Essays on Informational Asymmetries in Mergers and Acquisitions

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Abstract
This dissertation covers issues related to financing in mergers and acquisitions. It studies the relationship between firms' financing conditions and firms' decisions to either buy or sell assets. The first paper, *Cross-border mergers and acquisitions with financially constrained owners*, studies the effects of costly external financing in international asset sales. We propose a cross-border merger model with home biased financially constrained owners in which the subsequent investments of the buyer and seller can be determined. We show that governmental policies blocking foreign acquisitions to protect the domestic industry can be counterproductive and propose "financial efficiency" defense in merger law.

In the second paper, *Misvaluation and financial constraints: method of payment and buyer identity in mergers and acquisitions*, I study how stock price misvaluation and financial frictions affect whether an acquisition occurs between or within industries and whether the acquirer pays in cash or stocks. I set up a model where stock market misvaluation correlates within industries and across industries and assume that managers' have private information regarding their own firm and firms similar to it. The model yields predictions regarding which firm acquires which firm, and the method of payment used in transactions.

The third paper, *Misvaluation and merger activity*, investigates how merger activity varies over time and sectors of the economy. Using data on mergers between publicly traded US firms, I study the role of stock overvaluation on merger activity. I focus on how overvaluation affects mergers occurring within sectors differently from those occurring between sectors and how the effect differs between cash- and stock-financed mergers. The results suggest that marketwide misvaluation does not drive overall merger activity, but that sector-level overvaluation increases the probability that firms conduct stock-financed acquisitions of firms in other sectors. The results indicate that overvaluation affects stock-financed merger activity only if it increases the overvaluation of some firms *relative* to the overvaluation of other firms. An analysis of the acquisition decisions of individual firms support this interpretation.

Key words
Mergers and acquisitions; investments; asymmetric information; stock misvaluation; financial frictions; capital structure; antitrust policy

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Contents

Abstract

This dissertation covers issues related to financing in mergers and acquisitions. It studies the relationship between firms' financing conditions and firms' decisions to either buy or sell assets.

The first paper, Cross-border mergers and acquisitions with financially constrained owners (with Lars Persson and Pehr-Johan Norbäck), studies the effects of costly external financing in international asset sales. Since mergers give acquirers control over the assets of the merged entity and give sellers control over financial assets, selling assets is a way for firms to generate funds for new investments. We propose a cross-border merger model with home biased financially constrained owners in which the subsequent investments of the buyer and seller can be determined. We show that policies blocking foreign acquisitions to protect the domestic industry can be counterproductive. Foreign acquisition can increase domestic owner's investment in growth industries by reducing their financial restrictions. This calls for a "financial efficiency" defense in merger law. We also show that cross-border mergers and acquisitions are partly driven by the seller's alternative investment opportunities.

In the second paper, Misvaluation and financial constraints: method of payment and buyer identity in mergers and acquisitions, I study how stock price misvaluation and financial frictions affect whether an acquisition occurs between or within industries and whether the acquirer pays in cash or stocks. Building on the work of Rhodes-Kropf and Viswanathan (2004), I set up a model where stock market misvaluation correlates within industries and across industries. I assume that managers' private information allows them a better appreciation (than the

market) of their own firm's prospect, but also a better appreciation of the prospects of similar firms. The model yields predictions with regard to which firm acquires which firm, and the method of payment used in transactions, and shows that it is important to distinguish misvaluation affecting the whole market from misvaluation affecting only an industry or a single firm. It also highlights the importance of the assumptions we make regarding managers' information set.

The third paper, Misvaluation and merger activity, investigates how merger activity varies over time and sectors of the economy. Using data on mergers between publicly traded US firms, I study the role of stock overvaluation on merger activity during the period 1986–2007. I focus on how overvaluation affects mergers occurring within sectors differently from those occurring between sectors and how the effect differs between cash- and stock-financed mergers. The results suggest that marketwide misvaluation does not drive overall merger activity. However, sector-level overvaluation increases the probability that firms conduct stock-financed acquisitions of firms in other sectors, but not of firms in their own sector. Looking at the individual firm, the analysis finds that individually overvalued firms are more likely to undertake stock acquisitions of both firms from their own sector and firms from other sectors. These results suggest that overvaluation does not affect stock-financed merger activity if the overvaluation applies simultaneously to both acquirer and target, but it does have an effect if it changes the relative overvaluation of the acquirer and the target.

Keywords: Mergers and acquisitions; investments; asymmetric information; stock misvaluation; financial frictions; capital structure; antitrust policy.
JEL Classification: D21 D61 D92 D82 G31 G34 L40.

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While I was aware of the technical challenge of doing a PhD, I did not appreciate the amount of motivation and stamina needed to finish a thesis. When writing a thesis, moments of joy and excitement often give way to frustration and panic, which eventually turn to triumph and relief. As such, the PhD program *allows* you to develop as a researcher and *forces* you to develop as a person. Speaking personally, none of this would have been possible without the guidance and support of my supervisors, my colleagues, my friends and family.

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Introduction

This thesis investigates how asymmetric information affects the market for corporate assets through firms' ability to finance acquisitions and other investments. Chapter 2 focuses on how borrowing costs interact with investment opportunities to determine which firms divest assets and which firms acquire assets. The chapter also connects this to the effects of governmental restrictions on asset sales. Chapters 3 and 4 study how stock-market misvaluation and borrowing costs affect merger activity. The first two chapters are theoretical and the last chapter is empirical.

The remainder of this introduction lays out the general context of why asymmetric information affects mergers before discussing the thesis' contribution and summarizing the remaining chapters.

1 Asymmetric information in mergers and acquisitions

This thesis focuses on how asymmetric information affects mergers and acquisitions through firms' financing conditions. In their seminal paper, Modigliani and Miller (1958) derive the capital-structure irrelevance theorem, stating that a firm's value is independent of its capital structure. That is, it does not matter whether firms finance their activities through debt or equity. In this perfect world, capital flows freely to where it is most needed. However, in order to arrive at this conclusion, Modigliani and Miller assume there are no taxes, that there exist no agency or

bankruptcy costs, and that all market participants have access to the same information and can borrow at the same interest rate. Alas, the real world is not perfect, and when these assumptions do not hold, firm financing is important, and, hence, do affect merger and acquisition decisions.

Asymmetric information makes raising external funds costly because firms (or their managers) have incentive to use their informational advantage to benefit themselves at the expense of new investors and creditors (e.g., Myers and Majluf, 1984; Gale and Hellwig, 1985). The financial friction created by asymmetric information affects merger activity by influencing decisions to both buy and sell assets. On the selling side, if a firm is unable to raise external funds to finance new investments, an alternative is to sell off existing assets and use the generated cash flow to finance a new undertaking. Empirical studies have shown that this occurs regularly, with asset sales being a strong predictor of high investment levels (e.g. Maksimovic and Phillips, 2001; Hovakimian and Titman, 2006; Warusawitharana, 2008). An alternative for a financially constrained firm is to be acquired by a better-financed firm to finance the new investments through the acquirer's internal capital market (Cestone and Fumagalli, 2005; Erel, Jang, and Wiesbach, 2015). In both cases, selling assets can increase the value of the firm because doing so allows new profitable investments to be undertaken. On the acquiring side, firms might have to choose between different projects. If raising external funds is costly, then making an acquisition may force the acquirer to forego other attractive investments. So financing costs and the alternative use of funds affects the decisions of both the acquirer and the target.

A related question is how acquirers finance the merger itself. That is, how do they reimburse the target firm's shareholders? The most common methods of payment in mergers are cash and stocks, or a mix of the two. Acquirers would prefer to use stocks as payment for several reasons. One reason is that the informational asymmetry goes both ways, so the acquirer is not certain of the quality of the target firm's assets. In this case, paying with stocks works as an insurance against the target's assets being of low quality: Some of the "overpayment risk" (paying too much considering the true quality) is borne by the target's

shareholders. Another reason is to avoid having to pay the capital taxes incurred by the target's shareholders when they sell their shares for cash. Other reasons relate to the acquirer's financing situation. If it is expensive for the acquirer to borrow, then it can escape this cost by paying with stocks. Similarly, if the acquirer knows that its stocks are overvalued, using these as payment might allow them to acquire the target at a discount in terms of their real value.

2 Contributions of the thesis

The thesis contributes to different strands of the literature. Chapter 2 contributes to the theoretical literature on industrial organization and finance, concerning the allocation of capital through asset sales, and relates this to government restrictions on acquisitions. Chapters 3 and 4 contribute theoretically and empirically, respectively, to the literature on merger waves and market timing by studying the effects of stock-market misvaluation. So how do financial frictions and investment opportunities affect who acquires assets and who sells them? Where do the efficiency improvements in capital allocation come from? These questions are at the center of Chapter 2. In a theoretical model, we (the paper is coauthored with Lars Persson and Pehr-Johan Norbäck) model a bargaining game where two firms from two different countries try to decide which of them should sell parts of their assets (i.e. divest) to the other firm, and we use the model to study the welfare implications of government interventions. The chapter contributes to the literature on the welfare aspects of cross-border mergers in international oligopoly markets (see, e.g., Head and Ries, 1997; Horn and Persson, 2001b; Lommerud, Straume and Sorgard, 2004; Neary, 2007), and to the related literature on how cross-border acquisitions differ from greenfield investments in their determinants and welfare implications (e.g., Bjorvatn, 2004; Nocke and Yeaple, 2007, 2008; Mattoo, Olarrega and Saggi, 2004; Norbäck and Persson, 2007, 2008; Raff, Ryan and Stähler, 2005). This literature clarifies how cross-border mergers affect profits and welfare, depending on, for example, trade costs and domestic institutions. We add to this by examining how financial restrictions affect cross-border merger activity and subsequent investment. In particular, we show that

selling domestic assets to foreign owners can increase domestic investment by easing home-biased domestic owners' investment in new industries, thereby increasing domestic welfare. The paper also adds to the literature on endogenous mergers (e.g., Fridolfsson and Stennek, 2005; Horn and Persson, 2001a) by endogenously determining the identities of acquirer and seller in a setting where both firms make sequential investments.

The chapter is relevant for merger policy. First, it adds to the public debate regarding cross-border acquisitions. Many countries try to hinder foreign firms' acquisitions of domestic firms, while promoting (or at least viewing positively) the reverse. We contribute to this debate by showing that policies restricting foreign acquisitions may end up hurting the country itself by reducing investments and preventing an economic restructuring into future growth markets. Second, in most countries, the competition authorities focus on the acquiring side when deciding whether to allow an acquisition. From a welfare perspective, we argue that their scope ought to include the effects on the divesting firm as well because divestitures allow financially constrained firms to increase their investments.

Chapters 3 and 4 study how stock-market misvaluation affects merger activity. Both chapters study the effects of misvaluation on overall merger activity, its differential effect on merger activity between related and unrelated firms, and how it affects the balance between cash and stock payments. Chapter 3 adds to the theoretical literature on misvaluation and mergers (e.g., Hansen, 1987; Fishman, 1989; Eckbo, Giammarino and Heinkel, 1990; Shleifer and Vishny, 2003; Rhodes-Kropf and Viswanathan, 2004). I contribute to this literature by considering what happens if firms' private information extends to firms that are similar to themselves (related firms) in a setting where misvaluation correlates both within and between sectors. In particular, the model predicts that we ought to see more stock-financed mergers between unrelated firms during times when the whole market is overvalued and that overvaluation of a specific sector increases only the likelihood of unrelated mergers, but not that of related mergers. Furthermore, assuming that all firms are variously financially constrained allows me to study how changes in investment opportunities and borrowing costs af-

fect merger activity. In particular, the paper shows that reducing firms' financial constraints will have a greater effect on merger activity when the market is undervalued.

Chapter 4 contributes to the empirical literature on merger waves (e.g., Harford, 2005; Rhodes-Kropf, Robinson and Viswanathan, 2005; Komlenovic, Mamun and Mishra, 2011; Maksimovic, Phillips and Yang, 2013) and payment choice in mergers and acquisitions (e.g., Uysal, 2011; Di Guili, 2013; Eckbo, Makaew and Thorburn, 2016). I contribute to this literature by showing that overvaluation does not affect all types of mergers equally. The main results of the analysis are that marketwide overvaluation has no effect on merger activity, and overvaluation of a specific sector increases only stock-financed acquisitions of unrelated firms. The chapter concludes that misvaluation affects only stock-financed mergers, and it does so by increasing the overvaluation of the acquirer relative to the overvaluation of the target.

3 Papers included in the thesis

The remainder of the thesis is divided into three chapters. All chapters relate to the question of mergers and acquisitions and financial frictions, but each treats the subject differently and is separate from the others. Chapter 2, "Cross-border mergers and acquisitions with financially constrained owners", examines how financial constraints and investment opportunities affect asset divestitures. Chapter 3, "Misvaluation and financial constraints: method of payment and buyer identity in mergers and acquisitions", concerns itself with stock-market misvaluation and how it effects merger patterns when firms have an opportunity cost associated with cash payments. Chapter 4, "Misvaluation and merger activity", the only empirical chapter, studies how misvaluation affects different types of mergers.

Paper I: Cross-border mergers and acquisitions with financially constrained owners

In many countries, there is an ongoing public debate regarding foreign firms acquiring domestic firms' assets. This type of cross-border acquisition is often viewed with skepticism; in some instances, governments even move to block them. On the other hand, most countries view favorably their own firms expanding internationally by acquiring foreign firms. The economic argument underlying this view is that firms exhibit home bias in their investments. While there is merit to this argument (see, e.g., Delgado, 2006; Belderbos, Leten and Suzuki, 2013), we show in this paper that it is incomplete. We construct a model of cross-border mergers with home-biased, financially constrained owners. In the model, two firms decide which of them should divest assets to the other. We show that policies blocking foreign acquisitions (or policies restricting foreign acquirers) to protect the domestic industry can be counterproductive because it reduces the domestic investments in growth industries. The chapter also suggests a "financial efficiency" defense in merger law, where competition authorities also consider welfare effects stemming from increased investments by the seller. The paper is co-authored with Lars Persson and Pehr-Johan Norbäck.

Paper II: Misvaluation and financial constraints: method of payment and buyer identity in mergers and acquisitions

Paper 2 theoretically investigates how stock-market misvaluation and financial frictions affect merger activity, focusing on how it affects whether a merger occurs within or between sectors and whether the acquirer pays in cash or stocks. Building on the work of Rhodes-Kropf and Viswanathan (2004), I set up a model where stock-market misvaluation correlates both within and across industries, but where firms' private information allows them to get a more accurate estimate of firms similar to themselves (firms in the same sector). The model shows the importance of distinguishing between misvaluation that affects the whole market, a specific sector, or an individual firm and of the assumptions made on managers' information. The model predicts that marketwide overvalu-

ation leads to stock-financed merger waves and that these waves are due to increases in unrelated mergers (mergers between sectors). Since managers have better information than the public concerning similar firms, overvaluation of a specific sector causes firms within the sector to undertake more stock-financed mergers of unrelated firms, but it has little effect on mergers within the sector. Lastly, the model predicts that easing financial constraints have a greater effect on merger activity in undervalued stock markets.

Paper III: Misvaluation and merger activity

Using data on mergers between publicly traded US firms during the period 1986–2007, I study the role of stock-market overvaluation on merger activity. To study the effect of "shared" overvaluation (i.e., overvaluation that affects an entire group of firms), I employ and extend the market-to-book decomposition of Rhodes-Kropf, Robinson and Viswanathan (2005). Unlike earlier studies, the analysis distinguishes mergers occurring between related firms (firms in the same sector) from mergers occurring between unrelated firms while simultaneously distinguishing stock-financed mergers from cash-financed mergers. The results suggest that real economic factors, not marketwide misvaluation, drive overall merger activity. Similarly, the analysis finds no relationship between the overvaluation of a sector and within-sector merger activity. However, there is a robust relationship between the overvaluation of a sector and the share of firms in that sector who undertake stock-financed acquisitions of unrelated firms. Looking at the individual firm, the analysis finds that individually overvalued firms are more likely to undertake stock acquisitions of both related and unrelated firms. The results suggest that overvaluation only affects mergers if it increases the acquirer's valuation relative to the target's valuation.

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Paper i

Cross-border mergers and acquisitions with financially constrained owners

with Lars Persson and Pehr-Johan Norbäck

While many countries abolished restrictions on foreigners possibilities to acquire domestic firm during the 1990s and early 2000s, a reversion to a more protectionism view could be observed in the mid of the 2000ths. For instance, in 2005, the rumors about a takeover bid of the French dairy producer Danone by the American company PepsiCo provoked an outcry on the French political arena. A few weeks later, the French government officially proposed to shield ten "strategic" industries, including biotechnologies and secure information systems, from foreign acquisitions. This trend has then continued, in 2010, the Canadian government blocked mining giant BHP Billiton's hostile takeover bid for the fertiliser group Potash Corporation with the motivation that it was not convinced that the deal was in the Canadian interest.[1] In 2013, Archer-Daniels-Midland Co. 's (ADM) A$2 billion takeover of GrainCorp Ltd. (GNC) was blocked by Australia. At the time, Treasurer Joe Hockey remarked, "This proposal has attracted a high level of concern from stakeholders and the broader community. [...] Now is not the right time for a 100 percent foreign acquisition of this key Australian

[1]BBC, November 3 2010. "Canada blocks BHP takeover bid for Potash". http://www.bbc.co.uk/news/world-us-canada-11680181.

business."[2] [3] Still most countries are positive to their domestic firms expanding internationally by acquiring foreign firms.

The main economic argument put forward in the policy debate for why countries prefer their firms being buyers rather than sellers in cross-border merger and acquisitions (M&As) is that corporate owners have a home country bias in corporate decisions such us production and investment. In fact, home country bias is observed in various firm activities, such as in production (Delgado, 2006), trade (Wolf, 2000), and R&D (Belderbos, Leten and Suzuki, 2013). While the argument for favoring domestic corporate ownership has some economic merits, we show in this paper that the argument is incomplete. Indeed, we show that blocking acquisitions by foreign owners (or stimulating foreign acquisitions by domestic owners) can be counterproductive, leading to less investment in the domestic country since less financial capital becomes available to (home biased) domestic corporate owners. Moreover, the blocking might also lead to that less foreign financial capital is "locked into"domestic firm specific assets.

To this end, we develop a theoretical model where firm-level negotiations determine the buyer and seller identities in a cross-border M&A. Firms, either domestic or foreign, are active in a mature international market and possibly also in a new international growth market, and are assumed to have a home bias in the location of their investments. The novel feature of our model is that it captures the fact that a large share of sellers in cross-border M&As is owners that will use the proceeds to undertake other corporate investments. First, a large share of all sellers is conglomerates that divest affiliates.[4] Second, in many countries sellers in cross-border M&As are corporate owner groups (families) that will

[2]Bloomberg, November 29 2013. *ADM's $2 Billion GrainCorp Bid Blocked by Australia.* http://www.bloomberg.com/news/articles/2013-11-28/australian-treasurer-hockey-rejects-adm-takeover-of-graincorpl.

[3]Similar processes have recently taken place in several countries including China, Italy and USA. See: China Daily, August 30 2007, *China adopts anti-monopoly law*; CBC news, September 7 2007, *Canadians worried about foreign takeovers, want action: poll*; International Herald Tribune, Business, September 17 2005, *Bank chief in Italy off EU hook?*; New York Times, April 7 2008, *America for sale, 2 outcomes when foreigners buy factories*; and Graham and Marchick (2006).

[4]See for instance Maksimovic and Phillipps (2002).

use the proceeds to fund other corporate investments.[5] To capture that both buyers and sellers are active in product markets post acquisition, we assume that the two owners (owner groups) are unique in their ability to manage firms and will invest in new assets after the acquisition has taken place. Moreover, we assume that the owners are financially constrained so when they borrow money for new investment the interest rate gets higher the more they borrow.

We use a Nash bargaining solution to determine the surplus division in an acquisition when the roles of buyer and seller are given. However, this will not suffice to determine the buyer and seller identities in the bargaining game. We solve this by applying the equilibrium ownership-structure model proposed by Horn and Persson (2001a) and find that the direction of the sale is determined by the industry structure that gives the highest aggregate post-acquisition profits. This finding has several implications: (i) an owner may sell corporate assets to a less efficient owner if its use of cash to finance other corporate investments compensates for this loss, and (ii) an improved outside investment opportunity for an owner may trigger a corporate sale and may benefit the acquirer through a lower acquisition price.

We then turn to implications for the international investment pattern of the outcome in the acquisition bargaining game. We show that a foreign acquisition increases the domestic firm's investments in the growth industry, while it decreases the investments of the foreign firm. The reason is that the domestic firm's owner will become financially stronger due to the sale of their assets in the mature industry, thereby reducing the financial cost when borrowing to invest in the growth industry. In fact, the domestic country may obtain an increased capital stock even if the foreign owner shuts down domestic production of mature products since the increase in investment in the growth industry may be substantial. The foreign owner on the other hand becomes financially weaker since part of her financial capital is "locked in" the mature industry. The foreign owner will therefore reduce her investment in the growth industry, which will reduce the capital stock in her home country.

We then examine our results implications for (international) merger

[5] See Morck (2005) and Gourevitch and Shinn (2005).

policy. In most countries, an Antitrust Authority (AA) scrutinizes the market for corporate control and has the ability to put restrictions on mergers or outright block them. In most jurisdictions, the AA bases its decision on assessment of whether the merger specific efficiency gains are likely to offset the higher market power enjoyed by the merging firms. The typical assumption is that merger specific efficiencies accrue to the buyer, but as mentioned above, an acquisition can create merger specific financial efficiencies that the seller exploits in other markets. We then establish that a financial efficiency defense in the merger law can improve efficiency by inducing a more efficient use of ownership skills when owners are financially constrained.

An alternative to blocking foreign acquisitions is to put restrictions on shutting down the selling firm's plant in the mature industry. This would preserve jobs in the mature industry while at the same time ensuring a transition to the emerging industry. However, we show that such a policy can be counterproductive. By putting restrictions on the acquiring firm's use of the mature assets, the government will inadvertently reduce the acquisition price, which reduces investment in the growth industry.

The investment strategy of Investor (the largest investment bank in Sweden) in the last decade is an example where the selling of firms in mature industries has led to investments in growth industries in the domestic country. Between 1999 and 2009, Investor almost trebled the share of its portfolio invested in new growth markets, while at the same time it scaled back more traditional investments where it controlled a few very large firms. Of these new investments, 62 percent went to the Nordic region (Investor Annual Report 2001, 2010). Selling to foreign investors does not seem to have affected the number of Swedish employees in these firms in any remarkable way either. For example, the selling of Scania, the most notable of Investor's transactions, has not lead to a decrease in the number employed in their Swedish operations, rather this number somewhat increased over the decade as Investor started to scale down its ownership (Scania Annual Report 2000, 2009).[6] The view that the selling country can be the winner in a giant cross-border M&A was also put forward when Finnish Nokia sold its devices division

[6]The selling of Scania was conducted in several steps, but in 1999 Investor went from contolling 49.3 percent of the votes to contolling only 15.3 percent.

to U.S. Microsoft. Finland's minister for Trade and European Affairs then expressed the view that Finland benefited both from foreign financial capital being locked into Finnish industry specific capital (the devices division) and Finnish corporate owners (Nokia) gets more financial strength from the deal by saying: "We should look at the silver lining [...] From now on we will have two huge information technology giants in Finland." [7][8]

Our paper is related to the literature addressing welfare aspects of cross-border mergers in international oligopoly markets. This literature clarifies how cross-border mergers affect profits and welfare, depending on, for example, trade costs and domestic institutions (See e.g. Head and Ries (1997); Horn and Persson (2001b); Lommerud, Straume and Sorgard (2004); and Neary (2007)). Our paper is also related to the literature on cross-border M&As and greenfield investment which emphasizes that greenfield investments and cross-border acquisitions are not perfect substitutes, and have different determinants and welfare effects. (See, for instance, Bjorvatn (2004); Nocke and Yeaple (2007, 2008); Mattoo, Olarrega and Saggi,(2004); Norbäck and Persson, (2007, 2008); or Raff, Ryan and Stähler (2005). We add to this literature by examining how financial restrictions affect cross-border merger activity and subsequent investment. In particular, we show that selling domestic industry specific assets to foreign owners can increase domestic investment by easing home-biased domestic owner's investment in new industries, thereby increasing domestic welfare.[9]

[7]Bloomberg, September 4 2013. *Finns Mourn Loss of Icon Nokia as Microsoft Takes Over.* http://www.bloomberg.com/news/articles/2013-09-03/finns-mourn-loss-of-icon-nokia-as-microsoft-takes-over.

[8]The Economist, November 23 2013. *Planning the next bounceback.* http://http://www.economist.com/news/business/21590363-after-sale-its-devices-division-microsoft-what-was-once-worlds-biggest.

[9]Norbäck, Tekun-Koru and Waldkirch (2015) examine empirically divestments of foreign affiliates in Swedish multinational firms. They find that larger affiliates are more likely to be divested, but an increase in the relative size of an affiliate reduces the probability of divestiture. These results are broadly consistent with the buyer and seller interacting in order organize their production in a mutually beneficial way, as suggested by this paper. Norbäck, Tekun-Koru and Waldkirch (2015) use a much simplified version of the model in this paper to discuss the empirical results. Their model, however, assumes the identity of the seller to be exogenous and that investments are discrete. Moreover, no policy analysis is conducted. In contrast,

The paper also relates to a small literature on endogenous mergers where "who merges with whom" is the central question and there is an explicit modeling of the acquisition game (see, for instance, Fridolfsson and Stennek (2005), Horn and Persson (2001a) and Kamien and Zang (1993)). We add to this literature by providing a model where the identity of the acquirer and seller can be determined in an environment where both the buyer and seller may make sequential investments. The previous merger literature has shown that access to markets, low production costs, synergies, and market power all drive mergers. We identify another important factor: the sellers need for financial resources to invest in new growth markets. Moreover, we show that a financial efficiency defense in the merger law can improve efficiency by inducing a more efficient use of corporate ownership skills.

The paper adds to the literature that examines the interaction between financial structures and product markets. For example, Brander and Lewis (1986) demonstrated that limited liability commits a leveraged firm to produce more output in the product market since shareholders care more about positive than negative states of the world. Cestone and Fumagalli (2005) show that business groups with efficient internal capital markets may channel resources to either more or less profitable unit. Banal-Estañol and Ottaviani (2006) show that merging firms take both diversification and the strategic effects in to account when determining the optimal contractual split of profits. We add to this literature by showing that differences in financial restrictions and abilities affect the allocation of owner specific ability and industry specific capital in the product market. Finally, the paper relates to the literature on industrial reorganization in the financial literature that shows that changes in owner productivity and cost of new capital can trigger M&A activity, causing more productive owners to buy assets from less productive ones (see Jovanovic and Rosseau (2002); and Maksimovic and Phillips (2002)). We add by showing that financial constraints may affect this pattern by triggering mergers where efficient owners sell industry specific assets to invest in even more productive assets in other industries.

determining the identity of the seller and the buyer, examining the impact on the amount of investments and drawing policy conclusions, are key features in this paper.

1 Cross-border M&As and the market for corporate control: Background

In this section we describe institutional facts on which we will build our model of cross-border M&As and the international market for corporate control and investments. It is well established that cross-border mergers and acquisitions play a key role in the global industrial development and restructuring process. In particular, many studies examine how the change in ownership affects the merged entity's performance.[10] This focus seems motivated in the case of widely dispersed corporate ownership and when the whole firm is sold, since the seller of target firm's shares then likely will not affect firm behavior in other companies post acquisition.

However, there are two reasons why we should also examine the post acquisition behavior of the seller.

First, a large share of all assets sales is affiliate or plant sales that generate a cash flow for the seller. Several studies have documented a relationship between liquidity availability and investments (see, e.g., Fazzari, Hubbard and Petersen, 1988; Hoshi, Kashap and Scharfstein, 1991), and several have found asset sales to be a significant determinant of subsequent investment (e.g. Bates, 2005; Hovakimian and Titman, 2006; Warusawitharana, 2008; Ding, Guariglia and Knight, 2012; and Borisova and Brown, 2013). Maksimovic and Phillips (2001) examine a large sample of U.S. plant-level data for the period 1974-92 observing an active market for corporate assets, with close to 7 percent of plants changing ownership annually through mergers, acquisitions and asset sales in peak expansion years of the economy. Partial firm sales account for more than half of these transactions. The proceeding of these sells is largely used for corporate investments within the divesting firm. Furthermore, after a divestiture, sellers tend to refocus, i.e. they do not reenter the market segment they just divested. Dittmar and Shivdasani

[10] In the finance literature see, for instance, Maksimovic and Phillipps (2002) for theoretical work, and Andrade, Mitchell and Stafford (2001), and Maksimovic and Phillipps (2001), for empirical work.

In the IO literture se for instance Salant (1983) and Farrell and Shapiro (1990) for theoretical work, and Kim and Singal (1993) for empirical work.

(2003) report that divesting firms are usually not closely related to the segment they divest - only in about one eight of all cases are they in the same three-digit SIC. Ahn and Denis (2004) document that corporate focus increases after spin-offs.

Second, a large share of sellers of corporate assets are business groups or families.[11] La Porta, Lopez-de-Silanes and Shleifer (1999) traced the control chains of a sample of 30 firms in each of 27 countries, and documented the ultimate controlling owners and how they achieved control rights in excess of their ownership rights through deviations from the one-share-one vote rule, pyramiding, and cross-holdings. Claessens, Djankov and Lang (2000) carried out a similar task for 2,980 listed firms in nine East Asian countries. They found significant discrepancies between ultimate ownership and control, allowing a small number of families to control firms representing a large percentage of stock market capitalization. Faccio and Lang (2002) examined the ultimate ownership and control of 5,232 corporations in 13 Western European countries, and found that typically firms are widely held (36.93%) or family controlled (44.29%). Widely held firms were more important in the UK and Ireland, family controlled firms in continental Europe.

Consequently, a large share of owners of corporate assets are families or business groups that likely will use the proceeds from the selling of some of their assets in other investments within the family or business group. An example of this is the shift in corporate ownership that has taken place in Sweden over the last two decades. Henrekson and Jakobson (2012) documents that the influence on the Swedish stock market of owner groups and closed end investment funds (who traditionally have specialized in controlling large firms) declined significantly between 1998 and 2010.[12] Moreover, during the last decades several Swedish MNEs

[11] There are two basic models of corporate governance of public firms: (i) dispersed ownership and management control; and (ii) concentrated ownership and private blockholder control. The first model predominates in the Anglo-American world, where common law judicial systems largely govern. The second model, which exists in several varieties, dominates in virtually all other countries (Morck, 2005; Gourevitch and Shinn, 2005).

[12] The so-called Wallenberg group (which includes Sweden's largest investment fund, Investor) held controlling positions in companies accounting for 42 percent of the market cap of the SSE in 1998, but this share declined to 17.1 percent by the

divested affiliates while investing in their core investments in Sweden. For instance, Ericsson divested its mobile phone units to Sony, at the same time expanding its investments in systems in Sweden.

We will now incorporate these features of the international market for corporate control into a model of cross-border M&As and international corporate investment.

2 The Model

Consider a mature market denoted M (which could be a domestic market, regional market or a world market) where firms with different nationalities are competing. Among these firms we *focus* on two: firm h in country H and firm f in country F (define this set as $\mathcal{I} = \{h, f\}$). These firms are already in business in a mature market (e.g. trucks), but wish to expand their line of business in to a distinct/separate emerging market, E (e.g. information technology). We define the set of markets as $\mathcal{M} = \{M, E\}$.[13] Each firm owns existing assets used for production in the mature market, but to become active in the emerging market they need to invest in new assets. We assume that firms exhibit full home bias and therefore make all their new investments in their respective home countries.[14]

We assume the following timing of events: In the first stage firm h (or firm f) can buy its opponent's assets in the mature market. In the second stage, firms invest in new assets in their respective domestic market in

end of 2010. Similarly, the number of SSE-listed companies controlled by the group dropped from 14 to 7 over the same period.

Investor's Annual Report 2010 (p. 10) explicitly states "[...] we evaluate the long-term return potential of all investments. If our assessment shows that the potential of a holding does not meet our requirements, or is higher in another ownership structure, we look to exit the holding." As noted in the introduction, during this period Investor invested heavily in growth markets. Furthermore, most of these new investments went to the Nordic region, indicating a strong home bias.

[13]Note that both markets may have other incumbents. We also remain agnostic regarding the degree of competition in the two markets.

[14]The assumption of home bias does not play any role in the basic model, but it is important when we turn to discussing government intervention.

order to be able to operate in the emerging market (and possibly also restructure their mature assets). In the third, and last, stage, the firms sell their products in the markets they are active and earn profits.

A crucial assumption is that the firms are financially constrained and need to borrow at a *firm specific* interest rate r_i for investment, where it will be assumed that the interest rate is increasing in the amount borrowed. We do not model the underlying mechanism for having an increasing interest rate, but motivate it with previous research dealing with asymmetric information and financial constraints.

The next sections describe the product market interaction, new investment game and the acquisition game.

2.1 Period three: product market interaction

It is in the last stage of the model that firms earn money by being active in product markets. The product market profits will depend on the distribution of asset ownership, given from the investment game in period 2, and the acquisition game in period 1. In each market a firm operates, it earns revenue $R_{im}(x_{im}, \mathbf{x}_{-im}, \kappa_{im})$ that is a function of its own output (x_{im}), the output of all competitors ($\mathbf{x}_{-im}$), and its own capital holdings (κ_{im}).[15] We assume that both firms possess some capital in the mature market (denoted by $\bar{\kappa}_{iM}$), but need to invest in order to operate in the emerging market. New investments can be financed either by drawing on available cash or by borrowing (B_i) to a firm specific interest rate (r_i) that is assumed to be an increasing and convex function of how much the firm borrows. How much they need to borrow depend on the level of investments and the outcome of the first stage acquisition game.[16] In order to focus on investments in the emerging market we assume that neither firm will make any additional investments in the mature market, regardless of the outcome in the acquisition game.[17] Further-

[15] We include production costs in the revenue function.

[16] Allowing the firms to have some initial cash holdings to use for investments or to pay for an acquisition does not change our results, so in order to save unnecessary notation we disregard this aspect.

[17] That is, if an acuisition occurs the acquirer (i) will operate with a capital stock $\kappa_{iM} = \bar{\kappa}_{iM} + \bar{\kappa}_{jM}$ in the mature market, while the seller (j) will have $\kappa_{jM} = 0$ and

more, without loss of generalization we assume $\lim_{\kappa_{iE}\to 0} R'_{iE,\kappa_{iE}} = \infty$ $\lim_{\kappa_{iE}\to\infty} R'_{iE,\kappa_{iE}} = 1$, and $r_i(0) = 1$ to ensure that both firms borrow at least some cash, and to ensure that both firms invest at least some in their respective emerging market. If we let $l = \{h, f, n\}$ be a variable indicating who acquired whose mature ($l = n$ indicating the scenario of no acquisition), and S_l be the cash transferred from buyer to seller, then $B_i(i, S_i, \kappa_{iE}) = \kappa_{iE} - S_i$ is the amount borrowed if i is the buyer, and $B_j(i, S_j) = \kappa_{iE} + S_j$ if j is the seller. The product market profits of the buyer and seller are then[18]

$$\begin{aligned}\Pi_i(\mathbf{x}, \kappa, i, S_i) &= R_{iM}(\mathbf{x}_M,\kappa_{iM}) + R_{iE}(\mathbf{x}_E,\kappa_{iE}) \qquad (1)\\ &\quad -r_i(B_i(\kappa_{iE}, i, S_i))B_i(\kappa_{iE}, i, S_i)\\ \Pi_j(\mathbf{x}, \kappa, i, S_i) &= R_{jE}(\mathbf{x}_E,\kappa_{jE}) \qquad (2)\\ &\quad -r_j(B_j(\kappa_{jE}, i, S_i))B_j(\kappa_{jE}, i, S_i),\end{aligned}$$

where $\mathbf{x}$ and κ are matrices containing output and capital holdings of all firms in both markets.

We may consider the action x_{im} as setting a quantity à la Cournot, or a price à la Bertrand. Letting κ_m be the vector of all firms' capital holdings in market m, we assume there to exist a unique Nash-Equilibrium, $\mathbf{x}^*_m(\kappa_m,l)$, defined as:

$$R_{im}(x^*_{im}, \mathbf{x}^*_{-im} : \kappa_m,l) \geq R_{im}(x_{im}, \mathbf{x}^*_{-im} : \kappa_m,l), \quad \forall x_{im} \in \mathbb{R}_+. \qquad (3)$$

We assume this NE to exist irrespective of whether h and f compete with each other, or against other players in the markets.

From (3), we define the reduced-form profit functions for the buyer and seller as

$$\begin{aligned}\Pi_i(\kappa, i, S_i) &= R_{iM}(\mathbf{x}^*_M(\kappa_M,i), \kappa_{iM}) + R_{iE}(\mathbf{x}^*_E(\kappa_E), \kappa_{iE}) \qquad (4)\\ &\quad -r_i(B_i(\kappa_{iE}, i, S_i))B_i(\kappa_{iE}, i, S_i)\\ \Pi_j(\kappa, i, S_i) &= R_{jE}(\mathbf{x}^*_E(\kappa_E), \kappa_{iE}) \qquad (5)\\ &\quad -r_j(B_j(\kappa_{jE}, i, S_i))B_j(\kappa_{jE}, i, S_i),\end{aligned}$$

not participate in the market anymore. If no acquisition occurs both firms operate using their initial capital level.

[18] For the ease of exposition, we do not write out the expressions for other rivals.

where $\mathbf{x}_M^*$ depends on l (the outcome of the first-stage bargaining game) since it determines the number of firms in the mature market. Froot, Scharfstein and Stein (1993) demonstrated that this type of model can be mapped precisely in to the models of Townsend (1979), and Gale and Hellwig (1985), where lenders need to incur a fixed cost to verify the state of the world. Stein (1998) shows that an appropriately parameterized version of the Myers and Majluf's (1984) adverse-selection model (in which managers choose to issue equity when their private information regarding the state of the world is negative, and debt when it is positive; akin to the "lemon" problem examined by Akerlof (1970)) leads to essentially the same reduced form for firm profits (Stein, 2003). As shown by Kaplan and Zingales (1997), investments in these types of models are weakly increasing in firm wealth, and weakly decreasing in the convexity of borrowing costs.

2.2 Period two: investments

In period 2, firms invest in the emerging market given the outcome of the first period's acquisition game. This investment can be in capacity, R&D or marketing, and we assume that the revenue function (R_{iE}) is increasing and concave in κ_{iE}. We make the standard assumptions that reduced-form revenues, $R_{iE}(\kappa_E)$ decreases in the number of firms in the market, and that for a given number of firms in the market the reduced-form profit $R_{iE}(\kappa_E)$ is decreasing in rivals' investments κ_{-iE} (i.e. investments are strategic substitutes).

We then assume that firms' investment decisions take place simultaneously. Formally, firm i makes its choice $\kappa_{iE} \in \mathbb{R}_+$ to maximize the reduced-form profit, $\Pi_i(\kappa, l, S_l)$. Since we are focusing on investments in the emerging market we rewrite the function as $\Pi_i\left(\kappa_M, \kappa_{iE}, \overline{\kappa}_{-iE}, l, S_l\right)$, where κ_{-iE} denotes investments in new assets by i's rivals. We assume that there are no links between the two product markets and thus we can solve for the owners' optimal investments in each market separately. Note however that we need to take into account the wealth position of the owners.

We assume there to exist a unique Nash-Equilibrium for investments in

the emerging market, $\kappa_E^*(l, S)$ defined by[19]

$$\Pi_i\left(\kappa_M, \kappa_{iE}^*, \kappa_{-iE}^*, l, S_l\right) \geq \Pi_i\left(\kappa_M, \kappa_{iE}, \kappa_{-iE}^*, l, S_l\right) \quad \forall \kappa_{iE} \in \mathbb{R}_+, \quad (6)$$

which fulfills the following first order condition (using Equations (4) and (5))

$$\frac{\partial R_{iE}}{\partial \kappa_{iE}} = r_i(B_i(\kappa_{iE}^*, l, S_l)) + \frac{\partial r_i}{\partial \kappa_{iE}} B_i(\kappa_{iE}^*, l, S_l), \quad (7)$$

since $\frac{\partial B_i}{\partial \kappa_{im}} = 1$.[20]

The condition in equation (7) illustrates the fact that the firm not only has to take the cost of additional capital into account (the first term on the right-hand side), but also has to consider the effect further borrowing will have on the interest rate of all borrowed capital (second term on the right).

After the investment stage the asset ownership of a firm can then take three different shapes, one for each value of l. These are given by

$$\begin{aligned} \kappa_i^*(i, S_i) &= \left(\bar{\kappa}_{iM} + \bar{\kappa}_{jM}, \kappa_{iE}^*(i, S_i)\right), \quad (8) \\ \kappa_i^*(j, S_i) &= \left(0, \kappa_{iE}^*(j, S_i)\right), \\ \kappa_i^*(n) &= \left(\bar{\kappa}_{iM}, \kappa_{iE}^*(n)\right). \end{aligned}$$

Since equilibrium investments are functions of the first-stage acquisition game it follows that the product-market revenue and amount borrowed also reduces to being functions of the acquisition game in equilibrium: $R_{iE}\left(\kappa_E^*(l, S_l)\right) \equiv R_{iE}\left(l, S_l\right)$, and $B_i(\kappa_{iE}^*(l, S_l), l, S_l) \equiv B_i(l, S_l)$. This allows us to define $\Pi_i(l, S_l) \equiv \Pi_i(\kappa^*\left(l, S_l\right), l) \equiv \Pi_i(\mathbf{x}^*(\kappa^*\left(l, S_l\right)), \kappa^*\left(l, S_l\right), l))$ as a reduced-form profit function for firm i with ownership l in the mature market, encompassing the firms' optimal actions in period three, $\mathbf{x}^*$, and optimal investments in new assets in period two, κ^*.

[19] Notice that h and f may, or may not, be competitiors on the emerging market.

[20] We have then used (3) in the form $\frac{\partial R_{im}(x_{im}^*, \mathbf{x}_{-im}^*: \kappa_m, l)}{\partial x_{im}} = 0$.

2.3 Stage one: the acquisition bargaining game

In case of an acquisition, the foreign firm f and domestic firm h negotiate over the price to be paid. Given the equilibria in the investment and product market stages, we had that $\Pi_i(l, S_l)$ is the reduced-form of a firm's total profits. The surplus can not be divided after the realization of profits in stage three, rather, any division is realized though the acquisition game's effect on stage three profits. That is, choosing who will acquire whom (l) and to which price (S_l) will determine the firms' profits in the product-market stage.

A condition for there to be a sale, is that both firms benefit from it. We denote the set of bids acceptable to i as A_i, which means

$$A_i(l) = \{S_l \in \mathbb{R}_+; \Delta\Pi_i(l, S) \geq 0\}\,,\ i, l = \{h, f\}, \tag{9}$$

where $\Delta\Pi_i(l, S_l) = \Pi_i(l, S_l) - \Pi_i(n)$ for $l = \{h, f\}$.

If we define the lowest possible S accepted by the seller (j) as $\underline{S}$ and the highest price the buyer (i) is willing to pay as $\bar{S}$ then we can write[21]

$$A_j(i) = (\underline{S}, \infty), \tag{10}$$
$$A_i(i) = (-\infty, \bar{S}). \tag{11}$$

The set of possible outcomes then becomes

$$A(i) = A_j(i) \cap A_i(i). \tag{12}$$

Thus, for $A(i)$ to be non-empty we must have $\underline{S} \leq \bar{S}$, which puts restrictions on the convexity of costs as well as the shape of the demand in the two markets. Since we are interested in the effects a partial acquisition has, we will assume this condition to be fulfilled for some i (i.e. there is at least one direction of sale that is profitable for both firms).

[21] That is, $\underline{S}$ and $\bar{S}$ solves $\Delta\Pi_i(l, S) = 0$ for l equalling j and i respectively. These bounds are well defined and unique according to (13)-(15).

It is worth noting the following regarding our reduced-form profits,

$$\frac{dR_{iE}(j,S_j)}{dS_j} > 0, \frac{dr_i(j,S_j)}{dS_j} < 0 \Longrightarrow \frac{d\Pi_i(j,S_j)}{dS_j} > 0, \tag{13}$$

$$\frac{dR_{iE}(i,S_i)}{dS_i} < 0, \frac{dr_i(i,S_i)}{dS_i} > 0 \Longrightarrow \frac{d\Pi_i(i,S_i)}{dS_i} < 0. \tag{14}$$

$$\frac{d^2\Pi_i(j,S_j)}{dS_j^2}, \frac{d\Pi_i^2(j,S_j)}{dS_j^2} < 0 \tag{15}$$

If a firm sells (buys) assets, then the increase (decrease) in liquidity decreases (increases) the interest paid on further loans. The change in interest rates will affect the amount of investments undertaken by a firm according to equation (7), and, since it is assumed that product market profit in the emerging market (R_{iE}) is an increasing and strictly concave function of κ_{iE}, product market profit (R_{iE}) will be affected positively (negatively) for the seller (buyer).[22] From this the result in equation (13) and (14) follows. Since there are diminishing marginal returns to investments (R_{iE} is concave), and since further borrowing increases the interest rate (r_i) a firm pays, both profit functions are concave in the sale price: the more the buyer needs to pay, the more lucrative investments it needs to forego, while the new investments it allows the seller to undertake will have a lower return than previous ones.

Equations (9)-(14) define the negotiation problem: even if it is in both firms' interest to come to an agreement, they are still rivals when it comes to distributing the realized surplus from an acquisition, and it is this distribution the firms bargain over by negotiating S_l.

The sale price is determined by Nash-bargaining with equal bargaining power, so the solution (NBS) to any the bargaining game is given by the sale price

$$S_l^* = \arg\max_{S_l} \left[\Pi_i(l,S_l) - \Pi_i(n)\right]\left[\Pi_j(l,S_l) - \Pi_j(n)\right]. \tag{16}$$

[22]The product market profits in the mature market are unchanged due to our simplifying assumption that no further investments are undertaken in this market.

However, this only gives the solution for one direction of sale, meaning that we will have two solutions to pick from: one where h acquires f, and one where f acquires h.

3 Who acquires whom and why?

In this section we begin by solving the bargaining game (determining the price and direction of an acquisition), as well as making some statements about the characteristics of buyers and sellers.

Before we can proceed with any further analysis, we must clarify the problems of who buys whom, at which price, and why. Solving the problem postulated in (16) yields the following condition:

$$\frac{\frac{\partial \Pi_j(i,S_i^*)}{\partial S}}{\Pi_j(i,S_i^*)-\Pi_j(n)} = -\frac{\frac{\partial \Pi_i(i,S_i^*)}{\partial S}}{\Pi_i(i,S_i^*)-\Pi_i(n)}. \tag{17}$$

As we will see, there is a unique solution to (17), but the outcome will differ depending on who acquires whom. From equations (13)-(15) it follows that the NBS in (17) is unique for a given ownership $l = \{h, f\}$, but the outcome may differ depending on who acquires whom. To determine the identity of the buyer and seller is not possible in the standard Nash Bargaining framework since the bargaining set will then not be convex since we then add two separate convex sets. Moreover, the disagreement points will not be well defined. These can either be the market structure with no merger or the market structure with the alternative merger. The theory cannot be used to determine which is appropriate.

We therefore make use of a cooperative endogenous ownership model developed by Horn and Persson (2001a) which compares the stability of different possible ownership structures, i.e. different ownership of the corporate assets in the two industries we study. The ownership model has three basic components: (i) a specification of the owners possibility to move between two ownership structures determining whether one ownership structure dominates another; (ii) a criterion for determining

when the owners prefer the former structure over the latter; and (*iii*) a stability (solution) criterion that selects the ownership structures on the basis of all pairwise dominance rankings. The basic implication of the model is that ownership structures with high aggregate industry profits tend to be the equilibrium ownership structures. The reason is that ownership structures with low aggregate industry profits tend to be unstable since some owners then have strong incentives to deviate to other possible ownership structures.

In our two owner set-up we can use the following result from Horn and Persson (2001a):

Lemma 1. *With two owners the equilibrium ownership structure will be the one which give rise to the highest aggregate profits. (Horn and Persson (2001a))*

Using Lemma 1 we can state the following Lemma.

Lemma 2. *(i) The direction of sale (l^*) is unique, and the acquisition price (S_l^*) is unique and determined by equation (17).*

Proof. In general, if the firms are not identical the aggregate post-acquisition profit will depend on who acquires whom, i.e. $\Pi_i(i, S_i^*) + \Pi_j(i, S_i^*) \neq \Pi_i(j, S_j^*) + \Pi_j(j, S_j^*)$. Thus the stability criterion will give us a unique solution.

That the acquisition price is unique follows from the first-order condition in (17) and the properties of $\Pi_i(l, S_l)$ given in (13)-(15). By (13) and (15) the left-hand side of (17) is decreasing in S_i for all $S_i \in \mathbb{R}_+$, while (14) and (15) implies that the opposite is true for the right-hand side. Then, the left-hand side tends to infinity and the right-hand side goes towards a positive real number when S_i approaches $\underline{S}$, and vice versa when when S_i approaches $\bar{S}$. Thus, provided that the acceptance set $A(i)$ is non-empty, equation (17) has a unique solution. □

We can now use this Lemma to derive predictions on the identity of the acquirer. To this end we define efficiency of ownership of an asset as

how much profit an owner can generate from operating the asset. We can then state the following result:

Proposition 3. *(i) All else equal, a firm will be the acquirer if it is a more efficient owner of assets in the mature market. (ii) All else equal, a firm is more likely to be the acquirer if it has sparse investment opportunities in the new market.*

This result follows directly from Lemma 1 and Lemma 2: if a firm becomes a more efficient owner of the mature assets (i.e. can extract more profits from its operation) the aggregate industry profit will increase if it acquires the old assets. Equivalently, if a firm's investment opportunity as a seller decreases, an acquisition by the rival becomes less profitable. Given that the magnitude of the advantage in a sector is proportional to the size of the market, then Lemma 2 and Proposition 3 are also consistent with the findings of Maksimovic and Phillips (2001) that firms with several divisions tend to focus on their core activities when these experience positive demand shocks, and diffuse their focus under negative demand shocks.

However, it is not only the absolute efficiency of ownership that matters, but also the relative efficiency of ownership, as shown by the following proposition:

Proposition 4. *(i) Even though one firm is a more efficient owner of assets in the mature market, it will not be the acquirer, if it is even more efficient owner of new assets. (ii) Even though one firm is a more efficient owner of assets in the mature market, it will not be the acquirer, if its access to cash triggers a sufficient increase in investment in the new market.*

Proposition 4 follows directly from Lemma 2: a firm might be a more efficient owner of the mature assets (i.e. they can extract more profits from its operation) but makes sufficiently greater use of extra liquidity so that the solution l^* that maximizes aggregate profits is the inefficient owner. For example, consider the extreme case where h can produce at constant marginal cost c operating as a monopolist in the mature industry, while the corresponding figure for f is $c + \varepsilon$. Furthermore,

assume that h is (for any reason) restrained from borrowing for new investments even though management has projects they know have positive net present value (NPV), while f can borrow at zero interest but has no positive NPV projects. In this case there will exist $\varepsilon > 0$ where total surplus from the acquisition (which would here consist of the NPV of new projects undertaken by h, and the difference between duopoly and monopoly profits in the mature sector) is such that both firms are better off with f as the acquirer, even though the running of the mature industry could be better handled by h. That both firms are better off follows from the equilibrium price being sufficiently lower when h is the seller rather than the buyer. Note that the case where i is assumed to be disadvantaged in the money market is isomorphic to the case where i has greater investment opportunities in the emerging sector; either way cash is more useful.[23]

It then follows that the sale might allocate financing to the owner that can use the financing in the new market more efficiently, such that the increase in profit in the new market compensates for a merger loss in the mature market. Thus, we can state the following result:

Corollary 5. *A merger might take place even though the combined profit of the merged entities in the mature market is lower post-transaction than the sum of the entities' profits pre-transaction in the mature market.*

This phenomenon has been found in the empirical literature, however, it has then been viewed as an indication of managers' preferences for empire building, not as a rational consequence of profit maximizing behavior. If the profits for the merged enity is lower post-transaction than pre-transaction, then the selling price must be below the value that the seller derived from the assets. This is possible because the seller has sufficiently good use of the cash it receives to allow it to part from its mature assets at a discount. Officer (2007) documents that firms who divest and obtain cash payments tend to be credit constrained, and that assets are typically sold at an increasing discount when external capital is more expensive to the divesting firm.

[23] Of course this only refers to the problem of deciding the direction of a sale and distributing realized surpluses, not if we, for example, were to consider the effects on consumers and lenders.

3.1 Domestic investment effects of cross-border acquisitions

Let us now examine the investment effects of a cross-border acquisition. Suppose that an acquisition occurs in the mature industry where the acquiring firm shuts down production in the selling country and both firms invest new capital only in their respective domestic countries, i.e. complete home bias. The shut-down of production in the mature industry causes a loss of jobs in the seller's country which may warrant restrictions on the acquisition, or even an outright prohibition of the merger. We first examine a prohibition of the merger.

Note that the cost of any given investment level in stage two will depend on how much a firm needs to borrow in total to invest said amount. Since the selling firm receives cash, it can use this to finance part of its new investments. In fact, since the value of a unit of cash is 1, while the return to investment is strictly greater than 1, it will invest all cash it receives from selling its mature assets. The seller will still borrow money for investments; however, since there are decreasing marginal returns to investments, it will not borrow as much as before. The opposite holds for the buyer: any given level of investments now entails higher borrowing (since it will also have to borrow to finance S) and thus a higher marginal cost of capital, so it reduces its investments in the emerging market.

Under the standard assumption that investments are strategic substitutes, the cost for investing in the emerging market increases for the acquirer, while it decreases for the selling firm. Thus, the selling firm can commit to larger investment in the emerging market, whereas the acquirer will reduce its investment. It follows that given that there is a home bias for investments in the domestic market for serving the emerging market, total investments in country h can increase even if production is shut-down in the mature market after the merger, if $\kappa^*_{iE}(j) - \kappa^*_{iE}(n) > \bar{\kappa}_{iM}$.

Proposition 6. *If an acquisition occurs in the mature market, (i) this increases the seller's investments in the emerging market $\kappa^*_{jE}(i) > \kappa^*_{jE}(n)$, while reducing the investments in the emerging market by the acquiring firm $\kappa^*_{iE}(i) < \kappa^*_{iE}(n)$, and (ii) the selling country may face an increased capital stock even if production of mature products is shut down, i.e.*

$\kappa^*_{iE}(j) - \kappa^*_{iE}(n) > \bar{\kappa}_{iM}$ *may hold.*

Proof. We can rearrange (7) as $0 = R'_{iE,\kappa_{iE}} - r_i - r'_{i,B_i}B_i$, where the second subscript refers to the variable of differentiation, and unnecessary notation has been suppressed. Implicitly differentiation yields

$$\begin{aligned}\frac{d\kappa^*_{iE}}{dS} &= -\frac{-r_{i,B_i}B'_{i,S_l} - r''_{i,B_iB_i}B'_{i,S_l}B_i - r'_{i,B_i}B'_{i,S_l}}{R''_{iE,\kappa_{iE}\kappa_{iE}} - r'_{i,B_i}B'_{i,\kappa_{iE}} - r''_{i,B_iB_i}B'_{i,\kappa_{iE}}B_i - r'_{i,B_i}B'_{i,\kappa_{iE}}} \\ &= \frac{\left(r_{i,B_i} + r''_{i,B_iB_i}B_i + r'_{i,B_i}\right)B'_{i,S_l}}{R''_{iE,\kappa_{iE}\kappa_{iE}} - \left(r'_{i,B_i} + r''_{i,B_iB_i}B_i + r'_{i,B_i}\right)B'_{i,\kappa_{iE}}}.\end{aligned}$$

The denominator is negative for both buyer and seller, but the sign of the nominator is determined by the sign of B'_{i,S_l}. If i is the seller ($l = j$), then $B'_{i,S_l} = -1$, making the nominator negative and the whole expression positive. If i is the buyer ($l = i$), then $B'_{i,S_l} = 1$, and the expression becomes negative. Note that the magnitude of the denominator is larger than that of the nominator, so $\left|\frac{d\kappa^*_{iE}}{dS}\right| < 1$.

For (ii) it suffices to note that even though κ_{iE} affects profits in the emerging market, the way they it does so is in conjunction with parameters regarding the demand functions. Hence we will always be able to find parameter values for which (ii) holds true. □

It can be worth noting that the same reasoning can be carried over to the case of employment: if the emerging sector is more labor intensive than the mature sector (which is not unlikely if we look at the current shift away from manufacturing towards services and information), then the acquisition by a foreign competitor can have *positive* net effects on domestic employment.

4 Merger Policy and a financial efficiency defense

Let us now turn to the implications of our findings for (international) merger policy. In most countries, the market for corporate control in

concentrated markets is scrutinized through merger control by an Antitrust Authority (AA). When evaluating a merger, Antitrust Authorities in most jurisdictions try to estimate whether efficiency gains are likely to offset the higher market power enjoyed by the merging firms.

The US merger guidelines, on this point, read: "[T]he merging firms must substantiate efficiency claims so that the Agency can verify by reasonable means the likelihood and magnitude of each asserted efficiency, how and when each would be achieved (and any costs of doing so), how each would enhance the merged firm's ability and incentive to compete, and why each would be merger-specific. Efficiency claims will not be considered if they are vague or speculative or otherwise cannot be verified by reasonable means."(US Department of Justice and US Federal Trade Commission, 1997, Section 4).

More specifically, the US guidelines 2010 states on page 30 that "[T]he Agencies will not challenge a merger if cognizable efficiencies are of a character and magnitude such that the merger is not likely to be anticompetitive in any relevant market", and note 14 states that "[T]he Agencies normally assess competition in each relevant market affected by a merger independently and normally will challenge the merger if it is likely to be anticompetitive in any relevant market. In some cases, however, the Agencies in their prosecutorial discretion will consider efficiencies not strictly in the relevant market, but so inextricably linked with it that a partial divestiture or other remedy could not feasibly eliminate the anticompetitive effect in the relevant market without sacrificing the efficiencies in the other market(s). Inextricably linked efficiencies are most likely to make a difference when they are great and the likely anticompetitive effect in the relevant market(s) is small so the merger is likely to benefit customers overall."

Similarly, the following section was adopted into the 2004 European horizontal merger guidelines: "The Commission considers any substantiated efficiency claim in the overall assessment of the merger. It may decide that, as a consequence of the efficiencies that the merger brings about, there are no grounds for declaring the merger incompatible with the common market pursuant to Article 2(3) of the Merger Regulation. This will be the case when the Commission is in a position to conclude on

the basis of sufficient evidence that the efficiencies generated by the merger are likely to enhance the ability and incentive of the merged entity to act pro-competitively for the benefit of consumers, thereby counteracting the adverse effects on competition which the merger might otherwise have. (Commission of the European Communities, 2004, Paragraph 77).

The typical assumption is that these merger specific efficiencies must be used by the buying owners. However, as shown in the above analysis, an acquisition can create merger specific financial efficiencies that the selling owners exploit in other markets. These are investments that would not take place absent the merger, and are thus merger specific investments (efficiencies).

To proceed assume that the two markets, mature and emerging, are both located in the domestic country and that we have an active Antitrust Authority (AA) in the domestic country. The AA is maximizing the consumer surplus CS. Following Motta and Vasconcelos (2005) supposing that the Antitrust Authority is forward looking such that it considers whether other mergers may occur if a merger is blocked or allowed and that it accounts for the implications of such alternative mergers on the consumer surplus.

Consider now our set-up with a competition authority that maximize consumer surplus in the two markets, the mature market CS_M and the emerging market CS_E. We then compare two policies (i) merger policy without a financial efficiency defence and (ii) merger policy with a financial efficiency defence. We can then state the following result:

Proposition 7. *A merger policy without a financial efficiency defence will lead to lower expected total consumer welfare in the two markets than a merger policy with a financial efficiency defence*

The proposition follows directly from the observation that being able to make the decision contingent on more variables implies that the AA can "credibly" commit to a better policy. Since the AA can block mergers leading to worse outcomes for consumers, consumer welfare must increase from this possibility. This occurs through two distinct mechanisms:

Corollary 8. *From a consumer perspective, a merger policy with a financial efficiency defence can improve the merger market by allocating ownership efficiently between different markets, particularly when the risk premium is high in the economy.*

To see this consider a merger policy without a financial efficiency defence. Then consider a merger where the foreign firm proposes to acquirer the domestic owner's firm in the mature market and that this merger creates small synergies in the merged entity such that consumer prices will increase slightly due to the proposed acquisition. The AA will then block the merger. But, if the acquisition was allowed, the domestic owner would use the acquired financial strength to expand its investments in the local emerging market to such an extent that the consumer surplus there would substantially increase. This follows immediately from Proposition 6 and the assumption that consumer surplus increases in firm capital stock, i.e. $\frac{\partial CS_m}{\partial \kappa_{im}} > 0$. Under the merger policy with a financial efficiency defence the proposed acquisition will then go through and total consumer surplus in the domestic country (i.e. the sum of the domestic consumer surplus in the two markets) would increase even though the consumer surplus in the mature market decreases due to the market power effect.

Moreover, a proposed acquisition by the domestic owner acquiring the foreign owner's assets in the domestic market might be blocked under the merger policy with a financial efficiency defence since the ensuing expansion in the emerging market by the foreign owner will take place in the foreign market benefitting foreign consumers. This also follows immediately from Proposition 6 and the assumption that consumer surplus increases in the firm's capital stock.

The general insight from this exercise is that a merger policy with a financial efficiency defence can improve the merger market by inducing a more efficient use of ownership skills when owners are financially constrained.

One of the main obstacles to using a merger policy with a financial looking efficiency defence is asymmetric information problems. Firms that propose to merge are privately informed about merger-specific efficiencies. This enables the firms to influence the merger control procedure

by strategically revealing their information to an antitrust authority. (Heidhues and Lagerlöf (2005)). However, financial efficiencies should be easier to prove since information about a firm's borrowing conditions is easier to verify.

Another issue is that the actual investment has to take place after the acquisition has been approved, and it raises the concern how the merger authority can make sure that the investments actually take place. In principal, one can think about investment guarantees by the seller similar to divestitures by the buyer used in merger cases. But in practise this seems inefficient due to the long time horizon and associated information problems in new investments. Thus the competition authority has to judge if the investment argument is rational from an ex-post perspective.

It should be noted that the need of a financial efficiency defense will be less relevant in countries and in times with well-functioning financial markets. The reason is that the potential seller then could borrow for its new investments at lower interest rates and thus has less need of cash. It then follows that in aftermath of the financial crises a financial efficiency defence might be of importance for the industrial restructuring process.

4.1 Example: The European Commission Blocks the Merger of Three and O2

While there are several studies documenting the relationship between asset divestitures and investments (e.g. Hovakimian and Titman, 2006; and Borisova and Brown, 2013), we do not observe what the divesting firms would have done in cases where the divestiture would have been blocked.

In the introduction, we mentioned the Swedish case of Investor, where the authorities blocked the divestiture of Scania to Volvo but later approved the sale to Volkswagen. In this case, it seems likely that the sale of Scania to Volkswagen generated new investments by Investor. But the potential increase of investments by Investor was not considered by the competition authorities in the Volvo-Scania case when they evaluated the proposal . A financial efficiency defense could therefore have

been warranted. Another example that potentially calls for a financial efficiency defense is the blocked divestiture of Telefónica's cellphone operator O2 to Hutchinson Whampoa in 2015.

In March 2015, the large telecommunications and broadband company Telefónica announced a deal to sell the British cellphone operator O2 to Hong Kong based Hutchinson Whampoa. Hutchinson Whampoa planned to merge the O2 with its cellphone operator Three, creating the largest cellphone provider in Great Britain with around 41 percent of all subscribers.[24] However, the European Commission blocked the merger citing competition concerns; fearing increased consumer prices, negative effects on virtual operators (operators without their own communication networks), and less investments in mobile network infrastructure. In the end, the European Commission blocked the deal when they found no appropriate remedies to solve the problems created by the merger.[25]

The defense of the deal focused on Hutchinson Whampoa who argued that the deal would benefit consumers by increasing coverage, network capacity and speed, and encourage (rather than discourage) investments in Great Britain's digital infrastructure (BBC, May 11 2016). [26] However, looking at Telefónica, it seems as the deal was part of broader restructuring plans. O2 would not have been the first operation Telefónica divested. Telefónica previously divested similar companies in both the Czech Republic and Ireland, and the sale of O2 was motivated by rivals in the United Kingdom being able to offer packages combining phone subscriptions with television and internet services, something Telefónica was not able to do. [27] Instead, Telefónica planned to invest further into key markets in Spain and Latin America, where they planned to offer

[24]Wall Street Journal, March 24 2015. *Telefónica agrees to sell O2 for $13.83 billion* http://www.wsj.com/articles/telefonica-agrees-to-sell-o2-for-13-84-billion-1427217528.

Financial Times, January 21 2015. *Telefónica seeks O2 engagement.* http://www.ft.com/content/3221c1cc-9fe3-11e4-aa89-00144feab7de.

[25]EU Press Release, May 11 2016. http://europa.eu/rapid/press-release_IP-16-1704_en.htm

[26]BBC, May 11 2016. *EU blocks Three's takeover of O2.* http://www.bbc.com/news/business-36266924.

[27]Wall Street Journal, March 24 2015. *Telefónica Agrees to Sell O2 for $13.83 billion.* http://www.wsj.com/articles/telefonica-agrees-to-sell-o2-for-13-84-billion-1427217528.

a wider range of services, and it was expected to invest a large portion of the newly acquired funds in the German market, possibly with the intention of introducing a new type of mobile SIM card.[28]

Summing up, it is possible that a merger between Three and O2 could have generated an increase in consumer welfare even if competition in Great Britain deteriorated, because Telefónica's financial position would have been strengthened. That is, it is possible that the sale would have generated sufficiently high new investments in Spain and Germany so that the total consumer surplus in the European Union would have increased.

4.2 Employment and investment guarantees

In practise some governments not only use competition law to affect outcomes in the merger market but also use different types of industrial policies. Indeed, governments sometimes use employment and investment guarantees when foreign firms invest. Proposition 6 hints at a policy which would put restrictions on shutting down the selling firm's plant in the mature industry might be preferred to blocking the merger. This would preserve jobs in the mature industry while at the same time ensure a transition to the emerging industry. However, such restriction will reduce the acquisition price, which in turn will affect the level of new investments in the emerging market.

To see this, let ϕ be a restriction measuring how much of the sold assets, $\bar{\kappa}_{iM}$, that have to be used after the acquisition. It is reasonable to assume that such restrictions will reduce the efficiency of the industry so that profits in the mature industry are decreasing in ϕ. This implies that the gains from an acquisition in the mature industry, which we denote $\Delta\Pi_M(l,\phi)$,[29] are also decreasing in ϕ. However, if the gains from

[28] Financial Times, February 25 2015. *Telefónica promises sharper focus will bring return to growth.* https://www.ft.com/content/6ac49a4e-bcc2-11e4-a917-00144feab7de.

The Corner, March 27 2015. *Telefónica to focus attention on German market after O2 UK sale.* http://thecorner.eu/companies/telefonica-focus-attention-german-market-o2-uk-sale/44791/.

[29] Formally we have $\Delta\Pi_M(l,\phi) = R_{iM}(l) - R_{iM}(n)$ since neither firm is assumed

the acquisition are affected, so is the sales price S_l^*. This in turn implies that investments in stage 2 will be affected since capital costs will be affected (Proposition 6).Thus, there is a spillover from the profitability of the merger in the mature industry to the profitability in the emerging industry through capital costs affecting firms investments in the emerging market.

Rewriting (17) and defining this as a function $\Lambda(l, S_l^*(\phi), \phi) = 0$, we can use the implicit function theorem to arrive at the following lemma:

Lemma 9. *The sale price is strictly decreasing in the degree of government restriction.*

Proof. According to the implicit function theorem $\frac{dS_l^*}{d\phi} = -\frac{\Lambda'_\phi}{\Lambda'_{S_l}}$, where the subscripts refer to the derivative. Then, using the Nash bargaining solution given in equation (17) we see that

$$\frac{dS_l^*}{d\phi} < 0 \text{ if } \Pi''_{i,S_lS_l}\Delta\Pi_j + \Pi''_{j,S_lS_l}\Delta\Pi_i < -2\Pi'_{j,S_l}\Pi'_{i,S_l}.$$

which must always be true since profits are increasing and concave in liquidity, and since $S_l \in A(l)$ is a prerequisite for an agreement. □

Then, since a reduction in the sales price reduces the liquidity of the seller, we have:

$$\frac{d\kappa_{iE}^*}{d\phi} = \frac{d\kappa_{iE}^*}{dS_j^*}\frac{dS_j^*}{d\phi} < 0. \tag{18}$$

Thus, restrictions that the selling country places on the merger in the mature industry will reduce the amount of investments it receives in the emerging market if the marginal use of cash is diminishing in the amount held. The effect of this depends on how large a share firm h invests in its domestic market. If the home bias for this investment is very large, then restrictions may potentially reduce the capital stock in the selling country. The opposite holds for the domestic country of the acquirer. Thus we have derived the following result:

to make any further investments in the mature market.

Proposition 10. *Restriction on cross-border acquisition in the mature market may reduce the total assets in the selling country since restrictions reduce new investments in the emerging industry.*

This result is straight forward: since restrictions on the utilization of capital reduces the acquisition price (Lemma 9) it will be more expensive for the seller to invest compared to the case with no restrictions, and, following the same reasoning as in the proof of Proposition 6, it is feasible that the capital stock will be reduced as a direct consequence.

5 Concluding remarks

The fact that most investors have a home bias seems to indicate that countries should block foreign acquisitions to protect domestic production and investments. In this paper, we show that this is not necessarily the case when a partial asset sale takes place or in an "non-US corporate governance system" with active owner groups. The reason is that when foreign acquisitions are allowed, domestic owners improve their financial strength and thereby increase their other corporate investments. Then due to their home bias they will likely invest in *new* ventures in the domestic country. Moreover, the foreign owner becomes "locked in" in industry specific capital in the domestic market when acquiring, and will invest less in new ventures. This might in turn create a strategic advantage in the growth market for the seller. Indeed this finding calls for a financial efficiency defense in the merger law, in order to allow financially constrained owners to create consumer surplus in emerging markets.

In the previous literature, cross-border acquisitions have been shown to be driven by access to low production costs, access to markets, synergies and market power. We here identify another important factor: the seller's need of financial resources to be able to invest in new growth markets. Indeed, we show that the possibility of undertaking new investment can imply that countries (not only firms) can benefit from being sellers rather than buyers in cross-border acquisitions.

An interesting avenue for future work is empirical testing of how cor-

porate asset sales affect subsequent corporate investments decisions. Studies of demonstrating the correlation between asset sales and subsequent corporate investments such as Hovakimian and Titman (2006) and Warusawitharana (2008), are an excellent start but more work on how corporate asset sales by MNEs and Owner groups affect subsequent investment, location and employment decision in international markets would be welcome.

There are some countries that have a Foreign Investment Review Board (FIRB) that approve acquisitions (mergers) with explicit provision for political input.[30] Often there are other domestic firms in these markets (ignored in our model) that generate the political reaction. A domestic seller might in such cases call upon a financial efficiency defence arguing that the proceeds of the selling will be used to invest in other markets in the home country. Investigating such interactions seems as an interesting avenue for future research.

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[30] One such example is the Australian Foreign Investment Review Board (FIRB). (FIRB annual report 2014/2015, p.9). Australia's foreign investment review framework is designed to balance the need for foreign investment against the protection of the national interest. (Australia's foreign investment policy 2016-2017, p.8).

A case reviewed by the FIRB in 2013 that received quite some public attention and concern was the proposed acquisition of the publicly listed company GrainCorp by the US-based multinational Archer Daniels Midland (ADM). (The Guardian (29 November 2013)). ADM stated that the company intended to make a cash offer for all of the outstanding GrainCorp common shares. ADM hoped that the acquisition would lead to a strong positive development for both companies and provide the possibility of accessing fast-growing markets in the Middle East, Africa and Asia. (ADM press release)

On November 29, the Treasurer Joe Hockey held a media conference in Sydney regarding the much debated sale. At the conference, Hockey stated that "I had to determine that the acquisition of GrainCorp by ADM is contrary to the national interest and, based on all the information available, I have now made that decision".

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Paper ii

Misvaluation and financial constraints: method of payment and buyer identity in mergers and acquisitions

Counting from the late 19th century, more than half of all mergers have clustered in short so-called "merger waves" (Kolev, Haleblian and McNamara, 2012). For example, both the 1960s and the 1980s saw much lower merger activity during the first years of the decades than they did during the latter years, and the average yearly value of deals announced during the Dotcom years in the late 1990s was double the average value in the years after the stock market dropped. At the same time, merger waves differ from on to another: In the 1960s, acquirers and targets were usually from different industries, while the wave of the 1990s occurred within industries. Also, while stock payments were common in the 1960s and the 1990s, cash payments dominated the 1980s (Andrade, Mitchell, and Stafford, 2001; Shleifer and Vishny [SV], 2003).

In this paper, I contribute to the theoretical merger-wave literature by furthering the understanding of what determines whether acquirers and targets are from the same industry and whether the acquirer pays with cash or stocks. I do this within a framework of stock-market misvaluation and costly external financing. The model predicts that unrelated merger waves (i.e., mergers waves between industries) occur when the stock market is overvalued, and that the payment in these waves will

consist primarily of stocks. Industry-level misvaluation increases a firm's likelihood of undertaking stock-financed acquisitions of unrelated firms, but it has a weaker effect on the likelihood of acquiring firms in the same industry. For financial constraints, the model predicts that reducing financing costs increases the number of unrelated mergers, and reducing financing costs has a greater effect on merger activity during times of market undervaluation than it has during times of market overvaluation.

The model builds on Rhodes-Kropf and Viswanathan (RKV, 2004) where the basic setup is an auction with several bidders and one target. RKV divide firms into two groups: one that can only make stock bids, and one that can only make cash bids. The difference between the two payment forms is that the "true value" of stock bids is not known; due to private information, managers know more about their own firms' values than the stock market knows, causing misvaluation of the firm's stocks. The key assumption is that this "misvaluation" correlates within industries. RKV show that correlation in firms' misvaluation causes merger waves to occur because managers of targeted firms will overestimate the true value of stock bids during times when all firms are overvalued.

I modify RKV's model in three ways. First, I let bidders be from different industries (including from the target's own industry) with misvaluation correlating both between and within industries.[1] Second, I assume that managers' private information allows them to better estimate the value, not only of their own firm, but also of similar firms (firms in the same industry). Third, I let all bidders make both stock and cash bids, but I associate cash bids with an opportunity cost.

The modifications allow for new predictions, and change some of the predictions from the original model. Due to the first two changes, marketwide overvaluation (overvaluation that applies to all firms in the stock market) causes an increase in stock financed mergers between unrelated firms, but not between related ones. The reason for this is that in a more overvalued market, targeted firms are more likely to err by overestimating stock bids from unrelated firms, something that does not apply to

[1] RKV consider the case where the bidders are from a different industry than the target, but they do not consider several industries (including the target's industry) simultaneously.

stock bids from related firms since managers' private information allows them precise estimates of related firms' true values. For the same reasons, sector-specific overvaluation (overvaluation that applies to all firms in a specific sector) has a stronger effect on unrelated mergers than it has on related mergers. In both cases, more mergers occur because overvaluation allows acquirers to purchase the target's assets at a discount in terms of their true value. These predictions differ from RKV's who make no prediction regarding a differentiated effect of marketwide overvaluation on related and unrelated mergers, and who predict that both related and unrelated mergers increase with sector overvaluation. Allowing all firms to make both stock and cash bids, allows me to investigate how changes to financing conditions affect merger activity. Since cash payments avoids the problem of asymmetric information (misvaluation) and asymmetric information is a larger problem between industries, reducing the cost of external financing increases the number of unrelated mergers. Furthermore, due to the cost associated with cash bids, firms only pay by cash if the target ends up undervaluing their stock offer. This is more likely to occur when the market is undervalued, so reducing the cost of external financing has a greater effect on merger activity during these times than it has during times of overvaluation.

Apart from RKV, the most closely related article is SV, who also studies the role misvaluation may have in creating merger waves and affecting the choice of payment. SV assume that there is no informational asymmetry between firms, but that there exist an agency problem between managers and shareholders. In their model, a difference in the misvaluation of acquirer and target is necessary for stock financed mergers, so an increase in the misvaluation of all firms do not lead to more mergers. Empirically, my model's prediction with regard to marketwide overvaluation differ from SV's since it predicts that marketwide overvaluation will be associated with an increase in unrelated mergers (but both models predict that there will be no effect on related mergers), and they differ in a similar manner in their predictions on firm-specific overvaluation. However, the models make the same predictions for sector-specific overvaluation: Firms in overvalued sectors will conduct more stock-financed acquisitions of unrelated firms, but not of related ones, and targets are more likely to come from undervalued sectors.

The paper relates to the literature on merger waves and on method of payment in mergers and acquisitions. Several papers study merger waves as a rational response to changing economic circumstances, where economic chocks or technological innovations create profitable opportunities to reallocate assets between firms (e.g., Gort, 1969; Mitchell and Mulherrin, 1996; Jovanovic and Rousseau, 2002, 2008). Other papers study the effects of asymmetric information on the method of payment as a separate topic. This literature clarifies the varying reasons why acquirers choose to pay with cash or stocks, and when targets accept these as payment (see, e.g., Hansen, 1987; Fishman, 1989; Eckbo, Giammarino, and Heinkel, 1990; Berkovitch and Narayanan, 1990; Gorbenko and Malenko, 2014). I contribute to this literature by studying how the payment method varies with merger activity, and how the effects of financial constraints vary with stock-market misvaluation.

The next section provides the model setup. The section following it solves for equilibrium bidding strategies, and provides results regarding the target's evaluation of bids. Section 3 derives results concerning the identity of the acquirer and the method of payment, connecting these to misvaluation and the cost of external financing. Finally, Section 4 concludes the paper.

1 The model

The basic setup and timing of the model is as follows. The model begins with several potential acquirers targeting a single firm for a takeover. To decide which, if any, of the potential acquirers will buy the firm, the targeted firm arranges an auction. The auction mechanism is that of a second-price auction; that is, the firm with the highest bid wins, and pays the value of the second-highest bid. Furthermore, the auction is in two parts: In the first stage, the potential acquirers make bids with stocks and the target decides on a winner. In the second stage, losing bidders can challenge the winning stock bid by putting forth a cash bid at least as good as the winning stock bid. If any bidder puts forth such

a cash bid, a new second-price auction starts where all firms bid cash.[2]

The model assumes that managers try to maximize the true/long-term value of their stockholders' wealth. So, with perfect information, stocks and cash are perfect substitutes. However, it is reasonable to assume that managers possess private information regarding their own firms, meaning that their estimate of their own firm's value does not coincide with the estimate made by other agents. I will model this asymmetry with three assumptions. The first assumption is that managers possess superior information with regard to the prospects of their firm and can therefore make a better or more accurate estimate of the firm's true worth. Second, the private information that the manager possesses also allows her to make a more accurate estimate of similar firms. Third, the fact that the market does not have access to private information leads it to put a different value on the firm, and this "misvaluation" made by the market (as compared to the valuation made by the manager of the firm) is correlated between firms, particularly those in the same industry.

Under asymmetric information, accepting a stock payment is risky for the target manager since she does not know the true value of such bids, in contrast to cash offers (cash is cash, and its value is known). Thus, if there are no financial frictions, a bidder only prefers to pay in stock if it is overvalued, something that the target manager would know. Therefore, I assume that it is costly for bidders to pay in cash. The assumption is natural in a setting of asymmetric information (see, e.g., Stein, 2003), and it allows a rational target manager to accept stocks as payment.[3]

The model consists of three types of agents: the target firm, bidding firms, and the market. I consider the acquisition of only one, already given firm, which I denote by T. That is, I abstract from bidders searching for a target, and the effect of the potential to acquire other targets on the "outside option" of potential acquirers.[4] That is, the model starts in a setting where potential acquirers have already "found" a tar-

[2]Liu (2012) uses a two-stage auction where the second stage is triggered only if any bidder is willing to outbid the winner in the first stage.

[3]Vermaelen and Xu (2014) find that targets accept stock payments if stock payments are motivated by the bidder's capital structure.

[4]This last assumption means that the misvaluation between firms is correlated both within and across industries.

get and investigates how firm characteristics ought to affect which firm (if any) wins and the method of payment. On the bidding side, there are n potential acquirers ($\mathcal{I} = \{1, 2, \ldots, n\}$) sorted into $m + 1$ industries ($\mathcal{K} = \{\mathcal{T}, 1, 2, \ldots, m\}$), where $\mathcal{T}$ denotes the industry of the target firm.[5] The managers of all firms are risk neutral, and there are no agency problems between manager and stockholders. The final agent is "the market." The market does not participate in the auction, but it is important in its role of pricing (and mispricing) stocks.

Every firm has true a value, X_i, that is observed by the firm's own manager (more correctly, X_i is the manager's best prediction of the true value). However, this knowledge is not only conditioned on public information, but also on information private to the manager. The market does only have access to private information, so in general the market's estimate (the market value, M_i) will differ from the true value, X_i. To allow for correlation within and across industries, I follow RKV's approach and specify the market value of firm i as

$$X_i = M_i(1 - \varepsilon_i)(1 - \psi_k)\,(1 - \rho)\,. \tag{1}$$

Here ε_i, ψ_k, and ρ are a firm-specific, industry-specific and a marketwide mispricing factor, respectively. All mispricing factors are assumed to be independently and identically drawn from continuous zero-mean distributions denoted $F_\varepsilon(\varepsilon)$, $F_\psi(\psi)$, and $F_\rho(\rho)$. Following RKV I assume that $\log(1 - \varepsilon_i)$, $\log(1 - \psi_k)$, and $\log(1 - \rho)$ have log-concave distributions. Since the market value of a firm cannot be negative, the support of the mispricing factors must lie on $(-\infty, 1)$, and the zero mean implies that some of the range must be nonnegative.[6] As implied by the names, the firm-specific mispricing factor is unique to the individual firm, all firms in the same industry share the industry-specific factor, and all firms in the market share the marketwide factor. So if $\psi_k > 0$, then industry k is overvalued and $\rho > 0$ implies that the whole market is overvalued – effectively inducing correlation in the misvaluation within and between industries. That the mispricing factors are drawn i.i.d. means that the market prices the firms correctly on average – i.e., the market price is

[5] If firm i belongs to the same industry as the target, I write this as $i \in \mathcal{T}$.

[6] Note that the market valuation increase relative to the true value and whenever any of the mispricing factors increases. That is, $(1 - \varepsilon_i)(1 - \psi_k)\,(1 - \rho) < 1$ implies that the firm is overvalued.

the best estimate of a firm's true value given the public information ($E[X|Mt] = M$).

RKV discuss the interpretation of the misvaluation and the motivation for dividing it into separate components. One interpretation is that managers have superior information with regard to the future prospects of the firm. Superior information allows a manager to make a better prediction about her firm's true value compared to the market (X_i rather than M_i), but the manager is not sure how this information relates to other firms. However, the manager can surmise that some of her private information should be relevant to other firms; for example, seeing a drop in demand for her own firm, the manager might suspect that some of this drop is due to weakening aggregate demand and, thus, that the value of all firms should be affected. Nevertheless, managers do not know which parts of or to what extent their private information carries over to other firms. Thus, even if managers know the value of the whole misvaluation factor $(1-\varepsilon_i)(1-\psi_k)\,(1-\rho)$, they do not know how this is divided among the different subfactors – i.e., they do not know if it is the market, the sector, or just they themselves that are over/undervalued. Another interpretation offered by RKV is that ψ_k and ρ are mispriced factors shared by industries and the market, while the mispricing factors ε_i are not.

In contrast to RKV, I assume that the managers of a firm can also predict how their information relates to their direct competitors. This informational advantage is different from that modeled by RKV. RKV does not assume that managers have a direct informational advantage as compared to the market, but that there exists an indirect advantage because the firms share misvaluation factors. For example, if the market overvalues a firm by 10%, the manager might estimate that 3% of this is overvaluation of the firm itself, 3% is overvaluation of the industry, and the remaining 4% is due to an overvaluation of the entire market. The manager then adjusts her expectation of all other firms by adjusting their market value accordingly. However, the manager adjusts her valuation of other firms in an identical fashion – she adjusts the market prices by her estimates of the common mispricing factors. My assumption is that managers make individual predictions for the firms that they know the most about – their rivals. For example, a producer of smart

phones who receives a private signal about faltering demand for premium phones may conclude that this new piece of information is worse news for Competitor A, which specializes in premium phones, than it is for Competitor B which has most of its sales in the budget segment. If this were the case, the rational manager would revise her estimate of A's and B's true values differently, not just scale both of them by the same factor. In the model, I make the highly stylized assumption that the managers make the same update as the rivals themselves – i.e., they know their rivals' true value. While unrealistic, this simplification serves as a contrast to the aforementioned case and highlights the effects of having an informational advantage.

Shared misvaluation is important when firms make stock bids since it will affect the target's valuation of the bids. For cash bids, misvaluation does not have any direct effect since the value of cash is known. Instead, I assume that firms are financially constrained – i.e., that firms cannot freely access cash to finance investments. I incorporate this into the model by splitting the firms' true values into two parts, X^{A} and X^{O}, where

$$X^{\mathrm{A}} + X^{\mathrm{O}} = X. \tag{2}$$

X^{O} represents a firm-specific opportunity cost for paying in cash, that is, if acquirer i pays the target's shareholders in cash, the acquirer's stand-alone value drops from X_i to X_i^{A}. Introducing an explicit cost for paying with cash allows me to conduct comparative statistics on how changes to the financial constraint affect firms differently depending on how financially constrained they already are. Furthermore, it allows me to show how the effect of lowering the opportunity cost is stronger when the market is undervalued.

Since I have assumed that managers aim to maximize stockholders' true value, and since stock acquisitions are associated with misvaluation and cash acquisitions with opportunity costs, the possibility of real overall gains needs to exist. I follow RKV and let bidder i's valuation of acquiring the target be

$$V_i = (1 + s_i)X_{\mathrm{T}}. \tag{3}$$

Here s is the synergy effect associated with i taking over the target. Every bidder is assumed to know its own valuation of the target, and

while it does not know either X_{T} or s_i, it is common knowledge that s is drawn i.i.d. from a distribution $F_s(s)$, with $\log(1 + s_i)$ having a log-concave density function. One way to think about this setup is that the bidders know target's assets and how to use them if they acquire the target – i.e., they know what they get in an acquisition and its value to them (V). However, due to asymmetric information, the bidders do not know how the target is currently using its assets or how it intends to use the assets in the future, and hence they do not know the true value the assets have under the current ownership (X_{T}). In the model, it is of no consequence to the bidding firms that they do not know the true value of the target – the only thing that matters is their own valuation. This private-value setup eliminates the motivation for stock payment as a way of sharing "overpayment costs" (if the target's assets are of poor quality). This, in combination with stock misvaluation, means that we need to have some sort of opportunity cost of cash for there to be both stock and cash acquisitions.

To determine which firm (if any) becomes the acquirer, and how it pays, the outcome is decided through a two-stage second-price auction. In the first stage, bidders submit stock bids consisting of a fractional claim to the combined firm. Due to misvaluation, the target manager does not take the bids at face value, but instead uses all available information to estimate which bid is the highest. After picking a winner in the stock auction, as well as the "price" to be paid, the auction moves on to its second stage, where all bidders can instead post cash bids to rival the winner of the stock auction. If there exists no cash bid that exceeds the expected value of the winning stock bid, the winner from the first stage wins the whole auction and pays the agreed upon shares.

2 Equilibrium bids and the target's decision

Before analyzing the outcome of the model, we need to establish how firms bid and how the evaluation of the bids is connected to misvaluation. In this section, I establish the potential acquirers' equilibrium bids and describe how misvaluation affects how the target evaluates stock offers. The section shows how the perceived value of a bid changes due to mis-

valuation and, thus, highlights the role of the informational advantage of the target when evaluating bids from its own industry. The section begins by considering stock bids before moving on to cash bids. The section for stock bids draws on a corresponding section in RKV's paper. For two of the proofs, I direct the reader there. However, it is necessary to include this section for two reasons. The first reason is to comprehend some of the model's mechanics, allowing the reader to understand the remainder of the analysis. The other reason is that some of the lemmas differ between the papers due to assumption differences.

2.1 Stock bids

In the stock auction, interested buyers offer bids consisting of stocks in their respective firms. In the model, bidders offer to buy the target's assets in exchange for a fraction (α) of the shares in the combined firm; that is, bidder i's offer entitles the target's shareholders to the fraction α_i of i's existing assets as well as the fraction α_i of the acquired assets. Since the manager of the target considers the long-term interest of her shareholders, she attempts to choose the bid with the highest true value. This is where the problem occurs: The manager does not observe the true values of the bids. Instead, she has to make her decision based on estimates. So how does the manager do this? The true value of a bid equals $\alpha\,(X+V)$ (where $X+V$ is the true value of the bidder *if* it acquirers the target), and since managers consider the long-term interest of their shareholders, the target manager determines the stock-auction winner based on her conditional expectation of $\alpha\,(X+V)$. The ranking thus follows the cardinality of $E[\alpha_i(X_i+V_i)|\Phi_{\mathrm{T}}]$, where Φ_{T} is the target's information set.

That the expectation is taken with respect to the target manager's information set is crucial. In the absence of any private information, the best estimate of a firm's true value is its market value – i.e., the market value, M, is the expectation of X conditional on all public information. However, when the target evaluates the bids, it has two additional sources of information: its private signal and the size of incoming bids.

First, consider the effect of the private signal. To begin with, since firms

are able to predict how their private information relates to other firms in the same industry, the target knows the true value of bids from its industry peers. While the target manager is not able to do this for firms of other industries, she can still use the knowledge about her own misvaluation to "correct" the market's valuation of these firms. For example, consider the case when the target firm is overvalued. The target's manager only knows that the firm is overvalued, but she does not know whether this is due to an overvaluation of the firm itself (through ε_{T}), its industry (ψ_{T}), or of the entire market (ρ). As a Bayesian updater, the manager puts some weight on all three of these possibilities – expecting all misvaluation factors to be positive – and updates her expectations of other firms' true value accordingly. That is, the manager revises her expectation of the true value of all firms in the market downward by the appropriate amount, from M (the best prediction of X given no public information) to something less than M. Effectively, this means that all bids will look less appealing than they would in the absence of the target's private information.

The second set of new information consists of the bid sizes. A bid can be high in terms of market value for two reasons: 1) The bid is actually large – i.e., the bidding firm is actually willing to pay a great deal in terms of real value to acquire the target's assets; 2) the market overvalues the bidder's stock, inflating the apparent value of the bid. Therefore, upon receiving a bid, the target does not take it at face value, but instead uses its knowledge about the distributions of the misvaluation factors and the synergy to get a new estimate of the true value of the bid. Hence, when the target evaluates and ranks the bids, it does so based on

$$\Phi_{\mathrm{T}} = \{\alpha_i, M_i \ \forall i,\ X_j \ \forall j \text{ if } j \in \mathcal{T},\ M_{\mathrm{T}}, X_{\mathrm{T}}\}\,. \tag{4}$$

That is, the target incorporates information about its own misvaluation (X_{T} and M_{T}), the true value and misvaluation of its industry peers (X_j, M_j $\forall j$ if $j \in \mathcal{T}$), and the "size" of all bids (α_i, M_i $\forall i$), into its decision.

In RKV, all bids are scored symmetrically since all errors and synergies are independent. Since my model includes firms from different industries, this assumption is no longer valid, and I will only assume that symmetrical scoring applies within an industry. This assumption is made

for within-industry scoring rather than for the whole market, because of the industry-specific misvaluation factor, ψ_k. That the market price contains all public information about a firm's true value motivates ranking bids from the same industry symmetrically because these firms all have the same shared-misvaluation factors. All information regarding the shared components of firm i's misvaluation can be applied to the estimate of i's industry peers, but only some of this is applicable to firms in other industries. Based on the information she gets from i's bid, the target manager will thus revise her estimate of bids from i's industry differently than she will revise other bids. For example, upon observing a large fraction of high bids from industry k, the target manager estimates that this is due to the sector being overvalued and thus, that their bids only appear to be high. The target manager adjusts her expectations of the true value of bids from sector k accordingly, but if the manager believes that the overvaluation is due to sector overvaluation, then it makes no sense to adjust the estimates of firms in other sectors.[7] In the end, this means that identical bids (i.e., in the duple (α, M)) are not scored symmetrically if they are from different industries.

When a winner has been chosen, the "price" is determined by the target's estimate of the second highest bid. Letting subscript 1 refer to the firm with the highest estimated bid, and subscript 2 to the runner up, the share, $\hat{\alpha}_1$, that the winner must pay is determined by

$$\begin{aligned} &E[\hat{\alpha}_1(X_1 + V_1)|\hat{\alpha}_1, M_1, \alpha_2, M_2, \Phi_{\mathrm{T}-}] \\ &= E[\alpha_2(X_2 + V_2)|\alpha_2, M_2, \hat{\alpha}_1, M_1, \Phi_{\mathrm{T}-}], \end{aligned} \tag{5}$$

where $\Phi_{\mathrm{T}-}$ is the target's information set without the two "top bids." In words: $\hat{\alpha}_1$ is the smallest fraction that the winning firm could have bid and still won the auction.

RKV shows that the assumption of independent and log-concave distributed errors and synergies means that the expected value of firm i's bid increases with α_i. Furthermore, increasing α decreases the expected value of all competing bids because increasing the size of the bid will

[7] More precisely, the target will adjust the bids from other sectors as well because it will put an increased probability on the overvaluation of the whole market. This will also affect the bids from industry k.

increase the target's expectation of the shared misvaluation factors. Together this implies that a firm is more likely to win if it increases its bid, which allows RKV to show that the standard result of truthful bidding in a second-price auction also holds in this setup; that is, in equilibrium, all firms bid their true valuation of the target's assets:[8]

$$\alpha_i = \frac{V_i}{X_i + V_i}. \tag{6}$$

Given this result, the target's problem boils down to choosing the bidder it believes to have the highest valuation of the target's assets, that is, the ranking of bids follows $E[V_i|\Phi_{\mathrm{T}}]$.[9]

That bidders bid their true valuation of the target does not mean that the problem of asymmetric information disappears – the target is still unable to distinguish a bid that is truly high from one that only appears high. Nevertheless, "truthful bidding" means that a bid constitutes a signal regarding the bidder's valuation and misvaluation. RKV show that the statistic $\frac{\alpha_i}{1-\alpha_i}M_i$ ranks the bids in their setup, and that the target therefore ranks the bids in the same order as does the market. However, these results do not apply when bidders are from several different industries or the target knows the true value of its industry peers. Instead, we have Lemma 1.

Lemma 1. *If the misvaluation factors and synergies are independently distributed and have log-concave densities, then*

$$E[V_i|\alpha_i, M_i, \Phi_{\mathrm{T}}] = E\left[V_i \middle| \frac{\alpha_i}{1-\alpha_i}M_i \ \forall i,\ X_j \ \forall j \text{ if } j \in \mathcal{T},\ X_{\mathrm{T}}, M_{\mathrm{T}}\right] \tag{7}$$

and $\frac{\alpha_i}{1-\alpha_i}M_i$ *and* $X_j \ \forall j$ *if* $k = T$ *are sufficient statistics to rank the bids.*

Proof. The proof is a simple extension of RKV. □

Corollary 2. *The market's ranking of the bids is (generally) not the same as the target's ranking of the bids.*

[8] To get the truthful-bidding result, it is not necessary for the expected value of competing bids to fall when i increases its α_i – it is sufficient that the change in the expected value of i's bid is more positive.

[9] If $\alpha_i = \frac{V_i}{X_i+V_i}$, then $E[\alpha_i(X_i + V_i)|\Phi_{\mathrm{T}}] = E[V_i|\Phi_{\mathrm{T}}]$.

Proof. The best the market can do is to rank the bids according to

$$E\left[V_i \left| \frac{\alpha_i}{1-\alpha_i} M_i \ \forall i,\ M_{\mathrm{T}} \right.\right].$$

Lemma 1 stated that the statistic $\frac{\alpha}{1-\alpha}M$ is a sufficient statistic to rank the bids within an industry. The market thus ranks bids from other industries differently from the target industry in the same order as the target, but since the target observes the true value of bids from the same industry, it will (in general) give these bids a different rank. □

Given that the target knows the true value of bids from its industry peers, it is no surprise that its ranking of these bids will differ from the market's ranking. However, if I dispense of this assumption, $\frac{\alpha_i}{1-\alpha_i}M_i$ is still not a sufficient statistic because the target's knowledge of its own misvaluation allows a more accurate estimate of the shared misvaluation factors and, thus, of the bids' true values. Using the relationship between X_i and M_i in (1), and the result that bidders bid their true valuation (equation (6)), the statistic $\frac{\alpha_i}{1-\alpha_i}M_i$ simplifies to $\frac{(1+s_i)}{(1-\varepsilon_i)(1-\psi_k)(1-\rho)}$ – i.e., it is the ratio of the bidder's synergy to its misvaluation. The lemma thus states that the target cannot determine whether a bid is truly high, or just appears high due to misvaluation. Hence, $\frac{\alpha_i}{1-\alpha_i}M_i$ rank bids within an industry, but knowledge about the target's misvaluation (X_{T} and M_{T}) can change the ranking between industries.[10]

Lemma 1 tells us that misvaluation affects the ranking of bids, but it does not specify how the estimated value of the bids is affected. Consider, for example, an increase in the marketwide misvaluation. The increase makes all bids seem larger, but it also leads to a greater overvaluation of the target, causing the target to expect the marketwide misvaluation to be higher. To determine which effect dominates, I need to rewrite the target's information set (Φ_{T}). It turns out that we can rewrite the

[10] This means that if i and j come from the same industry, then $Z_i > Z_j$ (i.e., i's bid is given a better score) if and only if $\frac{\alpha_i}{1-\alpha_i}M_i > \frac{\alpha_j}{1-\alpha_j}M_j$. However, if they are from different industries, this relationship does not necessarily hold. Similarly, if j is from the same industry as the target (so that its valuation is known), then $\frac{\alpha_i}{1-\alpha_i}M_i > V_j$ does not imply that i's bid is ranked higher than j's bid.

information set as a collection:

$$\frac{(1+s_i)}{(1-\varepsilon_i)(1-\psi_k)\,(1-\rho)}, \tag{8}$$

$$\frac{(1+s_i)\,(1-\varepsilon_j)(1-\psi_l)}{(1-\varepsilon_i)(1-\psi_k)\,(1+s_j)}\ \forall j \neq i \text{ and } j \in l \in \mathcal{K}, \tag{9}$$

$$(1+s_j)\ \forall j \text{ if } j \in \mathcal{T}, \tag{10}$$

$$\frac{(1+s_i)\,(1-\varepsilon_{\mathrm{T}})(1-\psi_{\mathrm{T}})}{(1-\varepsilon_i)(1-\psi_k)} \tag{11}$$

Note that all I do is transform the variables using equations (1) and (6); that is, nothing has been added or subtracted from the information set. What is important is that all elements are now functions of the synergy or the misvaluation factors. Since the target knows the distributions of these factors, Lemma 3 holds.

Lemma 3. *Given the assumption of log-concave densities, the random variables* $(1+s_i)$, $\frac{(1+s_i)}{(1-\varepsilon_i)(1-\psi_k)(1-\rho)}$, $\frac{(1+s_i)(1-\varepsilon_j)(1-\psi_l)}{(1-\varepsilon_i)(1-\psi_k)(1+s_j)}$ $\forall j \neq i$, *and* $j \in l \in \mathcal{K}$, $(1+s_j)\ \forall j$ *if* $j \in \mathcal{T}$, *and* $\frac{(1+s_i)(1-\varepsilon_{\mathrm{T}})(1-\psi_{\mathrm{T}})}{(1-\varepsilon_i)(1-\psi_k)}$ *are affiliated.*

Proof. See RKV.[11] □

An affiliation between variables X and Y means that a higher value of Y implies a higher distribution of X in the sense of first-order stochastic dominance. For conditional expectations, this implies that the expectation of X conditioned on Y is increasing in Y.

Before turning to how misvaluation affects the auction outcome, I need to solve the second stage of the auction where firms bid with cash.[12]

[11] $(1+s_i)$ and $(1+s_j)$ are independent of each other and therefore affiliated. The proof for the other factors extends from the proof in RKV.

[12] Milgrom and Weber (1982) examine the role of affiliation in auctions of incomplete information. Caplin and Nalebuff (1991) discuss implications and applications of log-concavity in economic theory.

2.2 Cash bids

After the stock-bidding part of the auction, the target is committed to accepting the winning bid. At this stage, no profitable stock offers can challenge the winner; all firms have bid their true value so no one is willing to increase her offer. However, it might be the case that the target "wrongly" undervalues a firm with high synergies – i.e., the target expects that the misvaluation affecting the bidder is higher than it actually is and therefore puts a too low value on its stocks. In this case, the bidder can choose to make a cash offer to rival the winning stock bid.[13]

Unlike stock offers, asymmetric information does not plague cash offers – cash is cash, and everyone knows its value. The problem is that the bidders do not have costless access to cash. This means that the bidders' value of acquiring the target is reduced by the opportunity cost and becomes $V - X^{\mathrm{O}}$. Lemma 4 then applies under the second-price auction mechanism.

Lemma 4. *All firms bid their true value of acquiring the target with cash, that is, all firms bid* $V_i - X_i^{\mathrm{O}}$.

Proof. Let C_i denote firm i's cash bid. If the firm wins, then its net gain from the acquisition is

$$V_i - X_i^{\mathrm{O}} - C_2.$$

That is, the target's net value to firm i (V_i), minus the opportunity cost of using cash (X_i^{O}) and the second highest bid (C_2). To maximize its profit, i solves

$$\max_{C_i} E\left[\{V_i - X_i^{\mathrm{O}} - C_2\} 1_{\{\max_{\forall j} C_j \leq C_i\}} \middle| X_i^{\mathrm{A}}, X_i^{\mathrm{O}}, V_i\right],$$

where $1_{\{\cdot\}}$ is an indictor function that takes the value of one if the condition in the subscript is fulfilled.[14] Since it is a second-price auction,

[13] Empirically, it has been shown that cash is more likely to be used when two or more bidders compete for the same target (see, e.g., Eckbo, Makaew, and Thorburn 2016).

[14] Note that if there is only one cash bidder, then C_2 is the target's expected value of the winning bid in the stock-bidding part of the auction. If no stock offer was deemed good enough, it is $C_2 = X_{\mathrm{T}}$ – i.e., the target's stand-alone value.

the value for i from actually winning the auction is not dependent on its bid; the bid only affects the chance of winning, not its payment when winning. Thus, if $C_i > V_i - X_i^{\mathrm{O}}$, then reducing C_i to $V_i - X_i^{\mathrm{O}}$ only eliminates instances where winning the auction would entail a negative payoff to i, and if $C_i < V_i - X_i^{\mathrm{O}}$, then increasing C_i to $V_i - X_i^{\mathrm{O}}$ only adds instances where winning the auction yields a positive payoff. Therefore, it is a dominant strategy for i to bid $C_i = V_i - X_i^{\mathrm{O}}$. □

If no cash bid exceeds the expected value that the target puts on the winning stock bid, the winner from the first stage wins and pays the agreed upon fraction of its firm.

3 Acquirer identity and the method of payment

This section uses the previous results to investigate when the acquirer and target are more likely to be from the same industry and when the acquirer is more likely to pay with stocks rather than cash.

The target manager is obliged to act in the long-term interest of her shareholders, so a deal only occurs if the manager believes it benefits the shareholders in the long run. That is, a merger occurs if there is at least one bid that the target estimates to be worth more than the firm's stand-alone value. In the stock auction, this means that there exists a bid i such that

$$\alpha_i E[X_i + V_i | \Phi_{\mathrm{T}}] \geq X_{\mathrm{T}} \tag{12}$$

since the left-hand side is the expected value of firm i's bid. However, since there is a chance that someone challenges the stock-auction winner, this is only a necessary condition for a stock acquisition, not a sufficient condition. So when does a challenge happen? The auction enters the cash-bidding stage if a bidder puts forth a cash bid that is higher than the target manager's estimate of the winning stock bid. The natural question to begin with is, thus, "What is the target manager's valuation of the winning stock bid?" Equation (5) stated that the winning bidder must pay a fraction $\hat{\alpha}_1$ of its shares, where $\hat{\alpha}_1$ is defined as the minimum fraction the winner could have bid to just tie the second highest bid. The

target manager thus estimates the value of the winning bid to be

$$\hat{\alpha}_1 E[X_1 + V_1|\Phi_{\mathrm{T}}] = \alpha_2 E[X_2 + V_2|\Phi_{\mathrm{T}}],$$

or X_{T} if there is only one firm above the target's reservation value.[15] Using Lemma 4, the auction only enters the cash stage (and thus leads to a cash acquisition) if a bidder exists such that[16]

$$V_i - X_i^{\mathrm{O}} \geq \Lambda \equiv \max\{E[V_2|\Phi_{\mathrm{T}}], X_{\mathrm{T}}\}. \tag{13}$$

The condition in (13) is sufficient for a cash acquisition. A stock acquisition occurs if the target finds at least one stock bid good enough and no firm advances a cash offer to challenge it (i.e., if (12) holds but (13) does not hold). This yields the first results for the method of payment.

Lemma 5. *All cash-bidders are undervalued by the target manager.*

Proof. The easiest way to prove this is by showing that if the target overvalues a bidder, there is no cash bid that is profitable to the bidder, and then show that such bids can exist when the target undervalues the bidder. Lemma 4 showed that every bidder's dominant strategy is to bid its true valuation in the cash auction (i.e., to bid $V - X^{\mathrm{O}}$). Since a firm will only make a cash offer if it is profitable, $V_i - X_i^{\mathrm{O}} \geq \Lambda \equiv \max\{E[V_2|\Phi_{\mathrm{T}}], X_{\mathrm{T}}\}$. Consider first the case where the bidder does not win the stock auction but finds it profitable to make a cash bid. Necessarily,

$$\begin{aligned} V_i - X_i^{\mathrm{O}} &\geq \Lambda \equiv \max\{\alpha_2 E[X_2 + V_2|\Phi_{\mathrm{T}}], X_{\mathrm{T}}\} \\ &\geq \alpha_i E[X_i + V_i|\Phi_i] = E[V_i|\Phi_i] > V_i, \end{aligned}$$

where the last inequality follows from the bidder being overvalued by the target manager. However, this is a contradiction since $X_i^{\mathrm{O}} \geq 0$. Similarly, for the winner of the stock auction to prefer paying with cash,

$$V_1 - X_1^{\mathrm{O}} - \hat{\alpha}_1 E[X_1 + V_1|\Phi_{\mathrm{T}}] > V_1 - \hat{\alpha}_1(X_1 + V_1),$$

[15] If only one bid is deemed to be higher than the stand-alone value, the winner must pay the fraction $\hat{\alpha}_1$ such that $\hat{\alpha}_1 E[X_1 + V_1|\Phi_{\mathrm{T}}] = X_{\mathrm{T}}$.

[16] Here, I use that truthful bidding in the stock auction implies $\alpha_2 E[X_2 + V_2|\Phi_{\mathrm{T}}] = E[V_2|\Phi_{\mathrm{T}}]$. The condition also incorporates the situation where the target estimates that all stock bids are below its stand-alone value (X_{T}). In this case, a cash bidder has to bid above the stand-alone value of the target.

but this contradicts that $X_1^{\mathrm{O}} \geq 0$ and $E[X_1 + V_1|\Phi_{\mathrm{T}}] > (X_1 + V_1)$.

Finally, if firm i is undervalued, then $(X_i + V_i) > E[X_1 + V_1|\Phi_{\mathrm{T}}]$ (and $V_i > E[V_i|\Phi_{\mathrm{T}}]$); so, if the synergy is high enough (and the opportunity cost of cash low enough), it is profitable for the firm to offer a cash bid. □

The first proposition follows immediately from this lemma.

Proposition 6. *Firms from the same industry as the target never pay with cash.*

Proof. Since the target firm knows the true value of other firms in its industry, the proposition follows from Lemma 5. □

If i loses the stock auction, the payment the winner must pay is estimated (by the target) to be greater than the estimate of bidder i's bid (equal to the estimate if i is the runner up). Thus, if the target manager does not undervalue i, the reservation price in the cash auction must be greater than i's valuation of the assets because of truthful bidding. Within-industry mergers are never finalized using cash because the target manager knows the true value of these firms and, hence, the true value of their bids. While this assumption might seem extreme, evidence suggest managers know more about firms that are similar to their own, and that they therefore are more likely to accept stock payments in mergers (Eckbo, Makaew and Thorburn, 2016). If I dispense of this assumption and instead go to the other extreme – i.e., that they just observe the firms' market value, then Proposition 6 is nullified and Lemma 5 is the relevant result also for within-industry mergers. Note that Lemma 5 does not say that cash bidders are undervalued by the market – what is important is whether the target undervalues them. Situations where the target undervalues the bidder but the market overvalues it can occur when the target itself is overvalued, or when the market's overvaluation of other bidders is high. In both instances, the target will make a more forceful downward revision of all bids. Furthermore, since paying with cash is costly, it can still be profitable for a winning firm to stick to its stock offer even when the target undervalues its shares.

The above results say nothing about the probability of a merger actually occurring, nor when we should expect a merger to occur within industries. For this purpose, and to determine how the method-of-payment pattern relates to misvaluation, I turn to how misvaluation affects the target's evaluation of the stock bids.

Proposition 7. *A more overvalued market (i.e., a greater value of ρ) yields a greater probability of i) a merger occurring, ii) the merger being between industries, and iii) the merger being paid in stock.*

Proof. i) Because the target manager attempts to maximize the long-term value of the shareholders, she accepts any bid with an expected value greater than the stand-alone value, X_{T} (or accepts the highest bid if there is more than one bid that exceeds the stand-alone value). Using the expression in (12) and the definition of V_i in (3), this implies that a stock merger *may* occur if

$$E[V_i|, \Phi_{\mathrm{T}}] > X_{\mathrm{T}} \Longleftrightarrow E[(1+s_i)|\Phi_{\mathrm{T}}] > 1$$

for some i. The only conditioning factor in the target's information set affected by market misvaluation is $\frac{(1+s_i)}{(1-\varepsilon_i)(1-\psi_k)(1-\rho)}$, which increases in ρ. According to Lemma 3, this means that the expectation of the synergy is increasing in the market-misvaluation factor. Thus, it is more likely that any bid will exceed the target's reservation price when the market is overvalued. Since misvaluation does not affect bidders' willingness to pay in the cash auction, the probability of an acquisition increases with the market misvaluation.

ii) Bids from the target's own industry are unaffected by misvaluation. This means that the probability of a merger increases because it becomes more likely that an outside bid is deemed good enough by the target. At the same time, there will be cases where a bidder from the target industry would have won if the marketwide misvaluation were lower, but loses when it is increased. Altogether, this increases the share of between-industry mergers.

iii) Cash is the method of payment iff at least one bidder has a net gain from a cash acquisition higher than the reservation price in the second-stage cash-acquisition auction – i.e., if the inequality in (13) holds for

some i. Since $V_i = (1 + s_i)X_{\mathrm{T}}$ and s_i are independent of X_{T} and X_i^{O} (firm i's alternative cost), we have

$$\begin{aligned}
&\mathbb{P}\left\{(1+s_i)X_T - X_i^O \geq \Lambda\right\} = \mathbb{P}\left\{s_i \geq \frac{\Lambda + X_i^O}{X_T} - 1\right\} \\
&= 1 - F_s\left(\frac{\Lambda + X_i^O}{X_T} - 1\right),
\end{aligned}$$

where $F_s(\cdot)$ is synergy's cumulative density function. Since the synergy factors are assumed to be drawn independently from each other, the probability of any firm offering a cash bid is

$$\begin{aligned}
&\mathbb{P}\left\{(1+s_i)X_T - X_i^O \geq \Lambda \text{ for some } i\right\} \\
&= 1 - \prod_{i=1}^{N} F_s\left(\frac{\Lambda + X_i^O}{X_T} - 1\right).
\end{aligned} \tag{14}$$

If $\Lambda = E[V_2|\Phi_{\mathrm{T}}]$, the first part of the proof shows that $F_s\left(\frac{\Lambda + X_i^{\mathrm{O}}}{X_{\mathrm{T}}} - 1\right)$ increases with the market-mispricing factor (ρ), and, hence, the probability of a cash acquisition decreases. □

Parts i) and iii) are also found in RKV's original model. The reason the probability of a merger increases is not that the target does not revise its estimate of the bidders' true value. Rather, it does not revise them enough. Consider an overvalued target and assume that the overvaluation is solely due to marketwide overvaluation (i.e., $\rho > 0$, $\psi_{\mathrm{T}} = \varepsilon_{\mathrm{T}} = 0$). The target knows it is overvalued, but does not know if it is due to marketwide or industry- or firm-specific overvaluation. So, being a Bayesian updater, the target expects that all of these are positive. This prompts the target manager to revise the expectation of all other firms' true value downwards, to something below their market value. Now, assume that it gets one bid, that this bidder's synergy is zero (so $V = X_{\mathrm{T}}$) and that it is also only affected by marketwide misvaluation. The bidder bids its true valuation, but due to the marketwide misvaluation, the market value of its stock bid is higher than X_{T}. Given its first revision of the bidder's market value, the target's estimate of the bid is less than the market value. However, since the manager's best estimate is that some of its own misvaluation stems from firm-specific

and industry-specific misvaluation, the bid still appears higher than X_T. Given this, the target manager's best estimate is that a part of the high bid value is that its estimate of the bidder's true value is still inflated, prompting a further downward revision, but it still puts some probability on the possibility that the synergy is positive and, therefore, that accepting the bid is profitable. In the end, even if the target works diligently to estimate the bid's true value, it still ends up overestimating it. A consequence of this is that, all else equal, more "bad" deals are made during times of market overvaluation, and the average synergy can even be negative.[17]

The proposition's second part stems from the assumption that managers' private information allows them a better estimate of firms in the same industry. While marketwide overvaluation inflates the estimates of bids from firms in other industries, it does not affect bids coming from within the target's own industry. Since it benefits bidders from other industries, not only do firms from within the target's industry not benefit from the overvaluation, it actually ends up hurting their chances of winning since they are now more likely to lose to a firm from another industry. Parts i) and ii) of Proposition 7 thus imply that marketwide overvaluation can cause merger waves, and that these waves occur between industries.

The last part of the proposition states that market misvaluation will decrease the share of cash acquisitions. Misvaluation does not affect what a bidder is willing to pay in cash, but it affects the price set by an accepted stock bid; thus, it is less likely that any firm will have a high enough synergy to be willing to compete with the stock-auction winner. In the same fashion, the target overvalues more firms when the market is overvalued, so, according to Lemma 5, it is less likely that any firm will offer a cash bid, even when the stand-alone value of the target is the reservation price in the cash auction.[18]

[17] That models of misvaluation can generate waves of bad mergers is an important complement to neoclassical models. SV point out that neoclassical theory predicts mergers to be profitable on average, but that the evidence for this is mixed. Ravenscraft and Scherer (1987), and Servaes (1996) find that the mergers undertaken during the 1960s did not lead to any improvements in profitability. Kaplan (1989) and Healy, Palepu and Ruback (1992) find evidence that the mergers in the 1980s merger wave increased profitability.

[18] RKV show that shared misvaluation can cause merger waves.

The situation is reversed when the target itself, or the target industry, overvalued. The target still acts in the manner described before, but since the same overvaluation factor does not affect the stocks of other firms or firms from other industries, the target tends to undervalue stock bids.

Proposition 8. *A more overvalued target industry or target itself increases the probability of i) a merger not occurring, ii) the merger being within the industry, and iii) the merger being paid in cash.*

Proof. i) The expected values of bids that do not come from the target's industry are decreasing in the misvaluation of the target's industry (ψ_{T}) and the target itself (ε_{T}) since $(1+s_i)$ is affiliated with $\frac{(1+s_i)(1-\varepsilon_{\mathrm{T}})(1-\psi_{\mathrm{T}})}{(1-\varepsilon_i)(1-\psi_k)}$, which is strictly decreasing in ψ_{T} and ε_{T}. Hence, it is less likely that any stock bid fulfills (12), and since cash bids are not affected by misvaluation, the overall probability of a merger decreases.

ii) The second part follows immediately from the first part: Since the target knows the true value of bids from its own industry, one of these is more likely to win the stock auction when the expected value of other bids decreases.

iii) The third part of the proposition is proven in the same way as the third part of Proposition 7, and by noting that $\Lambda \equiv \max\{E[V_2|\Phi_{\mathrm{T}}], X_{\mathrm{T}}\}$ is decreasing in ψ_{T}. □

RKV also includes the second part of the proposition; however, it is somewhat different. First, in RKV, the likelihood of a within-industry acquisition increases in the misvaluation of the target's sector, but it decreases in the target's firm-specific misvaluation factor. Second, in RKV, increased sector overvaluation increases the targets estimate of bids from its own industry, but decreases its estimate of bids from all other industries. In this model, the estimates of bids from the same industry are unaffected since the target manager knows their true value, but we still have the effect that bids from other industries are estimated to be less valuable. Thus, within-industry mergers are more likely because firms from the same industry are less likely to lose to outside bids when the sector is overvalued, but the effect is weaker than in RKV.

Proposition 9. *A more overvalued bidder is i) more likely to win and ii) and more likely to pay in stocks.*

Proof. If we look at (8)–(11), we see that the conditioning variables are all increasing in the misvaluation factors affecting firm i (ψ_k, ε_i), so it follows from Lemma 3 that $E[V_i|\Phi_{\mathrm{T}}]$ increases with i's overvaluation. For all $j \notin k$, ψ_k enters only in the second expression's numerator, and we can once more use Lemma 3 to conclude that the target's estimates of all other bids are decreasing in the same variables. For firms in the same industry, the same holds with regard to ε_i, but not with regard to ψ_k. If $j \in k$, then ψ_k cancels out in the second expression but appears in the first. We can here use that firms are ranked symmetrically within an industry, and that the within-industry ranking is $\frac{(1+s_i)}{(1-\varepsilon_i)(1-\psi_k)(1-\rho)}$, to conclude that the within-industry ranking is unaffected. Finally, since $E[V_i|\Phi_{\mathrm{T}}]$ increases, it is less likely to be challenged by a cash offer when it wins.

The second part of the proposition follows from the first part of the proof and Lemma 5. □

The proposition contains several important empirical predictions. Proposition 8 shows that cash is more likely when the target is overvalued, which sets it apart from SV's model where undervaluation is a necessary condition for a cash acquisition. Therefore, it provides a tool to compare "managers acting in their own interest" and "managers acting in the interest of shareholders."

The other set of predictions regards the validity of the assumption of firms having better information about their industry peers. Taken together, Propositions 8 and 9 suggest that sector-level overvaluation may create merger waves between industries, but not within them. However, if the target manager has no informational advantage regarding the firms in her own industry (she observes M but not X), then the estimates of these bids are increasing in ψ_{T}. This means that sector-level overvaluation increases merger activity also within the overvalued industry. Similarly, the probability of a stock acquisition could go either way; it would decrease for between-industry mergers but increase for within-industry mergers.

Taken together, Propositions 7–9 show that the effects of overvaluation and undervaluation are not straightforward – highlighting both the importance of specifying on which level misvaluation affects a firm, and the need to account for both acquirer and target misvaluation simultaneously. Consider, for example, an overvalued target. When the overvaluation is due to firm or industry overvaluation, a takeover is less likely because the target undervalues stock bids. In contrast, when the overvaluation is due to the whole market being overvalued, the probability of a takeover increases because the same misvaluation also inflates the stock bids. That is, overvaluation that the target does not share with a bidder decreases the likelihood that the bidder wins the auction unless the target and the bidder are in the same industry.

However, a prediction from Propositions 8 and 9 is that the overvaluation of the acquirer is, on average, greater than the overvaluation of the target when the firms are from different industries, but that the relative difference is of no importance for within-industry mergers. Similarly, Ang and Chen (2006) find that the chance of a successful acquisition increases in the overvaluation of the bidder, and Edmans, Goldstein, and Jiang (2012) show that undervaluation increases the probability that a firm is acquired. In addition, Rhodes-Kropf, Robinson, and Viswanathan (2005), and Dong, Hirshleifer, Richardson, and Teoh (2006) provide evidence that acquirers are more overvalued than targets. Rhodes-Kropf, Robinson, and Viswanathan (2005) find that misvaluation difference is larger for between-industry mergers, and Komlenovic, Mamun, and Mishra (2011) find that misvaluation has a stronger effect on merger activity between industries than it has on merger activity within industries.

3.1 Changing the opportunity cost of cash

So far, the analysis has concerned the effects of changes in misvaluation, but it has ignored the effects of changes in the opportunity cost of cash payments. It turns out that changing the opportunity cost of cash not affects the share of deals paid in cash, it also affects the share of mergers occurring within industries.

Proposition 10. *Increasing the opportunity cost of cash i) reduces the probability of a merger occurring, ii) reduces the share of mergers paid in cash, and iii) increases the share of within-industry mergers.*

Proof. i) The opportunity cost of cash does not affect the stock-auction stage. Using (12) and (13), the probability of a merger is

$$\mathbb{P}\left\{\max_i \left[E[V_i|\Phi_{\mathrm{T}}], V_i - X_i^{\mathrm{O}}\right] \geq X_{\mathrm{T}}\right\}.$$

Since $\max_i \left[E[V_i|\Phi_{\mathrm{T}}], V_i - X_i^{\mathrm{O}}\right]$ is decreasing in X_i^{O} for all i, the probability of a merger is decreasing in the opportunity cost of cash.

For the second result, the probability of a stock merger ($\mathbb{P}\{E[V_i|\Phi_{\mathrm{T}}] \geq \max_i[V_i - X_i^{\mathrm{O}}, X_{\mathrm{T}}]\}$) increases by X_i^{O} while the probability of a cash merger ($\mathbb{P}\{V_i - X_i^{\mathrm{O}} \geq \max_i[E[V_i|\Phi_{\mathrm{T}}], X_{\mathrm{T}}]\}$) decreases, meaning that the share of cash mergers decreases.

The third result follows from Corollary 6, which implies that firms from the target's own industry are not directly affected by the opportunity cost of cash. A within-industry merger occurs if

$$\exists j \in \mathcal{T} \text{ s.t. } V_j \geq \max_{i \notin \mathcal{T}} \left\{E[V_i|\Phi_{\mathrm{T}}], V_i - X_i^{\mathrm{O}}, X_{\mathrm{T}}\right\},$$

where the right-hand side is decreasing in X_i^{O}. □

Corollary 11. *Decreasing the opportunity cost of cash increases the probability of a merger more in more undervalued markets.*

Proof. This follows from the first parts of Propositions 7 and 10: Decreasing the opportunity cost only increases the merger probability if the target deemed no stock bid good enough. □

If it becomes cheaper for firms to use cash, then more firms will do so. This is what the empirical literature finds (see, e.g., Harford, 2005; Blomkvist, 2014). Note that if firms are financially constrained, then their opportunity costs change with their investment opportunities. If a bidder's investment opportunities improve, then this alternative use of

cash becomes more attractive, so the synergy factor needed to induce a cash offer increases. Thus, we would expect to see fewer cash-financed mergers during times of good investment opportunities; in fact, Proposition 10 predicts that we will see fewer mergers in total during these periods.[19]

The number of within-industry mergers increases with the opportunity cost of cash because cash is a way for firms to circumvent the problem of misvaluation. Proposition 6 states that firms from the target's industry will never make cash offers, so the cost of cash does not affect them directly. However, it does affect them indirectly: When the cost of cash increases, firms from outside the target's industry are willing to offer less cash to acquire the target, so it is less likely for a related firm to win the stock auction only to lose to a subsequent cash bid.

That the effect on merger activity from reducing the opportunity cost of cash is stronger during times when the market is undervalued comes from the fact that marketwide overvaluation increases the likelihood that the target will accept a stock offer. Decreasing the opportunity cost of cash can only lead to a merger where before there was none if no one won the stock auction – i.e., if the target manager deemed none of the stock offers sufficiently high. Otherwise, it may only turn an stock acquisition into a cash acquisition. Since marketwide overvaluation increases the manager's estimate of all stock offers (apart for those offers coming from the same industry), the target is more likely to accept a stock offer during times of market overvaluation, so it is less likely that lowering the alternative cost of cash leads to an acquisition when there otherwise would not have been one. Corollary 11 thus predicts that a reduction in financing costs has a greater effect on the number of mergers when the market is undervalued.

[19] By the same reasoning, it is straightforward to prove that firms with good outside investment opportunities are less likely to make an acquisition, and, when they do, they are more likely to pay with stocks. This is in line with the empirical findings of Di Giuli (2013).

4 Conclusion

Fluctuations in merger activity can occur for many reasons. According to neoclassical theory, economic and financial shocks cause merger waves. In this theory, technological innovations and regulatory changes create profitable opportunities to reallocate assets between owners, and innovations to firms' financing conditions make previously unprofitable acquisitions profitable. In what have been called behavioral theories, the driving force is instead asymmetric information. In this paper, I have modified and extended RKV's behavioral model by assuming that firms can use their private information to get a correct estimate of the true value of firms in the same industry, and that all firms can make cash offers but are financially constrained to differing degrees.

Assuming that managers have information about the true value of their industry peers allowed me to derive results concerning the effect of marketwide misvaluation, predicting that not only are mergers more likely when the market is overvalued, but that they are also more likely to occur between than within industries. Another new prediction is that the acquirer is more likely to be from the same industry as the target when the target is overvalued at the firm level, while the opposite is true when it is undervalued. In the model, easing the credit conditions leads to more mergers since it is then cheaper for firms to sidestep the asymmetric-information problem and pay with cash when the target underestimates their true value. Since the problem of asymmetric information exists between industries, the model predicts that lower capital costs will lead to more mergers occurring between industries. Similarly, if firms are financially constrained they might have to choose between making an acquisition and making other investments, so the opportunity cost of spending cash on acquisitions is therefore higher during times of good outside investment opportunities. The model thus predicts that mergers are less common during these periods, and that this decline in merger activity is due to a decline in between-industry mergers.

The last result of my model pertained to how the effects of lowering the cost of paying with cash depend on market misvaluation. Since the manager of the targeted firm is more likely to underestimate bids during times of market undervaluation, she is more likely to decline all

bids during these times. Thus, making it cheaper for firms to bid with cash has a greater effect on the probability of a merger in these states of the world.

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Paper iii

Misvaluation and merger activity

Mergers and acquisitions cluster in time in so-called merger waves. Previous research shows that the clustering is procyclical: Merger waves tend to occur during times of high market valuations and economic activity (Jovanovic and Rousseau, 2001). The causes of merger waves, however, remain an open question. The dominant explanations are that either industry shocks (e.g., deregulation or technological change) or market misvaluation causes mergers to cluster. According to the first explanation, investment opportunities exhibit a wave pattern, and this drives merger waves by creating profitable opportunities to reorganize asset ownership (Mitchell and Mulherrin, 1996; Harford, 2005). The misvaluation explanation holds that the stock market makes mistakes in its valuations, causing firms' true value to differ from their current valuation. Overvaluation then makes it cheaper for public firms to finance takeovers, either by allowing them to pay with overvalued stock or by reducing the cost of raising cash. If valuation-errors are correlated between firms, mergers may cluster in time (Shleifer and Vishny [SV], 2003; Rhodes-Kropf and Viswanathan [RKV], 2004).

In this paper, I investigate how stock-market overvaluation affects acquisitions. Using mergers between publicly traded firms, I examine mergers where acquirer and target are from the same sector (related mergers) and compare these with mergers where acquirer and target are not from the same sector (unrelated mergers).[1] Furthermore, I examine the dif-

[1] I focus on deals between publicly traded firms. Netter, Stegemoller and Wintoki

fering impact of overvaluation on deals paid with stocks and deals paid with cash. Prior literature groups all mergers into the one category, or reviews only differences along one dimension (e.g., stock payments vs. cash payments). To my knowledge, I am the first to look at differences along both dimensions.

I distinguish between different types of mergers to develop predictions that separate SV's theory from RKV's. Because the theories differ with respect to their predictions on how "shared" misvaluation affects merger activity, I adopt the method of Rhodes-Kropf, Robinson and Viswanathan (RKRV, 2005) to estimate firms' misvaluation and decompose it into a sector-level component (misvaluation shared by all firms in a sector) and a firm-level component. To better distinguish the misvaluation theories, I decompose the sector-level component further by separating misvaluation shared by all sectors from misvaluation that sectors do not share. This extends the decomposition into three misvaluation components: firm specific, sector specific, and marketwide. In this new decomposition, a sector is defined as overvalued if it is overvalued relative to the market.

The analysis finds that misvaluation does not correlate with stock-financed merger waves if both acquirer and target share the misvaluation. While stock-financed mergers are more common when the stock market is overvalued, this correlation disappears once I include macroeconomic and sector-level controls in my regressions. Similarly, sector-specific overvaluation does not correlate with stock mergers between related firms once I control for other factors. However, I find a robust positive relationship between sector-level misvaluation and stock-financed mergers between unrelated firms, suggesting that misvaluation affects merger activity only if it increases the overvaluation of the acquirer relative to that of the target. Firm-level regressions support this interpretation, showing that individually overvalued firms are more likely to undertake acquisitions. These results are in line with SV, who suggest that overvaluation only increases the probability of a merger if it increases the overvaluation difference between acquirer and target. In contrast, this result contradicts RKV's idea where managers make mistakes that cor-

(2011) show that the "wave pattern" diminishes if one includes smaller deals and deals between private firms.

relate with shared misvaluation, leading target managers to (wrongly) accept more bids during times of sector or market overvaluation (see Section 1). Furthermore, controlling for firm and industry characteristics, I find that firms with higher long-run value are more likely to become acquirers. That is, better-run firms are more likely to make acquisitions. This result differs from RKRV's findings.

My paper relates to the growing literature on merger waves. I contribute to this literature both methodologically and empirically. My method extends RKRV's widely used measure by adding a third factor in the form of a marketwide pricing error (ME). This allows me to account for misvaluation shared between industries. Empirically, I show that, on the aggregate level, macroeconomic factors drive merger activity, not market misvaluation. Sector-level misvaluation affects acquisition activity, but does so differently depending on if the firms are related or unrelated and whether we look at cash or stock acquisitions. The results, thus, refine RKRV's previous findings by showing how sector misvaluation affects different types of mergers and showing that "shared" misvaluation does not increase stock acquisitions. My results are consistent with previous findings that stock acquirers are more overvalued than their targets (see, e.g., RKRV; Dong, Hirshleifer, Richardson and Teoh, 2006).

My results on the importance of economic conditions and of credit-market liquidity are in line with some previous studies. Harford (2005), Maksimovic, Phillips and Yang (2013), and Blomkvist (2014) find a strong negative relationship between the Commercial and Industrial (C&I) loan spread and merger activity, and the latter finds that this relationship is stronger for financially constrained firms (as measured by the KZ index of Lamont, Polk and Saaá-Requejo, 2001).[2] I find some support for the idea that firm-level constraints affect the probability of making cash acquisitions, but the result is not robust to the choice of estimation method.

Since I distinguish between acquisitions paid in stock and those paid in cash, my paper also relates to the literature on the method of payments

[2]Maksimovic, Phillips and Yang (2013) approximate firm-level financial constraints by high/low credit rating (or the lack thereof), while Blomkvist (2014) uses the KZ index of Lamont, Polk and Saaá-Requejo (2001).

in mergers and acquisitions. Di Giuli (2013) shows that both investment opportunities and misvaluation correlate positively with the use of stocks as payment, and Lee and Yerramilli (2016) find evidence for acquirers in stock-financed acquisitions timing the market to take advantage of overvalued stocks. Karampatsas, Petmezas and Travlos (2014) find that firms with high credit ratings are more likely to buy with cash. Uysal (2011) and Vermaelen and Xu (2014) relate the payment choice to firms' capital structure. I add to this literature by showing how the likelihood of making a cash or stock acquisition relates to a firm's misvaluation and fundamentals and that sector-level overvaluation increases firms' unrelated acquisitions.

The structure of the paper is as follows: Section 1 outlines and motivates my hypotheses. Section 2 describes the data, including my extension of RKRV's decomposition of the market-to-book ratio. Section 4 presents my analysis. Section 5 concludes.

1 Theoretical background and hypotheses development

The two main models relating misvaluation to merger timing and payment method are SV's and RKV's models. Some predictions are the same in SV and RKV, but there are instances where they differ. I will use this to test the two models against each other.

SV's and RKV's models both assume that the market misvalues firms, creating an opportunity for overvalued firms to acquire other firms "cheaply" by paying with overvalued equity. However, the models differ in the underlying mechanism, and this leads to somewhat differing predictions. In SV, managers are self-interested, but they differ with respect to their time horizons. Managers with short time horizons are willing to accept stock, which they know is overvalued, but managers with long time horizons are willing to make bids that are high in terms of market value. Mergers cluster because in some periods the market believes a "story" about merger synergies. In RKV, managers try to maximize long-term value for their shareholders, but do not know the long-term

value of stock bids. In the model, managers of targeting firms make mistakes when evaluating stock bids. These mistakes correlate with shared misvaluation.

Both models predict that, in general, overvalued firms are more likely to undertake stock-financed acquisitions; however, not all types of misvaluation affect related and unrelated mergers equally. Here, the models differ in their predictions. In SV, relative differences in misvaluation drive stock-financed mergers, implying that an increase in the acquirer's overvaluation does not affect the probability of a deal if that increase applies simultaneously to the target. In contrast, RKV predict that exactly this type of shared overvaluation causes stock-financed merger waves.[3] Since marketwide misvaluation applies to all traded firms, I thus get two competing predictions:

Empirical Prediction 1: *(SV) Marketwide overvaluation does not affect stock-financed merger activity.*

Empirical Prediction 1': *(RKV) Marketwide overvaluation increases stock-financed merger activity.*

By the same reasoning, SV's and RKV's models yield different predictions with regard to sector-specific overvaluation. SV's model predicts that sector-specific misvaluation has no effect on stock-financed mergers between related firms since it does not change the relative difference in misvaluation between acquirer and target. However, in this model, sector-specific overvaluation of the acquirer does affect stock-financed acquisitions of unrelated firms since it increases the acquirer's relative overvaluation. The model thus predicts that firms in overvalued sectors undertake more acquisitions of unrelated firms and that they pay for these acquisitions with stocks. RKV predicts instead that both related and unrelated stock-financed mergers increase with a sector's overvaluation because sector overvaluation leads the target's manager to overestimate the value of the acquirer's bid, making him or her more likely to accept it, regardless whether or not the acquirer and target are in the

[3]While the model of RKV cannot determine whether marketwide misvaluation has a greater or smaller effect on related mergers than it has on unrelated mergers, the modified model of Berg (2016) predicts that the increase in merger activity stems from an increase in unrelated mergers.

same sector. This yields two separate predictions:

Empirical Prediction 2: *(SV) Sector-specific overvaluation increases stock-financed acquisitions of unrelated firms but has no effect on stock-financed acquisitions of related firms.*

Empirical Prediction 2': *(RKV) Sector-specific overvaluation increases stock-financed acquisitions of both unrelated and related firms.*

Both models predict that firm-specific overvaluation (i.e., misvaluation that firms do not share with other firms) increases the likelihood of undertaking stock-financed acquisitions of both related and unrelated firms. Since the prediction is the same for both models, I cannot use it to distinguish between the two models.

My predictions separating the two models concern stock-financed acquisitions. SV make no predictions regarding bidder overvaluation and cash-financed acquisitions. In RKV's model, bidders cannot choose between cash and stock offers; their model forces some firms to bid with cash and others with stock. Nevertheless, both models predict that acquirers in stock-financed mergers are on average more overvalued than acquirers in cash-financed acquisitions.[4][5] The models sometimes yield different predictions with regard to overvaluation and cash payments, but the predictions are complicated by the possibility that overvaluation in the stock market correlates with overvaluation in the debt market. In a recent study Harford, Martos-Vila and Rhodes-Kropf (2014) found that debt-market overvaluation leads firms to capital restructuring, often consisting of issuing debt to finance acquisitions paid in cash. Since I am not able to control for debt-market overvaluation, I make no predictions

[4]In RKV, acquirers in cash-financed deals are, on average, less overvalued than acquirers in stock-financed deals. However, this is due to overvaluation in the latter category. Berg (2016) modifies RKV's model to allow bidders to make both stock and cash bids – the model predicts that the likelihood of making a cash-financed acquisition decreases in the acquirer's overvaluation.

[5]Previous empirical studies find support for this prediction. RKRV find that acquirers are more overvalued than the average firm, and the difference is greater in stock-financed deals than in cash-financed deals. Studies focusing on differences between deals find the likelihood of stock payment increasing in the overvaluation of the acquirer (see, e.g., Faccio and Masulis, 2005; Di Giuli, 2013; Karampatsas, Petmezas and Travlos, 2014).

regarding overvaluation and cash-financed mergers.

2 Data description

This section describes the data used in my analysis. The first subsection describes how the sample of merger deals is constructed and specifies how databases are matched. The second part describes the misvaluation measures used to test my predictions. The last subsection provides descriptive statistics for acquiring and targeted firms in different types of acquisitions, focusing on differences in misvaluation.

2.1 Sample selection

I construct my sample of mergers using Thomson Financial SDC Mergers and Acquisitions Database for the years 1986–1999 and Bureau van Dijk's Zephyr Database for the years 2000–2007. Following RKRV, I include successful and unsuccessful bids where both acquirer and target are domiciled in the United States, have publicly traded stocks and are in both Compustat and CRSP. To focus on the transfer of control, I exclude deals classified as bankruptcy acquisitions or divestitures, and I require the bidder to seek to own more than 50% of the target after the transaction.[6] Since the predictions separating the theories of SV and RKV depend on the method of payment, I only include deals with a known payment method, where the payment is "all cash," "all stocks" or "hybrid" (partly cash, partly stocks).[7][8] From the original sample,

[6]Since I only include deals between publicly traded firms, initial public offers, liquidations, leveraged buyouts, privatizations, reverse takeovers, and repurchases are excluded

[7]SDC include this classification but Zephyr does not. Nevertheless, Zephyr provides information on payment method that allows for replication of the SDC classification.

[8]Another common restriction is to consider only deals over a specific threshold. As a robustness check, I exclude deals worth less than 10 and 50 million US dollars (à la Karampatsas, Petmezas and Travlos [2014], and Harford [2005]) and rerun my regressions. Another common restriction is to exclude the two sectors Utilities and Financials (FF12 number 8 and 11, repectively). In exclude these in a separate

Table 1: Merger activity. Data on mergers are taken from Thomson Financial SDC Mergers and Acquisitions Database for the years 1986–1999 and Bureau van Dijk's Zephyr Database for the years 2000–2007. Deals are required to have acquirer and target information in Compustat, including stock-market data. Deals are only included if they are paid in cash, stock or a mix of the two and other derivative securities. A deal is classified as a related merger if the firms are in the same FF12 industry. *N* refers to the total number of transactions in each category. Cash and Stock refer to the percentage of deals paid exclusively in cash or stock, respectively. Mixed payment not tabulated.

	All mergers			Unrelated mergers			Related mergers		
Year	*N*	Cash (%)	Stock (%)	*N*	Cash (%)	Stock (%)	*N*	Cash (%)	Stock (%)
1986	84	74	20	39	92	5	45	58	33
1987	68	74	25	23	83	13	45	69	31
1988	69	59	35	26	81	19	43	47	44
1989	37	51	43	9	67	22	28	46	50
1990	47	45	47	18	50	39	29	41	52
1991	46	46	46	12	50	42	34	44	47
1992	65	38	48	15	40	40	50	38	50
1993	129	34	56	27	48	37	102	30	61
1994	164	40	50	34	53	38	130	36	53
1995	185	31	52	38	47	39	147	27	55
1996	227	28	55	42	52	38	185	23	58
1997	211	30	55	45	33	49	166	29	56
1998	194	38	46	45	47	42	149	36	48
1999	77	32	45	16	31	38	61	33	48
2000	158	28	35	43	33	35	115	27	35
2001	107	43	32	28	61	25	79	37	34
2002	124	35	31	35	46	26	89	30	33
2003	129	41	19	22	55	27	107	38	18
2004	140	49	19	25	56	36	115	48	15
2005	141	52	17	37	68	14	104	47	18
2006	115	47	11	23	74	9	92	40	12
2007	66	39	23	18	44	17	48	38	25
Total/average	2583	40	38	620	55	30	1963	36	41

the above criteria leave 2,583 deals between 1986 and 2007 that have the necessary data. I start the sample in 1986 due to data availability, and I end the sample in 2007 to exclude the financial crisis of 2008–2009. Table 1 presents the yearly acquisition activity. Columns 1–3 summarize overall activity in the form of the number of transactions, and the share of deals paid in stocks and cash respectively. Columns 4–6 and 7–9 do the same but for related (acquirer and target are in the same sector) and unrelated mergers.

The merger data is then matched with data from Compustat and CRSP, following RKRV's procedure. They collect fiscal year end accounting data from Compustat and associate it with CRSP's stock-market data occurring three months after the Compustat filing. Second, they associate an observation in the Compustat–CRSP data with a merger announcement if the announcement occurs at least one month after the date of the stock-market data (four months after the Compustat filing). If a merger announcement occurs in the four-month period after the fiscal year-end filing, this observation is matched with the previous year's observation.[9] Finally, they use Fama and French's industry classification to divide firms into 12 different sectors. The final sample thus consists of all firms who are on both Compustat and CRSP and have all the necessary data.

2.2 Estimating mispricing factors

I employ RKRV's measure of misvaluation and extend their decomposition by adding a factor for marketwide misvaluation.[10] RKRV decompose a firm's logarithmic market-to-book ratio into a misvaluation component and a long-run value component:

$$m - b = (m - v) + (v - b). \tag{1}$$

robustness test. (All robustness tables are found in Appendix C)

[9] Since a merger announcement is associated with a fiscal year-end filing in the window (–485, –120) the "year" of the Compustat data can be up to two years less than the "year" of the announcement.

[10] Appendix B contains a more detailed description.

Here m is the market value, b is the book value, and v is the firm's intrinsic value. v is unobservable, but is estimated as a linear function of the firm's book value, leverage and net income.[11] RKRV refer to the first component on the right-hand side, $(m-v)$, as the firm's "pricing error" (PE) and the second component, $(v-b)$, as the firm's long-run value (LR). They proceed by splitting the pricing error into two parts: a proxy for firm-level misvaluation and a proxy for sector-level misvaluation. I take this decomposition a step further and decompose their sector-level misvaluation proxy into two parts: one proxy for marketwide misvaluation and a new proxy for sector-level misvaluation. In this new decomposition, the market-level component describes misvaluation of the average sector, while the new sector-level component describes a sector's misvaluation relative to that average sector. My decomposition, thus, has four components: *marketwide pricing error (ME)*, *sector-specific pricing error (SE)*, *firm-specific pricing error (FE)*, and *long-run value (LR)*.[12] That is, the market-to-book ratio of firm i at time t is decomposed as

$$m_{it} - b_{it} = \underbrace{ME_{it} + SE_{it} + FE_{it}}_{m_{it}-v_{it}} + \underbrace{LR_{it}}_{v_{it}-b_{it}} . \tag{2}$$

In addition to the mispricing factors, the regression analysis in Section 4 includes control variables the previous literature has found affecting acquisition decisions. These are detailed in Appendix A.

2.3 Descriptive statistics

Table 1 shows that overall merger activity varies considerably over the sample period, with a peak in the IT years before the turn of the millennium, and acquisitions being more common in the latter half of the sample. Comparing acquisition activity between related and unrelated firms, we see that they move in much the same way, but the share of acquisitions taking place within industries has nevertheless varied between

[11] RKRV consider other specifications, but this specification is the one most commonly employed in subsequent works (e.g., Hertzel and Li, 2010; Fu, Lin and Officer, 2013).

[12] The sector-level pricing error employed by RKRV thus equals *ME* + *SE*. The *FE* and *LR* components are unchanged between the two decompositions.

Table 2: Summary statistics. Summary statistics from Compustat 1986–2007. Observations on mergers refer to the firm–year when the merger occurred. Monetary values are expressed in millions of 2010 US dollars. Market value is the market value of equity. Interest coverage is interest payment divided by assets. Invest opp is calculated using Almeida, Campello and Hackbarth's (2011) approach. Profitability is operating income before depreciation divided by total assets. a, b, and c indicate statistical significance at 10%, 5%, and 1% when testing the difference between acquirer and target, such as comparing acquirers in unrelated mergers with targets in unrelated mergers. α, β, and γ indicate statistical significance at 10%, 5%, and 1% when testing the difference between related and unrelated mergers, such as comparing acquirers in unrelated mergers with acquirers in related mergers

		Unrelated mergers		Related mergers	
Variables	No merger (1)	Acquirer (2)	Target (3)	Acquirer (4)	Target (5)
N	121326	561	593	1731	1870
Market value	2235	$13875^{c,\alpha}$	1217^{c}	$10781^{c,\alpha}$	1206^{c}
Book value	880	$4087^{c,\alpha}$	439^{c}	$3260^{c,\alpha}$	563^{c}
Sales	1755	$7514^{c,\gamma}$	1049^{c}	$5480^{c,\gamma}$	1026^{c}
Assets	4531	21035^{c}	$1104^{c,\gamma}$	17210^{c}	$3589^{c,\gamma}$
Liabilities	3651	16948^{c}	$666^{c,\gamma}$	13950^{c}	$3026^{c,\gamma}$
Net income	94	$639^{c.\alpha}$	49^{c}	$489^{c,\alpha}$	52^{c}
Capx	125	414^{c}	58^{c}	387^{c}	68^{c}
Invest opp	0.06	0.06^{γ}	0.06^{γ}	0.05^{γ}	0.05^{γ}
Interest coverage	18.5	29.1	22.9	24.5^{c}	15.3^{c}
Book leverage	0.52	$0.53^{c,\gamma}$	$0.46^{c,\gamma}$	$0.59^{b,\gamma}$	$0.58^{b,\gamma}$
$\ln(M/B)$	0.80	$1.03^{c,\beta}$	$0.77^{c,\beta}$	$0.95^{c,\beta}$	$0.60^{c,\beta}$
Profitability	0.05	$0.11^{c,\beta}$	$0.07^{c,\beta}$	$0.10^{c,\beta}$	$0.05^{c,\beta}$

50% and 80% over the sample period. In general, stock payments were more common in the 1990s than in the 2000s and are more common in related mergers than in unrelated mergers. Table 2 presents summary statistics for acquirers and targets in related and unrelated acquisitions. Acquirers in unrelated acquisitions are, on average, larger than acquirers in related acquisitions, irrespective of which measure of size we use, but the differences between the two groups of targets are smaller and statistically insignificant except for total asset value. On average, acquirers are significantly larger than targets, and they have a larger valuation "mark-up" in terms of market-to-book value.[13]

Tables 3 and 4 dig deeper into the valuation differences between related and unrelated mergers by reviewing the market-to-book ratio decomposition described in the previous section. Table 3 divides the sample according to whether firms are acquirers or targets in related or unre-

[13]Performance measures are winsorized at the 1%-level.

lated acquisitions, and Table 4 takes the division into subsamples a step further by comparing the same groups for cash and stock payments. In both tables the level of observation is the firm–year, and a firm is counted as an acquirer (target) in a related or unrelated merger if it has attempted an acquisition (been targeted for an acquisition) in that year. Firms are counted only once in each category in any given year. That is, if a firm attempts several acquisitions of related firms in the same year it counts as one observation in Column 4 of Table 3, but if it attempts one related and one unrelated acquisition in the same year, I count it as an observation in both Columns 2 and 4. The same principle is applied in Table 4. Both tables contain tests for equality of means where I test the difference in mean between acquirers and targets within a "type" of acquisitions (e.g., between acquirers and targets in unrelated acquisitions paid in cash), or the difference in mean between acquirers in different types of acquisitions (e.g., comparing acquirers in unrelated acquisitions paid in cash with acquirers in related acquisitions paid in cash). Table 4 also includes tests between, for example, acquirers in cash- and stock-financed unrelated mergers.

The second row of Table 3 reports the logarithm of the market-to-book ratio of all firms in the sample and for different subcategories. On average, acquirers have a significantly higher market-to-book ratio than firms who do not participate in mergers, and the ratio is significantly higher for acquirers in unrelated mergers than for acquirers in related mergers (1.06 compared to 0.95). Targeted firms deviate less from the group of nonmerging firms, and the difference goes in different directions: Targets in related and unrelated mergers have, on average, a lower market-to-book ratio than nonmerging firms (0.77 and 0.69, respectively, compared to 0.81). Looking at differences across method of payment in Table 4, we see that both acquirers and targets have higher market-to-book ratios in stock deals than in cash deals, and the differences are much larger in unrelated acquisitions. Furthermore, the market-to-book difference between cash and stock mergers is similar for acquirers and targets in both related and unrelated mergers (see first row in Table 4), so the relative difference between acquirers' and targets' market-to-book ratios changes very little with the method of payment.[14] Hence, if we use the

[14]For example, for mergers between unrelated firms, the difference in the market-

Table 3: Summary statistics of market-to-book decomposition The sample consists of all firm–year observations in Compustat with sufficient data to calculate the market-to-book ratio decomposition (described in Section 3). Acquirers and targets are identified using SDC and Zephyr. Variable values refer to the sample average, with standard deviation in parentheses. ME, SE and FE are marketwide, sector-specific and firm-specific pricing errors, respectively. PE = ME + SE + FE is the total pricing error. LR is the long-run value component. a, b, and c indicate statistical significance at 10%, 5%, and 1% when testing the difference between acquirer and target, such as comparing acquirers in unrelated mergers with targets in unrelated mergers. α, β, and γ indicate statistical significance at 10%, 5%, and 1% when testing the difference between related and unrelated mergers, such as comparing acquirers in unrelated mergers with acquirers in related mergers.

		Unrelated mergers		Related mergers	
Variables	No merger (1)	Acquirer (2)	Target (3)	Acquirer (4)	Target (5)
N	121326	561	593	1731	1870
$\ln(M/B)$	0.80	$1.03^{c,\beta}$	$0.77^{c,\beta}$	$0.95^{c,\beta}$	$0.69^{c,\beta}$
	(0.99)	(0.82)	(0.88)	(0.75)	(0.79)
PE	0.05	0.39^{c}	0.00^{c}	0.36^{c}	0.01^{c}
	(0.78)	(0.76)	(0.79)	(0.64)	(0.69)
ME	0.06	$0.08^{c,\gamma}$	$0.04^{c,\gamma}$	$0.11^{c,\gamma}$	$0.08^{c,\gamma}$
	(0.19)	(0.20)	(0.18)	(0.19)	(0.19)
SE	0.00	$0.03^{c,\gamma}$	$0.00^{c,\alpha}$	$0.01^{c,\gamma}$	$-0.01^{c,\alpha}$
	(0.19)	(0.21)	(0.17)	(0.17)	(0.17)
FE	0.00	0.29^{c}	-0.05^{c}	0.24^{c}	-0.05^{c}
	(0.74)	(0.73)	(0.74)	(0.59)	(0.64)
LR	0.75	$0.63^{c,\alpha}$	$0.78^{c,\gamma}$	$0.59^{c,\alpha}$	$0.68^{c,\gamma}$
	(0.61)	(0.53)	(0.52)	(0.50)	(0.54)

market-to-book ratio as a proxy for misvaluation, then the results in Table 4 suggest that stock payments are more common when acquirer and target are overvalued, but the relative difference in overvaluation plays no role in the payment choice.

Turning to the decomposition of the market-to-book ratio in Table 3, we see that both related and unrelated mergers are more common during times of high market valuation, such as when the *ME* is above zero. Comparing this with my first empirical prediction, we see that this speaks in favor of RKV's theory, which suggests that target managers make mistakes when evaluating merger offers (accepting offers that ought not be accepted), and that these mistakes correlate with market misvaluation. However, the theory also predict that we ought to see

to-book ratio is 0.23 in cash-financed deals and 0.24 in stock-financed deals, but the ratio for the acquirer (target) is 0.91 (0.68) in cash deals and 1.19 (0.95) in stock deals.

Table 4: The sample consists of firm–year observations for acquirers and targets with sufficient Compustat data to calculate the market-to-book ratio decomposition. Acquirers and targets are identified using SDC and Zephyr. The sample is split into four subgroups, depending on if the acquisition occurred within the same FF12 industry or not, and depending on if it was paid all in cash or all in stocks. Variable values refer to the sample averages, with standard deviations in parentheses. Columns marked "Diff./t-test" list the difference in averages between the indicated groups, and the values in parentheses refer to the t-value of a test for equality of means. The table also reports two additional t-tests. a, b, and c signify statistical significance of differences (at the 10%, 5%, and 1%-level, respectively) when testing differences between payment methods, such as comparing acquirers in stock-financed unrelated mergers with acquirers in cash-financed unrelated mergers. α, β, and γ signify statistical significance of differences when testing differences between related and unrelated mergers, such as comparing acquirers in cash-financed unrelated mergers with acquirers in in cash-financed related mergers.

	Unrelated mergers			Related mergers		
Variables	Acquirer (1)	Target (2)	Diff./t-test (1)-(2)	Acquirer (3)	Target (4)	Diff./t-test (3)-(4)
Cash						
ln(M/B)	0.91^{c}	0.68^{c}	0.23	0.93^{c}	0.64^{c}	0.29
	(0.77)	(0.81)	(3.71)	(0.70)	(0.79)	(7.01)
PE	0.27^{c}	-0.06^{a}	0.33	0.32^{c}	-0.07^{c}	0.38
	(0.66)	(0.69)	(6.17)	(0.61)	(0.67)	(10.71)
ME	0.06^{γ}	0.04	0.02	0.11^{γ}	0.06	0.04
	(0.20)	(0.18)	(1.57)	(0.19)	(0.19)	(4.18)
SE	0.01^{c}	-0.01^{c}	0.02	0.02	0.00	0.02
	(0.18)	(0.14)	(1.31)	(0.17)	(0.18)	(2.20)
FE	0.20^{c}	-0.09	0.29	0.19^{c}	-0.12^{c}	0.32
	(0.65)	(0.66)	(5.55)	(0.56)	(0.65)	(9.43)
LR	0.64	0.74^{c}	-0.1	0.61	0.7	-0.09
	(0.50)	(0.53)	(-2.37)	(0.48)	(0.56)	(-3.15)
Stocks						
ln(M/B)	$1.19^{c,\beta}$	$0.95^{c,\gamma}$	0.24	$1.04^{c,\beta}$	$0.76^{c,\gamma}$	0.29
	(0.87)	(0.97)	(2.51)	(0.81)	(0.82)	(6.84)
PE	$0.56^{c,\alpha}$	0.07^{a}	0.49	$0.45^{c,\alpha}$	0.07^{c}	0.39
	(0.92)	(0.90)	(5.10)	(0.69)	(0.71)	(10.74)
ME	0.07	0.03^{β}	0.04	0.10	0.06^{β}	0.04
	(0.20)	(0.16)	(2.26)	(0.20)	(0.17)	(3.76)
SE	$0.07^{c,\gamma}$	$0.03^{c,\gamma}$	0.05	$0.01^{c,\gamma}$	-0.01^{γ}	0.02
	(0.23)	(0.18)	(2.13)	(0.17)	(0.17)	(1.82)
FE	0.41^{c}	0.01	0.4	0.35	0.02^{c}	0.33
	(0.87)	(0.83)	(4.46)	(0.63)	(0.65)	(10.14)
LR	0.64	$0.88^{c,\gamma}$	-0.24	0.59	0.69^{γ}	-0.100
	(0.55)	(0.50)	(-4.44)	(0.52)	(0.53)	(-3.65)

more mergers within overvalued sectors (Empirical Prediction 2), but this is not the case for related mergers – the average *SE* is close to zero for both acquirer and target in related mergers. In unrelated mergers,

the *SE* is positive for acquirers and zero for targets, suggesting that firms in overvalued sectors seize the opportunity to acquire firms in less overvalued sectors. The results on sector-specific mispricing thus suggest that the relative difference in misvaluation between acquirer and target is what matters – supporting SV's prediction. The results in Table 4 support this interpretation. In RKV's model, stock mergers are more likely when shared overvaluation factors are high, while in SV overvaluation should not lead to more stock mergers if both firms are overvalued by the same amount. Comparing the marketwide and industry-specific pricing errors between cash and stock deals, there is almost no difference for either acquirers or targets when looking at related mergers. For unrelated acquisitions, however, we see that *SE* is higher for acquirers in stock deals than it is in cash deals, and while the *SE* of targets is also, on average, higher in stock mergers, the difference between acquirers and targets increases.

Both SV's and RKV's theory predict that an acquisition is more likely to occur when the acquirer (target) has a high (low) *FE*. This is indeed what we find in Table 3. Furthermore, they both predict that the acquirer's *FE* should be larger in stock acquisitions than cash acquisitions, which is born out in Table 4. However, the theories differ in their predictions with regard to the relationship between firm-specific misvaluation and payment method. RKV expect a negative relationship between stock payments and firm-specific misvaluation, while SV predict a positive relationship. The results in Table 4 support SV, showing that, on average, targets have a higher firm-specific mispricing factor in stock mergers than in cash mergers. In addition, SV predict that targets are always undervalued in cash acquisition, which is true on average: In Table 4, $PE = ME + SE + FE$ is negative for targets in cash deals, and this is true for both related and unrelated mergers.

3 Merger activity and the decision to buy

The descriptive statistics and univariate tests in the preceding section suggest that mispricing plays a role in acquisition decisions. That merging firms on average have a positive ME provides an indication that

shared misvaluation may affect merger activity. However, under this interpretation, we would expect a similar result for the SE in related mergers, which we did not. Furthermore, the SE component is, on average, equal in cash and stock deals between related firms, while it is larger in stock deals when looking at unrelated mergers. Taken together, the univariate results suggest that misvaluation affects merger decisions by creating a difference between the misvaluation of acquirer and target, and there seems to be some evidence that mergers are more frequent when a sector or the whole market is overvalued. However, to calculate the ME and SE components, I use deviations from long-run averages and concurrent accounting variables, which means that the pricing components are affected by macroeconomic and industry conditions that affect stock-market expectations (see, e.g., Dong, Hirshleifer, Richardson and Teoh, 2006). In this section, I control for macroeconomic and sectorial conditions, as well as firm characteristics, to account for economic factors that might influence valuation levels. I perform the analysis at both the sector and the firm level, and I continue to distinguish between related and unrelated mergers and between cash and stock payments. RKRV show that merger activity correlates with their version of sector mispricing, but my analysis suggests that this result is not robust to the inclusion of macroeconomic and sector-level controls. Further analysis shows that this stems from there being a common component in RKRV's sector-specific error (i.e., shared by all sectors), and that this covaries with both merger activity and the control variables. To account for this covariation, I rerun the regressions using my own decomposition from above, which splits RKRV's sector-specific error into ME and SE. The analysis finds a positive and robust relationship between SE and stock-financed acquisitions of unrelated firms, but no robust relationship between SE and other types of merges. The firm-level analysis reinforces this result and demonstrates a positive and robust relationship between firm-specific misvaluation and the likelihood of undertaking stock-financed acquisitions. I interpret my findings as macroeconomic and sector-level conditions driving most merger activity, but misvaluation playing a role if it increases the misvaluation of some firms relative to that of others.

3.1 Merger activity: The effects of market and sector valuation

Since I am interested to see if misvaluation has a differentiated effect on different types of mergers, I run separate regressions for different merger types. In all regressions, the dependent variable is the share of firms that undertake a specific type of acquisition, and the level of observation is the sector–year.[15] The measure "share of firms undertaking acquisitions" differs from RKRV's measure: They use the number of deals in each year as a measure of M&A activity. Since the number of firms in Compustat/CRSP is not constant over time, I normalize the value so that changes in the measure correspond to changes in the probability of undertaking acquisitions, rather than reflecting changes in the size of the sample population.[16] From a theoretical viewpoint, using the number of deals or the share of firms that undertake deals make no difference – misvaluation should have the same effect on both measures. Since theories relating merger activity to misvaluation predict a specific direction of sale (more-overvalued firms acquire less-overvalued firms), I use only acquirers in my measure. Tables 5–7 present regression results for sector-level acquisition activity where the data set is a pane with the sector–year as the unit of observation (Fama–French 12-sector classification). All estimates include sector fixed effects, and error terms are clustered on sectors with p-values estimated through a wild bootstrap.[17]

In the first set of tables, I use RKRV's decomposition. The general specification in these regressions is

$$y_{jt} = \alpha_j + \beta_1(ME_{jt} + SE_{jt}) + \beta_2 LR_{jt} + \gamma X_{jt} + \delta Z_t + \epsilon_{jt} \qquad (3)$$

[15] For example, in some regressions the dependent variable is the share of firms that acquire a firm in a different sector (unrelated merger) using stock, while in other regressions the dependent variable is the share of firms that acquire a firm in the same sector (related merger) using cash. I also perform regressions with more aggregated dependent variables.

[16] The number of firms varies considerably, from a low of just over 4,000 in 1990 to a high of more than 7,000 in 1996. Harford (2005) uses a similarly normalized measure to classify years into "merger-wave years."

[17] Cluster robust standard error might be biased downward when the number of clusters is small (five to thirty), leading to false rejections of the null. Cameron, Gelbach and Miller (2006) find that the wild cluster bootstrap works well in these situations.

y_{jt} is the share of firms in sector j that undertake an acquisition, and X_{jt} and Z_t are sector-level and macroeconomic controls (or time fixed effects), respectively. ME_{jt}, SE_{jt}, and LR_{jt} are averages of the corresponding firm-level variables in sector j at time t.[18]

Table 5 presents results from regressions where the only independent variables are RKRV's decomposition components. The dependent variable in Column 1 is the share of firms within an industry that undertake any type of acquisition in year t. As both SV and RKV predict, the variable $ME + SE$ correlates positively with acquisition intensity, suggesting that firms are more likely to undertake acquisitions when their sector is overvalued. Looking at Columns 2 and 3, we see that the relationship between the sector-mispricing component and acquisition activity derives solely from an increase in related mergers. That is, firms are more likely to undertake related acquisitions (Column 3) when the valuation of their sector is high, but that overvaluation does not affect unrelated acquisitions (Column 2). While RKV predict that sector-level overvaluation will lead to an increase in related mergers, they also predict that it will cause more unrelated mergers where firms in the overvalued sector acquire firms in undervalued (or less overvalued) sectors. According to SV's model, we ought to see more mergers when the relative misvaluation is large, and we would thus expect a positive relationship between the sector-specific error and unrelated acquisitions, but no relationship with related acquisitions. Furthermore, both models predict that the increase in mergers is due to an increase in stock mergers, but the results in Panel A of Table 5 suggest no relationship between overvaluation and stock-financed acquisitions. The results are thus hard to reconcile with models of misvaluation-driven merger activity.

However, $ME + SE$ measures changes in sector valuation relative to long-run averages, but these changes are not necessarily due to misvaluation. They could, instead, reflect rational changes in the expectation (or discounting) of future earnings. Panel B, therefore, repeats the previous regressions with sector and macroeconomic controls shown by the previous literature to affect merger decisions (see, e.g., Maksimovic, Phillips and Yang 2013; Harford, Martos-Vila and Rhodes-Kropf, 2014). The addition of control variables makes the coefficient on $ME + SE$ in-

[18]The notation $(ME_{jt} + SE_{jt})$ denotes the sector-specific pricing error of RKRV.

Table 5: Sector-level merger activity, 3-factor decomposition. The dependent variable in the first column is the share of firms in sector j that undertook any type of acquisition in year t. Column 2 (3) shows the share of firms that undertook unrelated (related) acquisitions, while Column 4 (5) reveals the share of firms that undertook an acquisition and paid cash (stock). *ME + SE* is the average sector-specific pricing error from RKRV, and *LR* is the average of the long-run value component. *Std(m-b)* is the yearly standard deviation of the log of the market-to-book ratio, *Econ shock* is calculated in accordance with Harford (2005), *Illiq* is the average of Amihud's (2002) Illiquidity index, and *Herfindahl* is the Herfindahl index. Averages and standard deviations are taken with respect to firms in industry j. *CFNAI* is an index measuring macroeconomic conditions, *S&P return* is the yearly return on the SP500 Composite, and *Credit spread* is the spread between C&I loans and the federal funds rate. All regressions are estimated with sector fixed effects. Errors are clustered on FF12 sectors, and *p*-values (in brackets) are estimated using wild bootstrap. *, **, and *** represent significance at the 10%, 5%, and 1% level, respectively.

Panel A

Variables	All (1)	Unrelated (2)	Related (3)	Cash (4)	Stocks (5)
ME+SE	.008**	.001	.008***	.002	.002
	[.012]	[.667]	[.000]	[.160]	[.555]
LR	.011	.005	.006	.011	.008
	[.477]	[.733]	[.528]	[.386]	[.280]
N	248	248	248	248	248
R2	.168	.160	.273	.114	.169
Year FE	No	No	No	No	No
Sector FE	Yes	Yes	Yes	Yes	Yes

Panel B

VARIABLES	All (1)	Unrelated (2)	Related (3)	Cash (4)	Stocks (5)
ME+SE	.004	.002	.002	.002	.001
	[.450]	[.459]	[.557]	[.458]	[.472]
LR	-.006	-.010	.004	-.006	-.000
	[.875]	[.430]	[.917]	[.748]	[1.000]
std(m-b)	-.015**	-.006**	-.009*	-.009***	-.001
	[.016]	[.031]	[.053]	[.001]	[.792]
Economic shock	.006**	.003***	.003	.003***	.001
	[.041]	[.001]	[.155]	[.005]	[.648]
Invest opp	-.069	-.030	-.039	-.034	-.039
	[.383]	[.464]	[.375]	[.174]	[.448]
Herfindahl	.105	.130	-.024	.193	-.121
	[.682]	[.479]	[.842]	[.217]	[.346]
Illiq	-5.400	22.162***	-27.562	14.469	-8.023
	[.811]	[.000]	[.245]	[.341]	[.481]
CFNAI	.006	.002	.003*	.004*	.001*
	[.110]	[.172]	[.063]	[.065]	[.063]

Continued on next page

Table 5 – continued from previous page

S&P return	-.006	-.004	-.001	-.005	-.001
	[.471]	[.266]	[.847]	[.232]	[.882]
Credit spread	-.012***	-.006**	-.006**	-.004**	-.008**
	[.001]	[.034]	[.043]	[.047]	[.046]
5-year yield	-.001	.000	-.001	-.000	.000
	[.250]	[.703]	[.102]	[.855]	[.623]
N	248	248	248	248	248
R2	.322	.294	.371	.262	.299
Year FE	No	No	No	No	No
Sector FE	Yes	Yes	Yes	Yes	Yes

significant in all regressions, suggesting that real economic factors drive merger activity, not stock-market misvaluation. This is in line with Harford's (2005) results that industry-level shocks and regulatory changes create merger waves, not misvaluation. Adding sector-level and macroeconomic controls separately reveals that the coefficient on $ME + SE$ becomes insignificant through the addition of the latter controls (results not tabulated). Hence, joint correlations with macroeconomic factors appear to explain the initially observed relationship between overvaluation and merger activity.

The results indicate that shared misvaluation does not affect merger activity. However, since macroeconomic factors affect the whole market, the valuation of sectors (and hence the $ME + SE$) covaries over time. This covariation makes it difficult to pick up the importance of relative misvaluation, that is, we risk missing if firms undertake more acquisition when their sector is overvalued compared to the rest of the market. To account for this, I extend RKRV's decomposition of the market-to-book ratio (described in the data section and Appendix B) and estimate

$$y_{jt} = \alpha_j + \beta_1 ME_{jt} + \beta_2 SE_{jt} + \beta_3 LR_{jt} + \gamma X_{jt} + \delta Z_t + \epsilon_{jt} \qquad (4)$$

The idea is that ME picks up valuation deviations common to all sectors in a year, leaving SE to proxy for the misvaluation of a sector relative to the rest of the market. The results in Panel A of Table 6 show that this further decomposition has a significant effect on the results and the conclusions we draw regarding the possible effects of misvaluation. The relative sector mispricing correlates positively with acquisition activity (Column 1). Unlike the results from Table 5's simple specification, this

appears to be because both unrelated and related mergers increase with sector-level mispricing (Columns 2 and 3). Furthermore, in Table 5, I found no relationship between cash and stock acquisitions and RKRV's sector-specific pricing errors, but when controlling for the comovement of these (i.e., by including ME and SE separately), the relative sector-specific pricing error becomes significant in both models. The marketwide pricing error is insignificant in all regressions except in Column 2, where the dependent variable is the share of firms undertaking unrelated acquisitions. The negative coefficient on ME in this regression suggests that, all else equal, firms are more likely to undertake unrelated acquisitions when the market is undervalued. Panel B repeats the regressions in Panel A, but uses time fixed effects instead of macroeconomic controls.[19] Qualitatively, the results on SE are robust to the inclusion of time fixed effects except for cash-financed acquisitions (Column 4) where the SE component goes from strongly significant in Panel A to insignificant in Panel B. The results suggest that sector-level overvaluation increases overall acquisition activity in a sector, increasing both related and unrelated acquisitions. Furthermore, as misvaluation theory suggests, increased stock deals seem to be behind the increase in overall deals.

Table 7 divides related and unrelated mergers into subcategories based on their method of payment. Table 6 found both related and unrelated acquisition activity correlating with sector-specific mispricing, as did the share of firms that undertook cash- or stock-financed acquisitions. Table 7 suggests that the increases in cash and stock deals do not apply equally to related and unrelated acquisitions. While the coefficient on SE is significant in both regressions for cash-financed acquisitions (Columns 1 and 2), it is significant only for unrelated acquisitions when looking at stock deals (Columns 3 and 4). Substituting time fixed effects for my macroeconomic control variables makes the SE coefficient insignificant for both types of cash deals; it remains significant only for stock-financed acquisitions of unrelated firms (Panel B).[20]

[19]Since time fixed effects purge the yearly average of all variables, the coefficient on ME can no longer be interpreted as the effect of marketwide overvaluation.

[20]When only including merger deals worth at least 50 million US dollars, the coefficient on SE becomes insignificant in all models in Panel A (with macroeconomic controls) except for cash-financed mergers between related firms. The results in Panel

Table 6: Sector-level merger activity, 4-factor decomposition. The dependent variable in the first column is the share of firms in sector j that undertook any type of acquisition in year t. Column 2 (3) shows the share of firms that undertook unrelated (related) acquisitions, while Column 4 (5) reveals the share of firms that undertook an acquisition and paid cash (stock). *ME* is the average marketwide pricing error, *SE* is the average sector-specific pricing error, and *LR* is the average of the long-run value component. *Std(m-b)* is the yearly standard deviation of the log of the market-to-book ratio, *Econ shock* is calculated in accordance with Harford (2005), *Illiq* is the average of Amihud's (2002) Illiquidity index, and *Herfindahl* is the Herfindahl index. Averages and standard deviations are taken with respect to firms in industry j. *CFNAI* is an index measuring macroeconomic conditions, *S&P return* is the yearly return on the SP500 Composite, and *Credit spread* is the spread between C&I loans and the federal funds rate. All regressions are estimated with sector fixed effects. Errors are clustered on FF12 sectors, and p-values (in brackets) are estimated using wild bootstrap. *, **, and *** represent significance at the 10%, 5%, and 1% level, respectively.

Panel A

Variables	All (1)	Unrelated (2)	Related (3)	Cash (4)	Stocks (5)
ME	-.015	-.007***	-.008	-.007	-.007*
	[.107]	[.004]	[.310]	[.135]	[.098]
SE	.012***	.006***	.007***	.006***	.005*
	[.000]	[.002]	[.000]	[.000]	[.059]
LR	-.007	-.010	.003	-.006	-.000
	[.866]	[.410]	[.924]	[.747]	[.987]
std(m-b)	-.018***	-.007***	-.010**	-.011***	-.002
	[.003]	[.005]	[.012]	[.001]	[.526]
Econ shock	.006**	.003***	.003	.003***	.001
	[.029]	[.001]	[.128]	[.001]	[.549]
Invest opp	-.059	-.025	-.034	-.029	-.035
	[.405]	[.468]	[.411]	[.173]	[.467]
Herfindahl	.129	.141	-.012	.205	-.112
	[.588]	[.476]	[.927]	[.183]	[.397]
Illiq	-8.339	2.770***	-29.109	13.056	-9.242
	[.755]	[.000]	[.281]	[.493]	[.393]
CFNAI	.007*	.003	.004**	.005*	.002
	[.076]	[.130]	[.036]	[.060]	[.005]
S&P return	.002	-.001	.003	-.002	.003
	[.768]	[.812]	[.619]	[.702]	[.312]
Credit spread	-.012***	-.006**	-.006**	-.004*	-.008
	[.003]	[.036]	[.042]	[.059]	[.048]
5-year yield	-.002***	-.001**	-.002**	-.001**	-.000
	[.002]	[.044]	[.013]	[.022]	[.301]
Observations	248	248	248	248	248
R^2	.351	.317	.384	.278	.316
Year FE	No	No	No	No	No
Sector FE	Yes	Yes	Yes	Yes	Yes

Continued on next page

Table 6 – continued from previous page

Panel B

Variables	All (1)	Unrelated (2)	Related (3)	Cash (4)	Stocks (5)
ME	-.018	-.001	-.016	-.023	-.007
	[.468]	[.920]	[.425]	[.227]	[.303]
SE	.014***	.005*	.009**	.004	.006*
	[.000]	[.054]	[.035]	[.188]	[.054]
LR	-.007	-.011	.003	-.003	-.006
	[.867]	[.403]	[.921]	[.937]	[.309]
std(m-b)	-.019**	-.007	-.013***	-.013**	.006
	[.013]	[.127]	[.001]	[.024]	[.284]
Econ shock	.004	.004**	-.000	.004	.000
	[.121]	[.022]	[.992]	[.112]	[.827]
Invest opp	-.064	-.054	-.010	-.060**	-.026
	[.494]	[.258]	[.861]	[.047]	[.678]
Herfindahl	.147	.127	.020	.166	-.047
	[.484]	[.434]	[.869]	[.214]	[.603]
Illiq	8.182	29.169*	-2.988	26.671	-25.538**
	[.744]	[.064]	[.269]	[.040]	[.020]
Observations	248	248	248	248	248
R^2	.400	.370	.446	.392	.433
Year FE	Yes	Yes	Yes	Yes	Yes
Sector FE	Yes	Yes	Yes	Yes	Yes

A possible explanation for the positive correlation between the sector-specific error and cash acquisitions is that stock-market misvaluation correlates with debt-market misvaluation. Harford, Martos-Vila and Rhodes-Kropf (2014) use an ex-post measure of credit-rating accuracy to study firms' capital decisions. Their findings indicate that firms issue more debt when the bond market is overvalued, and that almost half of that debt goes to financing cash acquisitions. If debt-market and stock-market overvaluation go hand in hand, this would show up as a positive correlation between a measure of stock-market misvaluation and cash acquisitions.

B (with time fixed effects) stay the same with the coefficient on SE being positive only for stock-financed mergers between unrelated firms. Using 10 million US dollars as cutoff yields the same results as in Table 7. Excluding Utilities and Financials (Sectors 8 and 11 in the Fama–French classification), the coefficient on SE in Column 1 and the coefficient on ME in Column 3 turn insignificant when using macroeconomic controls, but the results with respect to sector misvaluation and stock-financed mergers remain the same. In Panel B, all results on SE and ME are robust to excluding Utilities

Table 7: Sector-level merger activity, by type of merger. In each regression, the dependent variable is the share of firms in sector j that undertook a specific type of acquisition in year t. For example, in Column 1, the dependent variable is the share that undertook an unrelated acquisition and paid cash. *ME* is the average marketwide pricing error, *SE* is the average sector-specific pricing error, and *LR* is the average of the long-run value component. *Std(m-b)* is the yearly standard deviation of the log of the market-to-book ratio, *Econ shock* is calculated in accordance with Harford (2005), *Illiq* is the average of Amihud's (2002) Illiquidity index, and *Herfindahl* is the Herfindahl index. Averages and standard deviations are taken with respect to firms in industry j. *CFNAI* is an index measuring macroeconomic conditions, *S&P return* is the yearly return on the S&P500 Composite, and *Credit spread* the spread between C&I loans and the federal funds rate. All regressions are estimated with sector fixed effects. Errors are clustered on FF12 sectors, and *p*-values (in brackets) are estimated using wild bootstrap. *, **, and *** represent significance at the 10%, 5%, and 1% level, respectively.

Panel A

	Cash		Stocks	
Variables	Unrelated (1)	Related (2)	Unrelated (3)	Related (4)
ME	-.005**	-.003	-.002*	-.005
	[.032]	[.527]	[.100]	[.123]
SE	.002**	.003***	.004**	.000
	[.050]	[.000]	[.038]	[.734]
LR	-.007	.001	-.005	.005
	[.406]	[.963]	[.277]	[.388]
std(m-b)	-.004**	-.006**	-.002*	-.000
	[.020]	[.019]	[.081]	[.945]
Econ shock	.002***	.002**	.001***	-.000
	[.000]	[.027]	[.001]	[.826]
Invest opp	.004	-.033***	-.017	-.018
	[.800]	[.001]	[.315]	[.611]
Herfindahl	.150	.054	.006	-.117
	[.136]	[.392]	[.907]	[.153]
Illiq	17.897	-4.840	1.290	-10.532
	[.102]	[.355]	[.852]	[.001]
CFNAI	.002*	.002*	.001	.001
	[.063]	[.057]	[.273]	[.146]
S&P return	-.001	-.001	.000	.002
	[.775]	[.732]	[.852]	[.226]
Credit spread	-.003**	-.001	-.001	-.006
	[.020]	[.591]	[.232]	[.053]
5-year yield	-.000**	-.000	.000	-.000
	[.031]	[.268]	[1.000]	[.175]
Observations	248	248	248	248
R^2	.303	.243	.219	.352
Year FE	No	No	No	No
Sector FE	Yes	Yes	Yes	Yes

Continued on next page

Table 7 – continued from previous page

Panel B

	Cash		Stocks	
Variables	Unrelated (5)	Related (6)	Unrelated (7)	Related (8)
ME	-.007	-.016	-.000	-.007
	[.344]	[.217]	[.963]	[.112]
SE	.001	.003	.004***	.002
	[.327]	[.167]	[.000]	[.498]
LR	-.006	.003	-.007	.002
	[.433]	[.789]	[.146]	[.615]
std(m-b)	-.004	-.009	.000	.006
	[.101]	[.002]	[.913]	[.213]
Econ shock	.003**	.001	.001***	-.001
	[.039]	[.458]	[.005]	[.568]
Invest opp	-.024	-.036	-.020	-.006
	[.284]	[.001]	[.379]	[.880]
Herfindahl	.121	.045	.028	-.075
	[.182]	[.521]	[.514]	[.268]
Illiq.	25.316**	1.355	-4.197	-21.341***
	[.013]	[.905]	[.372]	[.009]
Observations	248	248	248	248
R^2	.430	.312	.297	.443
Year FE	Yes	Yes	Yes	Yes
Sector FE	Yes	Yes	Yes	Yes

The most robust relationship in Table 7 is that relative sector mispricing correlates with the share of unrelated stock acquisitions (Column 3). Coupled with the insignificant result for stock acquisitions of related firms (Column 4), Table 7 supports SV for the second separating empirical prediction. Concerning the first separating prediction, the findings in Panel A of Table 7 suggest that, if anything, stock-financed mergers are *less* common when the whole market is overvalued. This contradicts both SV and RKV: SV predict that marketwide overvaluation does not affect stock-financed mergers, and RKV predict a positive relationship.

The results in this section suggest that even though merger waves tend to coincide with periods of high valuations, real economic factors and credit-market liquidity drive most of this activity. However, the analysis suggests that the *relative* overvaluation of a sector matters, showing

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that relatively overpriced sectors conduct more related and unrelated mergers. Dividing mergers according to the method of payment reveals that sector-specific mispricing correlates with cash-financed acquisitions of both related and unrelated firms, as well as with stock-financed acquisitions of unrelated firms. However, only the result for stock-financed acquisitions of unrelated firms is robust to the inclusion of time fixed effects. This fits an interpretation where firms use overvalued stocks to acquire less overvalued firms at a discount in terms of their underlying (true) value.

3.2 Firm-level analysis: Who becomes an acquirer?

The results so far suggest that changes in pricing errors do not affect stock-financed acquisitions as long as target and acquirer share the pricing error. Instead, the sector-level analysis suggests that such acquisitions respond to changes in relative valuation by allowing firms in temporarily highly valued sectors to undertake unrelated acquisitions and pay with relatively overvalued stocks. This subsection adds to the previous analysis by examining the firm-level probability of undertaking an acquisition. This firm-level analysis enables the exploitation of valuation differences within industries (firm-specific error, FE) to investigate whether overvaluation of individual firms influences who acquires. Furthermore, since the regressions include market and sector mispricing, they provide a robustness test of the sector-level results on merger activity.

The general model in this section is given by

$$y_{it} = \begin{cases} 1 & \text{if } y_{it}^* \geq 0 \\ 0 & \text{otherwise} \end{cases} \tag{5}$$

with

$$\begin{aligned} y_{jt} = \alpha_j + \beta_1 ME_{it} + \beta_2 SE_{it} + \beta_3 FE_{it} + \beta_4 LR_{it} \\ + \lambda V_{it} + \gamma X_{jt} + \delta Z_t + U_i + \epsilon_{it}, \end{aligned} \tag{6}$$

where y_{it}^* is a latent variable. The level of observation is the firm–year, and the dependent variable in the regressions is an indicator taking

the value one if the firm undertakes an acquisition that year and the value zero otherwise. The variables of interest are the mispricing factors ME, SE, and FE, all of which are measured on the level of the firm. In addition to the controls included in the sector level analysis (α_j, X_{jt} and Z_t), the regressions include firm-level controls (V_{it}). Following Maksimovic, Phillips and Yang (2013), the parameters are estimated using logistic regressions with firm random effects (U_i). Standard errors are clustered at the Fama–French 49-industry level.

Table 8 presents the marginal effects on the probability of undertaking acquisitions, and includes regressions considering all types of acquisitions (Column 1) as well as subcategories (Columns 2–5). The results in Table 8 support SV's model for the first empirical prediction. RKV predict that marketwide misvaluation increases the likelihood that firms undertake stock-financed acquisitions of both related and unrelated firms, but the effect of ME is insignificant in both regressions that consider stock-financed acquisitions – which is what SV predict. The marginal effect of the marketwide mispricing component is significant only for cash-financed acquisitions of unrelated firms and then has a negative sign. The negative effect is predicted by both SV and RKV – firms are more likely to make cash-financed acquisitions of unrelated firms when the market is undervalued. However, both models predict that this should be the case for related mergers as well.

The results also support SV in the second separating prediction. Looking at the marginal effect of SE in Columns 4 and 5, we see a significant effect on stock-financed acquisitions of unrelated firms but an insignificant effect for stock-financed acquisitions of related firms. It thus seems like overvaluation increases the likelihood of stock-financed acquisitions only if it raises the overvaluation of the acquirer relative to the overvaluation of the target. The results for the FE component also support the importance of relative overvaluation. Firm-specific mispricing has a positive effect on the likelihood of all types of acquisitions, and the effect is larger for stock deals than it is for cash deals.[21] The results on

[21] A possible explanation for FE being significant also for cash deals can again be that overvaluation in the stock market correlates with overvaluation in the debt market, so that overvalued firms borrow cheaply and use this money to acquire other firms as in Harford, Martos-Vila and Rhodes-Kropf (2014). Another possible explanation

Table 8: Decision to acquire assets, by type of acquisition (Logit). The table reports marginal effects (in percent) from logistic estimations. Column 2–5 report the estimations for unrelated and related cash transactions and the two types of stock-financed acquisitions. *ME*, *SE* and *FE* are market error, sector error and firm error respectively. Standard errors (in parentheses) are clustered at the FF49 sector level. *, **, and *** represent significance at the 10%, 5%, and 1% level, respectively.

Panel A

		Cash		Stocks	
Variables	All (1)	Unrelated (2)	Related (3)	Unrelated (4)	Related (5)
ME	-0.19	-1.65***	-0.45	-0.15	0.03
	(0.21)	(0.43)	(0.34)	(0.61)	(0.24)
SE	0.10	-0.01	0.02	0.81*	0.13
	(0.14)	(0.53)	(0.25)	(0.45)	(0.27)
FE	0.50***	0.33**	0.22**	0.59***	0.69***
	(0.04)	(0.13)	(0.09)	(0.09)	(0.07)
LR	0.51***	0.87***	0.39***	0.01	0.44***
	(0.06)	(0.24)	(0.11)	(0.15)	(0.10)
Book value	0.43***	0.62***	0.49***	0.24***	0.41***
	(0.04)	(0.06)	(0.04)	(0.07)	(0.05)
Invest opp	-1.78	-6.75**	-3.35	-9.23*	-0.30
	(1.47)	(3.33)	(2.22)	(5.09)	(2.03)
SA index	-0.39***	-0.48***	-0.48***	-0.31*	-0.18
	(0.09)	(0.17)	(0.10)	(0.18)	(0.20)
Illiq, firm	-0.03	-0.01	-0.06*	-0.02	-0.07
	(0.02)	(0.01)	(0.03)	(0.02)	(0.05)
Profit	-0.07	1.05	1.16*	-0.25	-0.79*
	(0.31)	(0.70)	(0.65)	(0.58)	(0.47)
Illiq, sector	-0.03*	0.00	-0.07**	-0.02	-0.07
	(0.02)	(0.01)	(0.03)	(0.02)	(0.05)
Econ shock	0.19	0.26**	0.06	0.53**	-0.07
	(0.12)	(0.12)	(0.14)	(0.27)	(0.25)
std(m-b)	-0.88***	-1.77***	-1.72***	-0.37	-0.21
	(0.29)	(0.57)	(0.45)	(0.48)	(0.57)
Herfindahl	-6.57**	-1.83	-15.17***	-8.15*	-14.45
	(2.59)	(3.34)	(5.37)	(4.68)	(9.00)
CFNAI	0.31***	0.25	0.40***	0.31	0.24*
	(0.06)	(0.18)	(0.13)	(0.24)	(0.14)
S&P return	-0.03	-0.19	0.05	0.39	0.07
	(0.19)	(0.57)	(0.36)	(0.74)	(0.32)
Credit spread	-1.07***	-1.38***	-0.70**	-1.46***	-2.30***
	(0.10)	(0.39)	(0.31)	(0.37)	(0.27)
5-year yield	-0.07***	-0.12	-0.03	0.04	0.01
	(0.02)	(0.07)	(0.06)	(0.07)	(0.06)

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Table 8 – continued from previous page

Firm RE	Yes	Yes	Yes	Yes	Yes
Year FE	No	No	No	No	No
Sector FE	Yes	Yes	Yes	Yes	Yes
N	102,123	101,257	102,123	101,257	102,123

Panel B

		Cash		Stocks	
	All	Unrelated	Related	Unrelated	Related
Variables	(1)	(2)	(3)	(4)	(5)
ME	0.33**	-0.62	0.05	0.18	0.53*
	(0.16)	(0.61)	(0.44)	(0.62)	(0.28)
SE	-0.01	-0.35	-0.22	1.16***	0.11
	(0.16)	(0.58)	(0.27)	(0.42)	(0.29)
FE	0.49***	0.34**	0.21**	0.58***	0.67***
	(0.04)	(0.14)	(0.09)	(0.09)	(0.07)
LR	0.53***	0.88***	0.41***	0.05	0.46***
	(0.06)	(0.25)	(0.12)	(0.15)	(0.09)
Book value	0.45***	0.63***	0.52***	0.27***	0.43***
	(0.04)	(0.06)	(0.04)	(0.08)	(0.05)
Invest opp	-3.10**	-9.16**	-5.07**	-10.97**	-1.07
	(1.50)	(3.59)	(2.41)	(5.38)	(2.38)
SA index	-0.39***	-0.45**	-0.46***	-0.30*	-0.16
	(0.10)	(0.18)	(0.10)	(0.18)	(0.20)
Illiq, firm	-0.03	-0.01	-0.06*	-0.02	-0.07
	(0.02)	(0.01)	(0.03)	(0.03)	(0.05)
Profit	-0.14	0.98	1.07*	-0.32	-0.87*
	(0.31)	(0.72)	(0.64)	(0.58)	(0.46)
Illiq, sector	-0.03	0.00	-0.09**	-0.09	-0.08
	(0.02)	(0.01)	(0.03)	(0.08)	(0.05)
Economic shock	0.40***	0.68***	0.24*	0.39	0.26
	(0.11)	(0.18)	(0.13)	(0.29)	(0.27)
std(m-b)	-0.57	-1.15	-2.05***	1.19	1.03**
	(0.39)	(0.79)	(0.77)	(1.11)	(0.48)
Herfindahl	-5.95**	-2.79	-16.3***	-6.07	-6.26
	(2.44)	(3.88)	(5.99)	(5.06)	(8.13)
Firm RE	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes
Sector FE	Yes	Yes	Yes	Yes	Yes
N	102,123	101,257	102,123	101,257	102,123

is that FE reflects not only mispricing, but also some unaccounted growth opportun-

SE and FE are robust to substituting the macroeconomic controls for time fixed effects (Panel B).[22]

A last result is the positive effect the long-run valuation component, LR (except for stock-financed unrelated acquisitions, where the estimated effect is positive but insignificant). This result contrasts with RKRV, who find a negative relationship between long-run valuation and the probability of undertaking an acquisition. However, their specifications include only their valuation factors (i.e., $ME + SE$, FE, and LR). Re-running the regressions using this sparser specification (as well as using my own decomposition: ME, SE, FE, and LR) yields a negative coefficient on LR. Thus, the difference in the result is due to the inclusion of firm-level control variables, not a different sample or a different decomposition of the market-to-book ratio.Thus, the results in Table 8 suggest that, all else equal, firms with high fundamental values are more likely to make acquisitions – in line with an interpretation of acquisitions as the profitable reallocation of assets.

As a robustness check, I rerun the regressions in Table 9 using a linear probability model (LPM). The results for the sector-specific pricing component do not change qualitatively between Tables 8 and 9, and its coefficient is significant only for stock-financed acquisitions of unrelated firms (Column 3). In Panel A, the estimated marginal effect of ME becomes significant for stock-financed acquisitions of related firms (Column 4); suggesting firms are more likely to undertake this type of acquisition when the entire market is overvalued.

A concern with the approach of running separate regressions for each type of acquisition is that it is not certain that the choices are independent of each other. That is, instead of seeing a firm's choice set as consisting of the two options "buying a firm in a different industry and paying with cash" and "not buying a firm in a different industry and

ities. In this case, the observed positive correlation between FE and cash deals may reflect the reorganization of assets to better use as in Jovanovic and Rousseau (2002) and Yang (2008).

[22]The results for ME change, but using time fixed effects changes the interpretation of the ME component from the interpretation with macroeconomic controls. Since the time fixed effects absorb the time-t average of ME, the remainder of the ME component is firm i's deviation from this average.

Table 9: Decision to acquire assets, by type of acquisition (LPM). The table reports the coefficient from an OLS regression. Column 2–5 report the estimations for unrelated and related cash transactions and the two types of stock-financed acquisitions. *ME*, *SE* and *FE* are market error, sector error and firm error respectively. Standard errors (in parentheses) are clustered at the FF49 sector level. *, **, and *** represent significance at the 10%, 5%, and 1% level, respectively.

Panel A

		Cash		Stocks	
	All	Unrelated	Related	Unrelated	Related
Variables	(1)	(2)	(3)	(4)	(5)
ME	.005	-.003**	.000	.000	.003**
	(.005)	(.001)	(.002)	(.001)	(.001)
SE	.005	.000	.002	.002**	.002
	(.003)	(.001)	(.002)	(.001)	(.003)
FE	.009***	.001***	.002***	.001***	.004***
	(.001)	(.000)	(.000)	(.000)	(.001)
LR	.013***	.003***	.005***	-.000	.003*
	(.002)	(.001)	(.001)	(.000)	(.002)
Book value	.012***	.002***	.005***	.000**	.004**
	(.002)	(.000)	(.001)	(.000)	(.001)
Invest opp	-.048**	-.015**	-.016*	-.008*	-.015
	(.021)	(.007)	(.010)	(.005)	(.016)
SA index	-.002	-.000	-.000	-.001*	-.000
	(.002)	(.001)	(.001)	(.000)	(.001)
Illiq, firm	.000**	.000*	.000**	.000**	.000
	(.000)	(.000)	(.000)	(.000)	(.000)
Profit	-.006	-.000	.000	-.000	-.005
	(.007)	(.001)	(.002)	(.001)	(.005)
Illiq, sector	-.000	.000	-.000	.000	-.000***
	(.000)	(.000)	(.000)	(.000)	(.000)
Econ shock	.003	.000	-.000	.001**	-.000
	(.002)	(.000)	(.001)	(.000)	(.001)
std(m-b)	-.014**	-.005***	-.009***	-.000	.001
	(.006)	(.001)	(.003)	(.001)	(.003)
Herfindahl	-.097**	.004	-.063***	-.014*	-.039*
	(.039)	(.014)	(.020)	(.008)	(.021)
CFNAI	.004***	.001*	.002***	.000	.001
	(.001)	(.000)	(.001)	(.000)	(.001)
S&P return	-.001	-.001	-.000	.000	.002
	(.003)	(.002)	(.002)	(.001)	(.002)
Credit spread	-.018***	-.003**	-.003*	-.002***	-.014***
	(.003)	(.001)	(.002)	(.001)	(.004)
5-year yield	.000	-.000	.000	.000	.000*
	(.000)	(.000)	(.000)	(.000)	(.000)

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Table 9 – continued from previous page

Firm RE	Yes	Yes	Yes	Yes	Yes
Year FE	No	No	No	No	No
Sector FE	Yes	Yes	Yes	Yes	Yes
N	102,126	102,126	102,126	102,126	102,126

Panel B

		Cash		Stocks	
Variables	All	Unrelated	Related	Unrelated	Related
	(1)	(2)	(3)	(4)	(5)
ME	.025***	-.002	.004	.003**	.012***
	(.005)	(.001)	(.004)	(.001)	(.003)
SE	.003	-.000	.001	.002**	.002
	(.003)	(.001)	(.002)	(.001)	(.003)
FE	.009***	.001***	.002***	.001***	.004***
	(.001)	(.000)	(.000)	(.000)	(.001)
LR	.013***	.003***	.005***	-.000	.003*
	(.002)	(.001)	(.001)	(.000)	(.002)
Book value	.012***	.003***	.005***	.000**	.004**
	(.002)	(.000)	(.001)	(.000)	(.001)
Invest opp	-.064***	-.020***	-.021**	-.010*	-.021
	(.023)	(.007)	(.011)	(.005)	(.017)
SA index	-.002	-.000	-.000	-.001*	-.000
	(.002)	(.001)	(.001)	(.000)	(.001)
Illiq, firm	.000**	.000*	.000**	.000**	.000
	(.000)	(.000)	(.000)	(.000)	(.000)
Profit	-.007	-.001	-.000	-.000	-.006
	(.007)	(.001)	(.002)	(.001)	(.005)
Illiq, sector	-.000	.000	-.000	-.000	-.000***
	(.000)	(.000)	(.000)	(.000)	(.000)
Econ shock	.008***	.002***	.001*	.001***	.002
	(.002)	(.001)	(.001)	(.000)	(.002)
std(m-b)	-.011**	-.004*	-.010**	.002	.009**
	(.006)	(.002)	(.004)	(.002)	(.004)
Herfindahl	-.083**	-.001	-.063***	-.010	-.023
	(.037)	(.014)	(.021)	(.008)	(.018)
Firm RE	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes
Sector FE	Yes	Yes	Yes	Yes	Yes
N	102,126	102,126	102,126	102,126	102,126

paying with cash" (as I have done in Column 1 in Tables 8 and 9), we should look at the choice set that consists of "no acquisition" and all the

subcategories. I therefore estimate a multinomial logit that allows simultaneous estimation of the probability for the different outcomes. Table 10 presents the results in four columns; each column describing the marginal effects for each of the four acquisition types (no acquisition is the baseline). For unrelated stock-financed acquisitions (Column 3), SE is no longer significant in the specification that includes macroeconomic control variables (Panel A), but it regains significance in the specification that includes time fixed effects (Panel B). A difference compared to the results in Tables 8 and 9 is that FE is no longer significant for cash acquisitions.

The results in this section complement the findings in the sector-level analysis of merger activity. That the likelihood of a cash acquisition decreases in the ME is in line with SV's prediction that cash acquisitions occur when targets are undervalued. Further support for their theory comes from the results on the related and unrelated stock-financed acquisitions. Table 8 complements Table 7, and the results suggest that what matters in stock acquisitions is the relative overvaluation of the acquirer. That is, I find little evidence that shared misvaluation affects the merger probability. The results concerning SE are robust to using a linear probability model, and while SE is insignificant in a multinomial logit model using macroeconomic proxies, it regains its significance for stock-financed unrelated mergers when rerunning the estimation with time fixed effects.

In SV's model, target managers do not accept a price below the firm's market value (or a mark-up thereof), regardless whether the buyer offers cash or stocks as payment. Thus, if the market overvalues the acquirer and the target by the same amount, then the number of stocks (claims to future profits) the acquirer needs to offer is the same as if neither of them were overvalued. Hence, misvaluation only increases the merger likelihood if it raises the misvaluation of the acquirer relative to that of the target. The finding that shared mispricing factors do not affect the probability of stock-financed mergers is thus in line with SV's prediction, but it contradicts RKV's prediction. The results for the firm-specific error also speak in favor of the interpretation that relatively overvalued firms are more likely to undertake stock acquisitions.

Table 10: Decision to acquire assets, by type of acquisition (multinomial logit). The table reports the marginal effects (in percent) from a multinomial regression. The dependent variable has five outcomes: 0) make no acquisition, 1) acquire an unrelated firm and pay with cash, 2) acquire a related firm and pay with cash, 3) acquire an unrelated firm and pay with stock, 4) acquire a related firm and pay with stock. The "no acquisition" outcome is taken as baseline. *ME*, *SE* and *FE* are market error, sector error and firm error, respectively. Standard errors (in parentheses) are clustered at the FF49 sector level. *, **, and *** represent significance at the 10%, 5%, and 1% level, respectively.

Panel A

	Cash		Stocks	
Variables	Unrelated (1)	Related (2)	Unrelated (3)	Related (4)
ME	-0.96*	-0.32	-0.36	0.04
	(0.52)	(0.32)	(0.56)	(0.24)
SE	-0.22	-0.05	0.53	0.06
	(0.41)	(0.24)	(0.40)	(0.29)
FE	0.14	0.12	0.47***	0.60***
	(0.14)	(0.09)	(0.10)	(0.08)
LR	0.58**	0.22*	-0.13	0.30***
	(0.26)	(0.12)	(0.16)	(0.09)
Book value	0.55***	0.41***	0.15***	0.30***
	(0.07)	(0.04)	(0.05)	(0.04)
Invest opp.	-7.83***	-2.39	-10.48**	-1.37
	(2.96)	(2.26)	(4.34)	(2.28)
SA-index	-0.33	-0.47***	-0.45**	-0.3
	(0.21)	(0.10)	(0.19)	(0.18)
Illiq, firm	-0.03	-0.07	-0.05	-0.1
	(0.05)	(0.05)	(0.07)	(0.08)
Profit	0.24	1.07	-0.66	-0.93*
	(0.64)	(0.68)	(0.54)	(0.50)
Illiq, sector	-0.03	-0.09**	-0.05	-0.1
	(0.05)	(0.04)	(0.07)	(0.08)
Econ shock	0.21	0.03	0.47*	0.03
	(0.18)	(0.14)	(0.27)	(0.23)
std(m-b)	-1.25**	-1.54***	0.22	-0.22
	(0.58)	(0.35)	(0.55)	(0.64)
Herfindahl	-1.92	-13.67***	-7.86*	-11.51
	(3.49)	(4.92)	(4.61)	(7.87)
CFNAI	0.18	0.38***	0.33	0.14
	(0.18)	(0.12)	(0.24)	(0.14)
S&P return	-0.71	-0.07	0.15	0.02
	(0.54)	(0.38)	(0.78)	(0.38)
Credit spread	-1.51***	-0.67**	-1.67***	-2.56***
	(0.39)	(0.34)	(0.35)	(0.26)
5-year yield	-0.02	-0.01	0.00	0.01
	(0.09)	(0.06)	(0.08)	(0.06)

Continued on next page

Table 10 – continued from previous page

Firm RE	No	No	No	No
Year FE	No	No	No	No
Sector FE	Yes	Yes	Yes	Yes
N	105,660	105,660	105,660	105,660

Panel B

	Cash		Stocks	
	Unrelated	Related	Unrelated	Related
Variables	(1)	(2)	(3)	(4)
ME	0.21	0.28	-0.13	0.48
	(0.58)	(0.37)	(0.61)	(0.31)
SE	-0.63	-0.29	0.88**	0.01
	(0.46)	(0.28)	(0.39)	(0.29)
FE	0.15	0.11	0.46***	0.58***
	(0.15)	(0.09)	(0.10)	(0.07)
LR	0.60**	0.24**	-0.11	0.30***
	(0.27)	(0.12)	(0.16)	(0.09)
Book value	0.56***	0.43***	0.17***	0.31***
	(0.07)	(0.04)	(0.05)	(0.04)
Invest opp.	-9.80***	-4.22	-12.20***	-2.75
	(3.18)	(2.61)	(4.27)	(2.88)
SA-index	-0.3	-0.44***	-0.44**	-0.30*
	(0.21)	(0.10)	(0.19)	(0.18)
Illiq, firm	-0.03	-0.08	-0.06	-0.11
	(0.05)	(0.05)	(0.07)	(0.08)
Profit	0.18	0.99	-0.74	-0.89*
	(0.65)	(0.67)	(0.54)	(0.47)
Illiq, sector	-0.03	-0.14**	-0.19*	-0.12
	(0.05)	(0.06)	(0.11)	(0.08)
Econ shock	0.66***	0.23*	0.41	0.36
	(0.22)	(0.13)	(0.31)	(0.30)
std(m-b)	-0.63	-1.47**	2.13*	0.7
	(0.75)	(0.61)	(1.10)	(0.60)
Herfindahl	-2.65	-15.12***	-5.97	-3.8
	(3.84)	(5.61)	(5.09)	(7.34)
Firm RE	No	No	No	No
Year FE	Yes	Yes	Yes	Yes
Sector FE	Yes	Yes	Yes	Yes
N	105,660	105,660	105,660	105,660

3.3 Acquisitions of private targets

The previous sections presented the results for the SE component in the regressions on stock-financed acquisitions as evidence that firms take advantage of being overvalued by acquiring less overvalued firms. The argument is that acquirers in overvalued sectors are able to offer a mark-up over targets' stock-market valuations, but still acquire them at a discount in terms of the long-term (true) value of their stocks. However, an alternative interpretation is that, even after controlling for other economic factors, the mispricing does not proxy for misvaluation. Rather, it captures expectations about future growth opportunities. Under this interpretation, the positive correlation between the SE and stock-financed unrelated acquisitions reflects profitable opportunities to reallocate assets between sectors. This interpretation is consistent with the lack of an effect of SE on related acquisitions.[23]

To distinguish between the two interpretations, I examine the relationship between the mispricing factors and public firms' acquisitions of private firms.[24] If the previous result is due to the reallocation of assets from less productive sectors to more productive sectors, then this should also apply for private firms. That is, we ought to see public firms in high-priced sectors acquiring private firms in other sectors, but we would not see any increased probability of acquiring firms in their own sector since the reorganization opportunity is at the sector level.

In contrast, if it is a matter of using overvalued stocks to acquire firms at a discount, then SV's model predicts that sector overvaluation also increases the likelihood of acquiring private firms in one's own sector because managers/owners with short time horizons will accept overvalued stock and then resell it.[25] Thus, SV predict that SE correlates

[23] This Q-theory explanation does not predict that the method of payment should be stocks (SV) but it is conceivable that firms with good growth opportunities prefer to pay with stocks to maintain financial slack (see Di Giuli, 2013).

[24] As noted by Netter, Stegemoller and Wintoki (2011), "public" and "private" firms sit on the same continuum. Following Netter, Stegemoller and Wintoki, I classify firms not on CRSP as private.

[25] An alternative way for the private firm's managers/owners to capitalize on sector overvaluation is to issue an IPO. However, smaller firms may benefit less from being publicly traded because lower analyst coverage results in lower valuation ratios, and

Table 11: Decision to acquire privately held targets, by type of acquisition (Logit). The table reports marginal effects (in percent) from logistic estimations. Column 1–4 report the estimations for unrelated and related cash transactions and the two types of stock-financed acquisitions. *ME*, *SE* and *FE* are market error, sector error and firm error respectively. Standard errors (in parentheses) are clustered at the FF49 sector level. *, **, and *** represent significance at the 10%, 5%, and 1% level, respectively.

Panel A

	Cash		Stocks	
Variables	Unrelated (1)	Related (2)	Unrelated (3)	Related (4)
ME	0.27	-0.01	-0.09	-0.07
	(0.27)	(0.26)	(0.30)	(0.19)
SE	0.68**	0.00	0.95***	0.63**
	(0.27)	(0.28)	(0.22)	(0.31)
FE	0.23***	0.16***	0.65***	0.67***
	(0.06)	(0.04)	(0.06)	(0.08)
LR	0.29***	0.27***	0.20*	0.44***
	(0.10)	(0.08)	(0.11)	(0.14)
Book value	0.25***	0.27***	0.15**	0.28***
	(0.04)	(0.03)	(0.07)	(0.05)
Invest opp	-10.40***	-5.68***	-0.56	-3.64**
	(2.49)	(1.34)	(2.33)	(1.69)
SA index	-0.08	-0.04	0.33***	0.35*
	(0.11)	(0.07)	(0.12)	(0.19)
Illiq, firm	-0.01	-0.03	0.00	-0.02*
	(0.01)	(0.02)	0.00	(0.01)
Profit	2.29***	2.22***	-0.28	-0.09
	(0.35)	(0.28)	(0.23)	(0.31)
Illiq, sector	-0.09***	-0.04**	-0.01	-0.01
	(0.03)	(0.02)	0.00	(0.01)
Econ shock	0.07	0.05	0.04	-0.30
	(0.11)	(0.09)	(0.11)	(0.29)
std(m-b)	0.56*	1.00**	0.68	1.06***
	(0.33)	(0.40)	(0.51)	(0.38)
Herfindahl	2.05	-10.77**	-7.09*	-7.30
	(2.35)	(4.66)	(3.97)	(9.07)
CFNAI	-0.09	-0.09	0.24**	0.10
	(0.09)	(0.07)	(0.11)	(0.06)
S&P return	-0.38*	-0.57**	0.95***	0.08
	(0.22)	(0.22)	(0.28)	(0.30)
Credit spread	0.83***	1.34***	-1.07***	-2.02***
	(0.24)	(0.14)	(0.34)	(0.27)
5-year yield	-0.26***	-0.23***	0.05	0.07**
	(0.04)	(0.03)	(0.05)	(0.03)

Continued on next page

Table 11 – continued from previous page

Firm RE	Yes	Yes	Yes	Yes
Year FE	No	No	No	No
Sector FE	Yes	Yes	Yes	Yes
N	102,123	102,123	102,123	102,123

Panel B

	Cash		Stocks	
	Unrelated	Related	Unrelated	Related
Variables	(1)	(2)	(3)	(4)
ME	-0.27	-0.65**	-0.02	0.15
	(0.36)	(0.26)	(0.40)	(0.20)
SE	0.73***	0.05	0.83***	0.57**
	(0.27)	(0.23)	(0.24)	(0.29)
FE	0.24***	0.17***	0.65***	0.66***
	(0.06)	(0.04)	(0.06)	(0.08)
LR	0.31***	0.29***	0.22**	0.47***
	(0.10)	(0.08)	(0.11)	(0.14)
Book value	0.24***	0.26***	0.17**	0.31***
	(0.04)	(0.03)	(0.07)	(0.06)
Invest opp	-8.61***	-4.07***	-0.90	-3.40**
	(2.54)	(1.15)	(2.66)	(1.67)
SA index	-0.08	-0.03	0.35***	0.39**
	(0.11)	(0.08)	(0.12)	(0.18)
Illiq, firm	-0.01	-0.03	0.00	-0.02*
	(0.01)	(0.02)	0.00	(0.01)
Profit	2.30***	2.26***	-0.36	-0.18
	(0.34)	(0.30)	(0.23)	(0.30)
Illiq, sector	-0.01	-0.03	-0.09	-0.02*
	(0.01)	(0.02)	(0.06)	(0.01)
Econ shock	0.11	-0.22**	0.00	0.01
	(0.11)	(0.11)	(0.18)	(0.16)
std(m-b)	-0.18	-0.47	1.36	1.50***
	(0.63)	(0.52)	(0.91)	(0.52)
Herfindahl	1.35	-8.71***	-5.74	1.78
	(2.26)	(2.96)	(3.97)	(4.38)
Firm RE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
Sector FE	Yes	Yes	Yes	Yes
N	102,123	102,123	102,123	102,123

economies of scale can make being acquired a better option than issuing an IPO (Gao, Ritter and Zhu, 2013).

positively with stock-financed acquisitions of *both* related and unrelated private targets.

The regressions in Table 11 mirror those in Table 10, but examine the acquisition of private firms instead of the acquisition of publicly traded firms. In contrast to before, the marginal effect of SE is positive and statistically significant for related stock acquisitions (Column 4). That is, publicly traded firms are more likely to undertake stock-financed acquisitions of private firms when the SE is high. This speaks against the idea that what we observed in Table 10 (where targets are publicly traded) was the reallocation of assets between sectors due to changes in their relative productivity. That is, firms in more profitable sectors bought assets in less profitable sectors. Furthermore, the fact that SE does not correlate with the likelihood of undertaking related stock-financed acquisitions of publicly traded firms suggests that its correlation with stock-financed acquisitions of related private firms is not due to changing economic conditions. That is, if the correlation between SE and stock-financed acquisitions of related private firms was due to an unobserved change that correlates with both valuation levels (and hence SE) and the opportunity to reallocate assets within an industry, then the result ought to have been the same for public and private targets.

4 Summary and conclusion

The two dominant theories concerning misvaluation and merger waves are those of Shleifer and Vishny (2003) and Rhodes-Kropf and Viswanathan (2004). This paper examines whether misvaluation cause merger waves, and, if it does, then in what way. To see which of the theories (if any) best fits the data, I identify and test two instances where the theories yield different predictions with regard to shared misvaluation.

While the descriptive statistic suggested a relationship between marketwide overvaluation and merger activity, the relationship disappears when controlling for other economic factors. Furthermore, the analysis of merger activity finds that sector-level overvaluation increases stock-financed acquisitions of firms in other sectors (unrelated firms), but it has no effect on stock-financed acquisitions of firms in the same sector.

The firm-level analysis corroborates these results and finds that firms are more likely to undertake stock-financed acquisitions when only they themselves are overvalued (firm-specific overvaluation). Furthermore, the effect of firm-specific overvaluation is stronger for stock-financed acquisitions than it is for cash-financed ones.

Taken together, the results indicate that real economic factors drive much of merger activity, but that misvaluation may play a role. However, misvaluation only seem to affect stock-financed mergers if it increases the acquirer's overvaluation relative to that of the target. Overvaluation that affects both acquirer and target simultaneously has no effect on merger activity. Correlation in overvaluation does lead to fluctuations in merger activity at the sector level, but it does so by simultaneously increasing the overvaluation of all firms in a sector relative to firms in other sectors, allowing them to use stocks to acquire unrelated firms at a discount, thus creating a sector-level wave of unrelated mergers. SV predict that stock-financed mergers are more likely to occur when there are large differences in the market's misvaluation of firms. While RKV also make this prediction, they make the further prediction that increased overvaluation of a group of firms (e.g., the whole market or a specific sector) should lead to more mergers within that group. In line with SV's theory, I find no evidence for this. The analysis thus find some support for SV's theory, but fails to support RKV on points where the theories yield different predictions.

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Appendices

A List of variables

Table 12: List of variables.

Variable	Source	Definition
		A. Valuation components
PE	Author's calculation	Pricing error. PE = ME + SE + FE.
ME	Author's calculation	Marketwide pricing error. Calculation described in Appendix B.
SE	Author's calculation	Sector-specific pricing error. Calculation described in Appendix B.
FE	Author's calculation	Firm-specific pricing error. Calculation described in Appendix B.
LR	Author's calculation	Long-run value. Calculation described in Appendix B.
		B. Firm-level controls
Book value	Compustat	Book value. Calculated as the natural log of Total Assets – Total Liabilities
Illiq, firm	CRSP and author's calculations	Measure of stock illiquidity (Amihud, 2002). Calculated for the individual firm as $Illiq_{it} = 1/D_{it} \sum_d \lvert R_{itd} \rvert / VOLD_{itd}$. D_{it} is the number of days for which data on stock i is available in year t; R_{itd} is the daily return; $VOLD_{itd}$ and is the daily trading volume (in dollars). The firm-level measure is the deviation from the sector-level average.
Invest opp	Compustat and author's calculations	Measure of investment opportunities (Almeida, Campello and Hackbarth, 2011). Calculated by taking the average investment ratio (*Capital Expenditures / Total Assets*) of firms in the same Fama–French 49 industry that belong to the top quartile in terms of size (*Total Assets*), the top quartile in terms of interest coverage (*Operating Income Before Depreciation / Interest Expenditures*), and the top half in terms of profitability (*Operating Income Before Depreciation / Total Assets*).
Profit	Compustat	Profitability. Calculated as *Operating Income Before Depreciation / Total Assets*.

Continued on next page

Table 12 – continued from previous page

SA index	Compustat and author's calculations	Measure of financial constraints (Hadlock and Pierce, 2010). Calculated as: -0.737 * ln(*Total Assets*) + 0.043 * ln(*Total Assets*)^2 - 0.040 * *Age* . (*Total Assets* capped at 4.5 billion US dollars, and *Age* capped at 37 years).

C. Sector-level controls

Economic shock	Compustat and author's calculations	Measure of economic shocks (Harford, 2005). First component from a principal component analysis using the yearly sector medians of 1) *Cash Flow / Sales*; 2) *R&D Expenditures / Total Assets(t - 1)*; 3) *Capital Expenditures / Total Assets(t - 1)*; 4) (*Employees - Employees(t - 1) / Employees(t - 1)*; 5) *Net Income / Total Assets*; 6) (*Sales - Sales(t - 1)) / Sales(t - 1)*. Following Harford (2005), the variable is lagged one year in all regressions.
Herfindahl	Compustat	Herfindahl Index of sector concentration. Calculated as $\sum_{i \in j} Sales_{it}/Total\ sales_{jt}$, where $Total\ sales_{jt}$ is the total value of sales in sector j in year t.
Illiq, sector	CRSP and author's calculations	Measure of stock illiquidity (Amihud, 2002). Calculated for the individual firm as $Illiq_{it} = 1/D_{it} \sum_d |R_{itd}|/VOLD_{itd}$. D_{it} is the number of days for which data on stock i is available in year t; R_{itd} is the daily return; $VOLD_{itd}$ and is the daily trading volume (in dollars). On the sector level, the measure is the average over all firms in the sector.
Std(m - b)	Compustat	Standard deviation of the log of the market-to-book ratio.

D. Macroeconomic controls

S&P return	CRSP	Yearly return on S&P 500.
CFNAI	Federal Reserve	Measure of economic activity (Stock and Watson, 1998, 1999).
Credit spread	Federal Reserve	Measure of credit liquidity (Lown, Morgan and Rohatgi, 2000). Yearly average of the spread between Corporate and Industrial Loans (> 1 million US dollars) and the intended federal funds rate.
5-year yield	Federal Reserve	5-year treasury yield, constant maturity.

B Market-to-book decomposition

RKRV start by noting that, if v_{it} is the fundamental value of firm i at time t, then one can rewrite the market-to-book ratio as[26] [27]

$$m_{it} - b_{it} = (m_{it} - v_{it}) + (v_{it} - b_{it}), \tag{7}$$

where $(m_{it} - v_{it})$ is the market's mispricing of firm i at time t. Their approach is to express v_{it} as a linear function of firm i's fundamentals at time t, θ_{it}, and a vector of coefficients, α, and divide the mispricing factor into two components:

$$\begin{aligned} m_{it} - b_{it} = & \underbrace{m_{it} - v(\theta_{it}; \alpha_{jt})}_{\text{firm-specific error}} + \underbrace{v(\theta_{it}; \alpha_{jt}) - v(\theta_{it}; \alpha_j)}_{\text{sector-specific error}} \\ & + \underbrace{v(\theta_{it}; \alpha_t) - b_{it}}_{\text{long-run value}}. \end{aligned} \tag{8}$$

The decomposition in (8) distinguishes between time-t fundamental value, $v(\theta_{it}; \alpha_{jt})$, and long-run fundamental value, $v(\theta_{it}; \alpha_j)$. Time-t fundamental value is based on valuation multiples specific to industry j at time t, α_{jt}, while the long-run value derives from industry j's long-run multiples, α_j. The first component in brackets, thus, describes how the market value of firm i diverges from the pricing rule in sector j at time t, while the second component describes how the time-t valuation of firm i diverges from the long-run valuation due to a temporary change in the pricing rule for sector j. The last component is the long-run value to book.

In Berg's (2016) theoretical work, the probability of a related or unrelated merger depends not only on firm- and sector-specific valuations, but also on the pricing of the entire market. To study this, I need to allow all sectors to share a mispricing component. I allow for a marketwide error by modifying RKRV's decomposition, rewriting the above

[26] See original paper for a more thorough description and theoretical motivation.

[27] Lowercase letters denote the natural logarithm of variables: $x = \ln X$.

equation as

$$\begin{aligned} m_{it} - b_{it} = & \underbrace{m_{it} - v(\theta_{it};\beta_{jt}) - v(\theta_{it};\beta_{mt})}_{\text{firm-specific error}} + \underbrace{v(\theta_{it};\beta_{jt}) - v(\theta_{it};\beta_{j})}_{\text{sector-specific error}} \\ & + \underbrace{v(\theta_{it};\beta_{mt}) - v(\theta_{it};\beta_{m})}_{\text{marketwide error}} + \underbrace{v(\theta_{it};\beta_{j}) + v(\theta_{it};\beta_{m}) - b_{it}}_{\text{long-run value}}. \end{aligned} \tag{9}$$

In this new decomposition, β_{mt} and β_m refer to time-t and long-run multiples shared by the whole market, and the marketwide error for firm i is defined as the valuation difference stemming from β_{mt} deviating from long-term values. This means that the definition of the sector multiples and mispricing error change. The time-t sector multiples (β_{jt}) express how the pricing rule for sector j differs from the pricing rule applied to the market at time t, while their long-run counterparts, β_j, correspond to long-run differences in the fundamentals' valuation. The sector-specific error thus becomes a measure on sector j's mispricing relative to the mispricing of the whole market.

To calculate the misvaluation factors in Equation (9), I need a measure of $v(\theta_{it};.)$. I follow RKRV and estimate α_{jt} by running cross-sectional regressions for each sector–year, estimating[28]

$$\begin{aligned} m_{it} = & \alpha_{0jt} + \alpha_{1jt} b_{it} + \alpha_{2jt} \ln NI^{+}_{it} + \alpha_{3jt} D_{NI<0} \ln NI^{+}_{it} \\ & + \alpha_{4jt} \ln LEV_{it} + \epsilon_{it} \end{aligned} \tag{10}$$

where $\ln NI^{+}$ is the logarithm of the absolute value of net income, $D_{NI<0}$ is a dummy variable taking the value one if net income is negative, and $\ln LEV$ is the logarithm of book leverage. For brevity of exposition, I collect the independent variables in the vector X_{it}. Estimating a separate equation for every sector–year allows the valuation equation to differ not only between industries, but also across time.[29] RKRV estimate the time-t fundamental value as the fitted value from the regression in (10). That is, they let

$$v(X_{it};\hat{\alpha}_{jt}) = \hat{\alpha}_{jt} X_{it} \tag{11}$$

[28] RKRV estimate three different specifications. I have chosen to go with the most extensive one since it has the highest explanatory value and has become the norm in papers using RKRV's approach.

[29] RKRV provide a thorough motivation for both variable selection and estimation procedure.

be the estimate of $v(\theta_{it}; \alpha_{jt})$, where α_{jt} are the estimated coefficients from (10). To get the long-run value, they use the time-series average of α_{jt} and estimate $v(\theta_{it}; \alpha_t)$ as

$$v(X_{it}; \bar{\alpha}_j) = \bar{\alpha}_j X_{it} \tag{12}$$

where $\bar{\alpha}_j = 1/T \sum^T \hat{\alpha}_j$. They then use $v(X_{it}; \hat{\alpha}_{jt})$ and $v(X_{it}; \bar{\alpha}_j)$ to calculate firm- and sector-specific mispricing errors and the long-run component in accordance with equation (8).

The estimate of the firm-specific mispricing error is the difference between the observed market value at time t and the market value predicted by the estimated pricing rule for sector j, and the sector-specific mispricing is due to the pricing multiples deviating from their long-run values. Note that even though all firms within an industry share the same multiples, they still differ in their degree of sector mispricing since the valuation function, $v(\theta_{it}; \alpha)$, varies with a firm's fundamentals, X_{it}.

In my extended four-factor decomposition, I decompose the sector mispricing error of RKRV into two components. I estimate the time-t marketwide multiples, β_{mt}, as the average of the industry coefficients in period t:

$$\hat{\beta}_{mt} = \frac{1}{J} \sum^J \hat{\alpha}_{jt} \tag{13}$$

As before, the long-run correspondences to these are their time-series averages:

$$\bar{\beta}_m = \frac{1}{T} \sum^T \hat{\beta}_{mt} \tag{14}$$

I defined sector mispricing as the mispricing a sector does not share with other sectors. That is it is a time-t pricing component that that all firms within a sector share in addition to the pricing component they share with all firms in the market. To estimate these, I use the estimates of $\hat{\alpha}_{jt}$ and $\hat{\beta}_{mt}$ and let the new time-t sector multiples, $\hat{\beta}_{jt}$, be their difference:

$$\hat{\beta}_{jt} = \hat{\alpha}_{jt} - \hat{\beta}_{mt} \tag{15}$$

$$\bar{\beta}_j = \frac{1}{T} \sum^T \hat{\beta}_{jt} \tag{16}$$

The coefficients in $\hat{\beta}_{jt}$ describe how the pricing rule for sector j differs from the average pricing rule for all sectors at time t. However, part of this difference is permanent, and this permanent difference is captured by the long-run sector multiple, $\bar{\beta}_j$. For example, the market might take a more negative view of firms having high leverage if the firms are in a sector with high risk, which would show up as a more negative coefficient on leverage in $\bar{\beta}_j$. Thus, even if the four-component decomposition contains marketwide multiples in its formulation, it does not require discount rates or growth rates to be the same for all sectors. I estimate the mispricing errors and the long-run element of the four-component decomposition in (9) as

$$\hat{ME}_{it} = (\hat{\beta}_{mt} - \bar{\beta}_m)X_{it} \quad (17)$$

$$\hat{SE}_{it} = (\hat{\beta}_{jt} - \bar{\beta}_j)X_{it} \quad (18)$$

$$\hat{FE}_{it} = m_{it} - (\hat{\beta}_{jt} + \hat{\beta}_{mt})X_{it} \quad (19)$$

$$\hat{LR}_{it} = (\bar{\beta}_j + \bar{\beta}_m))X_{it} - b_{it} \quad (20)$$

I use both RKRV's three-component decomposition and my own four-component decomposition in my analysis to highlight the effect of distinguishing between market and sector mispricing.[30]

[30]Since $\hat{\beta}_{jt} + \hat{\beta}_{mt} = \hat{\alpha}_{jt}$ and $\bar{\beta}_j + \bar{\beta}_m = \bar{\alpha}_j$, FE and LR take the same values as in RKRV's decomposition. To get the sector-specific pricing error in RKRV we just sum ME and SE.

C Robustness tests

Table 13: Sector-level merger activity, by type of merger. Deal value above 10 million USD. In each regression, the dependent variable is the share of firms in sector j that undertook a specific type of acquisition in year t. For example, in Column 1, the dependent variable is the share that undertook an unrelated acquisition and paid cash. *ME* is the average marketwide pricing error and *SE* is the average sector-specific pricing error. *Std(m-b)*, *Econ shock*, *Illiq*, and *Herfindahl* are sector-level variables. Averages and standard deviations are taken with respect to firms in sector j. *CFNAI*, *S&P return*, S&P500 Composite, and *Credit spread* are macroeconomic variables. All variables are described in Appendix A. All regressions are estimated with sector fixed effects. Errors are clustered on FF12 sectors, and *p*-values (in brackets) are estimated using wild bootstrap. *, **, and *** represent significance at the 10%, 5%, and 1% level, respectively.

Panel A

	Cash		Stocks	
Variables	Unrelated (1)	Related (2)	Unrelated (3)	Related (4)
ME	-.003*	-.002	-.002	-.005
	[.060]	[.625]	[.178]	[.142]
SE	.001**	.003***	.004*	.001
	[.048]	[.008]	[.052]	[.679]
LR	-.007	-.001	-.004	.006
	[.313]	[.931]	[.344]	[.203]
std(m-b)	-.004**	-.005**	-.002	-.000
	[.018]	[.026]	[.116]	[1.000]
Econ shock	.002***	.002***	.001***	-.000
	[.000]	[.005]	[.004]	[.716]
Invest opp	-.002	-.013*	-.019	-.021
	[.906]	[.075]	[.175]	[.554]
Herfindahl	.121	.047	-.007	-.111
	[.248]	[.337]	[.713]	[.152]
Illiq	29.211***	-6.266	1.034	-11.072***
	[.000]	[.469]	[.846]	[.001]
CFNAI	.002*	.002**	.000	.001
	[.079]	[.050]	[.397]	[.139]
S&P return	.000	-.000	.000	.002
	[.819]	[.976]	[.809]	[.283]
Credit spread	-.002**	-.000	-.002	-.006**
	[.026]	[.902]	[.238]	[.050]
5-year yield	-.000**	-.000	-.000	-.000
	[.038]	[.138]	[.945]	[.114]
N	248	248	248	248
R^2	.301	.198	.211	.358
Year FE	No	No	No	No
Sector FE	Yes	Yes	Yes	Yes

Continued on next page

Table 13 – continued from previous page

Panel B

	Cash		Stocks	
Variables	Unrelated (1)	Related (2)	Unrelated (3)	Related (4)
ME	-.005	-.012	-.000	-.009
	[.403]	[.287]	[.993]	[.133]
SE	.001	.003	.004***	.002
	[.435]	[.146]	[.001]	[.443]
LR	-.007	.002	-.005	.003
	[.325]	[.914]	[.176]	[.353]
std(m-b)	-.004**	-.009***	.001	.006
	[.045]	[.004]	[.790]	[.200]
Econ shock	.002*	.001	.001***	-.001
	[.054]	[.593]	[.000]	[.417]
Invest opp	-.019	-.013	-.019	-.009
	[.155]	[.135]	[.417]	[.840]
Herfindahl	.106	.036	.013	-.069
	[.208]	[.553]	[.708]	[.313]
Illiq	33.955***	-.301	-3.955	-23.144**
	[.000]	[.955]	[.427]	[.012]
N	248	248	248	248
R^2	.392	.269	.290	.446
Year FE	Yes	Yes	Yes	Yes
Sector FE	Yes	Yes	Yes	Yes

Table 14: Sector-level merger activity, by type of merger. Deal value above 50 million USD. In each regression, the dependent variable is the share of firms in sector j that undertook a specific type of acquisition in year t. For example, in Column 1, the dependent variable is the share that undertook an unrelated acquisition and paid cash. *ME* is the average marketwide pricing error and *SE* is the average sector-specific pricing error. *Std(m-b)*, *Econ shock*, *Illiq*, and *Herfindahl* are sector-level variables. Averages and standard deviations are taken with respect to firms in sector j. *CFNAI*, *S&P return*, S&P500 Composite, and *Credit spread* are macroeconomic variables. All variables are described in Appendix A. All regressions are estimated with sector fixed effects. Errors are clustered on FF12 sectors, and *p*-values (in brackets) are estimated using wild bootstrap. *, **, and *** represent significance at the 10%, 5%, and 1% level, respectively.

Panel A

	Cash		Stocks	
Variables	Unrelated (1)	Related (2)	Unrelated (3)	Related (4)
ME	-.001	-.000	-.001	-.005*
	[.575]	[.933]	[.381]	[.057]
SE	.000	.003**	.003	.000
	[.927]	[.048]	[.190]	[.936]
LR	-.004	-.002	-.002	.007
	[.219]	[.867]	[.405]	[.167]
std(m-b)	-.003	-.005**	-.001	-.000
	[.101]	[.021]	[.235]	[.863]
Econ shock	.001***	.001***	.001***	.000
	[.000]	[.000]	[.002]	[.943]
Invest opp	-.012	-.002	-.025**	-.012
	[.392]	[.767]	[.023]	[.670]
Herfindahl	.079	.041	.000	-.091
	[.239]	[.412]	[.973]	[.254]
Illiq	14.566***	-.268***	3.197	-.891
	[.002]	[.970]	[.511]	[.731]
CFNAI	.001	.002*	.000	.001*
	[.104]	[.067]	[.437]	[.091]
S&P return	-.001	-.002	.001	.003
	[.687]	[.489]	[.435]	[.128]
Credit spread	-.001	-.000	-.002*	-.005*
	[.246]	[.962]	[.053]	[.053]
5-year yield	-.000	-.000	-.000	-.001**
	[.110]	[.186]	[.368]	[.043]
N	248	248	248	248
R^2	.215	.184	.217	.339
Year FE	No	No	No	No
Sector FE	Yes	Yes	Yes	Yes

Continued on next page

Table 14 – continued from previous page

Panel B

	Cash		Stocks	
	Unrelated	Related	Unrelated	Related
Variables	(1)	(2)	(3)	(4)
ME	-.002	-.010	.002	-.009**
	[.658]	[.395]	[.666]	[.034]
SE	-.000	.003	.003*	.001
	[.863]	[.296]	[.081]	[.519]
LR	-.004	.001	-.004	.004
	[.259]	[.915]	[.127]	[.219]
std(m-b)	-.004	-.009***	.002	.004
	[.242]	[.009]	[.380]	[.312]
Econ shock	.002*	.000	.001***	-.001
	[.067]	[.957]	[.007]	[.305]
Invest opp	-.022	-.001	-.026	-.002
	[.136]	[.951]	[.163]	[.977]
Herfindahl	.073	.024	.025	-.055
	[.218]	[.686]	[.471]	[.424]
Illiq	19.761***	6.250*	-2.168	-7.282
	[.000]	[.085]	[.651]	[.244]
N	248	248	248	248
R^2	.285	.276	.316	.433
Year FE	No	No	No	No
Sector FE	Yes	Yes	Yes	Yes

Table 15: Sector-level merger activity, by type of merger. Excluding Utilities and Financials. In each regression, the dependent variable is the share of firms in sector j that undertook a specific type of acquisition in year t. For example, in Column 1, the dependent variable is the share that undertook an unrelated acquisition and paid cash. *ME* is the average marketwide pricing error and *SE* is the average sector-specific pricing error. *Std(m-b)*, *Econ shock*, *Illiq*, and *Herfindahl* are sector-level variables. Averages and standard deviations are taken with respect to firms in sector j. *CFNAI*, *S&P return*, S&P500 Composite, and *Credit spread* are macroeconomic variables. All variables are described in Appendix A. All regressions are estimated with sector fixed effects. Errors are clustered on FF12 sectors, and *p*-values (in brackets) are estimated using wild bootstrap. *, **, and *** represent significance at the 10%, 5%, and 1% level, respectively.

Panel A

	Cash		Stocks	
Variables	Unrelated (1)	Related (2)	Unrelated (3)	Related (4)
ME	-.006*	-.003	-.002	-.004
	[.093]	[.557]	[.156]	[.224]
SE	.002	.003***	.004**	.001
	[.124]	[.009]	[.030]	[.616]
LR	-.008	-.001	-.005	.006
	[.325]	[.934]	[.351]	[.346]
std(m-b)	-.005**	-.007**	-.002	.001
	[.014]	[.028]	[.153]	[.598]
Econ shock	.001	.001	.002***	.000
	[.214]	[.179]	[.000]	[.773]
Invest opp	.010	-.028***	-.027	-.015
	[.707]	[.001]	[.313]	[.722]
Herfindahl	.159	.065	.004	-.120
	[.149]	[.268]	[.893]	[.191]
Illiq	-351.20	-178.54	123.71	235.23
	[.103]	[.515]	[.503]	[.391]
CFNAI	.002*	.002**	.001	.001***
	[.062]	[.050]	[.332]	[.007]
S&P return	-.000	-.001	.000	.001
	[.828]	[.791]	[.883]	[.615]
Credit spread	-.004**	-.001	-.002	-.005*
	[.026]	[.662]	[.209]	[.098]
5-year yield	-.000**	-.000	-.000	-.000
	[.032]	[.441]	[.902]	[.397]
N	220	220	220	220
R^2	0.322	0.243	0.211	0.289
Year FE	No	No	No	No
Sector FE	Yes	Yes	Yes	Yes

Continued on next page

Table 15 – continued from previous page

Panel B

	Cash		Stocks	
	Unrelated	Related	Unrelated	Related
Variables	(1)	(2)	(3)	(4)
ME	-.009	-.015	.000	-.006
	[.473]	[.492]	[.968]	[.399]
SE	.001	.003	.004***	.001
	[.524]	[.159]	[.000]	[.791]
LR	-.008	.002	-.008	.002
	[.369]	[.788]	[.211]	[.609]
std(m-b)	-.005	-.011***	.000	.008
	[.205]	[.001]	[.905]	[.152]
Econ shock	.002*	.001	.002**	-.001
	[.076]	[.622]	[.020]	[.606]
Invest opp	-.024	-.035***	-.030	-.012
	[.417]	[.001]	[.325]	[.864]
Herfindahl	.126	.045	.027	-.095
	[.180]	[.531]	[.471]	[.193]
Illiq	-28.22	-144.62	-32.88	-155.14***
	[.146]	[.751]	[.873]	[.010]
N	220	220	220	220
R^2	.447	.315	.295	.395
Year FE	No	No	No	No
Sector FE	Yes	Yes	Yes	Yes

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