# Predicting Acquisitions Specific Goodwill Write-downs

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# Predicting Acquisition Specific Goodwill Write-downs

**Abstract**. When managers anticipate synergy gains from an acquisition, they may pay more for target firm assets than their fair value, creating goodwill on an acquiring firm's balance sheet. If synergy is not subsequently realized and the fair value of goodwill falls below its book value, goodwill write-downs result from annual impairment tests. Managers and investors may be able to avoid value destroying acquisitions if goodwill write-downs can be predicted from information at acquisition completion. We use purchase price allocation information from SEC 10-K filings to evaluate goodwill write-downs of prior acquisitions. For a sample of 421 U.S. acquisitions with a subset of 49 that experienced deal-specific goodwill write-downs, we find that firms acquiring target firms with larger relative size are more likely to experience goodwill write-downs. However, this effect is mitigated when a target firm's value resides in identifiable intangible assets (e.g., brands and patents), suggesting acquirers may have private information about intangible asset combinations. Implications for management research and practice, as well as government policy are discussed.

**Keywords**: Acquisition, purchase price allocation, goodwill, write-down

**Introduction**

Average acquisition performance would be positive if the worst performing deals were avoided (Moeller, Schlingemann and Stulz, 2005). One indicator of acquisitions that failed is goodwill write-downs, and the ability to predict goodwill write-downs may help to avoid bad acquisitions (Gu and Lev, 2011). For example, the AOL Time Warner merger completed in 2000 recorded a $100 billion loss in 2003, including a $40 billion write-down of goodwill (CB Insights, 2018). When announced, goodwill write-downs have a significant, negative impact on an acquiring firm's stock price (Hirschey and Richardson, 2002; Hayn and Hughes, 2006; Knauer and Wöhrmann, 2016; Li et al., 2011; Li and Sloan, 2017, making goodwill write-downs are a meaningful indicator of acquisition performance (Linsmeier and Wheeler, 2021). However, goodwill is not inherently bad. For example, Disney has $31 billion of goodwill on its balance sheet from its acquisitions of Pixar, Lucasfilm, and Marvel that all created value (Root, 2019).

Evaluating acquisition decisions using goodwill write-downs is important, as goodwill grew from 5.3 to 9.1 percent of total assets for S&P 500 firms between 2005 and 2018 (Linsmeier and Wheeler, 2021), and goodwill on S&P 500 firms' balance sheets has reached $3.57 trillion (VRC, 2023). Goodwill is an intangible asset placed on an acquiring firm's balance sheet after an acquisition, when the purchase price paid for an acquired firm exceeds the fair value of its identifiable net assets. Goodwill has different potential explanations, including growth expectations of the acquired company, synergy expectations, and potential overvaluation. The creation of synergies between an acquirer and target firm is the most common justification of goodwill (Gore and Zimmerman, 2010), but approximately one-third of the value of goodwill may represent overpayment (Henning, Lewis and Shaw, 2000).

Purchase price allocation (PPA) is the method for identifying goodwill, and the information is available to managers before the acquisition is completed and available to investors in a firm's 10-K/Q filing after acquisition completion (Kubic, 2021). PPA follows three steps. First, all identifiable assets and liabilities of the acquired company are listed and valued. These include tangible assets (e.g., buildings, machinery, inventory) and intangible assets (e.g., patents, trademarks, customer relationships). Second, the fair value of each identifiable asset and liability is determined for the acquisition date. On a target firm's balance sheet, assets are listed at book value and this value is updated to fair value at the time of acquisition. Depending on the asset or liability, fair value may be based on market, income, or cost valuation. Third, once the fair values of the identifiable assets and liabilities are determined, the difference between the purchase price and the net fair value of these assets and liabilities is recognized as goodwill. Appendix A provides an example and advantages of purchase price allocation.

Prior research by accounting scholars has identified predictors of goodwill write-downs (e.g., Hayn and Hughes, 2006), but this research has shortcomings. For example, variables identified that predicting goodwill write-down often come after acquisition completion (Hayn and Hughes, 20016; Potepa and Thomas, 2023), limiting the ability to evaluate acquisitions before completion. Additionally, research tends to predict firm goodwill write-downs in general and not goodwill write-downs for a specific acquisition. For example, goodwill write-downs are associated with an acquiring firm's overvalued stock price (Gu and Lev, 2011), and goodwill write-downs correspond to higher deal values and overpayment (Li et al., 2011). Meanwhile, Feist (2013) finds that negative media sentiment is significantly associated with goodwill write-downs. However, large, high value deals that garner media attention, or this offers a limited contribution with limited generalizability to smaller, private acquisitions that generate less media

3

coverage. Further, there are concerns that media coverage offers effective corporate governance (Bednar, 2012).

To better understand goodwill write-downs and address limitations of prior research, we hand collected deal-specific goodwill write-downs from SEC 10-K filings for 49 of 421 acquiring U.S. firms that recorded goodwill between 2010 and 2014. We also add contextual variables from management research to help predict acquisition specific goodwill write-downs. For example, we examine the role of the relative size between a target and acquiring firm. Research consistently supports a negative relationship between relative size and acquiring firm performance, as well as its interaction with other acquisition variables (Campbell, Sirmon and Schijven, 2016; King et al., 2021). Additionally, we confirm Laamanen's (2007) insight that the premium paid in acquisitions is not universally bad, as it can indicate the presence of valuable assets. We validate this by showing that acquisitions with a greater allocation of the purchase price to intangible assets are less likely to experience goodwill write-downs. One reason may be that uncertainty surrounding intangible assets may mitigate overpayment (Coff, 1999)

Our research offers multiple additional contributions, and we highlight two prominent contributions. First, while we consider goodwill write-downs as an outcome, we predict it based on information from the pre-deal phase related to negotiation, due diligence, and valuation. As such, our research provides implications on the pre-deal phase on acquisitions (Welch et al., 2020), enabling managers to identify potentially problematic acquisitions. Alternatively, observable relationships for predicting goodwill write-downs can be useful to investors (e.g., Bergh et al., 2014) to identify and sell an acquiring firm's stock before a write-down occurs. These outcomes can help managers and investors to use purchase price allocation data to improve corporate governance of acquisitions. Second, we confirm that larger acquisitions are

more likely to result in goodwill write-downs (Li et al., 2011), but this is mitigated when a greater proportion of the purchase price is allocated to identifiable intangible assets. This emphasizes the importance of due diligence in identifying valuable intangible assets in the target firms. Overall, additional information from purchase price allocation data provides offers better insights into   the complexity of acquisitions.

**Hypothesis Development**

In evaluating acquisition decision-making, we examine factors that can help to predict the potential for goodwill write-downs. It is difficult to distinguish between good and bad acquisitions beforehand (King et al., 2021). For example, each acquisition has multiple and simultaneous characteristics, and good and bad acquisitions often share similar characteristics (e.g., Campbell et al., 2016). However, goodwill write-downs have universally negative consequences, so an ability to predict what influences goodwill write-downs offers an opportunity to improve acquisition decision-making and governance. In other words, only acquisitions with problems in selection or integration incur goodwill write-downs.

Better governance is associated with higher financial performance (e.g., Gompers, Ishii and Metrick, 2003), and there is an opportunity to identify problematic acquisitions, so they can be avoided. For example, while over half of acquisitions fall short of planned goals (Marks and Mirvis, 2001), only a quarter of them are abandoned before completion (Dikova et al., 2010). There are conflicting views on why there is a low abandonment rate of announced acquisitions (Arikan and Stulz, 2016) that fall at two extremes with reality likely somewhere in between. On one hand, if managers discount external stakeholder interests to complete deals (Luo, 2005), hubris, overconfidence, and/or escalation of commitment may explain acquisitions (e.g., Devers et al., 2013; Hayward and Hambrick, 1997; Malmendier and Tate, 2008; Shi et al., 2021;

5

Sleesman et al., 2018). On the other hand, acquiring managers may have private information on sources of value in combining resources from an acquisition (Barney, 1988; Laamanen, 2007; Schijven and Hitt, 2012) to complete acquisitions that account for external stakeholder interests.

In developing hypotheses, we begin with predictions based on research that larger acquisitions (i.e., relative size) are more difficult to integrate and are associated with lower performance and larger losses (Brueller et al., 2015; Campbell et al., 2016; King et al., 2021; Moeller et al., 2005). Variance in the effects of relative size on acquisition performance in meta-analyses also suggests that the effects of it are influenced by other variables (King et al., 2021), thus we examine how the effects of relative size likely vary based on information based on the purchase price allocation. Goodwill differs from other assets, as it is a non-identifiable intangible asset with indefinite useful life, driving annual impairment testing of the value of the recorded goodwill. Research suggests that identifiable intangible assets (e.g., patents and brands) are more valuable than tangible assets (e.g., Crook et al., 2008; Laamanen, 2007). Goodwill has not been considered in management research which is a critical oversight.

--- Insert Figure 1 about here ---

Our hypotheses are organized using the antecedents, moderators and outcomes framework, see Figure 1. Antecedents of goodwill write-downs are based on research that has consistently shown that larger acquisitions are more difficult to integrate and are associated with lower performance (Brueller et al., 2015; Cloodt et al., 2006; Campbell et al., 2016; Homberg et al., 2009; King et al., 2021; Moeller et al., 2005) and that we anticipate corresponds with goodwill write-downs. Goodwill write-downs are a separate event from goodwill recorded at acquisition completion, and they are an admission of strategic failure (Gu and Lev, 2011) associated with financial losses (Hayn and Hughes, 2006; Li et al., 2011; Li and Sloan, 2017). As

a result, a goodwill write-down is a meaningful indicator of acquisition performance (Linsmeier and Wheeler 2021).

We argue that allocating the purchase price to goodwill and intangible assets moderate the effects of size on performance. Tangible assets are not included in the model to avoid overspecification, and in recognition of the fact that tangible assets are easier to value (Ettenson & Knowles, 2006). We also control for variables that may influence anticipated relationships to avoid problems from missing variables, as well as time-based, instrumental variables to limit effects of endogeneity. Finally, our predicted outcome is the likelihood of deal-specific goodwill write-downs following an acquisition. Anticipated relationships are further developed in the following subsections.

*Relative Size*

A managerial motive behind acquisitions is greater discretion, as the increased complexity of larger firms hinders monitoring (Devers et al., 2013; Hill and Jones, 1992). As a result, larger firms are less likely to be acquired (Heeley, King and Covin 2006; Moeller, Schlingemann and Stulz 2004; Offenberg, 2009), reflecting a limitation of the market for corporate control, as large firms are often too expensive to purchase. However, it also reflects the fact that larger acquisitions are associated with large financial losses (e.g., Moeller et al., 2005) because large target firms are more difficult to integrate (e.g., Haspeslagh & Jemison, 1991; Villalonga and McGahan, 2005). For example, acquisitions involving a larger target firm often experience more political infighting and conflict during the integration process (Gomes et al., 2013).

Penrose (1959) identified manager capacity as a constraint to firm growth, and that problem is compounded in larger acquisitions by combining management teams without prior experience of working together to coordinate work in a combined firm (Lamont et al., 2019). As

a result, efforts to integrate a larger target firm to achieve desired resource combinations carries

risk because of the challenges involved in integrating the people, processes, and structures of two

formerly independent organizations (Gomes et al., 2013; Ranft and Lord, 2002; Vermeulen,

2005). The integration challenges for larger acquisitions also include a higher probability of

stakeholder responses that can lower firm performance (Derfus et al., 2008). For example,

market retaliation by competitors can hinder the ability to retain customers and maintain

relationships with suppliers (e.g., Harding and Rouse, 2007; Kato and Schoenberg, 2014; King

and Schriber, 2016; Rogan, 2014; Schriber et al., 2022). Therefore, we expect:

> **Hypothesis 1 (H1).** A larger relative size between a target and the acquiring firm is positively associated with the likelihood of a goodwill write-down.

### *Purchase Price Allocation Moderators*

We anticipate that the difficulty of integrating larger targets will be moderated by the type of

assets acquired, and purchase price allocation separately recognizes the value of identifiable

tangible and intangible assets with any residual of a target firm's purchase price allocated to

goodwill. Again, tangible assets are not included in the model to avoid overspecification. While

there is uncertainty in establishing a price for a target (Malhotra et al., 2015), paying higher

prices has been associated with acquiring firm managers overestimating their ability to improve

performance following an acquisition (Campbell et al., 2016; Dalton et al., 2007; Hayward and

Hambrick, 1997; Malmendier and Tate, 2008; Roll, 1986; Sirower, 1997).

Higher prices paid for acquisitions are often associated with poor managerial decisions

(Beckman and Haunschild, 2002; Sirower, 1997). Generating value after paying a price greater

than the value of a target firm's tangible and intangible assets heightens pressure on acquiring

firm managers to increase performance following an acquisition (Krishnan et al., 2007).

Recovering the cost paid for a target requires either lowering future expenses or increasing future revenues.

*Percentage of Goodwill*

Goodwill differs from other assets because it is a residual, or the portion of purchase price that cannot be specifically assigned to target firm assets. When assets acquired and liabilities assumed in an acquisition do not have quoted prices, estimation errors in the fair value of net assets are also carried over to goodwill, as the combination-specific asset from an acquisition. In other words, goodwill is only recorded from acquisitions, and it does not result from a firm's internal development. Goodwill represents a non-identifiable, intangible asset with indefinite useful life from acquisitions, leading to annual impairment testing. Impairment testing compares any anticipated cash flows to the book value of an asset, when book value exceeds perceived benefits then a write-down occurs.

For goodwill, cost savings cannot be anticipated, and cash flows are more uncertain. Anticipated cost savings from combining firms alone rarely justifies the price paid (Krishnan, Hitt & Park, 2007; Selden and Colvin, 2003), and this is the case for goodwill. The cost of goodwill is set from purchase price allocation, and it can only be decreased by making a write-down or an admission of overpayment (e.g., Gu and Lev, 2011). Additionally, as a residual, non-identifiable asset, future cash flows from acquisition goodwill are more uncertain than cash flows from identifiable intangible assets from acquisitions. Because goodwill can only generate future net cash inflows from combination with other assets (Johnson and Petrone, 1998), write-downs are more likely when goodwill reflects a greater proportion of an acquisition's purchase price allocation. Therefore, we expect the following:

**Hypothesis 2 (H2).** A higher percentage of goodwill in an acquisition's purchase price allocation positively moderates the relationship between a larger acquisition relative size and the likelihood of a goodwill write-down, making the relationship stronger.

*Percentage of Identifiable Intangibles*

Scholars believe that intangible resources (e.g., patents and brands) are more likely than tangible resources to contribute to a competitive advantage (Hitt et al., 2001), as they are difficult to imitate (Cefis and Marsili, 2012; Teece, 1998). This is supported by research showing that intangible assets are the primary source of value for firms in the S&P500 (Ettenson and Knowles, 2006). Intangible assets also contribute to acquisition activity (Balakrishnan and Fox, 1993; Montgomery and Hariharan, 1991; Moran and Ghoshal, 1999), because acquirers are often interested in a target firm's intangible assets. Further, the price paid by acquiring firms reflects the extent that a target firm has scarce resources (Bittlingmayer, 1996; Laamanen, 2007). The value of those resources, when combined with an acquirer, can generate value based on the potential synergy between the acquirer's and its target firm's resources (e.g., Feldman and Hernandez, 2021; Sirmon et al., 2011).

Estimating the value of resource combinations is an important role of firm strategy (Andrews, 1980; Lippman and Rumelt, 2003). For example, gaining synergy from an acquisition relies on managers generating additional cash flows that can be obtained by combining resources, transferring knowledge, and creating new capabilities (King et al., 2003; Lippman and Rumelt, 2003; Mirc, 2012; Sirmon et al., 2011; Wiklund and Shepherd, 2009). While acquisition synergies from intangible assets are considered difficult to achieve (Schweiger and Very, 2003), leveraging intangible resources often provides greater benefits. For example, intangible resources do not necessarily diminish the underlying resource when used and they can be applied in new areas to address unique problems or opportunities (Peteraf, 1993; Teece, 1998). In fact,

intangible resources can develop further and grow more valuable with use based on the accumulation of new knowledge that in turn increases the utilization of those intangible assets. Therefore, we predict:

> **Hypothesis 3 (H3)**. A higher percentage of identifiable intangibles in an acquisition's purchase price allocation negatively moderates the relationship between a larger acquisition relative size and the likelihood of a goodwill write-down, making the relationship weaker.

**Method**

We identified U.S. public firms that acquired either public or private targets in SDC Platinum from 2010 to 2014. Inclusion of private firms limited the collection of specific types of data, such as the acquisition premium, because the pre-acquisition market value of private target firms is not available. The years selected display a positive economic environment and they avoid the impact of the 2008 or 2020 financial crises on acquisition activity and firm operations, including allowing at least five years post-acquisition to observe deal-specific goodwill write-downs. For example, deals announced in 2014 have five years (2015 – 2019) to observe subsequent goodwill write-downs. While confounding events following an acquisition can contribute to later write-downs, an industry insider attributed goodwill write-downs within five years following an acquisition more to the quality of manager decision-making than to external economic events.[1] For example, goodwill write-downs increased following the 2008 financial crisis (Gore and Zimmerman, 2010).

We also restricted our sample to deals with 100 percent ownership and deal size greater than $100 million. In addition, we removed financial institutions (because their idiosyncratic attributes limit effective comparisons of the acquisitions in other industries), providing an initial

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[1] Comments by PJ Patel, a valuation specialist from Valuation Resource Corporation, during a September 23, 2021, webinar attended by two authors.

sample of 607 acquisitions. The final restriction based on the data available resulted in a final sample of 421 acquisitions with goodwill recorded and a subset of 49 acquisitions with deal-specific goodwill write-downs. Using deal-specific goodwill write-downs as a criterion is important because it allows examining specific acquisition characteristics associated with subsequent goodwill write-downs. Appendix B explains that goodwill write-downs in COMPUSTAT are not deal-specific, leading us to hand collect deal-specific write-downs from firm 10-K/Q filings.

*Dependent variable*

We used a categorical variable for deal-specific goodwill write-down within the five years following an acquisition as our dependent variable with value equal 1 for goodwill write-down and value equal 0 for no goodwill write-down. Firms are not required to disclose deal-specific goodwill write-downs (Linsmeier and Wheeler 2021). Again, Appendix B describes our method of identifying presence or absence of deal-specific goodwill write-downs. A dummy variable is used to avoid issues associated with wide variance in the magnitude of goodwill write-downs and the timing of a write-down from influencing results. Five years is used as a right-hand censor, as write-downs after five years are more likely to result from changing economic conditions than from integration problems occurring after the acquisition. As a result, the regression slope with our categorical dependent variable identifies the likelihood of goodwill write-down from a specific acquisition within 5 years after deal completion.

*Independent variables*

   *Relative size of target firm*. To compare the size of a target firm to that of its acquirer, we used the transaction value divided by the market capitalization of the acquiring firm on the day of announcement. Transaction value is used for target size, because our sample includes private

targets, and the stock market value for them is not available (Phelan & Mantecon, 2005). An alternate measure using target and acquiring firm assets provides similar results, but may be confounded with measuring goodwill.

*Percentage of goodwill in purchase price allocation*. We examine the percentage of purchase price allocated to goodwill. We anticipate that a higher amount of goodwill as a percentage of the purchase price indicates higher risk associated with an acquisition, because the likelihood of overpayment is greater with higher levels of goodwill in the deal. Houlihan and Lokey, a publicly traded investment banking firm, provided their manually collected purchase price allocation data from SEC 10-K/Q filings. SDC Platinum does not include purchase price allocation details.

*Percentage of identifiable intangible assets in purchase price allocation*. We examine the percentage of a target firm's purchase price allocated to identifiable intangibles, such as completed technology, in-process research and development, customer-related assets, trademark and trade names. Acquiring firms disclose these intangibles in their form 10-K, as a part of purchase price allocation data filed with the SEC.

### Control Variables

We add control variables that may influence the hypothesized relationships (King et al., 2021). *First*, we include time to completion measured as the number of days between acquisition announcement and the deal completion. In general, more complicated deals take longer to complete (e.g., Chakrabarti and Mitchell, 2016; Luo, 2005). *Second*, we measure the stock market's reaction to the acquisition announcement (Haleblian et al., 2009). We use 3-day (-1, +1) cumulative abnormal return (CAR) around the acquisition announcement day of zero. The stock market's reaction to an acquisition can help predict its completion (Luo, 2005). *Third*, we

include whether an acquiring and target firms operate in related industries (King et al., 2021).

Relatedness is measured as a categorical variable denoting whether an acquirer and target

operate in the same 2-digit SIC industry (0 = no; 1 = yes). *Fourth*, we control for acquiring firm

size using assets (millions). *Fifth*, we add acquiring firm profitability using return on sales (ROS)

for the year prior to an acquisition with data from COMPUSTAT. *Sixth*, we measure an

acquiring firm's prior acquisition experience using a count of the number of acquisitions they

completed in the prior 5 years before the focal acquisition. *Seventh*, we use the share of stock

used as payment, as stock payment dilutes ownership and it is consistently associated with lower

stock performance (Blackburn et al., 1997; King et al., 2021). *Eighth*, we include whether an

acquisition was cross-border or domestic. *Finally*, we also collected information on CEO

characteristics that have been associated with risk taking (Devers et al., 2020). We controlled for

CEO gender (Female CEO =1) and for CEO tenure, as well as CEO succession (If the CEO

changed between the announcement date and the write-down date). The data for these variables

were obtained from Execucomp, and information for firms not covered by Execucomp was hand-

collected from company disclosures.

**Results**

Table 1 presents descriptive statistics and correlations for included variables. Relationships are

largely consistent with expectations. For example, 11 percent of firms in our sample recorded

goodwill write-downs based on impairment testing, and this is consistent with prior research

showing that approximately 12 percent of U.S. firms have goodwill write-downs (Kroll, 2021).

Additionally, the average percentage of goodwill for our sample is 40 percent, and this is

consistent with research showing an average acquisition premium of 40 percent across different

decades (Laamanen, 2007). Further, the percentage of identifiable intangibles is significantly and

negatively correlated with goodwill write-downs (r = -0.12, p < .05) and relative size is significantly and positively correlated with goodwill write-downs (r = 0.17, p < .05). Meanwhile, goodwill does not have a statistically significant correlation with the likelihood of goodwill write-down (r = 0.003). The relative size of target/acquirer in our sample is 48 percent, but there is significant variation as the relative size has a standard deviation of 65 percent. Relative size has greater variance in our sample compared to prior research because most deals report targets that are 10 to 20 percent the size of an acquirer (Jansen et al., 2012). Recording goodwill may be more common for larger acquisitions and/or tracking deal-specific goodwill write-downs is easier for larger acquisitions.

--- Insert Table 1 about here ---

*Analysis*

Given that our dependent variable, goodwill write-downs, is measured as a dichotomous variable (zero for no write-down and 1 for write-down), we use logistic regression (Hosmer and Lemeshow, 2000). Table 2 shows our results with robust p-values shown below beta coefficient estimates. Model 1 shows results for our control variables. Interestingly, the stock market reaction to an acquisition's announcement (CAR) is not a statistically significant predictor of goodwill write-downs ($\beta$ =-0.293, p = 0.905). This finding is consistent with Ben-David et al. (2020), who claim that the short window market responses around acquisition announcements may fail to capture acquisition performance. Additionally, stock payment is positively and significantly associated with the higher likelihood of goodwill write downs ($\beta$ =1.275, p = 0.034). However, stock payment is not statistically significant in later models that include information on purchase price allocations. Additionally, CEO characteristics are not statistically

15

significant predictors of goodwill write-downs. These results suggest that goodwill write-downs are largely independent of managerial influence.

Model 2 presents our test of hypothesis 1. Results show that relative size is a statistically significant positive predictor of goodwill write-downs ($\beta = 0.352$, p = 0.013), providing support for H1. The marginal effect suggests that a one standard deviation in the relative size of the focal deal is associated with a 3.46 percent (p=.012) increase in the probability of the deal's goodwill being written down.[2] The predicted probability of a goodwill write-down when relative size is high is 1.81 times higher than when relative size is low.

--- Insert Table 2 about here ---

The interaction effects of relative size with our moderator variables are presented in Models 3 and 4 of Table 2. In model 3, the interaction of relative size with the percentage of goodwill in an acquisition's purchase price is not statistically significant ($\beta$= -0.054, p = 0.673), failing to provide support for H2. In model 2 and 3, the percentage of identifiable intangibles in an acquisition's purchase price has a statistically significant negative effect on goodwill write-downs ($\beta$= -0.410, p = 0.019 & $\beta$= -0.402, p = 0.023, respectively), but lose significance when interacted with relative size. The statistical significance of a direct effect for identifiable intangible assets from prior models supports the importance of its interaction with relative size.

The interaction of relative size with the percentage of identifiable intangibles in an acquisition's purchase price has a statistically significant negative effect on goodwill write-

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[2] The marginal effect of a statistical distribution is the change in the quantity of interest for a particular change in the independent variable. In nonlinear probabilistic models, this is complicated by the derivative of $x_k$ depending in part on $x_m$ in a multivariate model. In these models, the predicted probability is given by the cumulative density function (CDF), while the derivative of the CDF is given by the probability density function (PDF) multiplied by the coefficient of the variable of interest (by chain rule). In a logit model like ours, the CDF is $p = \frac{1}{1+e^{-x\beta}}$, while the marginal effect is given by $\frac{\partial p}{\partial (x_k)} = \left(\frac{e^{x\beta}}{(1+e^{x\beta})^2}\right) * \beta_k$, so that the marginal effect of $x_k$ depends on the values of all other $x \in \{x_1, x_2, \ldots, x_k, x_m\}$ and the values of all other $\beta \in \{\beta_1, \beta_2, \ldots, \beta_k, \beta_m\}$ in the matrix $x\beta$.

downs ($\beta$= 0.482, p = 0.010), providing support for H3. Additionally, the direct effect of relative

size becomes insignificant in Model 4 ($\beta$ = 0.233, p = 0.177) when it is included in the

interaction with percent of identifiable intangibles. This suggests that targets with greater than

average intangible assets are less likely to experience goodwill write-downs when they have a

larger relative size (see Figure 2). Overall, results are consistent in the full model (Model 5). A

negative effect on goodwill write-downs suggests that larger relative sized acquisitions with a

greater proportion of identifiable intangible assets is associated with more successful acquisitions

that are less likely to produce subsequent goodwill write-downs. To better interpret the

moderation effect, we graphed the interaction effects as depicted in Figure 2 and Figure 3.

--- Insert Figure 2 about here ---

As shown in Figure 2, the probability of goodwill write-down is high when relative size

is high and the percentage of identifiable intangibles is low (-1 std. deviation). Alternatively, the

probability of a goodwill write-down is consistently low when the percentage of identifiable

intangibles is high (+1 std. deviation). Importantly, the probability of a goodwill write-down

increases as relative size increases only when identifiable intangibles are low. In fact, when

identifiable intangibles are high, the probability of a goodwill write-down decreases as relative

size increases.

--- Insert Figure 3 about here ---

We calculated marginal effects following Hanmer and Kalkan (2013) and we used

stochastic simulation to quantify uncertainty and significance. In Figure 3, the marginal effect

(m.e.) of relative size on the probability of a goodwill write-down is plotted on the level of

percentage of intangible assets. The marginal effect of relative size at low levels of identifiable

intangibles is positive and statistically significant (m.e.= 0.079, p = <.001). In contrast, the

marginal effect of relative size at high levels of identifiable intangibles is not statistically significant (m.e. = -0.018, p = 0.45). This suggests that when a firm acquires another with low levels of identifiable intangible assets, acquiring a larger firm increases the chances of goodwill write-downs. However, acquiring companies that have high levels of identifiable intangibles negates this effect.

*Robustness checks*

We also replicate our results using survival analysis to predict how quickly (time in years) a write-down is made because the timing of goodwill write-downs is also informative. Following Chung and Hribar (2021), we analyze the hazard of a goodwill write-down using Cox proportional-hazard model. Here the dependent variable is whether a firm experienced a goodwill write-down in the years (1 to 5) following an acquisition, see Table 3. While the logistic model shown in Table 2 tests the probability of a goodwill write-down, the hazard model incorporates information on its timeliness. The mean time for firms that make write-downs is 3.1years, or a timeframe suggesting that integration and changes in performance take at least 3 years (King et al., 2008; Nadolska and Barkema, 2014). Model 2 of Table 3 shows that relative size is a statistically significant predictor of the hazard of goodwill write-downs ($\beta$ = 0.329, p = 0.009), supporting H1. Model 4 of Table 3 lacks evidence of an interaction effect between percentage goodwill and relative size on the hazard of goodwill write-downs ($\beta$ = -0.062, p = 0.613), failing to support H2. However, the direct effect percentage of identifiable intangibles in an acquisition's purchase price allocation is insignificant ($\beta$ = -0.258, p = 0.145). Again, consistent with expectations for H3, the interaction of identifiable intangibles with relative size is statistically significant and negative ($\beta$ = -0.360, p = 0.023). These results indicate that acquisitions of larger targets with more identifiable intangibles are less likely to produce

18

goodwill write-downs over time. Our robustness checks suggest that our results are stable

regarding our finding that target firms with identifiable intangibles are subsequently less likely to

experience a goodwill write-down and have a lower hazard of experiencing goodwill write-

downs.

--- Insert Table 3 about here ---

Further, we corrected for endogeneity by employing a Lewbel (2012) heteroskedastic-

based instrumentation using a control function in a Logit regression for both percent of

intangibles and percent of goodwill. We follow recommendations made by Baum and Lewbel

(2019). The Lewbel approach is an instrument free method that uses the heteroskeasticity

inherent in the endogenous independent variable to generate instrumental variables from other

covariates. Instrument-free approaches have been gaining in use by researchers in social science

research, due to the difficulty of satisficing data collections needed to satisfy all the assumptions

of traditional instrumental variables methods. For a recent review of these methods, including

Lewbel approaches, please see Eckert and Hohberger (2023). Associated results are shown in

Table 4, and they are consistent with the results of our prior analyses. We used this in a control

function because we are using polynomial terms (i.e., interaction terms) that facilitates a control

function approach (Wooldridge, 2010).

--- Insert Table 4 about here ---

**Discussion**

In acquisitions, assets of a target and acquiring firm are combined with the intention of

producing greater value, but this does not always happen. For example, acquiring firms often

overpay or have problems integrating a target firm. In evaluating overpayment in acquisitions,

management research has largely focused on the acquisition premium, or the price paid above a

target firm's stock price. Premium is only available for public targets, and it contains less information than accounting data provided by purchase price allocations presented in SEC 10-K/Q filings. For example, research disagrees on whether the premium paid reflects overpayment (Sirower, 1997) or the presence of valuable intangible resources (Laamanen, 2007).

Interestingly, our findings support both views as larger acquisitions are associated with an increased likelihood of goodwill write-downs (i.e., value destroying acquisitions), and that this is mitigated when a larger proportion of a target firm's purchase price is allocated to identifiable intangible assets (e.g., patents and brands). Greater nuance is possible by using more detailed information from purchase price allocations. Additional implications for management research, practice and policy, as well as limitations and opportunities for future research are discussed below.

*Research implications*

How resource combinations produce value is complex and ambiguous to many stakeholders external to the merging firms (Cording et al., 2008; Feng et al., 2017). Purchase price allocation data provides additional information and potential measures that help us to better understand the potential for overpayment or value creation from an acquisition. For value creation, a greater percentage of an acquisition's purchase price allocated to identifiable intangible assets are less likely to destroy value for an acquirer. Allocation of an acquisition's purchase price to identifiable intangibles requires specific identification of underlying assets, and it requires additional justification relative to more general allocations to goodwill. Still, additional research is needed to identify the specific resource combinations that increase or impede the creation of value (Schweiger and Very, 2003). For example, the amount of the purchase price allocated to goodwill appears to have little influence on subsequent goodwill write-downs.

Goodwill write-downs can help to identify integration failure after acquisition completion. Because acquisition goodwill is a non-identifiable asset with an indefinite useful life, accounting rules require annual impairment tests. Goodwill write-downs are the result of impairment testing that can reflect integration failure (Gu and Lev, 2011). Predicting goodwill write-downs from information available at acquisition completion is useful, as goodwill write-downs are often associated with significant financial losses (Hayn and Hughes, 2006; Li et al., 2011; Li and Sloan, 2017). This can facilitate better corporate governance, and potentially help managers and investors avoid problematic acquisitions. Specifically, our finding greater proportion of purchase price allocated to intangible assets decreases the likelihood of goodwill write-downs can mitigate information asymmetry between managers and investors, confirming the usefulness of signaling theory (Bergh et al., 2014). Additional information (e.g., purchase price allocation) can be used in corporate governance for manager acquisition decisions before an acquisition completes by corporate boards, and by investors after an acquisition completes to sell shares before goodwill write-downs (Dalton et al., 2007).

*Managerial implications*

Goodwill write-downs reflect a poor acquisition decision from overpayment or strategic misfit (Gu and Lev 2011), and they are often associated with CEO turnover (Cowan et al., 2023), making their prediction important to managers. Indeed, the average performance of acquisitions would be positive if value destroying acquisitions were avoided (Moeller et al., 2005). Our results confirm that larger acquisitions are associated with worse outcomes (Campbell et al., 2016; King et al., 2021). Specifically, we show that goodwill write-downs are more likely for targets with a greater relative size, and target firm size is obviously known to managers before an acquisition announcement and to investors at the time of an acquisition announcement. While

managers may have cognitive limits to recognize or act on information contrary to completing an

acquisition (e.g., Contractor et al., 2012; Shi et al., 2021), investors can use this information to

sell shares before goodwill write-downs or to avoid losses.[3] For managers, while few

acquisitions are terminated due to negative stock market reactions (Lai et al., 2006), it may be

better to abandon acquisitions that are poorly received by investors.

Of course, our results also suggest the key factor in determining the likely performance

effect of relative size is the extent that the acquisition entails identifiable, intangible assets. Thus,

our results suggest that acquiring firm managers may have private information on sources of

value in combining resources from an acquisition (Barney, 1988; Laamanen, 2007; Schijven and

Hitt, 2012), and this may be more likely for intangible assets. Intangible resources are often

socially embedded, reinforcing the need for managers to retain target firm employees (Gomes et

al., 2013; Graebner, 2004; Krug and Shill, 2008; Ranft and Lord, 2002).

*Policy implications*

The Financial Accounting Standards Board (FASB) establishes rules for goodwill accounting,

and they vary for private and public firms. Private firms can amortize goodwill in place of

impairment tests (FASB, 2014a; 2014b), but public companies use annual impairment testing

(Lugo, 2022). We find that the amount of a target firm's purchase price allocated to goodwill is

not an accurate predictor of subsequent goodwill write-downs for an acquisition. As a result,

impairment testing can provide better information of a firm's prospects than mechanical

amortization of goodwill. While Exxon received criticism for delaying a write-down of its assets

(Domonoske, 2020) due to its XTO acquisition including natural gas assets that declined in value

(Blackmon, 2020; Luhavalja, 2019), this evaluation would not have occurred under amortization.

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[3] We thank Duncan Angwin (associate editor) for this insight.

Further, our results suggest goodwill write-downs occur independent of CEO characteristics, validating the independence of the goodwill impairment testing.

*Limitations and future research*

We recognize several limitations of our study that represent additional opportunities for future research. First, our sample involves only U.S. public acquirers, and the accounting rules for private firms are different. Further, the institutional environment of the U.S. may produce important differences from those of other nations. For example, the transfer of intangible assets may depend on strong property rights (Claessens and Laeven, 2003) that are less strictly enforced in some other nations. Extending our research to other institutional settings represents a research opportunity. Second, although we included a significant number of control variables, our inclusion of private target firms limited the use of some controls typically used for target firms, because the information needed was not publicly available. Additionally, there may be differences between public and private targets. For example, private targets may be more difficult to value (Cuypers et al, 2017; Datar et al., 2001). While we incorporated CEO characteristics in our analysis, including whether a CEO changed before goodwill write-down, we do not control for CEO age as that information was not consistently available for firms in our sample not covered by Execucomp. Additional research into potential behavioral factors that may influence goodwill write-down decisions represents an opportunity for future research (Devers et al., 2020).

Next, our tracing of goodwill write-downs to specific acquisitions resulted in a relatively small sample (49 observations) and these acquisitions were compared to acquirers that did not have deal-specific write-downs within 5 years. This concern is at least partially mitigated based on an industry valuation specialist suggesting that write-downs within 5 years following an

acquisition are more likely to reflect managerial performance than broader environmental changes, and Hayn and Hughes (2006) finding most goodwill write-downs occur within 5 years. Still, a small number of observed goodwill write-downs may also reflect manager discretion or other biases (Beatty & Weber, 2006).[4] For example, Ayers and colleagues (2019) show goodwill write-downs are associated with an increase in the probability of auditor dismissal, and subsequent employment of auditors more favorable to goodwill impairment decisions.

Finally, our sample timeframe also intentionally avoided complications surrounding the 2008 and 2020 financial crises that affected acquisition activity and that may have influenced goodwill write-downs. Yet, confounding events within the 5 years following an acquisition may exist. Overall, our research supports a continued need to better incorporate available information to evaluate and improve acquisition decisions.

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[4] We thank Tomi Laamanen (former editor) for this insight.

**Appendix A**: Comparing Acquisition Purchase Price Allocation and Premium

As purchase price allocation is less familiar in management research than acquisition premium, we offer an example comparing premium and goodwill as separate measures of acquisition overpayment. For the sake of argument, imagine biotech giant AbbVie (ticker: ABBV) pursues an acquisition of Moderna Inc. (ticker: MRNA) because they are interested in expanding their mRNA technology portfolio. As of October 5, 2023 AbbVie has a market capitalization of $260 billion and Moderna has a market capitalization of $38.7 billion. Now, AbbVie offers $40 billion to buy Moderna or they offer an acquisition premium of $2 billion (or its equivalent in share price comparison of $107 per share offered versus $104 per share price). As such, our relative size measure would be 40/260=15.38%. However, Moderna's assets are currently 25.858 billion. This means that, if the acquisition completes, AbbVie paid 40-25.858=14.142 billion more than the current value of Moderna's assets. This excess needs to be recorded on AbbVie's balance sheet, and purchase price allocation reflects how that is allocated. Assuming AbbVie can use fair value to increase the basis of Moderna's intangible assets (currently valued at 6.735 billion) with the help of their auditors (Ernst & Young LLP), they set the fair market value of the identifiable intangible assets of Moderna at $10 billion or $3.265 billion more than Moderna's book value. That still leaves 14.142-3.265=10.877 billion that needs to be recorded in AbbVie's books as goodwill. Our measures for purchase price allocation in this example would be: 10.877/40=27.19% of percentage goodwill and 10/40=25% of percentage intangibles. This offers more detail than simply looking at the stock price premium, and it is less influenced by market variation. Additionally, the book value of goodwill is compared to its fair value annually in impairment testing. Further, both purchase price allocation and impairment testing are externally audited.

In comparing the premium paid and purchase price accounting, they both have the advantage of being visible to stakeholders as a measure of overpayment. For purchase price allocation, the information is available to acquiring firm managers before deal completion, but it is not available to investors until the 10-K/Q filing after acquisition completion (Kubic, 2021). Additionally, goodwill accounting offers multiple advantages over the use of premium in management research.

First, purchase price allocation data is available for public and private target firms. In contrast, acquisition premium, defined as the difference in the purchase price for a public firm and its market value the month prior to acquisition announcement, is only available for public targets.

Second, purchase price allocation provides a more fine-grained measurement of an acquisition's purchase price. Traditionally, premium is viewed as overpayment (Sirower, 1997), but Laamanen (2007) highlights that premium can provide an indication of valuable intangible resources held by a target firm. Purchase price allocation separately identifies and values intangible and tangible resources, as well as any residual goodwill. A target firm's identifiable assets are estimated using fair value by, in descending order: 1) publicly quoted price for identical assets or liabilities, 2) quote for similar assets or liabilities, or 3) discount of expected future cash flows. Since goodwill represents the portion of a target's purchase price that cannot be allocated to identifiable tangible or intangible assets, it likely serves as a better indicator of

overpayment. For example, a target firm's stock price may become inflated due to acquisition rumors, leading to premiums being underestimated up to eight percent (Eaton et al., 2021).

A third advantage is that firms are required to perform annual goodwill impairment testing drives recognizing goodwill write-downs when the anticipated value from an acquisition is not achieved. As a result, goodwill from purchase price allocation offers insights into both an acquiring firm's pre- and post-acquisition decisions, and premium only offers insight into pre-acquisition decisions.

**Appendix B**: Identifying deal-specific goodwill write-downs

We identify acquisition goodwill (GDWL) and goodwill write-downs (GDWLIP) from COMPUSTAT annual. However, COMPUSTAT does not enable linking goodwill write-downs to a specific acquisition as it only reports firm level goodwill write-downs in aggregate each year. To identify deal specific goodwill write-downs from an acquisition, we first identified 93 acquisitions where firms had goodwill write-downs within 5 years from 421 acquisitions recording goodwill by U.S. firms between 2010 and 2014 that met our sample screening criteria. We then followed the process described by Ben-David et al. (2020) to hand collect deal-specific goodwill write-downs.

For each acquirer, we examined the 10-K annual report in SEC EDGAR filings for the year of acquisition and the next 5 years. The notes to consolidated financial statements in 10-K filings contain information on goodwill write-downs. For write-downs that mention a prior acquisition of interest, we recorded the initial goodwill amount, the amount of goodwill write-down for that deal, and the year that it occurred. Some acquisitions had more than one write-down in our 5-year period, leading to our primary use of a dummy variable if a write-down occurred, and supplementary analysis of goodwill write-down hazard rates (year). Some acquirers ceased operations within 5 years due to bankruptcy or being acquired, reducing the ability to track information.

Matching goodwill write-downs to a specific acquisition was often straight forward with the target firm mentioned, or the amount of goodwill for a deal matching the amount of a goodwill write-down. For these deals, we also performed a search of press releases and news articles to see if a write-down was attributed to an acquisition using Google. Goodwill write-downs that were not clearly tied to an acquisition based on information in the notes to consolidated financial statements in 10-K filings or other public information were not included. This process resulted in 49 acquisitions with deal-specific goodwill write-downs identified.

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**Table 1**. Variable mean, standard deviations, and correlations

| | | Mean | SD | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | Write-down (Dummy) | 0.12 | 0.32 | 1 | | | | | | | | | | | | | |
| 2 | Time to Completion | 63.47 | 67.68 | .01 | 1 | | | | | | | | | | | | |
| 3 | CAR | 0.02 | 0.08 | -.02 | .05 | 1 | | | | | | | | | | | |
| 4 | Related (Dummy) | 0.74 | 0.44 | -.04 | -.02 | .07 | 1 | | | | | | | | | | |
| 6 | Assets | 8808.98 | 18684.81 | -.08 | .15 | -.09 | -.01 | 1 | | | | | | | | | |
| 7 | Profit | 0.06 | 0.07 | .04 | -.01 | -.10 | -.06 | .04 | 1 | | | | | | | | |
| 8 | Acquisition Exp. (5y) | 3.97 | 3.52 | -.08 | .03 | -.05 | .01 | .12 | .43 | 1 | | | | | | | |
| 9 | Share of P. as Stock | 0.10 | 0.23 | .09 | .20 | -.07 | -.05 | .27 | -.02 | -.16 | 1 | | | | | | |
| 10 | Cross Border | 0.06 | 0.24 | .03 | -.01 | -.02 | .01 | -.02 | -.01 | .00 | .05 | 1 | | | | | |
| 11 | CEO Changed | 0.51 | 0.50 | -.07 | .02 | .01 | .05 | .02 | .04 | -.03 | .04 | -.02 | 1 | | | | |
| 12 | Female CEO | 0.03 | 0.17 | .02 | -.03 | .00 | -.05 | -.03 | .17 | .08 | -.04 | -.08 | -.05 | 1 | | | |
| 13 | CEO Tenure | 6.46 | 7.31 | .00 | .00 | .11 | .00 | -.04 | -.06 | -.04 | -.03 | -.06 | .02 | .05 | 1 | | |
| 14 | Pct. Goodwill Deal | 0.40 | 0.19 | .00 | -.18 | -.12 | -.06 | -.08 | .08 | .02 | .15 | -.05 | .06 | -.01 | .03 | 1 | |
| 15 | Pct. Intangibles Deal | 0.31 | 0.17 | -.12 | -.11 | -.05 | .02 | .01 | .04 | .16 | .10 | -.15 | .01 | .10 | -.07 | -.10 | 1 |
| 16 | Relative Size | 0.48 | 0.65 | .17 | .21 | .15 | -.01 | .28 | -.21 | -.03 | -.22 | .32 | -.07 | -.06 | -.08 | .06 | -.13 |

n = 4218; All correlations above |r|>.096 are significant at an alpha level of $\alpha=0.05$

**Table 2**. Logistic regression predicting a deal specific goodwill write-down

| | Model 1 | Model 2 | Model 3 | Model 4 | Model 5 |
|---|---|---|---|---|---|
| CEO Changed | -0.463 | -0.346 | -0.343 | -0.379 | -0.379 |
| | (0.150) | (0.294) | (0.300) | (0.259) | (0.260) |
| CEO Tenure | 0.007 | 0.0004 | 0.0007 | 0.002 | 0.002 |
| | (0.754) | (0.988) | (0.978) | (0.933) | (0.930) |
| Time to Completion | 0.0005 | -0.002 | -0.002 | -0.001 | -0.001 |
| | (0.839) | (0.587) | (0.619) | (0.730) | (0.739) |
| CAR | -0.293 | -1.056 | -1.033 | -0.857 | -0.878 |
| | (0.905) | (0.660) | (0.668) | (0.741) | (0.735) |
| Related (Dummy) | -0.226 | -0.184 | -0.189 | -0.109 | -0.112 |
| | (0.524) | (0.606) | (0.595) | (0.769) | (0.761) |
| Assets | -0.00003 | -0.00003 | -0.00003 | -0.00003 | -0.00003 |
| | (0.303) | (0.322) | (0.319) | (0.340) | (0.339) |
| Profit | 2.490 | 2.972 | 2.788 | 2.990 | 2.896 |
| | (0.225) | (0.161) | (0.200) | (0.173) | (0.200) |
| Acquisition Exp. (5y) | -0.190 | -0.075 | -0.080 | -0.141 | -0.143 |
| | (0.639) | (0.852) | (0.842) | (0.730) | (0.727) |
| Share of Payment as Stock | 1.275 | 0.666 | 0.670 | 0.462 | 0.457 |
| | (0.034) | (0.280) | (0.274) | (0.490) | (0.494) |
| Cross Border | 0.752 | 0.875 | 0.872 | 0.907 | 0.906 |
| | (0.253) | (0.185) | (0.186) | (0.177) | (0.178) |
| Female CEO | 0.933 | 0.809 | 0.814 | 0.976 | 0.977 |
| | (0.264) | (0.361) | (0.356) | (0.267) | (0.267) |
| Pct. Goodwill Deal | | 0.001 | 0.014 | 0.057 | 0.062 |
| | | (0.993) | (0.928) | (0.728) | (0.707) |
| Pct. Intangibles Deal | | -0.410 | -0.402 | -0.292 | -0.285 |
| | | (0.019) | (0.023) | (0.094) | (0.115) |
| **H1**: Relative Size | | 0.352 | 0.348 | 0.233 | 0.238 |
| | | (0.013) | (0.013) | (0.177) | (0.178) |
| **H2**: Pct. Goodwill Deal*Relative Size | | | -0.054 | | -0.033 |
| | | | (0.673) | | (0.853) |
| **H3**: Pct. Intangibles Deal*Relative Size | | | | -0.482 | -0.478 |
| | | | | (0.010) | (0.012) |
| Num.Obs. | 423 | 418 | 418 | 418 | 418 |
| AIC | 314.5 | 309.3 | 311.2 | 305.1 | 307.1 |
| BIC | 379.3 | 386.0 | 391.9 | 385.8 | 391.8 |
| Log.Lik. | -141.272 | -135.650 | -135.589 | -132.565 | -132.550 |
| F | 101.918 | 82.649 | 72.596 | 86.382 | 80.771 |
| RMSE | 0.31 | 0.31 | 0.31 | 0.30 | 0.30 |
| Std.Errors | HC1 | HC1 | HC1 | HC1 | HC1 |

p-values shown below beta coefficient estimates

**Table 3**. Survival analysis, Cox Proportional Hazards

| | Model 1 | Model 2 | Model 3 | Model 4 | Model 5 |
|---|---|---|---|---|---|
| CEO Changed | -0.470 | -0.371 | -0.368 | -0.399 | -0.397 |
| | (0.115) | (0.218) | (0.222) | (0.192) | (0.195) |
| CEO Tenure | 0.008 | 0.003 | 0.004 | 0.006 | 0.006 |
| | (0.695) | (0.880) | (0.867) | (0.778) | (0.781) |
| Time to Completion | 0.0005 | -0.002 | -0.001 | -0.0007 | -0.0008 |
| | (0.822) | (0.502) | (0.570) | (0.778) | (0.758) |
| CAR | -0.278 | -1.187 | -1.135 | -0.829 | -0.837 |
| | (0.868) | (0.473) | (0.494) | (0.629) | (0.626) |
| Related (Dummy) | -0.184 | -0.178 | -0.181 | -0.095 | -0.096 |
| | (0.557) | (0.572) | (0.566) | (0.768) | (0.766) |
| Assets | -0.00003 | -0.00002 | -0.00002 | -0.00002 | -0.00002 |
| | (0.119) | (0.209) | (0.209) | (0.199) | (0.201) |
| Profit | 2.250 | 2.726 | 2.498 | 2.779 | 2.858 |
| | (0.217) | (0.141) | (0.193) | (0.146) | (0.144) |
| Acquisition Exp. (5y) | -0.208 | -0.110 | -0.117 | -0.163 | -0.161 |
| | (0.562) | (0.757) | (0.741) | (0.651) | (0.654) |
| Share of Payment as Stock | 1.102 | 0.501 | 0.509 | 0.428 | 0.413 |
| | (0.046) | (0.401) | (0.393) | (0.461) | (0.481) |
| Cross Border | 0.686 | 0.818 | 0.815 | 0.829 | 0.830 |
| | (0.227) | (0.151) | (0.152) | (0.146) | (0.146) |
| Female CEO | 0.918 | 0.789 | 0.806 | 0.951 | 0.949 |
| | (0.222) | (0.301) | (0.292) | (0.217) | (0.218) |
| Pct. Goodwill Deal | | 0.003 | 0.025 | 0.076 | 0.066 |
| | | (0.986) | (0.869) | (0.620) | (0.678) |
| Pct. Intangibles Deal | | -0.397 | -0.385 | -0.258 | -0.265 |
| | | (0.018) | (0.023) | (0.145) | (0.142) |
| **H1**: Relative Size | | 0.329 | 0.326 | 0.183 | 0.180 |
| | | (0.009) | (0.010) | (0.260) | (0.270) |
| **H2**: Pct. Goodwill Deal*Relative Size | | | -0.062 | | 0.024 |
| | | | (0.613) | | (0.850) |
| **H3**: Pct. Intangibles Deal*Relative Size | | | | -0.360 | -0.373 |
| | | | | (0.023) | (0.033) |
| Num.Obs. | 423 | 418 | 418 | 418 | 418 |
| AIC | 596.0 | 590.2 | 592.0 | 586.2 | 588.2 |
| BIC | 656.8 | 662.9 | 668.6 | 662.9 | 668.9 |
| RMSE | 0.34 | 0.34 | 0.33 | 0.33 | 0.33 |
| Std.Errors | HC1 | HC1 | HC1 | HC1 | HC1 |

p-values shown below beta coefficient estimates

**Table 4**. Instrumental variable analysis using Logit analysis, heteroskedastic instrumental variables (Lewbel, 2012)

| | Model 1 | Model 2 |
|---|---|---|
| CEO Changed | -0.342 | -0.369 |
| | (0.291) | (0.261) |
| CEO Tenure | -0.004 | -0.002 |
| | (0.878) | (0.940) |
| Time to Completion | -0.001 | -0.0008 |
| | (0.658) | (0.802) |
| CAR | -1.328 | -1.183 |
| | (0.559) | (0.631) |
| Related (Dummy) | -0.153 | -0.091 |
| | (0.671) | (0.808) |
| Assets | -0.00002 | -0.00002 |
| | (0.373) | (0.381) |
| Profit | 3.265 | 3.195 |
| | (0.166) | (0.210) |
| Acquisition Exp. (5y) | -0.100 | -0.163 |
| | (0.804) | (0.693) |
| Share of Payment as Stock | 0.589 | 0.402 |
| | (0.357) | (0.566) |
| Cross Border | 0.612 | 0.643 |
| | (0.310) | (0.293) |
| Female CEO | 0.693 | 0.894 |
| | (0.457) | (0.323) |
| Pct. Goodwill Deal | 0.030 | 0.025 |
| | (0.948) | (0.960) |
| Pct. Intangibles Deal | -0.347 | -0.277 |
| | (0.404) | (0.506) |
| **H1**: Relative Size | 0.342 | 0.214 |
| | (0.021) | (0.270) |
| **H2**: Pct. Goodwill Deal*Relative Size | | -0.028 |
| | | (0.883) |
| **H3**: Pct. Intangibles Deal*Relative Size | | -0.482 |
| | | (0.014) |
| Num.Obs. | 418 | 418 |
| AIC | 312.2 | 310.2 |
| BIC | 380.8 | 386.9 |
| Log.Lik. | -139.113 | -136.110 |
| F | 1.310 | 1.454 |
| RMSE | 0.31 | 0.31 |
| Std.Errors | HC1 | HC1 |

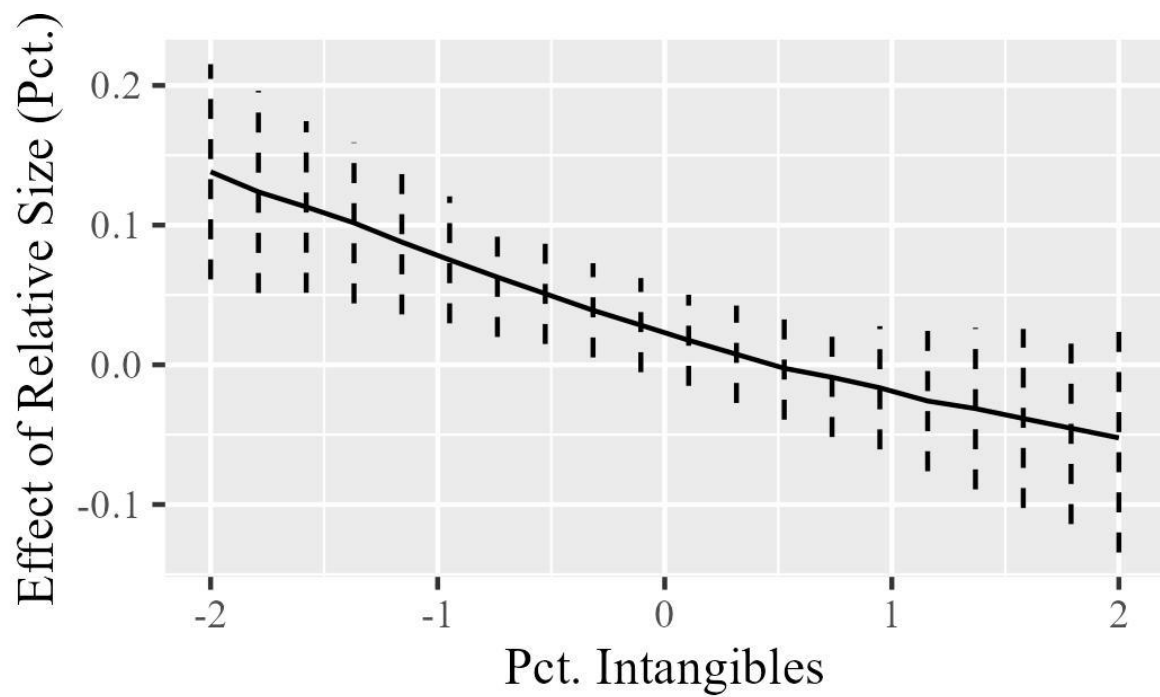p-values shown below beta coefficient estimates
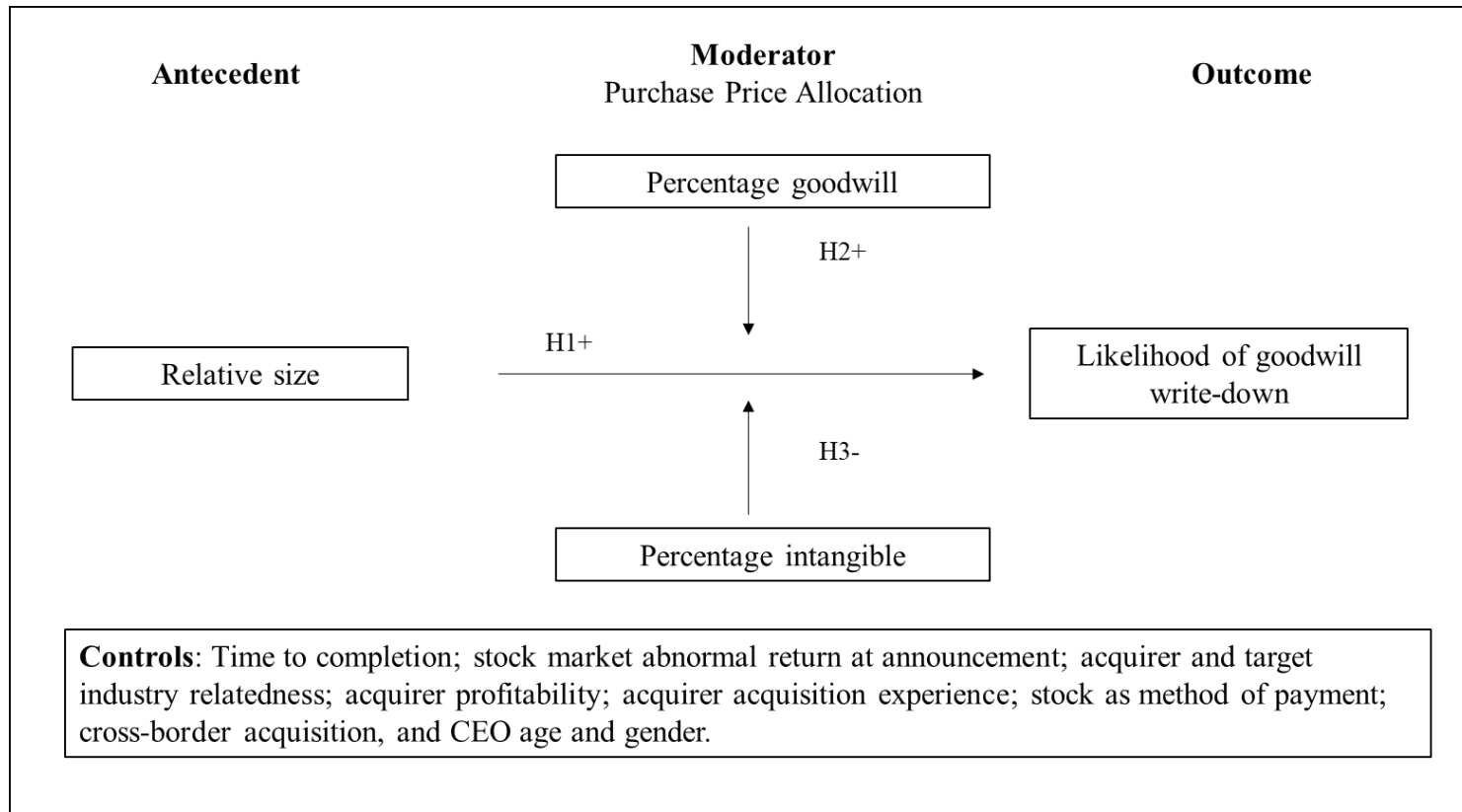
**Figure 1**. Hypothesized framework for predicting deal-specific goodwill write-downs
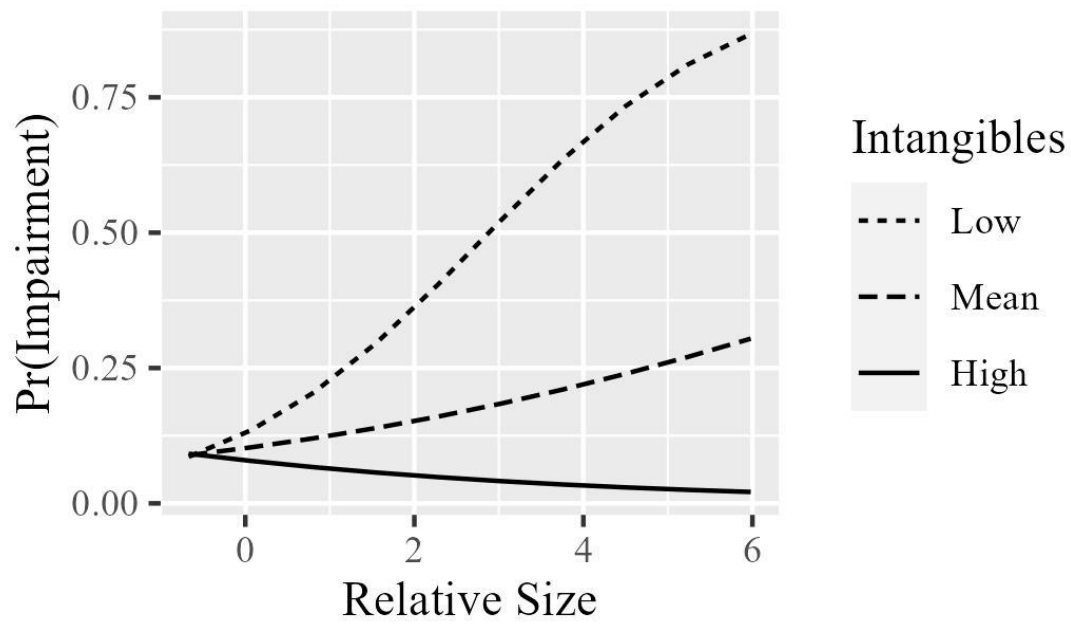
**Figure 2**. Probability of goodwill write-down; interaction of percent intangible and relative size, centered around the mean of relative size with two standard deviations around it

**Figure 3**. Marginal effect of relative size on the probability of goodwill write-down; dependent of percent intangible