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STICKY COSTS AND ZOMBIE FIRMS: A UNIQUE APPROACH TO EXPLAINING DECLINING COST STICKINESS

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Abstract

This research paper investigates the phenomenon of "sticky cost behavior" among firms in response to changes in their revenue, specifically focusing on the decline of such behavior in US public companies and examining the impact of the increased presence of "zombie firms" in the economy. Sticky cost behavior refers to the asymmetric cost changes for a sales increase or decrease in traditional cost accounting theory. Recent research studies have found that when examining selling, general, and administrative (SGA) costs, sales revenue decreases result in a smaller change in SGA costs than when sales revenue increases. The study finds that zombie firms exhibit no significant cost stickiness, while non-zombie firms exhibit cost stickiness, leading to the conclusion that zombie firms' debt and related debt servicing costs constrain their ability to compete with non-zombie firms when facing similar circumstances of declining revenue. The sample is drawn from Compustat's annual combined industrial data bases spanning from 1997 to 2016, and the final sample consists of 18,851 firms over the 2006-2016 period. Results indicate that zombie firms are less likely to maintain SGA costs when revenues decline. This research paper is significant because prior studies examining the decline of the sticky cost phenomenon have focused on changes in cost structure and not on the changes in the firms' characteristics.

INTRODUCTION

The traditional cost accounting theory found in cost accounting textbooks classifies costs into fixed and variable components. On the one hand, a fixed cost does not change in total in a given period even with changes in the total sales volume. On the other hand, a variable cost increases in total for volume increases and decreases in total for volume decreases. In addition, the effect on total costs for volume increases (decreases) is symmetric, that is

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the total costs increase (decrease) by an amount that is equal in response to changes in volume of the same magnitude. This cost symmetry is evidenced by a simple example. Figure 1 provides a simple example of sales volume increases and decreases of the same magnitude and the effect on total costs. The effect is symmetric for volume changes of 4,500 units with total costs changing by $45,000 (see Figure 1).

FIGURE 1
EXAMPLE OF COST SYMMETRY BEHAVIOR

ASSUMPTIONS:
• 1 product sold
• Base level sales volume = 18,000 units
• Sales price = $20/unit
• Variable cost per unit = $10/unit
• Total fixed costs = $100,000
PANEL A: Profit for Base Level Sales Volume (18,000 units)
Profit = Sales − Total Variable Costs − Total Fixed Costs
Profit = (18,000x20) − (18,000x10) − 100,000
Profit = 360,000 − 180,000 − 100,000
Profit = 80,000
□ Profit = $80,000; Total Revenues = $360,000; Total Costs = $280,000
PANEL B: Profit for a 25% Increase Over Base Level Sales Volume (22,500 units)
Profit = Sales − Total Variable Costs − Total Fixed Costs
Profit = (22,500x20) − (22,500x10) − 100,000
Profit = 450,000 − 225,000 − 100,000
Profit = 125,000
□ Profit = $125,000; Total Revenues = $450,000; Total Costs = $325,000
PANEL C: Profit for a 25% Decrease Under Base Level Sales Volume (13,500 units)
Profit = Sales − Total Variable Costs − Total Fixed Costs
Profit = (13,500x20) − (13,500x10) − 100,000
Profit = 270,000 − 135,000 − 100,000
Profit = 35,000
□ Profit = $35,000; Total Revenues = $270,000; Total Costs = $235,000
SUMMARY:
• Change from 18,000 to 22,500 units:
o Increase in sales volume = 25%

o Increase in total revenues = $90,000
o Increase in total costs = $45,000
• Change from 18,000 to 13,500 units:
o Decrease in sales volume = 25%
o Decrease in total revenues = $90,000
o Decrease in total costs = $45,000
CONCLUSION: Changes in total costs are symmetric for sales volume increases and decreases of the same magnitude.

Initial academic accounting research in the application of the traditional cost accounting model disputes the cost symmetry phenomenon (i.e., Anderson et al., 2003). Specifically, the Anderson et al. (2003) research study focuses on selling, general, and administrative (SGA) costs because these costs are related to sales and constitute a significant portion of many companies' total expenses. In a seminal study, they find that SGA costs display asymmetric behavior when responding to increases and decreases in revenue of the same magnitude. That is, SGA costs increase more when revenue increases by a certain magnitude than when SGA costs decline in response to a revenue decline of the same magnitude. This "stickiness" in SGA costs when revenues decline covered the 1979 to 1998 period in the Anderson et al. (2003) study.

Research after the Anderson et al. (2003) study find a decline in cost stickiness with U.S. public companies. These studies focus on cost structure and not on the firms' characteristics (e.g., Anderson and Lanen, 2007; Balakrishnan et al., 2014). The purpose of this research paper is to examine the decline in cost stickiness from another perspective, by examining the impact of the increased presence of "zombie firms" in the economy. Zombie firms are characterized by high debt levels and the related excessive debt servicing costs. Specifically, a firm is identified as a zombie when it has 10 consecutive years of operating earnings and an interest coverage ratio less than 1 for 3 consecutive years. The interest coverage ratio is defined as the times interest earned ratio [i.e., (Net Income + Interest Expense +Income Tax Expense) / Interest Expense]. This definition of a zombie firm is used extensively in studies sponsored by the Organization for Economic Co-Operation and Development (OECD) and allows for comparisons across international jurisdictions (see McGowan et al. 2017, p. 15).

Results show that zombie firms' SGA costs are not sticky, implying zombie firms cut SGA costs when revenues decline to avoid falling into bankruptcy. This conclusion supports the view that zombie firms' debt and the related debt servicing costs constrain their ability to compete with non-zombie firms when facing similar circumstances of declining revenues. The contribution of this research study is important because prior studies examining the decline of the sticky cost phenomenon focus on changes in cost structure and not on the changes in the firms' characteristics. That is, once a firm becomes classified as a zombie, it reacts differently to declines in sales volume and does not seek to maintain short-term SGA costs.

This research paper is organized as follows:

- Literature review − cost stickiness and zombie firms;
- Research design and methodology; • Results; and
- Conclusion.

LITERATURE REVIEW

Cost Stickiness

Insights into the characteristics of SGA costs are important because these costs are a primary determinant of a firm's earnings (e.g., advertising expenditures). Predicting a firm's earnings is central in determining its market

value. In addition, improving the understanding of SGA costs should lead to more accurate earnings' forecasts and a greater ability to detect earnings management with respect to changes in SGA costs.

The traditional cost accounting model that assumes the symmetry of changes in costs in response to increasing or decreasing changes in sales of the same magnitude is not realistic when empirically tested. Anderson et al. (2003) tests the belief by examining the movement of SGA costs in conjunction with changes in sales. Over the sample period from 1979 to 1998, they find SGA costs change more with a 1% increase in sales than with a 1% decrease in sales. This finding leads to the conclusion that SGA costs change by a greater percentage with volume increases than with volume decreases.

Anderson et al. (2003) provides several reasons for the cost stickiness. First, SGA costs include "adjustment costs" that are incurred to remove committed resources when volume declines. For example, labor costs are not entirely variable with declines in sales volume because labor laws or union contracts require employers to pay severance packages. Also, employee layoffs could lead to lower morale for the remaining employees resulting in lower productivity. Thus, employers have an incentive not to reduce the workforce. Next, if the sales decline is believed to be temporary, then employers may decide to retain employees because of excessive costs to train new hires when sales recover. Finally, if their reporting unit is downsized, then managers may suffer reputational loss (i.e., loss of status). Thus, managers have an incentive to delay such downsizing. Overall, Anderson et al. (2003) provides legitimate reasons for the presence of sticky cost behavior.

The cost stickiness phenomenon is not restricted to U.S. based firms. He et al. (2010) finds that Japanese firms exhibit sticky SGA costs. Other studies find evidence of SGA cost stickiness in a variety of countries such as Mexico (Reynoso et al., 2021) and Egypt (Ibrahim and Ezat, 2017). These results suggest that managements' decision-making processes to asymmetrically reduce SGA costs in the short-run in the wake of declining revenues are applicable over a variety of profit-oriented business operations in different jurisdictions. Other studies support the sticky cost phenomenon based on the SGA/Sales ratio's association with future firm performance. Anderson et al. (2007) partitions their sample by changes in revenues (i.e., revenue increasing and revenue decreasing) to determine whether the SGA ratio (i.e., SGA costs / sales) signals future firm performance (i.e., either positive or negative). They find that future earnings are positively associated with an increase in the SGA ratio during a period when revenues decline supports the sticky cost phenomenon.

Johnson (2016) examines the informativeness of the SGA ratio as a predictor of future performance and extends the Anderson et al. (2007) study by partitioning firms into one of six sub-samples that represent all the combinations for changes in sales, SGA costs, and the SGA ratio. For example, sub-sample 1 represents an increase in sales, an increase in SGA costs, and a decline in the SGA ratio. The decline in the SGA ratio means sales are rising faster than the SGA costs. Johnson (2016) finds that changes in the SGA ratio signal future performance in four of the six sub-samples, including two that support the sticky cost effect.

Another aspect of the cost stickiness literature stream concerns the cost structure of SGA expenses. Specifically, certain SGA costs may be stickier because managers are unable to alter these costs in the short run. That is, these costs are inherently stickier. For example, Shust and Weiss (2014) find operating expenses inclusive of depreciation expense are significantly more sticky than operating expenses before depreciation expense. This finding suggests that compliance under generally accepted accounting principles (GAAP) constrain managers in exercising their discretion to reduce expenses when sales decline. Further, this finding supports the view that prior period fixed asset acquisition decisions result in current period depreciation expenses and increase the level of cost stickiness in the current period.

Balakrishnan et al. (2014) examine the relation between cost structure and sticky costs. Similar to the results of Shust and Weiss (2014), they find that the cost structure obscures the results usually attributed to cost stickiness. The authors suggest that the existence of fixed costs biases finding toward a negative value for the β_2 coefficient (see model 1) in the Anderson et al. (2003) research model. A negative value for the β_2 coefficient is critical to interpreting the research model's results for the presence of sticky costs. In addition, large firms are expected to employ a higher percentage of fixed costs in their cost structure to take advantage of economies of scale. Fixed costs would represent a smaller percentage of sales for larger firms and if the proportion of sales decline observations is negatively correlated with firm size, then the cost stickiness models could show a spurious result of cost stickiness (Balakrishnan et al., 2014). Overall, Balakrishnan et al. (2014) do not find a consistent pattern of cost stickiness over time.

Banker and Byzalov (2014) extend the Anderson et al. (2003) sample period by 10 years by examining firm-level data for the 1988 to 2008 period. The authors identify an interesting consideration involving cost stickiness, that is, not all costs are sticky and costs that exhibit stickiness are not always sticky. Rather, the degree of stickiness varies across cost accounts, firms, industries, countries, and time periods.

Anderson and Lanen (2007) reexamine the Anderson et al. (2003) paper and argue that the cost stickiness phenomenon cannot be applied to all costs (e.g., advertising and research and development costs) under the similar managerial discretion of SGA costs. That is, managerial reaction to a sales decline is to cut advertising and research and development costs by an even greater proportion (p. 12, Anderson and Lanen, 2007). Also, the authors provide results of the degree of cost stickiness by year for the period 1979 to 2004. They find that the degree of cost stickiness declined in recent years, even reversing for the years 2001, 2002, and 2003 (Table 5, p. 36, Anderson and Lanen, 2007). These results when coupled with the findings of Banker and Byzalov (2014) and Balakrishnan et al. (2014) suggest cost stickiness is not applicable throughout all time periods and for all cost categories.

Overall, the results of these studies show that evidence of cost stickiness exists in foreign countries. In addition, in more recent studies (e.g., Anderson and Lanen, 2007; Balakrishnan et al., 2014), the findings suggest that changes in the firms' cost structure over time may change the degree of cost stickiness found in the original Anderson et al. (2003) study. However, none of these studies suggest that an important firm's classification (zombie vs. non-zombie firm) may also change over time and result in changes in cost stickiness. Taken together, these literature streams showcase the gaps in explaining the declining cost stickiness phenomenon in the U.S. since the original Anderson et al. (2003) study. This study takes a unique approach by classifying firms into zombie and non-zombie firm categories to explain the overall decline in cost stickiness in the U.S. public companies.

Zombie Firms

The emergence of zombie firms is established by the economic events occurring in Japan and the western economies over the past 30 years. First, Japan endured a severe economic crisis during the 1990s.

The banks' response to this crisis was to extend credit to financially troubled firms. The banks extended credit to these firms because of the extensive ties between the banks and business firms in Japan (i.e., "keiretsu group"). A keiretsu group is "a group of firms with business ties cemented with extensive crosshareholding and interlocking boards of directors and centered around a major bank," (Peek and Rosengren, 2005). By extending credit to financially troubled firms, Japanese banks also weakened their financial position and capital ratios. Saddled with debt, the troubled firms became zombie firms. Caballero et al. (2008) find that the presence of zombie firms in the Japanese economy widens the productivity gap between productive firms and non-productive

firms. Barriers are created preventing the unproductive zombie firms to exit and the more productive firms to enter the economy, resulting in low economic growth and lagging productivity.

The second event is recent and pertains to the western developed countries (e.g., western European countries such as Italy and North American countries such as Canada and the United States). McGowan et al. (2017) discuss how the low productivity zombie firms congest markets and increases the difficulty for more productive firms to enter markets. Zombie firms represent a significant share of public companies across the western economies. Banerjee and Hofmann (2018) state that 12% of non-financial publicly traded firms are zombies in Australia, Belgium, Canada, Denmark, France, Germany, Italy, Japan, the Netherlands, Spain, Sweden, Switzerland, the United Kingdom, and the United States. In Canada, a Deloitte study finds 16% of Canadian publicly traded companies are zombies (McLeod, 2018).

Research into the causes of the zombie phenomenon focus on the weak financial sector in Europe and world-wide low interest rates. On the one hand, the Japanese experience provides evidence of banks propping up weak non-financial firms through the keiretsu group effect. On the other hand, in the western European economies, the banking sector was weakened by the 2008 financial crisis to such an extent that the public questioned the viability of many European banks. The European Central Bank applied a stress test to European banks and found 130 banks failed the test, a failure rate approximating 20% (Onaran, 2017). Whereas the U.S. banks recapitalized after the 2008 crisis due to increased regulation (i.e., DoddFrank Wall Street Reform and Consumer Protection Act, 2010), European banks continue to sit on inactive loans and support non-productive businesses. Onaran (2017) estimates that $1 trillion of dud loans exist on the books of European banks.

The major negative impact of continuously supporting zombie firms is that economic resources can be employed elsewhere more productively, that is productive investments are crowded out by maintaining investments in the zombie firms (Banerjee and Hofmann, 2018; Andrews et al, 2017). Banerjee and Hofmann (2018) substantiate this “zombie congestion” and find non-zombie firms are characterized by greater investments and higher employment growth.

Banerjee and Hofmann (2018) suggest that a low interest rate environment encourages lenders not to clean up their balance sheets by writing off non-performing loans. Furthermore, zombie firms may be incentivized to take greater risks because of the western governments’ low interest rate monetary policies.

The greater risk-taking is evidenced by the zombie firms’ increasing debts and lack of adequate returns on their investments. Thus, the combination of low interest rates, greater risk appetite by zombie firms, and weak banks has created more zombie firms or prolonged their existence.

RESEARCH DESIGN AND METHODOLOGY

The findings from the earlier research into sticky SGA costs provide evidence that SGA costs exhibit asymmetric cost behavior that is SGA costs change by a greater percentage with volume increases than with volume decreases (i.e., Anderson et al., 2003). Academic research performed since the seminal Anderson et al. (2003) study find similar results in foreign jurisdictions (e.g., He et al., 2010; Reynoso et al., 2021), but more recent U.S. based studies find a diminishing asymmetric cost effect with respect to SGA costs (e.g., Anderson and Lanen, 2007). Further, studies try to clarify the conditions of asymmetric

SGA cost behavior by examining cost structure (e.g., Banker and Byzalov, 2014; Balakrishnan et al., 2014; Shust and Weiss, 2014). These studies focus on the characteristics of the SGA costs and not the characteristics of the firm and how a firm’s characteristics can change over time. This study takes an alternative approach by focusing on a particular characteristic of the firm, that is whether the firm is classified as a zombie firm or not.

A firm is classified as a zombie if it operates for at least 10 consecutive years with operating earnings and has an interest coverage ratio less than 1 for 3 consecutive years. The interest coverage ratio is defined as the times interest earned ratio [i.e., (Net Income + Interest Expense +Income Tax Expense) / Interest Expense]. This definition of a zombie firm has been used in studies (e.g., McGowan et al. 2017, p. 15) sponsored by the OECD. This research study adopts the view that once a company becomes a zombie firm, then it will react in a different manner than a non-zombie firm when faced with declining sales volume. Since the zombie firms' presence in the economy has increased, then distinguishing between zombie and non-zombie firms can shed light on the asymmetric SGA costs' phenomenon.

Classifying firms into the mutually exclusive categories of zombie and non-zombie firms is the first step in testing for the extent of association between zombie firms and SGA cost stickiness. The classification results in two samples, one consisting entirely of zombie firms and the other consisting entirely of non-zombie firms. The next step is to test each sample for cost stickiness using the model employed in Anderson et al. (2003).

The first hypothesis considers the impact of zombie firms and that these firms are less likely to exhibit the sticky cost behavior. A zombie firm's focus will be on survival when sales decline given its high debt level and interest charges. A zombie firm will place a greater emphasis on avoiding bankruptcy than a nonzombie firm. The typical method for a firm to address a potential bankruptcy situation is to cut costs in the short term, especially discretionary costs that are categorized as SGA expenses (e.g., advertising expense).

Thus, a zombie firm is less likely to possess sticky SGA costs than a non-zombie firm. Hypothesis 1 reworks the Anderson et al. (2003) first hypothesis and is stated as:

***H_1**: The relative magnitude of an increase in SGA costs for an increase in sales revenue is greater than the relative magnitude of a decrease in SGA costs for a decrease in sales revenue, for non-zombie firms only.*

A difference in the SGA cost behavior between non-zombie and zombie firms suggests that there are other differences between the two categories of firms. These differences are evident by the differences in key financial ratios. The key financial ratios focus on the profit margin, asset turnover, and debt-to-assets ratios. These ratios are described below:

- Profit Margin = Net Income / Total Revenues
- Asset Turnover = Total Revenues / Average Assets
- Debt-to-Asset Ratio = Total Debt / Average Assets

Lower profit margin, lower asset turnover, and higher debt to assets are indicative of "Weaker Financial Indicators."

Hypothesis 2 is stated as follows:

***H_2**: Zombie firms display weaker financial indicators than non-zombie firms.*

H_1 employs the research model first adopted by Anderson et al. (2003). This model as presented in Anderson et al. (2003) is:

$$\text{Log}\left[SGA_{i,t} / SGA_{i,t-1}\right] = \beta_0 + \beta_1 \log\left[REVENUE_{i,t} / REVENUE_{i,t-1}\right] + \beta_2 * DECREASE\_DUMMY_{i,t} * \log\left[REVENUE_{i,t} / REVENUE_{i,t-1}\right] + \varepsilon_{i,t} \quad (1)$$

where: $SGA_{i,t} / SGA_{i,t-1}$ = the dependent variable, the firm's selling, general, and administrative costs at time t divided by its selling, general, and administrative costs at time t - 1;

$REVENUE_{i,t} / REVENUE_{i,t-1}$ = the firm's revenues at time t divided by its revenues at time t - 1; and

$DECREASE\_DUMMY_{i,t}$ = an indicator variable, equal 1 when revenues decrease between periods t -1 and t, otherwise equal 0.

This loglinear model is used extensively to test the cost stickiness phenomenon (e.g., Anderson et al., 2003; Banker and Byzalov, 2014; He et al., 2010). Anderson et al. (2003, p.52) choose the loglinear specification rather than a linear regression model because of improved comparability across firms and lower heteroskedasticity. The presence of sticky costs in non-zombie firms would result in $\beta_1 > 0$ and $\beta_2 <$

0. As a result, a non-significant β_2 co-efficient supports H_1 indicating zombie firms' SGA costs are not sticky when revenues decline.

For H_2, the zombie firms' presence in the population of public companies is expected to have a negative impact on the profit margin, asset turnover, and debt-to-assets financial ratios. The procedure to test H_2 is described below:

1. For each year, calculate the zombie firms' median for each financial ratio in the zombie firms' sample.
2. For each year, calculate the non-zombie firms' median for each financial ratio in the nonzombie firms' sample.
3. Calculate the means of the medians for the zombie and non-zombie firms' samples for each financial ratio.
4. Calculate the difference in means between the zombie and non-zombie firms' samples for each financial ratio.
5. Test the difference in means for statistical significance (i.e., two-tail test).

Using the medians for each financial ratio in steps 1 and 2 reduces the impact of outliers and skewness affecting the results. The difference in means test captures the difference in key financial measures between the zombie and non-zombie firms. The expectation is that the zombie firms will possess weaker financial ratios. The overall financial weakness of zombie firms means that these firms are less likely to maintain SGA costs when revenues decline. Thus, zombie firms are not expected to possess sticky SGA costs with declining revenues.

RESULTS

The sample is drawn from Compustat's annual combined industrial data bases. Data collection spans the 1997 to 2016 period because 10 years of data are required to categorize the zombie firms beginning with 2006. The sample period covers 2006 to 2016. Beginning with 78,221 firms, the final sample consists of 18,851firms over the 2006 to 2016 period (see Table 1 for details). Classifying the firms into zombie and non-zombie firm categories results in 2,676 zombie firms and 16,175 non-zombie firms over the 2006 to 2016 period (see Table 2). Zombie firms represent approximately 16% (2016) of the total firms in recent years with a peak of 16.44% in 2015. The SAS statistical software is used to generate the results.

H_1 and model 1 address the sticky cost phenomenon for zombie and non-zombie firms. Evidence of sticky costs in this model occurs when the coefficients $\beta_1 > 0$ and $\beta_2 < 0$ and both are statistically significant. Anderson et al. (2003) results support the sticky cost phenomenon. That is, SGA costs increase by a greater amount for a given magnitude of higher revenues than when SGA costs decline by a revenue decline of the same magnitude.

Table 3, Panel A shows the results for model 1 for the non-zombie firms. Coefficient β_1 is positive and significant whereas coefficient β_2 is negative and significant. From the results, the conclusion is that nonzombie firms exhibit sticky cost behavior.

TABLE 1

SAMPLE SIZE AFTER DATA CLEANSING

Year	No. of Firms Raw Data	No. of Firms after Removing Missing OIAD	No. of Firms after Removing Firms without 10 Consecutive Years of Data	No. of Firms after Removing Firms without Interest Coverage Ratio	No. of Firms after Removing Firms with Non-Positive SGA and Revenues	No. of Firms after Removing Financial Institutions
2006	5,253	4,443	2,389	1,960	1,450	1,397
2007	5,768	4,572	2,576	2,085	1,550	1,488
2008	6,002	4,702	2,708	2,212	1,630	1,560
2009	6,314	4,858	2,805	2,313	1,715	1,639
2010	6,752	5,127	2,897	2,378	1,757	1,682
2011	7,304	5,437	2,978	2,449	1,883	1,725
2012	7,782	5,925	3,046	2,514	1,943	1,773
2013	8,097	6,294	3,477	2,935	2,353	1,826
2014	8,277	6,390	3,562	3,036	2,453	1,900
2015	8,378	6,364	3,589	3,079	2,490	1,922
2016	8,294	6,103	3,590	3,091	2,512	1,939
Totals	78,221	60,215	33,617	28,052	21,736	18,851

TABLE 2
CLASSIFYING ZOMBIE AND NON-ZOMBIE FIRMS

	No. of Firms	No. of Zombie Firms	% of Zombie Firms	No. of Non-Zombie Firms	% of Non-Zombie Firms
2006	1,397	159	11.38%	1,238	88.62%
2007	1,488	169	11.36%	1,319	88.64%
2008	1,560	198	12.69%	1,362	87.31%
2009	1,639	246	15.01%	1,393	84.99%
2010	1,682	254	15.10%	1,428	84.90%
2011	1,725	240	13.91%	1,485	86.09%
2012	1,773	230	12.97%	1,543	87.03%
2013	1,826	264	14.46%	1,562	85.54%
2014	1,900	298	15.68%	1,602	84.32%
2015	1,922	316	16.44%	1,606	83.56%
2016	1,939	302	15.58%	1,637	84.42%
Totals	18,851	2,676		16,175	

Further, the sum of the β_1 and β_2 coefficients equal 0.38324 (0.46942 − 0.08618) meaning a 1% decrease in sales revenues result in a 0.38324% decrease in SGA costs. This result is similar to the result across all firms found by Anderson et al. (2003, p. 54) with $\beta_1 + \beta_2 = 0.3545$. In addition, these results suggest that the zombie firms'

presence in the economy has increased from the Anderson et al. (2003) study (i.e., 1979 to 1998) to the period covered by this study (i.e., 2006 to 2016).

For the zombie firms, the results for model 1 are presented in Table 3, Panel B. Coefficients β_1 (significant and positive) and β_2 (not significant and negative) support the conclusion that zombie firms do not possess sticky SGA costs. These results suggest that the greater presence of zombie firms in the economy does impact the sticky cost phenomenon as zombie firms are less likely to exhibit sticky cost behavior. Overall, the declining sticky cost effect over time can be explained by the increasing percentage of zombie firms present in the economy

TABLE 3

REGRESSION RESULTS FOR MODEL 1

PANEL A − Non-Zombie Firms Only (n = 16,175)

$$\log [SGA_{i,t} / SGA_{i,t-1}] = \beta_0 + \beta_1 \log [REVENUE_{i,t} / REVENUE_{i,t-1}] + \beta_2 * DECREASE\_DUMMY_{i,t} * \log [REVENUE_{i,t} / REVENUE_{i,t-1}] + \varepsilon_{i,t} \quad (1)$$

Parameters	df	β	SE(β)	t Value	Pr > |t|
Intercept	1	0.01064	0.00069	15.34	<.0001
$\log [REVENUE_{i,t} / REVENUE_{i,t-1}]$	1	0.46942	0.00774	60.66	<.0001
$DECREASE\_DUMMY_{i,t} * \log [REVENUE_{i,t} / REVENUE_{i,t-1}]$	1	-0.08618	0.01168	-7.38	<.0001

$R^2 = 0.3206$
Adjusted $R^2 = 0.3206$

PANEL B − Zombie Firms Only (n =2,676)

$$\log [SGA_{i,t} / SGA_{i,t-1}] = \beta_0 + \beta_1 \log [REVENUE_{i,t} / REVENUE_{i,t-1}] + \beta_2 * DECREASE\_DUMMY_{i,t} * \log [REVENUE_{i,t} / REVENUE_{i,t-1}] + \varepsilon_{i,t} \quad (1)$$

Parameters	df	β	SE(β)	t Value	Pr > |t|
Intercept	1	-0.01383	0.00289	-4.78	<.0001
$\log [REVENUE_{i,t} / REVENUE_{i,t-1}]$	1	0.18233	0.01395	13.07	<.0001
$DECREASE\_DUMMY_{i,t} * \log [REVENUE_{i,t} / REVENUE_{i,t-1}]$	1	-0.00889	0.02135	-0.42	0.6773

$R^2 = 0.1264$
Adjusted $R^2 = 0.1258$

where: $SGA_{i,t} / SGA_{i,t-1}$ = the dependent variable, the firm's selling, general, and administrative costs at time t divided by its selling, general, and administrative costs at time t - 1;

$REVENUE_{i,t} / REVENUE_{i,t-1}$ = the firm's revenues at time t divided by its revenues at time t - 1; and

$DECREASE\_DUMMY_{i,t}$ = an indicator variable, equal 1 when revenues decrease between periods t -1 and t, otherwise equal 0.

H_2 compares zombie and non-zombie firms on the key financial ratios of profit margin, asset turnover, and debt-to-assets. The expectation is that the zombie firms display weakness on each ratio. That is, zombie firms display lower profit margins, lower asset turnover, and higher debt-to-assets. H_2 is tested with a difference in means test. Table 4 provides the descriptive statistics (i.e., mean and standard deviation) for each financial ratio by zombie and non-zombie firms. On average, zombie firms perform poorly when compared to the non-zombie firms as expected (i.e., lower profit margin, lower asset turnover, and higher debt-to-assets ratios). Table 5, Panels A and B show the median profit margin, asset turnover, and debt-to-assets ratios for the zombie and non-zombie firms, respectively. Over the 2006 tom 2016 period, zombie firms operate at a loss each year as evidenced by the negative median earnings each year. Also, zombie firms' median asset turnover ratio is lower than the median asset turnover ratio for non-zombie firms each year. Finally, zombie firms carry a greater percentage of debt versus non-zombie firms as evidenced by the higher debt-to-assets ratios from 2006 to 2016.

In addition, zombie firms are much smaller than non-zombie firms in terms of asset size (see Table 4). The mean asset size of zombie firms over the 2006 to 2016 period is $1,860.23 million versus $11,334.02 million for non-zombie firms. This finding suggests that non-zombie firms may be inclined to take greater advantage of economies of scale because of their larger size. However, zombie firms greater debt-to-assets ratio (see Table 4, Panel A; mean = 5.462) when compared to non-zombie firms (see Table 4, Panel B; mean = 1.003) suggests zombie firms are not employing the higher debt effectively given the zombie firms' lower profit margins and lower asset turnover.

When testing for statistically significant differences, the zombie firms are significantly weaker than non-zombie firms on each financial ratio (see Tables 6 to 8). For the profit margin measure, the zombie firms' mean of the median profit margins is -0.2316 versus 0.0484 for the non-zombie firms (see Table 6). The difference in means is statistically significant. Further, the zombie firms' median profit margins are negative for every year from 2006 to 2016 (see Table 5). Similarly, zombie firms show weaker efficient deployment of their assets as evidenced by the lower asset turnover ratios and weaker financial position as evidenced by the greater debt-to-assets ratios for every year from 2006 to 2016 (see Table 5). The differences on these measures are statistically significant for the two groups. The results for the financial measures suggest that zombie firms will display a greater sensitivity to reduce SGA costs when revenues decline because further declines in sales may lead to bankruptcy. The significance of the H_2 results is that firms displaying significant financial weaknesses on the three ratios will possess a higher likelihood of being classified as a zombie firm and a lower likelihood of reporting sticky SGA costs. The failure to maintain important SGA costs (e.g., advertising expenditures) when revenues decline may put a zombie firm in such financial difficulty that the likelihood of bankruptcy increases substantially. A non-zombie firm without the financial pressures of low profit margins, low asset turnover, and high debt-to-assets ratios possesses a greater likelihood of maintaining critical SGA costs when revenues decline. A logical extension of this study is to examine a potential link between zombie firms, non-sticky SGA costs, and the bankruptcy prediction of zombie firms.

In conjunction with the prior studies analyzing the firms' cost structure to explain the decline in cost stickiness in the U.S. (e.g., Balakrishnan et al., 2014; Banker and Byzalov, 2014), an explanation to be investigated is a negative correlation between a firm's fixed cost structure and their categorization as a zombie firm. For example, this study shows that zombie firms as measured by average total assets (see Table 4) are smaller than non-zombie firms. Zombie firms may be less inclined to employ an economies of scale strategy and would possess lower fixed costs. With lower fixed costs, then a zombie firm's SGA costs would likely be less sticky.

An interesting sidenote from examining Table 5, Panel B is the declining median asset turnover ratios of non-zombie firms over the 2006 to 2016 period (i.e., from 2006: 1.0997 to 2016: 0.8268). This result suggests lower productivity among firms in the overall economy that is not attributable to the greater presence of zombie firms. A thorough analysis of this result is beyond the scope of this research study but warrants further investigation.

TABLE 4
DESCRIPTIVE STATISTICS-KEY FINANCIAL RATIOS
PANEL A: Zombie Firms (n=2,676)

Variable	Mean	Standard Deviation
Profit Margin	-10.501	138.886
Asset Turnover	1.096	1.370
Total Debt to Average Total Assets	5.462	70.298
Average Total Assets (millions $)	$1,860.23	$10,132.61

PANEL B: Non-Zombie Firms (n= 16,175)

Variable	Mean	Standard Deviation
Profit Margin	0.112	9.442
Asset Turnover	1.175	0.961
Total Debt to Average Total Assets	1.003	25.355
Average Total Assets (millions $)	$11,334.02	$36,898.73

Notes: Profit margin = Net Income / Total Revenues
Asset Turnover = Total Revenues / Average Total Assets
Debt-to-Assets = Total Debt / Average Total Assets

TABLE 5
MEDIAN PROFIT MARGIN, ASSET TURNOVER, AND DEBT-TO-ASSETS RATIIOS
PANEL A: Zombie Firms

Year	Total # of Firms	Median Profit Margin	Median Asset Turnover	Median Debt-toAssets
2006	159	-0.2673	0.7953	0.7217
2007	169	-0.2905	0.8827	0.7130
2008	198	-0.3424	0.8034	0.7765
2009	246	-0.2664	0.7191	0.7018
2010	254	-0.1369	0.8161	0.6359

2011	240	-0.1812	0.7790	0.7031
2012	230	-0.2432	0.7994	0.7885
2013	264	-0.1945	0.8512	0.7175
2014	298	-0.1761	0.8005	0.7233
2015	316	-0.2342	0.7732	0.7026
2016	302	-0.2148	0.6983	0.6980
Total Firms	2,676			
Mean		-0.2316	0.7926	0.7165

PANEL B: Non-Zombie Firms

Year	Total # of Firms	Median Profit Margin	Median Asset Turnover	Median Debt-toAssets
2006	1,238	0.0544	1.0997	0.5070
2007	1,319	0.0551	1.0334	0.5137
2008	1,362	0.0399	1.0309	0.5375
2009	1,393	0.0360	0.9414	0.5132
2010	1,428	0.0544	0.9738	0.5107
2011	1,485	0.0523	1.0071	0.5195
2012	1,543	0.0481	0.9391	0.5296
2013	1,562	0.0503	0.9055	0.5187
2014	1,602	0.0495	0.8869	0.5359
2015	1,606	0.0458	0.8461	0.5496
2016	1,637	0.0467	0.8268	0.5581
Total Firms	16,175			
Mean		0.0484	0.9537	0.5267

Notes: Profit margin = Net Income / Total Revenues

Asset Turnover = Total Revenues / Average Total Assets Debt-to-Assets = Total Debt / Average Total Assets

TABLE 6

PROFIT MARGIN □

DIFFERENCE IN MEANS BETWEEN ZOMBIE AND NON-ZOMBIE FIRMS

	Non-Zombie Firms	Zombie Firms
Mean	0.0484	-0.2316
Variance	3.8047E-05	0.0035
Observations	11	11
Pearson Correlation	0.4536	
Hypothesized Mean Difference	0	
df	10	
t Stat	16.4905	

P(T<=t) two-tail	1.40024E-08	
t Critical two-tail	2.228	

The "Mean" represents the mean for the median profit margins over the 11-year period 2006 to 2016, each for the zombie firms sample (n = 2,676) and non-zombie firms sample (n = 16,175).

Conclusion: The two tailed test suggests that the difference in means is statistically significant with the zombie firms sample possessing lower profit margin.

TABLE 7

ASSET TURNOVER □

DIFFERENCE IN MEANS BETWEEN ZOMBIE AND NON-ZOMBIE FIRMS

	Non-Zombie Firms	Zombie Firms
Mean	0.9537	0.7926
Variance	7.1722E-03	2.7199E-03
Observations	11	11
Pearson Correlation	0.4452	
Hypothesized Mean Difference	0	
df	10	
t Stat	6.9234	
P(T<=t) two-tail	4.0766E-05	
t Critical two-tail	2.228	

The "Mean" represents the mean for the median asset turnover ratios over the 11-year period 2006 to 2016, each for the zombie firms sample (n = 2,676) and non-zombie firms sample (n = 16,175).

Conclusion: The two tailed test suggests that the difference in means is statistically significant, with the zombie firms sample possessing lower asset turnover.

TABLE 8

DEBT-TO-ASSETS RATIO □

DIFFERENCE IN MEANS BETWEEN ZOMBIE AND NON-ZOMBIE FIRMS

	Non-Zombie Firms	Zombie Firms
Mean	0.5267	0.7165
Variance	2.8276E-04	1.6292E-03
Observations	11	11
Pearson Correlation	0.2265	
Hypothesized Mean Difference	0	
df	10	
t Stat	-15.7211	
P(T<=t) two-tail	2.2249E-08	
t Critical two-tail	2.2281	

The "Mean" represents the mean for the median debt-to-assets ratios over the 11-year period 2006 to 2016, each for the zombie firms sample (n = 2,676) and non-zombie firms sample (n = 16,175).

Conclusion: The two tailed test suggests that the difference in means is statistically significant, with the zombie firms sample possessing higher debt-to-assets.

CONCLUSION

This research paper synthesizes the research of zombie firms and sticky costs. Zombie firms are defined as performing for at least 10 consecutive years with operating income and have an interest coverage ratio less than 1 for 3 consecutive years. Prior research shows zombie firms are detrimental to the overall economy because of lagging productivity and the crowding out of more productive investment opportunities (e.g., Banerjee and Hofmann, 2018). The sticky cost phenomenon unravels the cost accounting principle of costs and volume moving symmetrically. Anderson et al. (2003) finds with respect to selling, general, and administrative (SGA) costs that SGA costs change by a greater percentage with volume increases than with volume decreases. Recent research suggests a declining sticky cost effect for U.S. public companies or the sticky cost effect can only be found with particular controls for cost structure (e.g., Anderson and Lanen, 2007; Balakrishnan et al., 2014). This study's findings show classifying firms into zombie and non-zombie categories results in sticky SGA costs for non-zombie firms only. That is, zombie firms do not display sticky cost behavior when revenues decline. This result supports the view that zombie firms are constrained by their debt servicing costs and are unable to compete with non-zombie firms that face a similar situation of declining revenues. Also, the zombie firms' smaller size as measured by average total assets may suggest zombie firms are less likely to take advantage of economies of scale and would thus possess a lower percentage of fixed SGA costs. With lower fixed costs, then zombie firms' SGA costs would be less sticky. These findings suggest that studies finding evidence of the sticky SGA cost phenomenon should not be limited to cost structure considerations but should also consider the firms' characteristics such as the nonzombie vs. zombie firm classification employed in this study. In addition, when examining a management's decision-making process with respect to declining sales and how to manage SGA costs, the distinction between a zombie and non-zombie firm may be the deciding factor on whether a particular cost is drastically cut or not in the short run. The adjustment costs that are incurred to remove committed resources when sales decline may be a less relevant factor to zombie firms.

Also, the link between zombie firms and non-sticky SGA costs should be investigated further to test for associations with bankruptcy. That is, are zombie firms with non-sticky SGA costs more likely to fail?

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