A Holistic Approach to Merger Models with an Emphasis on Heterogeneity*

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Abstract

Though mergers and acquisitions comprise a significant share of aggregate economic activity in the US, researchers disagree on the effect and importance of M&A determinants. Such disagreement stems from adherence to disparate theoretical models that preclude the use of significant explanatory variables. Our paper contributes to this scattered literature by demonstrating the presence of significant bias in the most common approaches to this question. We do so by comparing the Neoclassical, behavioral, and macro approaches to explaining M&A activity. Finding that the assumptions of these respective paradigms have inhibited individual researchers from including important determinants of M&A, we show that these constraints have generated misleading point estimates. By constructing a more holistic model of M&A activity, we produce more accurate estimates of merger determinants and reveal the bias of previous estimation techniques. Additionally, we relax the common, yet unrealistic, assumption that firms are homogeneous, showing that the determinants of M&A vary by firm size, region, and sector. These results demonstrate that an aggregated approach to merger determinants conceals important variation.

JEL Codes: G31; G34; G38; D21
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1 Introduction

Between 1998 and 2015, US firms executed well over 140,000 domestic mergers and acquisitions.[1] The aggregate transaction value of these mergers totaled over 16 trillion dollars, a figure approaching 90% of US GDP for 2015. What are the drivers of these transactions? Despite the importance of this question, there is no widely held consensus on which determinants of M&A are the most important (Andrade, Mitchell, and Stafford 2001). Writing in the late 1980's, Golbe and White (1988) state that time series analyses of mergers and acquisitions have been "sparse." Since the writing of that paper, there has been additional research, but perspectives remain, at best, incomplete and fractured (Komlenovic, Mamun, and Mishra 2011).

Disparate perspectives are the result of disparate assumptions. For example, one scholar might assume markets are perfectly efficient, while another may hold that markets contain significant and widespread inefficiencies. Some argue that merger activity can be explained primarily by traditional microeconomic influences, whereas others contend that overall macroeconomic conditions are the primary drivers of M&A phenomena (Becketti 1986). These diametric assumptions translate into myriad models of merger activity. Komlenovic, Mishra, and Mamum (2011) helpfully categorize this array of merger models into three theoretical categories according to whether they possess "Neoclassical," "behavioral," or "macro" foundations.

In addition to the aforementioned foundational differences, researchers operating within the same framework also frequently differ concerning the expected signs and magnitudes of key M&A determinants. Weston (1953), who was among the first to explore M&A activity with the use of time series analysis, examined merger data between the two World Wars. He reports a significant, positive relationship between mergers and securities

[1] As explained below, our data includes both "mergers" and "acquisitions." Accordingly, we use those terms, as well as "M&A," interchangeably when describing the observations in our dataset.

prices, a finding confirmed by several others (Nelson 1959; Steiner 1975; Beckenstein 1979). Conversely, others, such as Golbe and White (1988), state that they expect a negative relationship between securities prices and merger activity.[2] In a similar contradiction, Steiner (1975), Beckenstein (1979), Chung and Weston (1982), Melicher, Ledolter, and D'Antonio (1983), and Becketti (1986) each use various measures of the interest rate and disagree on either its sign or significance. These authors are likewise mixed on the sign and significance of other determinants such as GNP.[3] While the importance of M&A activity is acknowledged, there is much debate (and even confusion) with respect to the determinants.

Early attempts to determine the drivers of M&A generally utilized single country time series data. More recent efforts to address this question have focused on cross-country comparisons of merger activity.[4] Similar to previous time series analyses, the modern literature on cross-country determinants of M&A lacks consensus due to competing assumptions. For instance, Erel, Liao, and Weisbach (2012) focus on relative short-run performance of an economy, as measured by stock prices and currency appreciation; while, Rossi and Volpin (2004) highlight long-run determinants of economic performance, such as legal protection for investors. For the purposes of this paper, we draw on findings from both cross-country and intra-country analyses to study merger activity, as each literature supplies various theoretical perspectives and each suggests covariates that may be important.

Building on this vast literature, we examine merger activity through an analysis of previous approaches to the study of merger determinants. We employ a novel dataset that is constructed from data on all mergers collected by Bloomberg between US-based firms from January, 1998 through December, 2015, a span of 216 months. Our paper offers uniquely specified models based on the taxonomic divisions of Komlenovic, Mishra, and

[2]These researchers, in fact, find the opposite, something we return to later in the paper.

[3]Recent papers tend to employ GDP rather than GNP measures.

[4]For more on cross-country analysis of M&A, see Gonzalez et al. (1998), Rossi and Volpin (2004) or Bris and Cabolis (2008).

Mamum (2011). Through our analysis, we show that each of these models, by itself, exhibits significant bias as a result of excluding known, significant determinants. (We hasten to clarify that our approach does not necessarily disprove any of the theoretical approaches employed by the literature; instead, it is intended to cast doubt on the point estimates generated by those theoretical approaches. To the extent that those approaches preclude the inclusion of important determinants, the estimates are subject to bias.)

Additionally, we examine the heterogeneous effects of determinants by target firm size, region, and sector. This is an improvement on the literature that frequently treats firms as homogeneous despite the economic intuition that firms of various sizes, located in different regions, and operating in different sectors will be affected by differing determinants. For example, firms with 40 employees face different constraints and opportunities than do firms with 4,000 employees—an intuition that is easily extended to various regions and sectors. Our results demonstrate that aggregation conceals these important firm-level differences—size, region, and sector—and yields a less-than-complete picture of merger determinants. Specifically, we find evidence of significant size-, region-, and sector-specific shocks to M&As, and demonstrate that all but two of our determinants vary statistically significantly by firm size, region, or sector.

Section 2 offers both theoretical and empirical analyses of the Neoclassical, behavioral, and macro perspectives found in the literature, demonstrating the biases present in previous analyses. Section 2.1 provides the theoretical basis for the construction of our models. Section 2.2 describes our models and discusses our variables, noting where there is precedent for their use and where we believe there is theoretical justification for the inclusion of new variables. Section 2.3 displays the results of our analysis. Section 3 provides theoretical and empirical analyses of the heterogeneity of determinants, confirming the importance of size, region, and sector heterogeneities. Section 3.1 provides the theoretical foundation for analysis of merger heterogeneities. Section 3.2 describes the empirical models used to test for

the presence of heterogeneities. Section 3.3 displays the results of our heterogeneity analysis by firm size, region, and sector. Section 4 concludes.

2 A Holistic Approach

2.1 Theory

Following Komlenovic, Mamun, and Mishra (2011), we divide modern economic research on the drivers of M&A activity into Neoclassical, behavioral, and macro models.[5] Such a delineation provides a useful categorization for navigating what can be an otherwise confusing array of explanatory variables employed by various researchers. Rather than simply replicating the models offered by Komlenovic, Mamun, and Mishra (2011), we instead use their taxonomy to construct our own models that are rooted in the broader literature.

The Neoclassical approach to merger activity assumes managers maximize profits, capital markets allocate with perfect efficiency, and firms undertake mergers to increase wealth (Vancea 2012). In the strictest sense, this approach also assumes perfect information and foresight on the part of firm managers. Accordingly, such explanations rely on relative price effects and exogenous industry shocks that dictate the profitability of merging with or acquiring another firm (Mitchell and Mulherin 1996, Harford 2005). Neoclassical models often incorporate GDP and measures of business regulation. The former accounts for economy-wide demand shocks that would alter the profitability of merging. The latter attempts to measure the costliness of commercial activity on which business regulation may have a significant impact (Becketti 1986; Rossi and Volpin 2004; Harford 2005; Komlenovic, Mamun, and Mishra 2011; Vancea 2012). Inclusion of a regulation measure is a straightforward application of the notion that changing the rules of the game will change the play

[5]Others also recognize the utility of taxonomic division such as this one. For example, Shleifer and Vishny (2003) differentiate between Neoclassical and behavioral theories of mergers. Additionally, Garita and Marrewijk (2007) distinguish between Neoclassical, strategic, and "mis-valuation" (behavioral) theories of M&A activity.

within the game itself.

Additionally, Neoclassical models have included a measure of the capital capacity utilization rate. As Becketti (1986) explains, firms may view acquisition as an expeditious way to expand their capital capacity. When firms are operating near full capacity, acquiring a firm can be a quicker path to expansion than undertaking additional construction or hiring.

Finally, two recent papers suggest the importance of including an exchange rate measure, as changes in the exchange rate may exert influence on merger activity (Wang 2009; Uddin and Boateng 2011). This variable fits well into the Neoclassical model, according to the logic proposed by Uddin and Boateng (2011)—appreciation of the dollar would, *ceteris paribus*, increase the costliness of acquiring domestic firms relative to foreign ones. However, it is not clear that the relationship would necessarily be in the direction just described. For instance, a highly variable or consistently depreciating currency may indicate a nation's monetary instability. Accordingly, acquiring firms may prefer targets with assets denominated in stable or appreciating monetary units as an appreciating currency signals strong, underlying growth fundamentals and stable monetary policy. These competing theories suggest that the effect of currency appreciation is indeterminate. This example of competing predictions—the former that might be categorized under the Neoclassical model and the latter under the macro model—highlights the tension generated by scholars' disparate assumptions.

An alternative to the Neoclassical model is the behavioral model, which centers on how firms may leverage misvaluation in order to merge. Some have argued that this perspective is necessary to complement (if not entirely supplant) the Neoclassical perspective because the latter is seemingly unable to explain the long-run under-performance of many firms that have merged (Komlenovic, Mamun, and Mishra 2011). In contrast to Neoclassical models, agents' information in behavioral models is imperfect and speculative. Accordingly, measures such as aggregate Tobin's Q or price-to-book ratios—both of which depend on expectations—may be predictive (Gonzalez, Vasconcellos, and Kish 1998).

Tobin's Q—the ratio of an asset's current market value to its replacement value—is a variable often used to test overvaluation theories of merger behavior (Gonzalez, Vasconcellos, and Kish 1998).[6] These theories suggest that managers of temporarily overvalued firms exploit the mispricing to acquire undervalued firms. As Klomenovic, Mamun, and Mishra (2011) explain, when a firm's Q ratio increases, it becomes more profitable for that firm to acquire other firms. Several researchers advocate for the use of price-to-book ratios in addition to Tobin's Q (Holmstrom and Kaplan 2001; Ang and Cheng 2006; Komlenovic, Mamun, and Mishra 2011). Consistent with the Q overvaluation theory, it is expected that there will be more acquisitions when the average firm in the economy possesses a high price-to-book ratio, that is when the average firm in the economy is overvalued.[7]

We caution, however, against such a simplistic view of overvaluation. If aggregate measures of valuation reveal that firms are overvalued then, on average, firms will be more expensive to acquire. The behavioral literature, in an attempt to separate itself from the Neoclassical perspective, has shied away from the simple relative price story that is inherent in a given firm's valuation. While a highly-valued firm may leverage its overvaluation to more easily acquire another firm, aggregate overvaluation also implies that the marginal target is more costly to acquire. As a consequence, some researchers expect that Tobin's Q would be inversely correlated with merger activity (Golbe and White 1988). Thus, our theoretical analysis suggests that the expected sign of overvaluation is, at best, indeterminate. The influence of overvaluation is a function of which effect—that offered by the broadly behavioral model or the one offered by the broadly Neoclassical model—dominates the economy, a question that must be addressed empirically.

Finally, we argue that expectations about future government regulatory strictures may also influence decision-making. Uncertainty about future government action is analyt-

[6] We use the term "overvaluation" in line with the finance literature, referring to an asset whose price is not justified by current earnings.

[7] This measure is also called a market-to-book or a book-to-market ratio.

ically separable from an existing regulation that inhibits certain types of business activity. A regulation that increases the cost of an activity is more accurately categorized under the Neoclassical model in which agents are fully informed. Uncertainty regarding the impact of future regulation fits more properly into the behavioral model where agents' information is speculative.[8]

Other work has demonstrated that uncertainty about government policy may dampen investment[9] in physical capital (Serven 1998; Bloom, Bond, and Van Reenen 2007).[10] This is a consequence of the fact that investment is (at least to some extent) irreversible. As such, greater uncertainty increases the "option value" of postponing investment. Combined with Becketti's (1986) finding that acquisition may serve as a substitute to additional investment in physical stock, the irreversible nature of investment provides sound theoretical reason to believe that macroeconomic uncertainty may have a dampening impact on M&A. Alternatively, greater uncertainty might lead firms to acquire another firm in an attempt to shore up their market position. In sum, there are theoretical reasons to believe that uncertainty may either increase or decrease the number of mergers.

Another theoretically distinct approach to explaining M&A activity is derived from macroeconomic theory. The macro model of mergers implies that the position of the economy with respect to the business cycle is the most important predictor of merger activity. Shleifer and Vishny (2003) suggest, for instance, that mergers are procyclical because borrowers are credit-constrained during recessions. Measures such as the NBER recession indicator and

[8]BBD's "Economic Policy Uncertainty Index" is a relatively new dataset that has been used to answer a wide variety of questions, but has not yet been employed in testing the determinants of M&A. The index we use is comprised of three components: newspaper stories, the quantity of federal tax provisions up for re-evaluation, and divergence among professional economic forecasters. For more details, see http://www.policyuncertainty.com/us_monthly.html

[9]The findings of Bloom, Bond, and Van Reenen 2007 are slightly more nuanced. They contend that uncertainty about government policy slows a firm's activities. Thus, a firm engaging in investment will slow its investment, whereas a firm engaging in disinvestment will likewise slow its disinvestment.

[10]Similarly, Higgs (1997) offers evidence that policy uncertainty reduced private fixed investment during the Great Depression.

the Chicago Fed's National Activity Index (CFNAI) have been used to test the relationship between macro conditions and merger activity (Komlenovic, Mamun, and Mishra 2011). [11]

In addition to these direct measures of cyclicality, other measures such as the interest rate, stock prices, and the money supply have all been included in macro models of M&A (Becketti 1986). A large number of papers attempting to predict mergers include some measure of the interest rate because many mergers and acquisitions rely on debt-financing (Steiner 1975; Beckenstein 1979; Chung and Weston 1982; Melicher, Ledolter, and D'Antonio 1983; Becketti 1986; Golbe and White 1988; Komlenovic, Mamun, and Mishra 2011). Though many researchers suspect that the interest rate should be significant, there is little consensus about which measure of the interest rate to use.[12] Perhaps more surprisingly, there is also a lack of consistent empirical evidence regarding the statistical significance and sign of the interest rate. For instance, Steiner (1975) and Beckenstein (1979) find interest rate effects to be positively related to the number of mergers, whereas Becketti (1986) and Golbe and White (1988) find a negative interest rate effect. Other measures, such as earnings per share or stock prices, are also frequently included to proxy overall macroeconomic conditions (Nelson 1959; Melicher, Ledolter, and D'Antonio 1983; Clarke and Ioannidis 1996). Finally, some have suggested inclusion of a money supply measure, arguing that increases in the money supply tend to boost overall economic activity, at least in the short-run (Wang 2009; Uddin and Boateng 2011).

2.2 Models and Data

We construct four unique, time series models to obtain point estimates of US M&A determinants between the years 1998 and 2015. Consistent with the literature, we also include deal

[11] The CFNAI is constructed to have an average value of zero and a standard deviation of one. Since economic activity tends toward trend growth rate over time, a positive index corresponds to growth above trend, whereas a negative index corresponds to growth below trend.

[12] Our analysis follows Steiner (1975) and Beckenstein (1979) in using the prime rate of interest.

value as a dependent variable. We caution, however, against serious consideration of the results where deal value is the dependent variable as these data are less reliable.[13] Following several papers in the literature (Mitchell and Mulherin 1996, Wang 2009, Aharon, Gavious, and Yosef 2010, Komlenovic, Mamun, and Mishra 2011) our models do not include lags. We contend that the significant variation in the length between initiation and completion of merger deals, may muddle the results should lags be included. When using the completion date of mergers to aggregate individual mergers into monthly totals, the inclusion of lags implicitly assumes that there is a "standard" or common period of time that elapses between firms investigating a potential transaction and the completion of that deal. Inclusion of lags would also assume that mergers in different stages are affected equally by the change in a given variable in a given time–a dubious assumption at best. Therefore, we do not include lags and instead measure only the contemporaneous effects.

The models we construct below are categorized according to the theory described above. Our fourth model includes all of the variables from the Neoclassical, behavioral, and the macro models, an improvement upon the extant literature. Combining these variables in a single regression demonstrates the superiority of a more holistic approach to modeling merger activity. We delineate the Neoclassical (1), behavioral (2), macro (3), and full (4) models below, viz,

$$m\&a_t = \alpha + \beta_1 regu_t + \beta_2 tcu_t + \beta_3 lnngdpi_t + \beta_4 twex_t + \gamma \mathrm{X} + \varepsilon_t \tag{1}$$

$$m\&a_t = \alpha + \beta_1 tobinq_t + \beta_2 ptb_t + \beta_3 epu_t + \gamma \mathrm{X} + \varepsilon_t \tag{2}$$

$$m\&a_t = \alpha + \beta_1 cfnai_t + \beta_2 mprime_t + \beta_3 eps_t + \beta_4 lnm2_t + \gamma \mathrm{X} + \varepsilon_t \tag{3}$$

$$\begin{aligned} m\&a_t = \alpha + \beta_1 regu_t + \beta_2 tcu_t + \beta_3 lnngdpi_t + \beta_4 twex_t + \beta_5 tobinq_t + \beta_6 ptb_t \\ + \beta_7 epu_t + \beta_8 cfnai_t + \beta_9 mprime_t + \beta_{10} eps_t + \beta_{11} lnm2_t + \gamma \mathrm{X} + \varepsilon_t \end{aligned} \tag{4}$$

[13] This is a standard issue that the literature confronts because many firms do not report deal value. As such, most papers that analyze value urge caution in interpreting these results.

where $m\&a_t$ is measured as either the aggregate number or dollar value of mergers and acquisitions in the given month, t, and X is a matrix of linear, quadratic, and cubic time trends.[14] The first three models (Equations (1), (2), and (3)) are subsets of the final, full model (Equation (4)), where each of the subset models are nested in the full model.

As Table 1 displays, the vast majority of our data are sourced from either Bloomberg or the St. Louis Federal Reserve's FRED. The variables are listed in the order of our models: Equations (1), (2), and (3). The summary statistics for our data are provided in Table 2. The non-aggregated totals for the dependent variables used in Sections 2 and 3 are listed under "total" for the relevant variables. As Table 2 displays, this dataset, once aggregated to monthly counts and values, contains 216 observations or monthly totals from January, 1998 to December, 2015. In addition to the summary statistics of Table 2, for clarity we have also included a correlation matrix of our explanatory variables, displayed in Table 3.

These data pose two fundamental limitations to our analysis. The first is a result of our aggregating the data comprising our dependent variable in order to examine it by month. As a consequence, while we begin with more than 140,000 mergers and acquisitions, we sum these mergers for each month (first by number and value, and then by number and value for various sizes, regions, and sectors), thereby reducing our total number of observations to 216. For most of our independent variables, there is simply not sufficient variation to examine daily or even weekly measures of merger activity.

Aggregating by month also obscures important firm-level dynamics. The literature suggests, for instance, that an overvalued firm may leverage its position to acquire an undervalued firm. Our results obscure those firm-level dynamics by instead looking at aggregate measures of Tobin's Q and the price-to-book ratio. Though aggregation is standard practice in the literature, it may conceal information that could be gleaned from disaggregated data.

[14] These trends allow for M&A activity to vary over-time, in linear, as well as non-linear, ways. This helps to account for well known "merger waves."

Table 1: Variable Definition and Source

Variable	Definition	Unit	Source
mnum	the monthly count of mergers and acquisitions for US firms merging with or acquiring another US firm	number of mergers	Bloomberg
mval	the monthly value of mergers and acquisitions for US firms merging with or acquiring another US firm	millions of US dollars	Bloomberg
regu	the monthly sum of all Federal Trade Commission (FTC) legal actions brought before courts in the US	number of cases	FTC
tcu	the total industry capacity utilization rate	percent of capacity	FRED
lngdpi	the natural logarithm of nominal gross domestic product, interpolated from quarterly to monthly using cubic spline interpolation	logarithmic scale	FRED
twex	the trade weighted US dollar index for major currencies	index normalized for January 1997=100	FRED
tobinq	nonfinancial corporate business, corporate equities, and liability in level terms divided by 1000 over nonfinancial corporate business and net worth in level terms, interpolated from quarterly to monthly using cubic spline interpolation	millions of US dollars dived by billions of US dollars	FRED
ptb	the price to book ratio for the S&P 500 index, interpolated from quarterly to monthly using cubic spline interpolation	US dollars divided by US dollars	Bloomberg
epu	the economic policy uncertainty index from the Baker, Bloom, and Davis index on economic uncertainty	index normalized for mean=100 during period 1985-2014	BBD 2013
cfnai	the Chicago Fed National Activity Index	index normalized for 0=historic trend growth rate	FRED
mprime	the bank prime loan rate	percentage points	FRED
eps	the earnings per share for the S&P 500 index, interpolated from quarterly to monthly using cubic spline interpolation	US dollars	Bloomberg
lnm2	the natural logarithm of the M2 money supply	logarithmic scale	FRED

Table 2: Mergers Model Comparison

	total	mean	sd	min	max
mnum	148247.00	686.33	175.43	204.00	1257.00
mnum_sm_t	4125.00	19.10	14.82	1.00	70.00
mnum_mid_t	14013.00	64.88	21.34	25.00	167.00
mnum_lrg_t	4394.00	20.34	6.43	5.00	44.00
mnum_ne_t	20661.00	95.65	40.98	23.00	206.00
mnum_s_t	24770.00	114.68	44.34	18.00	228.00
mnum_mw_t	13176.00	61.00	25.90	13.00	127.00
mnum_w_t	31662.00	146.58	68.94	22.00	307.00
mnum_comm	23648.00	109.48	38.81	11.00	191.00
mnum_consum_t	44864.00	207.70	88.34	18.00	455.00
mnum_energy_t	6813.00	31.54	15.86	1.00	92.00
mnum_financial_t	21047.00	97.44	44.44	12.00	211.00
mnum_industrial_t	14455.00	66.92	28.41	6.00	170.00
mnum_tech_t	19246.00	89.10	46.55	8.00	226.00
mval	16113813.82	74600.99	48021.81	10392.29	312491.75
mval_sm_t	171485.21	793.91	1528.64	0.13	12849.68
mval_mid_t	1732251.29	8019.68	5467.28	559.88	29066.58
mval_lrg_t	7867300.18	36422.69	38859.86	326.96	241161.17
mval_ne_t	3610668.18	16716.06	25119.18	245.96	223575.06
mval_s_t	4028142.41	18648.81	19856.67	848.01	117236.13
mval_mw_t	2275815.00	10536.18	13772.37	188.41	93223.16
mval_w_t	3006644.40	13919.65	16736.36	936.40	130669.85
mval_comm_t	3113939.69	14416.39	24868.18	288.73	196024.09
mval_consum_t	4553581.79	21081.40	21673.00	1510.59	161385.70
mval_financial_t	3130366.73	14492.44	17525.35	570.78	173982.50
mval_industrial_t	1054377.63	4881.38	4843.80	164.38	38370.76
mval_tech_t	1029532.97	4766.36	6037.02	241.07	50121.00
regu		2.10	1.68	0.00	11.00
tcu		77.58	3.47	66.70	84.40
lngdpi		9.50	0.20	9.09	9.81

Continued on next page

Table 2 – continued from previous page

	total	mean	sd	min	max
twex		86.21	11.93	69.02	112.20
tobinq		0.96	0.21	0.54	1.60
ptb		2.93	0.84	1.80	5.07
epu		110.55	36.95	57.20	245.13
cfnai		-0.24	0.86	-4.59	1.51
mprime		5.32	2.19	3.25	9.50
eps		18.18	6.17	0.93	29.05
lnm2		8.87	0.32	8.31	9.42
ltrend		108.50	62.50	1.00	216.00
qtrend		15660.17	14002.78	1.00	46656.00
ctrend		2542806.00	2883988.59	1.00	10077696.00
N	216				

Notes: Totals are only given for merger and acquisition data. These data have been aggregated from the raw totals to monthly counts and values. Mean, sd, min, and max all refer to the aggregated monthly values. The sample period for these data is January, 1998 to December, 2015. *Source*: See Table 1.

Table 3: Correlation Matrix

	regu	tcu	lnngdpi	twex	tobinq	ptb	epu	cfnai	mprime	eps	lnm2
regu	1.00										
tcu	0.07	1.00									
lngdpi	-0.12	-0.36	1.00								
twex	0.16	0.21	-0.77	1.00							
tobinq	0.13	0.57	-0.36	0.35	1.00						
ptb	0.15	0.65	-0.79	0.71	0.79	1.00					
epu	-0.01	-0.59	0.34	-0.36	-0.38	-0.56	1.00				
cfnai	-0.05	0.45	-0.08	0.02	0.44	0.27	-0.34	1.00			
mprime	0.09	0.72	-0.68	0.50	0.44	0.76	-0.57	0.12	1.00		
eps	-0.10	0.03	0.85	-0.63	0.02	-0.47	0.09	0.32	-0.43	1.00	
lnm2	-0.10	-0.43	0.98	-0.72	-0.32	-0.77	0.41	-0.08	-0.76	0.83	1.00

Source: See Table 1.

The second limitation results from the scope of our dependent variable data. Our data on M&A is for a seventeen year period within a single country. Bloomberg's data is most reliable starting in 1998; consequently, we limit the dependent variable data to the

time span in question for the sake of increased accuracy. Given the data comes from only one country, questions of external validity might be raised. These data limitations do not pose serious problems for our results. However, future research should consider them when crafting questions related to our findings.

Another potential limitation that must be addressed is endogeneity or reverse causality. We contend that the construction of our models and the definition of the variables used are sufficient to relieve concerns of endogeneity; together they provide the foundation of our causal claims. First, due to the contemporaneous nature of our model, policy variables such as regulation, interest rates, and the money supply are exogenous. That is, policy variables are not driven by economic activity, including merger activity, within the month in question (Bernanke and Mihov 1998; Blanchard and Perotti 2002). Second, it has been well-documented that pre-merger expectations often diverge significantly from post-merger financial performance (Ravenscraft and Scherer 1987; Klein 1998; Komlenovic, Mamun, and Mishra 2011). This suggests that there is no systematic tendency toward improved (or worsened) performance from merging. Furthermore, while firms may merge to better utilize plants and equipment, there is no systematic effect of higher capacity utilization from merging. Similarly, mergers do not have a systematic effect of the production of final goods and services, stock valuations, or firm performance. This reasoning removes concerns of endogeneity for total capacity utilization, NGDP, Tobin's Q, price-to-book, CFNAI, and earnings per share. Next, we turn to the trade weighted exchange rate (TWEX). It is a well-known economic fact that models attempting to explain exchange rate behavior perform poorly (Meese and Rogoff 1983a, 1983b). While we cannot prove that M&A activity does not affect the exchange rate, the broader exchange rate literature does not suggest that endogeneity is an issue with this variable. Lastly, we turn to economic policy uncertainty (EPU). The EPU index is a composite of three components. M&As will have no effect on two of these three: proximity to a scheduled change in tax law and a measure of forecasters' divergence

regarding future economic conditions. Admittedly, the third component—the incidence of words related to EPU appearing in major newspapers—could theoretically be caused by M&A activity.[15] Nonetheless, this is only a third of the data comprising a given EPU score and countless other events may also contribute to an increase in policy uncertainty-related words in newspapers, suggesting that reverse causality is unlikely to be a concern in most instances.

2.3 Results

The results are listed by the four models as outlined above. Each model reports the results for both the monthly count and the total value of mergers and acquisitions. In line with conventional approaches, each model includes linear, cubic, and quadratic time trend variables. The main finding of our analysis, as seen in Table 4, is the lack of robustness of any of the subset models. No model, on its own, performs as well as the combination of all models together. Furthermore, many variables that are found to be significant in a given model are not robust to the inclusion of variables contained within other models. This finding of significant bias suggests that future work should not limit itself to the constraining assumptions of any particular theoretical model, but rather should seek to explore the determinants of merger activity by way of a more inclusive approach.

We interpret the three subset models of Table 4 as follows. For the Neoclassical model, total capacity utilization and GDP are significant, but our measure of regulation and the trade-weighted exchange rate are insignificant.[16] Consistent with both the theory discussed above and the broader literature, the sign on total capacity utilization is positive

[15] For example, news of two large companies merging might incite fears of antitrust activity in subsequent periods, and such anticipation might be reflected in relevant news articles.

[16] There is no widely-used monthly measure of business regulation. To proxy the costliness of regulation, we created a variable that measures FTC enforcement. It consists of the monthly sum of all merger, non-merger, and civil penalty cases brought by the FTC against US businesses between January, 1998 and December, 2015. While not a perfect measure of regulatory costs, the variable enables us to capture FTC "activism."

Table 4: Mergers Model Comparison

	Neoclassical		Behavioral		Macro		Full	
	mnum	mval	mnum	mval	mnum	mval	mnum	mval
regu	1.09	854.38					2.53	483.05
	(3.56)	(1319.00)					(2.97)	(1271.89)
tcu	14.23***	-435.97					2.73	471.93
	(4.45)	(1768.32)					(5.28)	(2543.68)
lngdpi	941.35*	1016028.87***					-186.90	-37663.35
	(531.22)	(228345.45)					(889.04)	(590238.67)
twex	-0.84	628.58					-3.35*	-1059.50
	(1.60)	(655.24)					(1.76)	(865.73)
tobinq			25.91	-42101.95			-115.65	21844.60
			(94.35)	(45304.22)			(85.39)	(50460.28)
ptb			173.84***	51933.41***			123.92***	-8699.38
			(35.68)	(18505.23)			(41.05)	(19884.27)
epu			0.18	-92.03			1.06***	83.34
			(0.27)	(110.37)			(0.32)	(123.89)
cfnai					3.22	3860.20	3.58	3215.72
					(10.33)	(4622.82)	(11.38)	(4961.67)
mprime					32.05***	17287.44***	28.75***	18844.43***
					(6.48)	(2569.50)	(10.17)	(7027.08)
eps					11.21***	-1869.44	10.85***	-2745.22
					(3.42)	(1437.03)	(4.00)	(1810.05)
lnm2					565.53	-48121.68	904.55	-75318.52
					(783.04)	(221753.69)	(748.22)	(218125.23)
_cons	-9169.25**	-9180364.27***	-430.95***	-113113.27	-4621.72	333922.53	-6165.59	960407.43
	(4484.03)	(1936979.71)	(155.75)	(73547.73)	(6530.08)	(1846580.94)	(10110.04)	(5030452.22)
N	216							
adj. R^2	0.721	0.251	0.701	0.174	0.749	0.299	0.779	0.284
X	Included							

Notes: Robust standard errors in parentheses; * $p < .1$, ** $p < .05$, *** $p < .01$; Dickey-Fuller tests revealed stationarity for all dependent variables. *Source*: See Table 1.

and the magnitude is significant. This implies that as firms approach full capacity, they may merge with other firms to expand their output capabilities. GDP is also statistically significant, suggesting that as the economy grows, the broader wealth effects create potential for M&A activity. With an adjusted R^2 of 0.72, the Neoclassical model performs strongly.

The behavioral model, while statistically significant, is a marginally less valuable predictor of M&A activity. The coefficients on Tobin's Q and price-to-book—both measures of overvaluation—are positive, though Tobin's Q is insignificant. As we argued in Section 2.1, there are two potential, competing effects of overvaluation. First, overvalued firms may leverage their current valuation to acquire other firms. Second, overvalued firms are less attractive targets. Our results suggest that over-valued firms are able to leverage that over-valuation in acquiring under-valued firms. Our behavioral model also includes a measure of policy-induced uncertainty, though this proves statistically insignificant. With an adjusted R^2 of 0.7 compared to the 0.72 of Neoclassical, the behavioral model displays marginally weaker predictive capabilities.[17]

Lastly, the macro model shows strong, significant results, with the exception of the CFNAI and the money supply measure. The lack of significance of the national economic activity index is likely due to the construction of the index itself. At its core, the CFNAI is a very broad measure of economic activity. Intuitively, a "busy" economy does not necessarily imply a merging economy. Such a comprehensive measure of various forms of economic activity has too much noise to be useful in this context. This lack of finding is directly at odds with the strong findings of Komlenovic, Mishra, and Mamum (2011). The positive sign on the interest rate measure is the most counterintuitive result, a finding that has also puzzled other researchers (Beckenstein 1979). Beckenstein hypothesizes that this result follows from firm managers pursuing growth maximization, specifically a rate of growth

[17]The use of an adjusted R^2 allows for inter-model comparisons of models with a differing number of explanatory variables.

that exceeds the cost of capital.[18] Because older firms have lower rates of return than do new firms, an increase in the cost of capital leads firms, on the margin, to acquire rather than grow by internal expansion as they seek a return in excess of the cost of capital. The estimate for earnings per share of the S&P 500, a fine-grained measure of overall economic performance, is consistent with both the macro and neoclassical model. This measure tracks GDP, but does so with greater variance, allowing for a more detailed fit. Our results show that earnings-per-share is a strong predictor of merger activity. Finally, the money supply is statistically insignificant. Overall, the macro model—with an adjusted R^2 of 0.75—is the best performing, by a slim margin, of the three theoretical models.

Thus far, our results have followed the format of the broader literature, displaying the findings of each model individually. We now turn to the full model which demonstrates the superiority of our holistic approach relative to any of the subset models. Displayed as the final two columns in Table 4, the full model reveals the preceding models' lack of robustness. Table 5 quantifies the difference between the subset models and the full model, noting where there is a statistically significant difference between the two estimates. This difference shows the failure of point estimates obtained from individual theoretical models.

As shown in Tables 4 and 5 the coefficients of the Neoclassical model alone are very different from the coefficients of the Neoclassical model when used with other covariates. All four of the Neoclassical determinants vary statistically significantly in either number or value of monthly mergers. Regulatory enforcement is not significant in the full model for merger number, a finding that is consistent with our previous results. Capacity utilization, a variable that was first found to be significant by Becketti (1986), while very statistically significant in the Neoclassical model of merger number, no longer displays significance in the full model. This difference is highly statistically significant, revealing the measure's lack of robustness to the inclusion of other determinants. Capacity utilization is correlated with both

[18] Also see (Mueller 1969) for a similar discussion.

behavioral and macro determinants, suggesting that the magnitude of capacity utilization in the Neoclassical model is upwardly biased. NGDP is also insignificant in the full model of monthly mergers, a finding inconsistent with many previous researchers. This change in NGDP is highly statistically significant. Finally, the exchange rate becomes significant in the comprehensive model of mergers, revealing an upward bias in the Neoclassical model. The negative magnitude of TWEX becomes greater in the comprehensive model, suggesting that an appreciation of the domestic currency is associated with a decrease in M&A activity.[19]

Following the Neoclassical model, each of the variables in the behavioral model contain large and statistically significant bias in either number or value of mergers. For the monthly count of mergers, price-to-book is significant in both the nested and full models, EPU changes in significance between the model, and Tobin's Q switches signs, though it remains insignificant in both. This reveals the weakness of the standalone behavioral model. Recall that Tobin's Q and price-to-book—measures of overvaluation—were both positive in the behavioral model. The full model demonstrates that, once other variables are included, while the effect is still positive overall, Tobin's Q exerts a negative effect and price-to-book's effect is significantly smaller. We suggest that the negative sign on Tobin's Q and the reduction in price-to-book are a consequence of the fact that overvaluation operates in both directions: while some firms can leverage their overvaluation to acquire, others simply become more expensive. Our results suggest that the ability of overvalued firms to leverage their overvaluation swamps the increased costliness of acquiring other overvalued firms. More than likely, overvalued firms look for "deals"—targets that are undervalued even when the average firm is currently overvalued. This finding serves to clarify the puzzlement expressed by Golbe and White (1988) over finding a positive relationship between Tobin's Q and merger activity. While the change in economic policy uncertainty is not significant, the co-

[19]Because we do not control for international M&A activity, it is unclear if an appreciation of the US Dollar causes a decline in only domestic mergers or in worldwide mergers.

efficient does change in significance between the models for mergers. The resulting estimate is contrary to other scholarship that finds firms postpone investment in the face of policy-induced uncertainty (Higgs 1997; Serven 1998; Bloom, Bond, and Van Reenen 2007). Our result clarifies the theoretical indeterminacy of policy-induced uncertainty suggesting that it incentivizes firms to "shore up" their market positions rather than militating investment.

Lastly—and in similar manner to the preceding two models—each of the macro model variables are statistically different in either number or value of mergers between the macro and the full model. Each of the significant macro model variables are also significant in the full model, all retaining their original signs. However, two of the coefficients for number and all for value do differ statistically. The measure of national business activity, CFNAI, is insignificant in both the macro and the full models, however the difference between the two is significant. The interest rate is significant for both deal value and also for the quantity of mergers. Furthermore, it is statistically robust to the inclusion of other covariates for the monthly number of mergers. The estimate for the effect of the interest rate suggests that firms select more and higher valued mergers when the cost of financing a merger increases. It also lends support to the views expressed by other scholars that acquisition may yield a greater rate of return than does internal growth for some firms (Mueller 1969; Beckenstein 1979). Earnings-per-share is statistically significant and very robust, with little change in the magnitude and no change in significance, suggesting that broader wealth effects are positive and robust for the number of mergers. Finally, the money supply continues to lack significance in the presence of additional covariates, however, the change in magnitude is significant. Our result suggests that an increase in the money supply does not exert even short term effects on the number or value of M&As.

Each theoretical model—Neoclassical, behavioral, and macro—is able to explain a portion of merger activity. However, due to the competing assumptions that rule out inclusion of other determinants, none of the three theoretical models is able to explain M&As as

Table 5: Mergers Model Comparison

	mnum		mval	
	d	bias	d	bias
regu	1.44	−	371.33***	+
	(0.75)		(0.52)	
tcu	11.49***	+	907.90***	−
	(2.98)		(0.16)	
lnngdpi	1128.25***	+	1053692.35***	+
	(1.66)		(4.40)	
twex	2.51	+	1688.08***	+
	(1.72)		(0.75)	
tobinq	141.55***	+	63946.55***	−
	(1.23)		(0.79)	
ptb	49.92***	+	60632.79***	+
	(3.54)		(2.68)	
epu	0.88	−	175.37***	−
	(3.03)		(0.48)	
cfnai	0.36***	−	-644.47***	+
	(0.04)		(0.53)	
mprime	3.30	+	1556.99***	−
	(3.93)		(6.20)	
eps	0.36	+	875.78***	+
	(1.79)		(0.78)	
lnm2	339.02***	−	27196.84***	+
	(0.94)		(0.27)	

Notes: * $p < .1$, ** $p < .05$, ***; d is the absolute value of the difference between the coefficient in the full model and the nested models; standard errors, of the differences, are calculated according to Clogg, Petkova, Haritou (1995); bias is the sign of the omitted variable bias in the nested model. *Source*: See Table 1.

well as the full model. With an adjusted R^2 of 0.78 for the monthly merger count, the full model explains merger activity very well. The exchange rate, price-to-book, economic policy uncertainty, the interest rate, and earnings-per-share are all significant predictors of M&As, as the full model shows. These variables are based on competing assumptions, revealing a tension between the priors of each theoretical camp as compared with economic reality—a reality that each camp, on its own, unsuccessfully attempts to capture. Table 5 quantifies this failure, showing the significance and direction of the bias for each of the covariates. With

empirical support for our holistic model of mergers and acquisitions clearly established, we now turn to the effects of firm heterogeneity and incongruous merger determinants.

3 Heterogeneity

3.1 Theory

Firms possess access to distinct and heterogeneous resources in both physical and human capital (Barzel 1997; Foss et al. 2007; Foss and Klein 2012). This heterogeneity may be particularly important for analysis of M&As. Consider two firms of differing sizes: a small physicians' office and a large hospital. It is unlikely that the physicians' office will own an MRI machine, while most hospitals will. This is true despite the fact that both firms are concerned with the provision of "health care," broadly defined.

Because firms that are different sizes possess heterogeneous resources, we expect the explanatory variables in our holistic model of merger activity to have differential impacts across firm size. The drivers of acquisitions for small firms may have varying (or even diametric) effects on the demand for large firms. For example, a large company with assets diversified across many countries may be less likely to be affected by changes in the value of currency than is a small firm with less diversified holdings. Most of the existing research on the determinants of mergers tends to downplay the importance of firm heterogeneity.

If resources differ by firm size, it is obvious that resource heterogeneity exists between industries. Assets specific to production in one industry may be ill-suited to production in another, yet many models of aggregate economic activity model the entire capital stock as a single, undifferentiated "K." One important exception to treating firms as homogeneous across industries is found in a recent paper by Entezarkheir and Moshiri (2017). The authors analyzed the influence of merger activity on firm innovation, attempting to determine whether the influence differs by industry. They find that innovation's effects do differ between

industries, a finding that unambiguously lends support to the argument that heterogeneities are important to consider in the context of merger determinants.

Finally, there may also be important heterogeneities that stem from regional differences. In the literature on regional business cycles, industrial mix, migration, and culture have all been recognized as significant factors explaining regional economic variation (Siegel 1966; Artis, Dreger, and Kholodilin 2011; Basile, Nardis, and Pappalardo 2013). As each of these components may differ by region—producing differing demand for firms in each region—one would expect that M&As would differ by region. Additionally, North (1990) famously argued that the institutional "rules of the game" are key determinants of economic activity. Similarly, Buchanan (2008) argued that the "same players" will yield different outcomes when playing a different "game". Thus, regulation, which comprises part of the "rules of the game," will alter the play within those rules. Given the significant geographic size of the United States, it stands to reason that there may be regional differences in the rules of the game—formal or informal—which alter the costs and benefits of merging.

3.2 Heterogeneity Models

Using the same data as Section 2, we now turn to the topic of heterogeneity. To test the hypothesis that there are heterogeneous effects by size, region, and sector, we conduct two separate analyses. First, we use approximate factor analysis to generate indices of size-, region-, and sector-specific shocks in mergers and acquisitions. These indices demonstrate the importance of heterogeneity by quantifying and displaying heterogeneous shocks to M&As. Second, we employ the full model—Equation (4)—from Section 2.2 to test for significant differences in the coefficients by target firm size, region, and sector.

For both of these analyses, we define the following categories of firm size, region, and sector. Small firms contain a subset of mergers and acquisitions where the target firm consist of 1 to 49 employees. Medium firms contain a subset of mergers and acquisitions where the

target firm consist of 50-499 employees. Large firms contain a subset of mergers and acquisitions where the target firm consist of 1,000 or more employees. Firm regions are defined by the US Department of Commerce's Economics and Statistics Administration according to the following.[20] Firm sectors are pre-defined in the Bloomberg database and include Basic Materials, Communications, Consumer, Diversified, Energy, Financial, Industrial, N.A., Technology, and Utilities.[21]

To construct our index of specific shocks, we first estimate an approximate factor model, following Mehrotra and Sergeyev (2013), viz,

$$\eta_t = \lambda_t F_t + \epsilon_t \tag{5}$$

where η_t is a $N \times 1$ vector of either the number or value of mergers and acquisitions by target firm size, region, or sector, where each have been standardized to have a mean-zero stationary series with the variance normalized to unity. This standardization ensures that no one size, region, or sector has a disproportionate effect on the factors. On the right-hand side of Equation (5): λ_t is a $N \times K$ matrix of factor loadings; F is a $K \times 1$ vector of factors; and, ϵ_t is a $N \times 1$ vector of shocks.

The residual, ϵ_t, captures the size-, region-, or sector-specific shocks of interest. These shocks represent the heterogeneous effects of merger determinants for firms of various sizes, regions, or sectors. That is, ϵ_t captures specific factors that are not common to firms of different sizes, located in different regions, or operating in different sectors. For example, we

[20]Mergers and acquisitions in the North East region includes the subset of mergers and acquisitions for firms in the following states: Connecticut, Maine, Massachusetts, New Hampshire, New Jersey, New York, Pennsylvania, Rhode Island, Vermont. The South: District of Colombia, Alabama, Arkansas, Delaware, Florida, Georgia, Kentucky, Louisiana, Maryland, Mississippi, North Carolina, Oklahoma, South Carolina, Tennessee, Texas, Virginia, West Virginia. The Mid-West: Illinois, Indiana, Iowa, Kansas, Michigan, Minnesota, Missouri, Nebraska, North Dakota, Ohio, South Dakota, and Wisconsin. The West: Alaska, Arizona, California, Colorado, Hawaii, Idaho, Montana, Nevada, New Mexico, Oregon, Utah, Washington, Wyoming

[21]For our sectoral analysis, we only use sectors were there is at least one M&A per month and exclude mergers categorized as N.A.. For the number of mergers, our analysis includes the subset of mergers and acquisitions for the following sectors: Communications, Consumer, Energy, Financial, Industrial, and Technology. Because data on the value of every merger is not available, our analysis of the value of mergers excludes the Energy sector.

are able to isolate shocks that only affect one size of firm, not affecting all firms. Using these specific shocks, we construct indices to quantify the heterogeneous effects of these specific shocks over time. Each index is calculated by measuring cross-sectional dispersion, squaring the size, region, or sectoral M&A residuals from Equation (5), viz,

$$S_t^{size,region,sector} = \frac{1}{K}\left(\sum_{i=1}^{K} \epsilon_t^2\right)^{\frac{1}{2}} \tag{6}$$

where $S_t^{size,region,sector}$ is the index of shocks by size, region, or sector over time. These indices are displayed in Section 3.3.

Having quantified and visually displayed the broad importance of firm heterogeneities, we turn to exploring these heterogeneities by individual determinant. Zellner's seemingly unrelated regressions (Zellner 1962) and simple Wald tests enable us to test for statistically significant variations in the coefficients of the full model by firm size, region, and sector. Specifically, we test,

$$H_0\text{: } \beta_{j,i} = \beta_{j,n} \tag{7}$$

$$H_A\text{: } \beta_{j,i} \neq \beta_{j,n} \tag{8}$$

for every coefficient by firm size, region, and sector i to n.

With a null hypothesis that each coefficient is equal across regressions of heterogeneous firms, we display the effect of firm heterogeneities on the determinants in the following section, conducting three sets of test for heterogeneity of determinants, one by size, one by region, and one by sector. The results of our heterogeneity analysis are displayed in the following section.

3.3 Results

Figures 1 to 3 display the indices specified in Equation (6). Because the shock indices are created from the residuals of the factor analysis, the scale of each index is the same as the dependent variables, the monthly number of mergers and acquisitions. As previously noted,

Figure 1: Size Specific Shocks to Mergers and Acquisitions

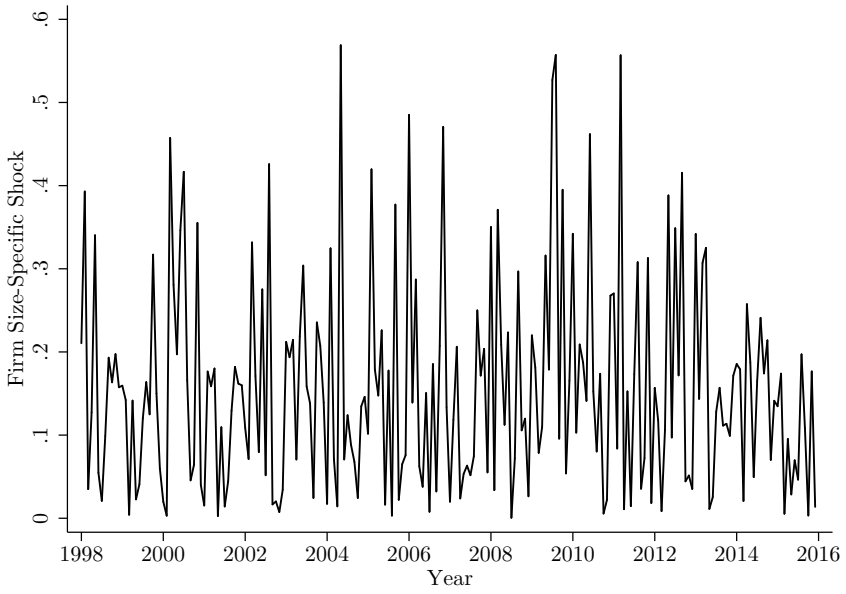
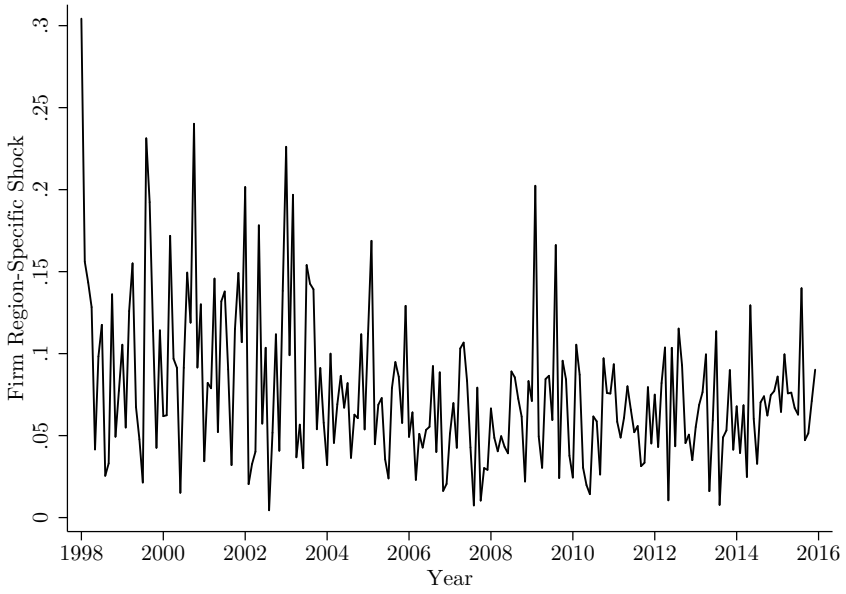
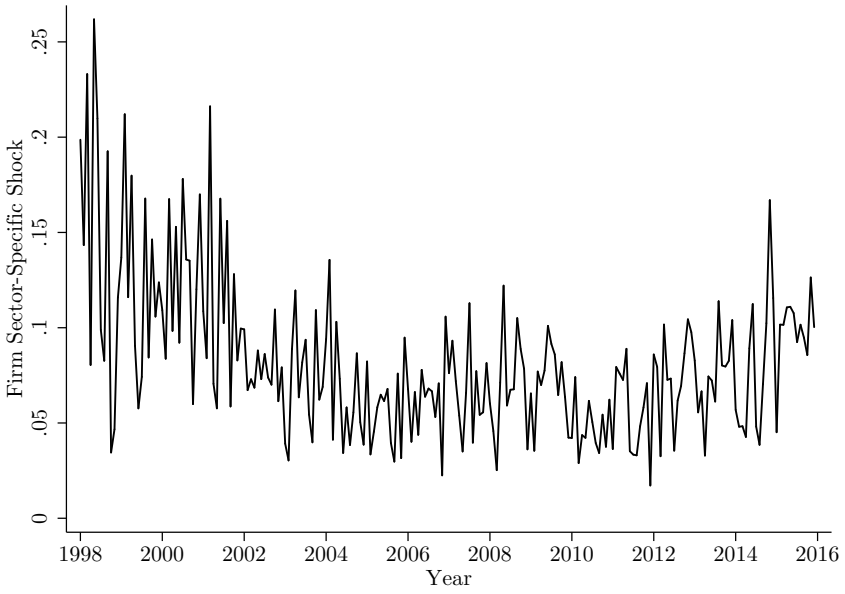


Figure 2: Region Specific Shocks to Mergers and Acquisitions



the dependent variables have been standardized for these indicies, resulting in an intuitive and interpretable index where the magnitude of the index is simply the percent of a standard deviation of the monthly number of M&As.

Figure 3: Sector Specific Shocks to Mergers and Acquisitions



In Figure 1 we see that there are frequent shocks of at least 40% of a standard deviation and three shocks (mid-2004, late-2009, and early-2011) of greater than half a standard deviation. This index reveals that size-specific shocks are common in the number of M&As. That is, there are regular shocks to the demand for firms of a specific size. Figure 2 displays the region-specific shocks in the number of monthly M&As. It is evident that region-specific shocks are less common and of a lower magnitude than size-specific shocks. However, regional shocks at or above 20% of a standard deviation do occur 6 times (early-1998, late-1999, late-2000, early-2002, early-2003, and early-2009) in our 18 year sample. Finally, Figure 3 displays the index of sector-specific shocks to the monthly number of M&As. Sector-specific shocks are the least common and have the lowest magnitude of our thee shock indecies. The relative stability of M&As by sector is as notable a finding as the relative instability of M&As by firm size. With visual confirmation that firms of various sizes, in various regions, operating in various sectors experience shocks specific to their peer group, we turn to a more detailed analysis of merger determinants by size, region, and sector.

Table 6: Target Merger Model by Size

	Small		Medium		Large	
	mnum	mval	mnum	mval	mnum	mval
regu	0.20	32.53	-0.32	357.11*	0.39*	73.05
	(0.23)	(39.41)	(0.45)	(199.74)	(0.22)	(1165.44)
tcu	0.23	-208.49**	1.96**	194.25	0.16	-1189.42
	(0.36)	(85.02)	(0.76)	(274.11)	(0.31)	(2339.48)
lngdpi	11.80	50935.57***	50.69	54952.69	-1.40	63412.78
	(72.24)	(18158.36)	(137.10)	(49337.77)	(55.36)	(546075.28)
twex	0.05	-22.74	0.17	125.57	-0.08	-1151.20
	(0.13)	(32.05)	(0.27)	(105.43)	(0.14)	(831.00)
tobinq	16.43**	1440.71	9.43	-2879.52	-5.28	14242.56
	(6.45)	(2175.07)	(12.37)	(5027.26)	(5.89)	(48315.95)
ptb	1.47	-814.42	12.17**	4187.34**	4.00*	-2887.27
	(2.70)	(1186.98)	(5.47)	(1815.09)	(2.41)	(19207.06)
epu	0.02	13.01**	0.12**	-4.18	0.03	118.77
	(0.03)	(5.95)	(0.05)	(14.95)	(0.02)	(102.43)
cfnai	-0.81	113.36	-1.01	-1138.76**	0.72	2377.08
	(0.85)	(123.67)	(1.67)	(553.53)	(0.74)	(4538.16)
mprime	1.26*	-166.50	0.16	-635.68	1.01	12394.96*
	(0.76)	(127.31)	(1.64)	(574.42)	(0.74)	(6564.24)
eps	0.09	4.32	1.14*	260.76	0.40	-2124.26
	(0.21)	(45.47)	(0.59)	(280.34)	(0.25)	(1649.21)
lnm2	156.02***	-14885.80	232.98*	-50223.20*	-5.35	-119002.15
	(54.67)	(9110.91)	(136.53)	(29869.01)	(46.36)	(192192.99)
_cons	-1451.38**	-316617.42**	-2606.41	-116387.94	44.78	557451.17
	(694.61)	(123328.17)	(1758.10)	(474672.00)	(635.97)	(4691807.88)
N	216					
adj. R^2	0.808	0.212	0.619	0.300	0.271	0.102
X	Included					

Notes: Robust standard errors in parentheses; * $p < .1$, ** $p < .05$, *** $p < .01$; Dickey-Fuller tests revealed stationarity for all dependent variables. *Source*: See Table 1.

In accordance with the prediction that heterogeneity matters, our results demonstrate that the same determinants exert differing influences for firms of distinct sizes (Table 6), in distinct regions (Table 8), operating in distinct sectors (Tables 10 and 11). While the majority of the extant literature treats firms as homogeneous, we demonstrate that this common, simplifying assumption should be relaxed.[22] Relaxing the homogeneity assumption

[22]Firm-level studies, such as Shleifer and Vishny (2003) and Granier (2008), relax this assumption. They do this, however, at the cost of excluding many, known determinants.

generates insightful and robust results. Firms are not homogeneous, and analysis that treats them as such simply obscures the true, underlying relationships.

Table 7: F Statistic for Identical Coefficients by Firm Size

	mnum	mval
regu	0.96	1.35
tcu	2.93*	1.06
lnngdpi	0.07	0.00
twex	0.04	1.63
tobinq	3.08**	0.40
ptb	1.71	2.63*
epu	3.78**	1.15
cfnai	1.31	2.24
mprime	0.21	3.43**
eps	1.79	1.60
lnm2	7.19***	0.75

Notes: * $p < .1$, ** $p < .05$, *** $p < .01$; the F Statistic is produced from a Wald test for differences in coefficients by firm size where H_0: $\beta_{j,i} = \beta_{j,n}$ and H_A: $\beta_{j,i} \neq \beta_{j,n}$ for firm sizes i to n. *Source*: See Table 1.

The purpose of this investigation is to display the heterogeneous effects of merger determinants. Our analysis is not sufficiently detailed to (or even intended to) capture precise point estimates of these determinants. Such an analysis would require size, region, and sector level controls in addition to the covariates of Equation (4). Rather, our purpose is to work within the existing norms of this literature to demonstrate that the heterogeneity of firms (by size region, and sector) should be considered in future analysis. The clear importance of firm heterogeneity is captured in Tables 7, 9 and 12, where we display the statistical significants of determinant heterogeneity. In Tables 6, 8, 10 and 11, we utilize the full model from Section 2.2 to analyze firms of differing sizes, located in differencing regions, and operating in differing sectors.

Table 8: Regional Merger Models

	North East		South		Mid-West		West	
	mnum	mval	mnum	mval	mnum	mval	mnum	mval
regu	0.28	-65.79	1.49**	-245.41	0.79*	208.78	0.46	252.32
	(0.55)	(715.89)	(0.65)	(560.81)	(0.40)	(413.27)	(0.70)	(687.93)
tcu	-0.28	1604.26	-0.72	771.02	-0.38	-2000.46**	-0.76	-409.46
	(1.04)	(1772.47)	(1.25)	(822.87)	(0.81)	(1006.93)	(1.14)	(835.65)
lngdpi	738.13***	-552802.84	965.97***	71358.65	568.11***	312766.60**	1014.24***	138477.01
	(165.47)	(495781.75)	(219.16)	(168179.33)	(134.35)	(129195.72)	(213.03)	(196919.31)
twex	0.01	-1036.66	-0.35	455.84	-0.28	-390.17	-0.25	-210.79
	(0.39)	(708.92)	(0.46)	(363.53)	(0.26)	(269.27)	(0.50)	(347.65)
tobinq	-32.58***	15772.80	-63.15***	703.92	-27.44***	2463.47	-50.44***	-5063.03
	(11.97)	(25947.04)	(17.70)	(18485.67)	(10.31)	(20165.80)	(18.64)	(19358.33)
ptb	14.92***	-13021.63	12.35*	8215.28	4.09	-6124.70	15.72**	5664.58
	(4.78)	(9723.65)	(7.05)	(6733.82)	(4.11)	(6979.08)	(7.65)	(8091.99)
epu	0.20***	-30.20	0.09	58.45	0.06	30.47	0.17**	38.98
	(0.05)	(77.63)	(0.06)	(47.77)	(0.04)	(36.54)	(0.07)	(39.96)
cfnai	3.45*	-2000.16	10.71***	1583.27	4.92***	2705.41	4.43*	1561.14
	(1.76)	(3005.59)	(2.39)	(2028.35)	(1.55)	(1997.53)	(2.44)	(1669.23)
mprime	-6.13***	11002.13*	-4.19*	2981.16	-2.19	1319.42	-5.22**	1932.18
	(1.80)	(6396.27)	(2.44)	(2114.67)	(1.52)	(1536.19)	(2.58)	(2016.83)
eps	1.37**	-2064.75	0.64	-461.12	0.18	27.92	2.05**	-633.13
	(0.60)	(1294.03)	(0.81)	(883.59)	(0.66)	(579.74)	(0.97)	(509.62)
lnm2	-82.03	97082.65	130.16	-95815.27	-31.79	-38439.47	36.87	-124033.05*
	(118.02)	(104635.72)	(157.27)	(96310.36)	(97.80)	(96648.64)	(167.88)	(74297.47)
_cons	-5985.14***	4167680.96	-9697.13***	-15090.72	-4793.92***	-2295237.56*	-9408.55***	-198530.98
	(1754.55)	(4355140.21)	(2340.89)	(1730458.14)	(1421.21)	(1204424.59)	(2242.28)	(1741272.47)
N	216							
adj. R^2	0.876	0.014	0.829	0.134	0.800	0.062	0.919	0.203
X	Included							

Notes: Robust standard errors in parentheses; * $p < .1$, ** $p < .05$, *** $p < .01$; Dickey-Fuller tests revealed stationarity for all dependent variables; Analysis for the value of target firms in the Energy sector was excluded due to a lack of data for this sector. *Source*: See Table 1.

Table 9: F Statistic for Identical Coefficients by Firm Region

	mnum	mval
regu	1.28	0.11
tcu	0.12	2.13*
lnngdpi	3.14**	3.67**
twex	0.43	1.42
tobinq	1.95	0.16
ptb	1.43	1.43
epu	4.53***	0.29
cfnai	5.00***	0.52
mprime	1.88	2.21*
eps	2.52*	0.87
lnm2	1.77	0.58

Notes: * $p < .1$, ** $p < .05$, *** $p < .01$; the F Statistic is produced from a Wald test for differences in coefficients by firm region where H_0: $\beta_{j,i} = \beta_{j,n}$ and H_A: $\beta_{j,i} \neq \beta_{j,n}$ for firm regions i to n. *Source*: See Table 1.

Table 6 presents the results of our analysis by firm size for all of our determinants.[23] Analyzing merger determinants by target firm size quickly reveals a lack of homogeneity. Table 7 reveals that over half of the determinants differ significantly by firm size for either the number or value of monthly mergers. Specifically, Table 7 shows that total capacity utilization, Tobin's Q, price-to-book, economic policy uncertainty, the interest rate, and the money supply all differ in their effect on mergers by firm size.

Table 8 presents the general results of the analysis by target region.[24] Similar to Table 6, the results of Table 8 reveal a lack of homogeneity and a resulting lack of robustness of the full model by firm region. This lack of homogeneity is quantified in Table 9, which shows that over half of the determinants differ significantly by firm region in either number or

[23]See Section 3.2 for definitions of firm size.
[24]See Section 3.2 for definitions of firm regions.

value. Specifically, total capacity utilization, GDP, economic policy uncertainty, the Chicago Fed National Activity Index, the interest rate, and earnings per share all posses differing impacts on mergers and acquisitions for firms located in differing regions.

Table 10: Target Merger Model by Sector, part 1

	Communications		Consumer		Energy	
	mnum	mval	mnum	mval	mnum	mval
regu	-1.49	-577.92	1.38	326.90	0.35	–
	(0.91)	(703.15)	(1.26)	(576.28)	(0.28)	–
tcu	6.86***	3048.41**	2.50	-2656.20*	0.10	–
	(1.21)	(1356.00)	(2.22)	(1373.76)	(0.54)	–
lngdpi	-1329.16***	-939220.28**	3.19	504208.93**	17.63	–
	(244.34)	(440467.31)	(362.66)	(226191.52)	(98.41)	–
twex	2.12***	-666.54	0.26	-322.10	0.23	–
	(0.50)	(558.60)	(0.74)	(418.68)	(0.19)	–
tobinq	40.36	32038.47	-58.27**	-24566.26	-8.05	–
	(26.48)	(27423.93)	(28.88)	(19807.40)	(7.05)	–
ptb	22.59**	-4739.19	-3.47	7606.28	0.27	–
	(11.08)	(8778.24)	(11.67)	(6497.85)	(2.59)	–
epu	0.30***	-59.41	0.32**	99.10**	0.03	–
	(0.06)	(74.05)	(0.13)	(47.72)	(0.03)	–
cfnai	-9.44***	-3451.07	2.09	5373.48**	1.71*	–
	(2.88)	(3014.76)	(4.44)	(2659.77)	(0.99)	–
mprime	12.13***	12560.31**	6.48	2289.58	1.55	–
	(3.33)	(5589.56)	(4.14)	(2271.20)	(1.19)	–
eps	2.86***	-1787.06*	5.11***	20.03	0.91***	–
	(0.96)	(1008.47)	(1.44)	(648.16)	(0.31)	–
lnm2	232.09	-101905.15	252.55	125185.85	97.89	–
	(142.99)	(114436.63)	(314.99)	(114876.84)	(82.20)	–
_cons	9068.01***	9095644.10**	-2418.94	-5394672.44***	-1019.35	–
	(2491.07)	(3822223.06)	(4314.62)	(2043335.42)	(1153.54)	–
N	216					–
adj. R^2	0.695	0.112	0.863	0.211	0.746	–
X	Included					

Notes: Robust standard errors in parentheses; * $p < .1$, ** $p < .05$, *** $p < .01$; Dickey-Fuller tests revealed stationarity for all dependent variables; Analysis for the value of target firms in the Energy sector was excluded due to a lack of data for this sector. *Source*: See Table 1.

Finally, Tables 10 and 11 display the results of our analysis for each of the sectors independently.[25] It is apparent from our results that merger determinants vary significantly

[25]See Section 3.2 for definitions of firm sectors.

by firm sector. Table 12 quantifies the statistical significance of these differences, revealing that only two determinants—federal regulatory enforcement and the money supply—do not differ significantly by target firm sector. All other determinants differ significantly at the 5% or less level for either the number or value of mergers.

Table 11: Target Merger Model by Sector, part 2

	Financial		Industrial		Technology	
	mnum	mval	mnum	mval	mnum	mval
regu	1.26	279.35	0.06	-49.71	-0.42	416.71*
	(0.83)	(743.99)	(0.56)	(175.78)	(0.64)	(246.68)
tcu	-0.67	-388.85	0.65	240.14	0.36	-590.83**
	(1.31)	(1149.58)	(0.77)	(269.61)	(0.83)	(298.91)
lngdpi	455.70*	286332.18	6.17	2086.58	194.18	52794.23
	(263.60)	(217354.04)	(147.05)	(46077.19)	(163.73)	(51031.07)
twex	-0.47	-631.61	0.16	32.09	-0.01	-169.60
	(0.53)	(428.97)	(0.31)	(74.74)	(0.35)	(146.20)
tobinq	-17.64	6992.20	-25.82**	-3300.33	-13.93	-10046.34
	(20.88)	(24005.23)	(11.85)	(3963.61)	(14.94)	(6219.60)
ptb	-12.72	-17629.81	1.62	2265.15	4.84	4461.95
	(7.84)	(15361.22)	(4.55)	(1426.73)	(6.20)	(2739.97)
epu	-0.09	-30.67	0.09	10.60	0.16***	21.84
	(0.07)	(41.37)	(0.06)	(17.65)	(0.05)	(18.27)
cfnai	4.45	-497.29	-1.24	356.66	-0.33	545.45
	(2.78)	(1718.10)	(1.80)	(481.20)	(2.03)	(601.37)
mprime	0.82	2143.75	3.73*	290.34	1.60	589.41
	(3.11)	(2009.77)	(1.91)	(492.46)	(1.97)	(738.57)
eps	0.57	-883.88	1.87***	-217.97	1.42**	113.59
	(0.97)	(1117.66)	(0.56)	(210.52)	(0.63)	(202.21)
lnm2	89.18	-17836.63	184.32	-5606.30	296.66***	-60259.51
	(162.72)	(83866.98)	(136.73)	(38989.50)	(107.36)	(41871.54)
_cons	-4723.00*	-2273316.86	-1691.68	469.76	-4303.48**	69971.59
	(2569.92)	(1741547.81)	(1808.94)	(526146.45)	(1688.94)	(580434.29)
N	216					
adj. R^2	0.778	0.085	0.791	0.078	0.895	0.193
X	Included					

Notes: Robust standard errors in parentheses; * $p < .1$, ** $p < .05$, *** $p < .01$; Dickey-Fuller tests revealed stationarity for all dependent variables. *Source*: See Table 1.

The results of Tables 6 to 12 extend the findings of Tables 4 and 5 and reveal the need for more fine-grained analysis—analysis which captures the features of M&A activity

that are contingent on heterogeneities such as size, place, and sector. The variables that are significant for all mergers, columns 7 and 8 in Table 4, do not predict, with much success, M&As across firm size, region, or sector. These results are rather intuitive and suggest that treating firms of varying sizes, regions, and sectors alike, when analyzing merger activity, is simply naive. Furthermore, the results displayed in Figures 1 to 3 clearly demonstrate the regularity and significant magnitude of size-, region-, and sector-specific shocks. Our results suggest that a significantly more detailed analysis, that which properly controls for the heterogeneities we have outlined, is needed to better understand the true nature of M&A determinants.

Table 12: F Statistic for Identical Coefficients by Firm Sector

	mnum	mval
regu	1.76	0.84
tcu	6.48***	3.73***
lnngdpi	11.83***	6.13***
twex	4.79***	1.06
tobinq	2.88**	1.14
ptb	1.78	1.96*
epu	6.81***	1.12
cfnai	5.03***	1.63
mprime	3.72***	3.52***
eps	2.98**	1.17
lnm2	0.85	0.82

Notes: * $p < .1$, ** $p < .05$, *** $p < .01$; the F Statistic is produced from a Wald test for differences in coefficients by firm sector where H_0: $\beta_{j,i} = \beta_{j,n}$ and H_A: $\beta_{j,i} \neq \beta_{j,n}$ for firm sectors i to n. *Source*: See Table 1.

4 Conclusion

The restrictive assumptions of the Neoclassical, behavioral, and macro models have caused researchers operating within these respective paradigms to overlook crucial determinants of M&A activity. This failure has resulted in misleading coefficients that contain bias, affecting the sign, magnitude, and significance of estimates; every explanatory variable that we study is statistically significantly biased, in either the number or value of mergers, without the inclusion of competing theoretical variables.

Furthermore, an under-appreciation of heterogeneous determinants has lead to a "one-size-fits-all" approach that does not accurately model mergers and acquisitions. Demand for firms of one size are not necessarily representative of demand conditions for other firm sizes. Similarly, demand for firms also varies across geographic region and industry sector, though the magnitude of this variance is lower than that for firm size. Relatedly, our analysis demonstrates that size-, sector-, and geographic region-specific shocks also play a significant role in merger activity. These large heterogeneous shocks may help to explain the notoriously mysterious "merger waves."

Taken together, these findings highlight the lack of robustness inherent in any one of the three theoretical models. While the specific models used in this paper are unique, they mirror the unnecessarily restrictive models found in the extant literature, and in so doing, reveal significant weaknesses in those models. Additionally, our results caution against drawing strong conclusions regarding merger determinants from highly aggregated data. In order to accurately identify determinants of M&A, future research should be undertaken from a more holistic, yet fine-grained, perspective.

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