^{-1}$, where "failure" means that the first period project payoff is 0, and "success" means that the payoff is R_S. Thus, we see that when the manager only invests in S_G at $t = 0$, so that: $\theta_1 = \theta_1^+$ if there is success in the first period (given by (A.3)), and $\theta_1 = \theta_1^- = 0$ if there is failure in the first period (given by (A.2)). Therefore, for the manager to get funding at $t = 1$ conditional upon the success of the first-period project, it must be the case that:

$$p\left\{\theta_1^+ R_S + (1-\theta_1^+)qR_S\right\} > 1. \tag{6}$$

Note that, (A.6) directly follows from (7) and the fact that $\theta_1^+ > \theta_0$ (which clearly follows from (A.3)). The interpretation of this is that at $t = 1$ we know that the manager will invest in S_G in the second period if he has a G project, and in S_B if he does not have a G project. We know that $\Pr(G) = p$ and $\Pr(B) = 1 - p$, and also that the payoff the manager gets with B is 0. Therefore, in (A.6), p (the probability that the manager has a G project) is multiplied with the expected payoff of a G project with managerial type uncertainty (the expectation is taken over the manager being T or U).

It is also clear that if there is failure at $t = 1$ that the manager will never get funding at $t = 1$, since $\theta_1^- = 0$ and thus that the expected payoff is $pqR_S < 1$ (as a result of (4)). ■

Proof of Proposition 1: Suppose first that the manager has a G project. If he proposes S_G (the good short project), his expected utility will be:

$$\begin{aligned} U_{M,t=0}(S_G) &= w_0 + \beta + \theta_0(w_1^+ + \beta) + [1-\theta_0]\left\{q(w_1^+ + \beta) + [1-q]w_1^-\right\} \\ &= w_0 + \beta + [\theta_0 + (1-\theta_0)q]\,(w_1^+ + \beta), \end{aligned} \tag{7}$$

where q is the probability that an untalented manager will succeed, w_1^+ is the upward-revised wage given that the manager succeeds (see (9)), and w_1^- is the downward-revised wage given that the manager fails in the first period (see (10)). Since $\theta_1^- = 0$, we see that $w_1^- = 0$. Thus, the manager's expected utility at $t = 0$ from an S_G project is a function of his initial wage, his private benefit from taking on the project, and the probability weighting of his type (and how likely he is to succeed given that he is untalented). Similarly, if the manager proposes L_G (the good long project), his expected utility will be:

$$U_{M,t=0}(L_G) = w_0 + \beta + (w_0 + \beta), \tag{8}$$

where in (A.8) $w_1 = w_0$ since there is no new information about the manager's type at $t = 1$, and therefore his wage will not be revised. We want to verify whether $U_{M,t=0}(L_G) > U_{M,t=0}(S_G)$, ie whether it is the case that:

$$w_0 + \beta > [\theta_0 + (1 - \theta_0)q]\,(w_1^+ + \beta). \tag{9}$$

Comparing term by term, since $[\theta_0 + (1 - \theta_0)q] < 1$ we have $\beta > [\theta_0 + (1 - \theta_0)q]\,\beta$. It thus only remains to compare the terms w_0 and $[\theta_0 + (1 - \theta_0)q]\,w_1^+$. Now, using (8) and (9) we have:

$$\theta_0 w_1^+ = \theta_0 \theta_1^+ w^T = \left[\frac{\theta_0}{\theta_0 + q(1 - \theta_0)}\right] \theta_0 w^T = \left[\frac{\theta_0}{\theta_0 + q(1 - \theta_0)}\right] w_0 \tag{10}$$

Thus,

$$w_0 = [\theta_0 + (1 - \theta_0)q]\,w_1^+. \tag{11}$$

From (A.11), it follows that (A.6) holds, and that $U_{M,t=0}(L_G) > U_{M,t=0}(S_G)$. Thus, the manager will always propose L when he has G. Finally, we need to show that the manager will prefer to propose L over the option to propose nothing at all. To see this, note that the utility from proposing L is $U_{M,t=0}(L_G) = w_0 + \beta + (w_0 + \beta)$ and the utility from proposing nothing is $U_{M,t=0}(\varnothing) = w_0 + (w_0 + \beta)$. Thus $U_{M,t=0}(L_G) > U_{M,t=0}(\varnothing)$, so the manager will prefer to propose L. Appendix A: Analysis of the Formal Theoretical Model

Now suppose that the manager has a B project. His expected utility at $t = 0$ from an S_B project is:

$$U_{M,t=0}(S_B) = w_0 + \beta. \tag{12}$$

And the expected utility from an L_B project is:

$$U_{M,t=0}(L_B) = w_0 + \beta + (w_0 + \beta). \tag{13}$$

It is clear that $U_{M,t=0}(L_B) > U_{M,t=0}(S_B)$, so L is better for the manager, given that he has only B. In addition, suppose that the manager proposes nothing at $t = 0$ with B. This would give him utility $U_{M,t=0}(\varnothing) = w_0 + (w_0 + \beta)$ versus proposing L_B, which gives utility $U_{M,t=0}(L_B) = w_0 + \beta + (w_0 + \beta)$. It is clear that $U_{M,t=0}(L_B) > U_{M,t=0}(\varnothing)$, so the manager would prefer to propose L when he only has a B project. ■

Proof of Lemma 4: If the manager has a B project that has a short payback, then his expected utility will be $U_{M,t=0}(S_B) = w_0 + \beta$ from (A.12). If the manager proposes nothing at $t = 0$, then his utility will be $U_{M,t=0}(\varnothing) = w_0 + (w_0 + \beta)$, since he will retain access to the second-period funding. We see now that $U_{M,t=0}(\varnothing) > U_{M,t=0}(S_B)$, so the manager would rather not propose anything than propose a short-term B project. On the other hand, if the manager has a short-term G project, then proposing it at $t = 0$ leads to $U_{M,t=0} = w_0 + \beta + [\theta_0 + (1 - \theta_0)q]\,(w_1^+ + \beta)$ from (A.7). From (A.9) we had that

$w_0 + \beta > [\theta_0 + (1-\theta_0)q]\,(w_1^+ + \beta)$. To show that $U_{M,t=0}(S_G) > U_{M,t=0}(\varnothing)$, we need to show that:

$$w_0 + \beta + [\theta_0 + (1-\theta_0)q]\,(w_1^+ + \beta) > w_0 + (w_0 + \beta). \tag{14}$$

Now, from (A.11) we know that $[\theta_0 + (1-\theta_0)q]\,w_1^+ = w_0$. We thus see that (A.14) is satisfied as long as $\beta > 0$, which holds by assumption. ■

Proof of Proposition 2: The proof requires comparing the NPV from choosing S with the NPV from choosing L. Note that this can be done independently of calculating the dilution in ownership, y, for current shareholders, since a strategy that maximizes fundamental value will also minimize y. The NPV from choosing S (denoted by $\bar{V}_S^{NPV}$) is given by $\bar{V}_S$ minus the unconditional expected investment costs (since the manager may not invest in a short-term project in each period), which are given by $p\{1+\theta_0+q[1-\theta_0]\} - [1-p]\{1\}$. We can write this as:

$$\begin{aligned}
\bar{V}_S^{NPV} &\equiv \bar{V}_S - p\{1+\theta_0+q[1-\theta_0]\} - [1-p]\{1\} \\
&= \bar{A} + p\{\theta_0[R_S + pR_S] + [1-\theta_0]\,q\,[R_S + pqR_S]\} + [1-p]p\,[\theta_0 + q[1-\theta_0]]\,R_S \\
&\quad + \{p[1-\theta_0][1-q] + [1-p]\}\{1\} - 2w_0 - p\{1+\theta_0+q[1-\theta_0]\} - [1-p]\{1\} \\
&= \bar{A} - 2w_0 + p\{\theta_0[R_S + pR_S] + [1-\theta_0]\,q\,[R_S + pqR_S] + [1-p]\,[\theta_0 + q\,(1-\theta_0)]\,R_S\} \\
&\quad + p[1-\theta_0][1-q] + [1-p] - p\{1+\theta_0+q[1-\theta_0]\} - [1-p] \\
&= \bar{A} - 2w_0 + p\{\theta_0[R_S + pR_S + [1-p]R_S] + [1-\theta_0]\,qR_S[1+pq+1-p]\} \\
&\quad - p\,[1+\theta_0+[1-\theta_0]\,[2q-1]]\,.
\end{aligned} \tag{15}$$

The NPV from choosing L (denoted by $\bar{V}_L^{NPV}$) is given by $\bar{V}_L - 2$, since the manager will invest in a project in both periods for sure. Thus, $\bar{V}_L^{NPV}$ is given by:

$$\begin{aligned}
\bar{V}_L^{NPV} &\equiv \bar{V}_L - 2 \\
&= \bar{A} + p\{\theta_0[R_L + R_S] + [1-\theta_0]\,[qR_L + qR_S]\} - 2w_0 - 2.
\end{aligned} \tag{16}$$

We want $\bar{V}_S^{NPV} > \bar{V}_L^{NPV}$, so we want (A.15) to exceed (A.16). That is, after re-arranging terms, we want:

$$\begin{aligned}
2 - p\,[[1-\theta_0]\,[2q-1] + 1 + \theta_0] \;&>\; p\{\theta_0\,[[R_L + R_S] - [R_S + R_S] +]\} \\
&\quad + p\theta_0\,[[1-\theta_0]\,q\,\{[R_L + R_S] - (R_S + R_S[pq+1-p])\}]
\end{aligned} \tag{17}$$

Now, note that the left-hand side in (A.17) is:

$$\begin{aligned}
1-p+1-p\,[\theta_0 + (1-\theta_0)\,(2q-1)] &> 1-p+1-p \\
&= 2(1-p).
\end{aligned} \tag{18}$$

where the inequality follows since $\theta_0 + (1-\theta_0)(2q-1) < 1$. So, for (A.17) to hold it is sufficient that

$$2[1-p] > p\left\{\theta_0 (R_L - R_S) + (1-\theta_0) q \left[R_L - R_S[pq + 1 - p]\right]\right\}, \tag{19}$$

which is guaranteed by (17). The proof of the remaining part of the proposition follows trivially. ■

Proof of Corollary 1: Given that the CEO attempts to maximize firm value (as she will with a low ω), the asymmetric information problem disappears, taking us back to the first-best case. Following from Lemmas 1 and 2, the CEO (who is now proposing the project instead of the manager) will only propose a project if it is G. At $t = 0$, if he receives a G project, he will structure it as an L project. Therefore, a constraint that the project must have a short payback is suboptimal. ■

Proof of Proposition 3: For the short-termism constraint to be preferred to the wage contracting solution, we need the expression in (19) to exceed that in (18). This comparison yields the inequality:

$$(1-p)\beta + (w_0+1)\left[1-\theta_0-(1-\theta_0)q\right] > p\left\{\theta_0 + (1-\theta_0)q\right\}\left[R_L - R_S\right] + (1-q)(1-\theta_0)pqR_S. \tag{20}$$

Clearly, the left-hand side (LHS) of (A.20) is increasing in β, w_0, and the initial investment, whereas the right-hand side (RHS) is increasing in $[R_L - R_S]$. Moreover, if $p = 1$, then:

$$LHS = (w_0+1)\left[1-\theta_0-(1-\theta_0)q\right], \tag{21}$$

$$RHS = \left\{\theta_0 + (1-\theta_0)q\right\}\left[R_L - R_S\right] + (1-\theta_0)(1-q)qR_S, \tag{22}$$

and $\frac{\partial LHS}{\partial \theta_0} < 0$. Moreover, $\frac{\partial RHS}{\partial \theta_0} > 0$ at $q = 0$ and hence by continuity $\frac{\partial RHS}{\partial \theta_0} > 0$ for q small enough. Moreover, comparing (A.21) and (A.22), we see that at $\theta_0 = 1$, the $RHS = R_L - R_S > 0 = LHS$. Thus, payback is dominated at $\theta_0 = 1$. At $\theta_0 = 0$, $LHS = (w_0+1)(1-q)$ and $RHS = q[R_L - qR_S]$. Thus, $LHS > RHS$ for $q = 0$ and hence inequality (A.20) holds for q small enough by continuity, so short-termism dominates at $\theta_0 = 0$. Since $\frac{\partial LHS}{\partial \theta_0} < 0$, $\frac{\partial RHS}{\partial \theta_0} > 0$, short-termism dominates at $\theta_0 = 0$, and wage contracting dominates for $\theta_0 = 1$, it has been proven that short-termism dominates for θ_0 low enough and wage contracting dominates for θ_0 high enough.

Now set $\theta_0 = 1$. Then,

$$LHS = (1-p)\beta \tag{23}$$

and

$$RHS = p[R_L - R_S]. \tag{24}$$

At $p = 1$, $LHS = 0$ and $RHS = R_L - R_S$, so short-termism is dominated. At $p = 0$, $LHS = \beta$ and $RHS = 0$, so short-termism dominates. Now, $\frac{\partial LHS}{\partial p} < 0$. Further, $\frac{\partial RHS}{\partial p} > 0$, and it follows immediately that $LHS > RHS$ at $p = 0$, $LHS < RHS$ at $p = 1$, and the two curves intersect at $p \in (0, 1)$ such that short-termism dominates if p is low enough and wage contracting dominates if p is high enough. ■

Proof of Lemma 5: Given the payoff-contingent wage contract with the γ_1 given in (30) the manager never proposes a B project. Thus, the value of the second-period project is $\mu_G(\mathbb{E}(T_1))$ (see (22)). With just an up-front wage, the value is $p\mu_G(\mathbb{E}(T_1))$ since the manager will propose B if he does not have G. It follows that $\mu_G(\mathbb{E}(T_1)) > p\mu_G(\mathbb{E}(T_1))$ since $p \in (0, 1)$. ■

Proof of Lemma 6: Let $U^i(j \mid k)$ be the expected utility of the manager at $t = 0$ if he proposes the i version of the project with $i \in \{L, S\}$, has a type k project with $k \in \{G, B\}$, and reports $j \in \{G, B\}$. Suppose first that the manager is proposing an S project. Then

$$\begin{aligned} U^S(G \mid G) &= w_0 + c_0^S \left\{\mathbb{E}\left(\tilde{R}\right) - \mu_G(\mathbb{E}(T_0))\right\} + \beta, \\ &\quad + \{\theta_0 + q[1-\theta_0]\} p \{w_1^+ + \beta, \} \end{aligned} \tag{25}$$

where w_0 is the up-front wage at $t = 0$, c_0^S is the payoff-contingent bonus term, β is the first-period private benefit, $\theta_0 + q[1-\theta_0]$ is the probability of success of the G project given the prior belief θ_0, p is the probability of having G in the second period, w_1^+ is the wage if the manager's second-period project is funded (which only happens if the first-period project succeeds), and β in the $\{w_1^+ + \beta\}$ term is the second-period private benefit. Since $\mathbb{E}\left(\tilde{R}\right) = \mu_G(\mathbb{E}(T_0))$, (A.25) simplifies to:

$$U^S(G \mid G) = w_0 + \beta + \{\theta_0 + q[1-\theta_0]\} p \{w_1^+ + \beta\}. \tag{26}$$

Similarly,

$$U^S(G \mid B) = w_0 - c_0^S \mu_G(\mathbb{E}(T_0)) + \beta + w_0, \tag{27}$$

since $\mathbb{E}\left(\tilde{R}\right) = 0$ on B. Further,

$$U^S(B \mid B) = w_0 + p\beta + w_0, \tag{28}$$

since the manager receives no first-period funding when he reports B at $t = 0$, so there is no first-period bonus or private benefit (only the up-front wage w_0). If he receives G in the second-period (probability p), he requests funding and hence a private benefit β. Given that we are taking the second-period reporting game as given, the incentive compatibility is assured and the manager does not ask for funding with B. Since $\mathbb{E}\left(\tilde{R}\right) = \mu_G(\mathbb{E}(T_1))$ in the second period, the bonus term drops out as in (A.26). The second-period up-front wage w_0 is paid unconditionally at $t = 1$.

Incentive compatibility requires that $U^S(B \mid B) \geq U^S(G \mid B)$, so we need

$$p\beta \geq -c_0^S \{\theta_0 R_S + [1-\theta_0] q R_S\} + \beta, \tag{29}$$

where $\mu_G(\mathbb{E}(T_0)) = \theta_0 R_S + [1-\theta_0] q R_S$ has been substituted. Recognizing that the IC constraint is binding and solving (A.29) as an equation yields (32). It is easy to verify that with this c_0^S, $U^S(G \mid G) > U^S(G \mid B)$. The analysis of the L version of the project is exactly the same as the analysis in the text preceding Lemma 5. This is because no information is revealed at $t=1$, so regardless of what the manager reports at $t=0$, the outcome is the same at $t=1$, which means the events at $t=1$ have no effect on the analysis. This is why c_0^L in (31) is the same as γ_1 in (30). ■

Proof of Proposition 4: We can use (15) to write the value of the firm with S. The only difference is that, with payoff contingent contracting, the manager will never propose a B project, which means cash will idle in more states of the world relative to (15). Using V_i^* to designate the value of the firm with $i \in \{S, L\}$, we can write a modified version of (15):

$$\begin{aligned} V_S^* &= \bar{A} + p\{\theta_0[1+p]R_S + [1-\theta_0]q[1+pq]R_S\} \\ &\quad + [1-p]p\{\theta_0 + q[1-\theta_0]\}R_S \\ &\quad + \{p[1-\theta_0][1-q] + 1 - p\} + 2[1-p]^2 - 2w_0. \end{aligned} \tag{30}$$

In comparing this to (15), note that there is an additional term, $2[1-p]^2$, which represents the state in which \$2 idles (no funding in either period), the probability of which is $[1-p]^2$. Similarly, adapting (16), we can write:

$$\begin{aligned} V_L^* &= \bar{A} + p\{\theta_0[R_L + R_S] + [1-\theta_0]qR_L + qR_S\} \\ &\quad + \{[1-p]p + p[1-p]\}\{1\} + [1-p]^2\{2\}, \end{aligned} \tag{31}$$

where the last two terms represent the idle cash states. The probability that the manager will have G in only one period is $[1-p]p+p[1-p]$, and in this state \$1 idles. The probability that the manager will have G in neither period is $[1-p]^2$, and in this state \$2 idles. Simplifying (A.31) yields:

$$\begin{aligned} V_L^* &= \bar{A} + p\{\theta_0[R_L + R_S] + [1-\theta_0]qR_L + qR_S\} \\ &\quad + 2\left[1-p^2\right]. \end{aligned} \tag{32}$$

By comparing (A.30) and (A.32) and recalling that $\bar{\triangle}_0 = \theta_0[R_L - R_S] + [1-\theta_0]q[R_L - R_S]$, it can be shown that $V_L^* > V_S^*$ if (33) holds. Note further that for the right-hand side of (33) to be positive, we need

$$p[1-\theta_0][1-q] > [1-p][4p-1]. \tag{33}$$

Now, we ask if $p > [1-p][4p-1]$ is true? This simplifies to verifying whether $0 > -[2p-1]^2$, which clearly is true. Thus, by continuity, (A.33) will hold for θ_0 and q small enough. That is, with θ_0 and q small enough, the right-hand side of (33) will be positive. Consequently, if $\bar{\triangle}_0$, θ_0, and q are small enough, the inequality in (33) will be reversed (note that the reversal occurs for $\bar{\triangle}_0 = \theta_0 = q = 0$, and hence occurs by continuity for $\bar{\triangle}_0$, θ_0, and q small enough). ■

Proof of Lemma 7: The proof is straightforward, resulting from the discussion preceding the lemma and the previous analysis in Lemmas 5 and 6 and Proposition 4. ■

Proof of Proposition 5: If the CEO cares only about the value of the firm, then she will always want to minimize the firm's wage bill. Because $0 \in supp(f)$, the CEO can always claim that the realized y and x were both zero. If $x > 0$, the manager knows that the CEO is misrepresenting x, but lack of verifiability means that a positive bonus $c_0^L > 0$ cannot be enforced. Consequently, the CEO maximizes ex post firm value by paying $c_0^L = 0$ at $t = 2$. When S is chosen at $t = 0$ and the CEO observes a payoff of R_S at $t = 1$, she will find it subgame perfect to fund the manager's second-period project because this maximizes firm value. The willingness to fund the manager's second-period project perfectly reveals, however, that $x = R_S$ was observed by the CEO. Third-party verification can therefore rely on this inference and require the payment of $c_0^S > 0$ to the manager despite lack of direct observability of x. Given this, the CEO has no incentive to misreport x at $t = 1$. Of course, in the second period, this consideration is absent, so again the CEO will report at $t = 2$ an x that minimizes the firm's wage bill. ∎

References

[1] Acharya, Viral V., Myers, Stewart C., and Raghuram G. Rajan, 2010, “The Internal Governance of Firms”. *Journal of Finance* 66 (3), 689-720.

[2] Aghion, Philippe, and Patrick Bolton, 1992, “An Incomplete Contracts Approach to Financial Contracting”. *Review of Economic Studies* 59, 473-494.

[3] Appel, Ian and Gormley, Todd A. and Keim, Donald B., “Passive Investors, Not Passive Owners”. (December 18, 2014). Available at SSRN: http://ssrn.com/abstract=2475150 or http://dx.doi.org/10.2139/ssrn.2475150

[4] Anderhub, Vital, Werner Güth, Uri Gneezy, and Doron Sonsino. "On the interaction of risk and time preferences: An experimental study." *German Economic Review* 2, no. 3 (2001): 239-253.

[5] Bebchuk, Lucian.A., and J.M. Fried, 2010, “Paying for Long-Term Performance.” *University of Pennsylvania Law Review* 158, 1915-1960.

[6] Benhabib, Jess, Alberto Bisin, and Andrew Schotter. "Present-bias, quasi-hyperbolic discounting, and fixed costs." *Games and Economic Behavior* 69, no. 2 (2010): 205-223

[7] Berkovitch, Elazar, and Ronen Israel, 2004, “Why the NPV Criterion Does Not Maximize NPV”. *The Review of Financial Studies* 17 (1), 239-255.

[8] Beyer, Anne, Guttman, Ilan, and Iván Marinovic, 2014, "Earnings Management and Earnings Quality: Theory and Evidence." Available at SSRN 2516538.

[9] Bolton, Patrick, Mehran, Hamid, and Joel Shapiro, 2011, “Executive Compensation and Risk Taking”. Working Paper, Columbia University, November 3, 2011.

[10] Bolton, Patrick, and David Scharfstein. "A Theory of Predation Based on Agency Problems in Financial Contracting." *American Economic Review* 80, no. 1 (1990): 93-106.

[11] Bolton, Patrick, Scheinkman, José, and Wei Xiong, 2006[a], “Executive Compensation and Short-Termist Behaviour in Speculative Markets”. *Review of Economic Studies* 73 (3), 577-610.

[12] Bolton, Patrick, Scheinkman, José, and Wei Xiong, 2006[b], “Pay for Short-Term Performance: Executive Compensation in Speculative Markets”. *The Journal of Corporation Law* 30 (4), 721-748.

[13] Budish, Eric, Benjamin N. Roin, and Heidi Williams. "Do firms underinvest in long-term research? Evidence from cancer clinical trials." *The American Economic Review* 105, no. 7 (2015): 2044.

[14] Burgstahler, David, and Ilia Dichev, 1997, “Earnings management to avoid earnings decreases and losses”. *Journal of Accounting and Economics* 24 (1), 99-126.

[15] Burgstahler, David, and Michael Eames, 2006, "Management of earnings and analysts' forecasts to achieve zero and small positive earnings surprises". *Journal of Business Finance & Accounting* 33 (5-6), 633-652.

[16] Chen, Jeff Z, 2009, "The Choice between Real and Accounting Earnings Management." Working Paper.

[17] Collins, Daniel W., and S. P. Kothari, 1989, "An analysis of intertemporal and cross-sectional determinants of earnings response coefficients". *Journal of Accounting and Economics* 11 (2), 143-181.

[18] Darrough, Masako N. "Managerial Incentives for Short-Term Results: A Comment." *The Journal of Finance* 42, no. 4 (1987): 1097-1102.

[19] Dechow, Patricia, Weili Ge, and Catherine Schrand, 2010, "Understanding earnings quality: A review of the proxies, their determinants and their consequences". *Journal of Accounting and Economics* 50 (2), 344-401.

[20] DeMarzo, Peter M., and Yuliy Sannikov. "Optimal Security Design and Dynamic Capital Structure in a Continuous-Time Agency Model." *The Journal of Finance* 61, no. 6 (2006): 2681-2724.

[21] Dichev, Ilia D., Graham, John R., Harvey, Campbell R., and Shiva Rajgopal, 2013, "Earnings quality: Evidence from the field". *Journal of Accounting and Economics* 56 (2), 1-33.

[22] Dohmen, Thomas, Armin Falk, David B. Huffman, and Uwe Sunde. "Interpreting Time Horizon Effects in Inter-Temporal Choice." No. 6385. Institute for the Study of Labor (IZA), 2012.

[23] Dutta, Sunil, and Stefan Reichelstein. "Accrual accounting for performance evaluation." *Review of Accounting Studies* 10, no. 4 (2005): 527-552.

[24] Elster, Jon. "Emotions and Economic Theory." *Journal of Economic Literature* 36, no. 1 (1998): 47-74.

[25] Ewert, Ralf, and Alfred Wagenhofer. "Economic Effects of Tightening Accounting Standards to Restrict Earnings Management." *The Accounting Review* 80, no. 4 (2005): 1101-1124.

[26] Fudenberg, Drew, and Jean Tirole, 1995, "A Theory of Income and Dividend Smoothing Based on Incumbency Rents." *Journal of Political Economy* 103 (1).

[27] Frederick, Shane, George Loewenstein, and Ted O'Donoghue. "Time discounting and time preference: A critical review." *Journal of Economic Literature* 40, no. 2 (2002): 351-401.

[28] Giannetti, Mariassunta, and Xiaoyun Yu. "The Corporate Finance Benefits of Short Horizon Investors." Available at SSRN 2723357 (2016).

[29] Gigler, Frank, Chandra Kanodia, Haresh Sapra, and Raghu Venugopalan. "How Frequent Financial Reporting Can Cause Managerial Short-Termism: An Analysis of the Costs and Benefits of Increasing Reporting Frequency." *Journal of Accounting Research* 52, no. 2 (2014): 357-387.

[30] Gompers, Paul, Ishii, Joy and Andrew Metrick, 2003, "Corporate Governance and Equity Prices". *Quarterly Journal of Economics*, 118 (1), 107-155.

[31] Graham, John R., and Campbell R. Harvey, 2001, "The Theory and Practice of Corporate Finance: Evidence from the Field". *Journal of Financial Economics*, 60 (2-3), 187-243.

[32] Graham, John R., Harvey, Campbell R., and Shiva Rajgopal, 2005, "The Economic Implications of Corporate Financial Reporting". *Journal of Accounting and Economics* 40 (1-3), 3-73.

[33] Grenadier, Steven, and Neng Wang, 2005, "Investment Timing, Agency, and Information". *Journal of Financial Economics* 75 (3), 493-533.

[34] Gümbel, Alexander. "Trading on short-term information." *Journal of Institutional and Theoretical Economics JITE* 161, no. 3 (2005): 428-452.

[35] Harris, Milton and Artur Raviv, 1996, "The Capital Budgeting Process: Incentives and Information". *Journal of Finance* 51 (4), 1139-1174.

[36] Hart, Oliver, and John Moore. "Default and Renegotiation: A Dynamic Model of Debt." *The Quarterly Journal of Economics* 113, no. 1 (1998): 1-41.

[37] Hirshleifer, David, Chordia, Tarun, and Sonya S. Lim, 2001, "Firm and Managerial Incentives to Manipulate the Timing of Project Resolution". Dice Center Working Paper No. 2001-4.

[38] Holmstrom, Bengt, 1999, "Managerial Incentive Problems: A Dynamic Perspective". *Review of Economic Studies* 66 (1), 169-182.

[39] Holmstrom, Bengt, and Joan Ricart i Costa, 1986, "Managerial Incentives and Capital Management". *The Quarterly Journal of Economics* 101 (4), 835-860.

[40] Jensen, Michael C., and William H. Meckling, 1976, "Theory of the Firm: Managerial Behavior, Agency Costs and Ownership Structure". *Journal of Financial Economics* 3 (4), 305-360.

[41] Jensen, Michael C., 1986, "Agency Costs of Free Cash Flow, Corporate Finance, and Takeovers". *American Economic Review* 76, 323-329.

[42] Laibson, David, 1997, "Golden Eggs and Hyperbolic Discounting." *The Quarterly Journal of Economics* 112 (2), 443-478.

[43] Lefley, Frank, 1996, "The Payback Method of Investment Appraisal: A Review and Synthesis". *International Journal of Production Economics* 44, 207-244.

[44] Levit, Doron, and Nadya Malenko, "The Labor Market for Directors, Reputational Concerns, and Externalities in Corporate Governance". Working paper, the Wharton School and Boston College, July 2012.

[45] Malenko, Andrey, "Optimal Design of Internal Capital Markets". Working paper, MIT Sloan School of Management, February 2012.

[46] Myerson, Roger B. "Mechanism Design by an Informed Principal." *Econometrica* 51, no. 6 (1983): 1767-1797.

[47] Narayanan, M. P., 1985[a], "Managerial Incentives for Short-term Results". *Journal of Finance* 40 (5), 1469-1484.

[48] Narayanan, M. P., 1985[b], "Observability and the Payback Criterion". *Journal of Business* 58 (3), 309-323.

[49] O'Donoghue, Ted, and Matthew Rabin. "Doing It Now or Later." *The American Economic Review* 89, no. 1 (1999): 103-124.

[50] Osband, Kent, and Stefan Reichelstein. "Information-eliciting compensation schemes." *Journal of Public Economics* 27, no. 1 (1985): 107-115.

[51] Peng, Line, and Ailsa Roell, 2008, "Executive Pay, Earnings Manipulation, and Shareholder Litigation". *Review of Finance* 12 (1), 141-184.

[52] Pike, Richard H., 1996, "A Longitudinal Survey on Capital Budgeting Practices". *Journal of Business Finance and Accounting* 23 (1), 79-92.

[53] Polsky, Gregg D., and Andrew C. W. Lund, 2013, "Can Executive Compensation Reform Cure Short-termism?" *Issues in Governance Studies* 58, 1-8. www.brookings.edu/governance.aspx

[54] Pozen, Robert C., "Curbing Short-termism in Corporate American: Focus on Executive Compensation". *Governance Studies at Brookings*, May 2014.

[55] Rappaport, Alfred, and John C. Bogle, *Saving Capitalism From Short-termism: How to Build Long-term Value and Take Back Our Financial Future*, The McGraw-Hill Companies.

[56] Reichelstein, Stefan. "Providing managerial incentives: Cash flows versus accrual accounting." *Journal of Accounting Research* 38, no. 2 (2000): 243-269.

[57] Shleifer, Andrei, and Robert W. Vishny, 1989, "Managerial Entrenchment: The Case of Manager-Specific Investments". *Journal of Financial Economics* 25 (1), 123-139.

[58] Stein, Jeremy, 1988, "Takeover Threats and Managerial Myopia". *Journal of Political Economy* 95 (1), 61-79.

[59] Stein, Jeremy, 1989, "Efficient Capital Markets, Inefficient Firms: A Model of Myopic Corporate Behavior". *The Journal of Quarterly Economics* 104 (4), 655-669.

[60] Stein, Jeremy C. "Agency, information and corporate investment." *Handbook of the Economics of Finance* 1 (2003): 111-165.

[61] Stulz, Rene M., 1990, "Managerial discretion and optimal financing policies." *Journal of Financial Economics*, 26 (1), pp.3-27.

[62] Thakor, Anjan V, 1990, "Investment 'Myopia' and the Internal Organization of Capital Allocation Decisions". *Journal of Law, Economics, & Organization* 6 (1), 129-154.

[63] Van den Steen, Eric J, 2010, "Disagreement and the Allocation of Control". *Journal of Law, Economics, and Organization* 26 (2), 385-426.

[64] Von Thadden, Ernst-Ludwig. "Long-term contracts, short-term investment and monitoring." *The Review of Economic Studies* 62, no. 4 (1995): 557-575.

[65] Whited, Toni M, 1992, "Debt, Liquidity Constraints, and Corporate Investment: Evidence from Panel Data". *The Journal of Finance* 47 (4), 1425-1460.

[66] Zang, Amy Y, 2011, "Evidence on the trade-off between real activities manipulation and accrual-based earnings management." *The Accounting Review* 87 (2), 675-703.

Table 3-1: Project Payoff Distributions

Project Type	Manager Type	Project Payoff
L_G	T	$R_L > 1$ with probability 1 at $t = 2$, with investment at $t = 0$.
L_G	U	$R_L > 1$ with probability q and 0 with probability $1 - q$ at $t = 2$, with investment at $t = 0$.
S_G	T	• $R_S > 1$ with probability 1 at $t = 1$, with investment at $t = 0$. • $R_S > 1$ with probability 1 at $t = 2$, with investment at $t = 1$.
S_G	U	• $R_S > 1$ with probability q and 0 with probability $1 - q$ at $t = 1$, with investment at $t = 0$. • $R_S > 1$ with probability q and 0 with probability $1 - q$ at $t = 2$, with investment at $t = 1$.
L_B or S_B	T or U	0 with probability 1

Figure 3-1: Timeline of Actions and Events

$t = 0$	$t = 1$	$t = 2$
• A G project arrives with probability p. Manager has access to a B project regardless. • The common prior belief is that the probability is θ_0 that the manager is type T. • Manager may propose an S or L project for the first period. • CEO either accepts or rejects proposed project. • Manager is paid a wage of w_0. • The firm raises financing in the capital market.	• If an S project was proposed, it pays off 0 if it was B. If it was G, it pays off R_S with probability 1 if the manager is T, but with probability q (and 0 with probability $1 - q$) if the manager is U. • Beliefs about the manager's type being T are revised to θ_1. • If an L project was proposed, nothing is observed, and $\theta_1 = \theta_0$. • A G project arrives with probability p. Manager always has access to a B project. • Manager may propose an S project for the second period. • CEO either accepts or rejects proposed project. • Manager is paid a second-period wage of w_1^+ if $\theta_1 > \theta_0$, w_1^- if $\theta_1 < \theta_0$, or $w_0 = w_1$ if $\theta_1 = \theta_0$.	• If an L project was proposed at $t = 0$, it pays off 0 if it was B. If it was G, it pays off R_L with probability 1 if the manager is T, but with probability q (and 0 with probability $1 - q$) if he is U. • If an S project was proposed at $t = 1$, it pays off 0 if it was B. If it was G, it pays off R_S with probability 1 if the manager is T, but with probability q if the manager is U. • The game ends.