# Supply and Demand of Information Influencing Firm Valuation

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*"Accounting represents firm information economics" is a premise for the allocation of scarce resources. Here, the analysis starts with a clean surplus model as the conceptual framework. Then, the theoretical firm information pertaining to the economic supply-and-demand features are incorporated within a path diagram. This framework is investigated empirically with simultaneous regression equations and a structural equation model (SEM). Both approaches have explanatory power. Also, a latent variable measure of internally generated intangible assets positively and significantly affects net income. Sensitivity subsamples investigate size and risk factors for robustness. Thus, this study expands the SEM financial accounting research frontier.*

*Keywords: information economics, SEM, intangible assets*

## INTRODUCTION

A central firm economic principle is that investors and management want to understand where to allocate scarce resources. This precept motivates this current study analysis of the supply and demand of information economics in the explanation of firm worth. Over the past several decades, academic research has evolved and adopted positive accounting theory originated by Watts and Zimmerman (1978) and Watts and Zimmerman (1986), which endeavors to explain "actual" accounting information economics. Here, the theoretical development will begin with the well-known clean surplus (Feltham & Ohlson, 1995) concept, which hypothesizes the market value as a function of three factors: 1) beginning book value adjusted for goodwill, 2) goodwill, and 3) net income which are available from the financial statements (Berk & DeMarzo, 2020). Then, additional information economic features are added to the clean-surplus core concept to capture the larger set of "actual" factors impacting firm value (Barney, 2014). Specifically, this research design includes analyst forecasts and a latent variable for internally-generated intangible value (Lev, Radhakrishnan, & Evans, 2016). The summary theoretical design incorporates information economics in a path flow diagram of internal firm factors and external industry factors, which both affect firm valuation. The motivation for this study is the creation of a vehicle that future research can build upon by adding or modifying components to the path diagram.

For model purposes of demonstration and robustness, two empirical methodologies are employed. The first approach is a simultaneous regression system, where the dependent variables are: 1) firm market value, and 2) net income (Berk & DeMarzo, 2020). Positive goodwill represents the intangible value of an

external acquisition, in which the amount of the consideration exceeds the net fair value of the acquired entity. Internally generated intangible asset factors are computed from a principal component analysis (Jolliffe, 2012). Net income is hypothesized to be driven by a set of variables that include implied intangible factors.

The second methodology is a structural equation model (SEM). The findings indicate significant effects (at conventional levels) upon the market value for the internally-generated intangible assets (Lev & Sougiannis, 1996). This line of research becomes challenging, because data internally-generated from intangible asset in arms-length exchanges (Barney, 1996) is nonexistent. In other words, internally-generated intangible assets are difficult to codify (Kogut & Zander, 1992); (Conner & Prahalad, 1996). Therefore, this study's exploratory analysis assumes that internally-generated asset values will have to be implied with a latent variable in the structural equation modelling (Schreiber, Stage, King, Nora, & Barlow, 2006). This previously unaddressed latent variable approach represents a contribution of the study (Pindyck & Rubinfeld, 1992).

The study is organized into six sections. Section 1 is the introduction, and Section 2 is the literature review of prior research. Section 3 creates the theoretical development, five research questions and five hypotheses. Section 4 explains the empirical research design and procedures. Section 5 presents the statistical findings, and section 6 summarizes the conclusions.

## LITERATURE REVIEW

### Conceptual Framework

Accounting information economics is based upon positivism and the grounded theory literature. Watts and Zimmerman (1986) initiated positive theory as an alternative to normative theory for the generation of standards. Subsequent positive accounting work (Scott, 2014) has focused upon decision-making usefulness of accounting information for determining firm value.

After the introduction of positive[1] accounting theory (Watts & Zimmerman, 1978, 1986), extensive research has been completed, which addresses a wide range of concepts that explain and predict firm value. Most of this research can be put in a *nexus of contracts* perspective, however not all of it, because firm management may not have direct interaction with some forms of market information. In order to place an overall framework on this accounting research, the concept of "grounded research" will be considered. The grounded theory concept is the systematic application of methodology to research situations (Martin & Turner, 1986); (Ralph et al., 2015). The grounded theory (Martin & Turner, 1986; Ralph et al., 2015) facilitates qualitative as well as quantitative research. Positivism (Comte & Bridges, 2009) also has a fundamental basis in grounded theory, and therefore, links it to the positive accounting theory for purposes of the current analysis. These theoretical concepts enable the current research study to incorporate a set of factors (which are discussed in the next section) that drive firm valuation.

### General Model Background

As previously described, positive and grounded theory (Ralph et al., 2015; Martin & Turner, 1986) will permit the big-picture perspective of how firm value is generated for decision-making purposes by stakeholders (investors and creditors). Traditionally, firm asset value is the sum of the discounted value of the applicable cash flows (Rajan, 2012). With regards to firm value, (Feltham & Ohlson, 1995), the Modigliani-Miller (1958) Theorem theorizes that it does not matter how the firm capital structure (market value of equity and debt) is financed (Fama &French, 1993). This traditional framework is based upon an arms-length Pacioli (Brown, 2014) double-entry bookkeeping system. In addition, there has been one paradigm shift in accounting from historical cost to fair value. In summary (up to the most recent times), this general approach represents the means to identify firm value for investors from accounting information.

Accounting information represents the economics of the firm for decision-making purposes, and therefore, it is appropriate to consider changes in the economic circumstances. Considering the premise is that firms transform resources (assets) into greater value as perceived by investors. In the previous

century, the transformation process was applied primarily in physical manufacturing. In a value chain, firms acquired inventory, made products and sold the goods to consumers. More recently, several changes have occurred in the firm economics. The service sector has developed and become larger than the manufacturing sectors. Even, the manufacturing value chain has embedded service attributes, which sell and maintain the products.

Innovation represents a key feature of the aforementioned economic change. How can research measure the innovation economics, so that investors/management can determine firm market value? This question is where intangible assets become part of a firm's value framework. The simplest example of an intangible asset is goodwill. As a matter of generally accepted accounting principles (GAAP), the accounting conceptual framework needs a measure (i.e., goodwill) to describe situations, where one entity would purchase another for more consideration than the identifiable fair value of the acquisition's accounts, in order to identify the firm's intangible value.

Whereas, positive goodwill is a measure of intangible asset creation from an external transaction, conservatism precludes any generation of internal intangible assets (Ball, Kothari, & Nikolaev, 2013). For example, when a firm conducts research and development (R&D) activities, this R&D expenditure amount is expensed in the current period (US GAAP codification ASC 730), except for specific conditions, where R&D is deemed technologically feasible. The GAAP logic is that the value of R&D expense is uncertain, and therefore, should not be capitalized in financial statements. However, R&D value may be identified and capitalized, when an entity is purchased. In that acquisition situation, in-process R&D activities represent an identifiable intangible asset value. Obviously, this purchased R&D intangible value did suddenly appear out of nowhere (Penman, 2009). Thus, there is a motivation for this study to apply statistical methodology, in order to improve the assessment of firm internally-generated intangible value, which is potentially useful to determine firm valuations (Szewczyk, Gesetsekos, & Zantout, 2014; Anagnostopoulou, 2008; Peters & Taylor, 2017).

More recently, there have been investigations into firm economics indicating that internal intangible asset capital factors are influencing both management behavior and investor valuations. As another research motivation, the amount of dollars involved may be huge. For example, Leonard Nakamura, an economist at the Federal Reserve Bank of Philadelphia, suggests that cumulatively, all the U.S. companies could have established more than $8 trillion in intangible assets, which is nearly half of the combined $17.9 trillion market capitalization of the S&P 500 index (Amonga, 2016). However, internal intangible information may not be fully disclosed due to GAAP treatment. Specifically, the internal intangible asset analyses can be broadly classified in terms of four factors: customer, organizational, human and R&D capital. Next, the literature review of prior studies covers further detail of these topics.

**Specific Intangible Asset Factors**

Prior research has posited that firm value derives from the customers, which is considered as a source and (Belo, Lin & Vitorino, 2013; Vitorino, 2014) creates a production function, in which advertising expense is an independent variable. Drozd and Nosal (2012) develop a customer capital model from the international markets theory.

Lev et al. (2016) point to the existence of organizational capital by noting that some companies are more competitive, than others in any given industry. They create a historical development and analyze measures of organizational capital. Organization capital has a long history (Prescott & Visscher, 1980). More recently, Bloom, Satun and Van Reenan (2016) advance the idea of human capital with a paper on management as a technology. They hypothesize a firm production function, in which management is one of the independent variables.

R&D capital has been the subject of considerable prior research (see (Anagnostopoulou, 2008) for a literature review). Recently, Warusawitharana (2016) designs a production-function-based R&D capital model that indicates the firm value and profitability are a result of R&D activities and expenditures. He argues that innovation is a consequence of R&D, and it is the innovations that drive positive firm behavior. Thus, his article is consistent with the framework (Rajan, 2012) that was identified at the beginning of this section.

Return on assets is included as a driver of intangible value (Arthur, 1996). Information technology is an increasingly intangible asset that contributes to firm value (Saunders & Brynjolfsson, 2015). The logic is also that service firms, in particular, have smaller asset bases, and there should be a relation of return on assets and intangible asset value, which generates net income (Feng &Baruch, 2011).

In summary, the literature points toward an economic impact of internally-generated intangible assets. However, the nature of intangible asset characteristics, used by both management and investors, remains an open area of research.

**Summary of Empirical Analysis**

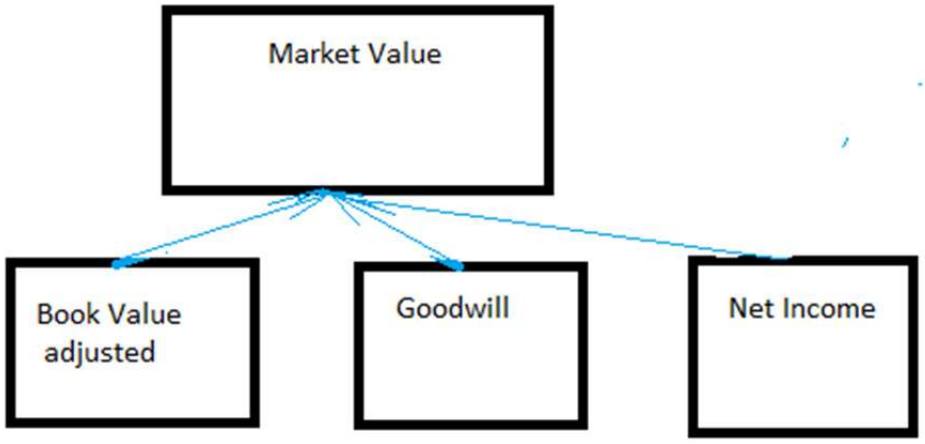
During the development time of this current study, structural equation analysis should be described as a relatively new and open area of financial market research. Hinson and Utke (2019) discuss empirical formulation issues and characterize alternative approaches. They characterize empirical techniques that consist of the following: multiple regression, principal component analysis (Jolliffe, 2012), partial least squares, SEM (Hinson & Utke, 2019; Schreiber et al., 2006) and path analysis. This approach included in the current work is a blend, where the overall theoretical design incorporates intangible asset latent information in a variable (Feng & Baruch, 2011; Amonga, 2016). Then, the intangible variable and tangible asset information, along with external firm factors, are analyzed with both regression and path analysis.

## RESEARCH DESIGN

**Structural Equation Model Path Diagram Based on Information Economics**

Figure 1a presents the conceptual core of the structural equation model. The Ohlson clean surplus relation represents the underlying research design premise. This logical framework is well established in that the external security market values should be representing a firm's accounting financial statement information (Feltham & Ohlson, 1995). Because this structural equation model (Hinson & Utke, 2019; Schreiber et al., 2006) focuses upon tangible and intangible value, the analysis decomposes the beginning book value into the intangible asset goodwill and other book value. In the current study's formulation, a dependent variable is market value, although analyses with the enterprise value, in which the sum of market value plus firm debt (Rajan, 2012; Berk & DeMarzo, 2020) generated similar findings. The current study presents market value, which is the more established Ohlson clean surplus accounting information variable. It is anticipated that goodwill as purchased intangible asset will have a significant effect on firm value.

**FIGURE 1A**
**CLEAN SURPLUS INFORMATION ECONOMICS PATH DIAGRAM**



With the clean surplus (Feltham & Ohlson, 1995) relation anchoring the analysis, the approach will be a stepwise addition of factors shown in Figure 1, which is developed from a conceptual core. Figure 1b presents the tangible assets (Feng & Baruch, 2011) resources, which are theorized to be drivers of net income. Total assets represent the base resource value that will generate net income and the log of the total assets is taken under the presumption of diminishing returns. New capital assets are included, because they should indicate an expansion of the firm's ability to generate net income. The square of the capital assets is included under the assumption that management will incur a declining marginal value with each additional dollar of expenditure. Risk can be hypothesized as a fundamental aspect of all business activities that create net income (Lyle et al. 2013). Therefore, the firm beta derived from the market value will be considered as an interaction term with market value for net income driver.

**FIGURE 1B**
**TANGIBLE ASSET DRIVERS OF NET INCOME**

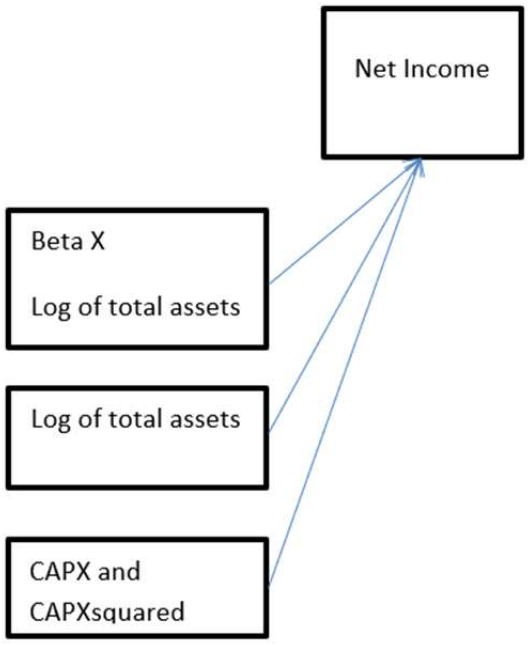



Figure 1c presents intangible assets impact upon net income. The intangible asset is a latent variable, of which its components were previously discussed in the literature review of prior studies. The use of factors to explain firm value has been previously established by Fama and French (1993) and Fama and French (2015). In this study, the approach will take variables of interest that are suppositions from internal intangible asset generation theory. Then, the creation of principal components (Jolliffe, 2012) will be applied empirically. Note that principal components have been utilized in the interest swap finance literature (Darbyshire & Hamish, 2016). Principal components are predictive measures of intangible asset information in this study's firm value equation framework, specifically on net income. This approach is consistent with Penman (2009), who argues that the income statement is the place where intangible asset effects impact net income.

The presentation of the set of hypothesized intangible asset variables follows in no particular order. The first variable is the ratio of advertising expense divided by revenue. As mentioned in the literature review, Vitorino (2014) and Belo et al. (2014) find that advertising brand value associates with firm value. The difference between past works and the present analysis is that this current study incorporates the advertising expense as an impact on accounting net income. This study is proposing that advertising products and services can enhance a firm's earnings power, which will be evidenced on the income

statement bottom line (Penman, 2009). There is a presumption that management will take steps with intangible factors to increase net income. Also, investors will monitor and consider the factors in the price earnings (PE) determination.

The second variable is selling, general and administrative (SG&A)[2] expense divided by revenue. This variable represents the effect of human capital on firm net income (Feng & Baruch, 2011). The third value driver is R&D expense (Jones, 1995; Ball, Kothari and Nikolaev, 2013). Wooldridge (1988) finds R&D activities generate a positive market response (Coccia, 2009). There is a presumption that expenditures on innovations have a diminishing return to scale, and therefore, a R&D squared term is included. The last variable is the return on assets, ROA, which represents the income effect of the yield on the assets of the firm.

**FIGURE 1C**
**INTANGIBLE ASSET DRIVERS OF NET INCOME**

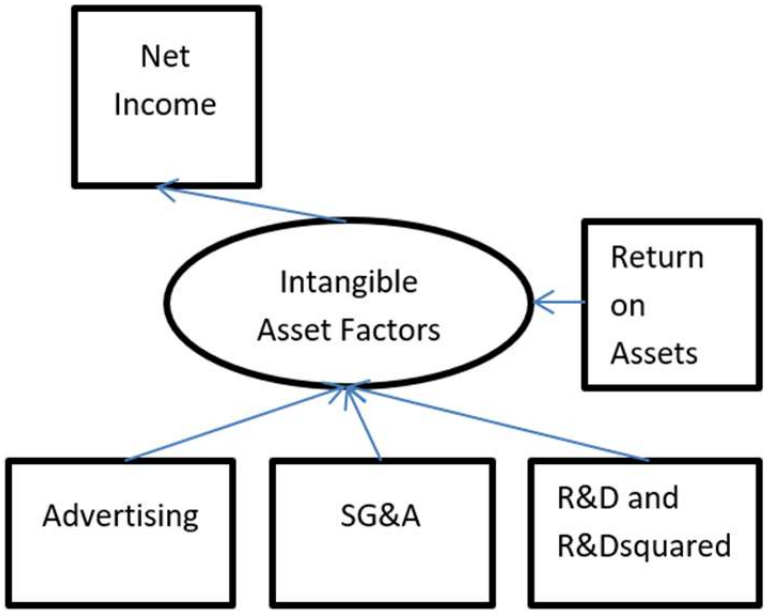



Figure 1d covers the external variables to the firm. External agents to the firm will provide information that will potentially impact firm market value in the clean surplus relation (Feng & Baruch, 2011). For example in publicly traded firms, auditors will render an opinion (clean or otherwise) that investors will utilize in stock pricing (Fama & French, 1993). Financial analysts give buy, sell and hold recommendations. These analysts use financial statement ratio information. Analysts' reporting is an important source that investors consider in their firm valuation. In this study, the Bloomberg "Buy," "Sell," and "Hold" ratings ascribe value to the firm market price (Hirshleifer, 1958). Also, financial statement ratios are used to assess firm value. This feature is subjective, and therefore, a factor analysis is performed and utilized. The quality of the information is important to firm valuations by investors. Therefore, auditor opinion is incorporated, because "clean opinion" reports can be relied upon by investors, where auditor qualified opinions cast doubt on firm financial position, cash flow and net income.

**FIGURE 1D**
**EXTERNAL SOURCES' INFORMATION ECONOMICS COMPONENTS**

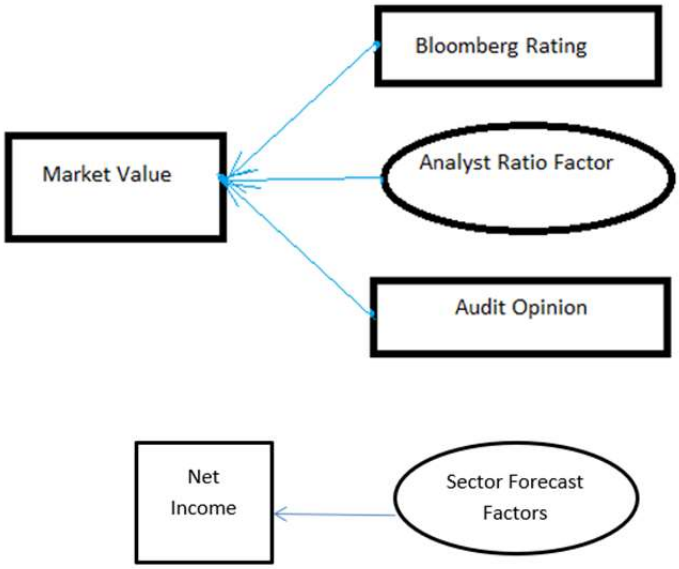
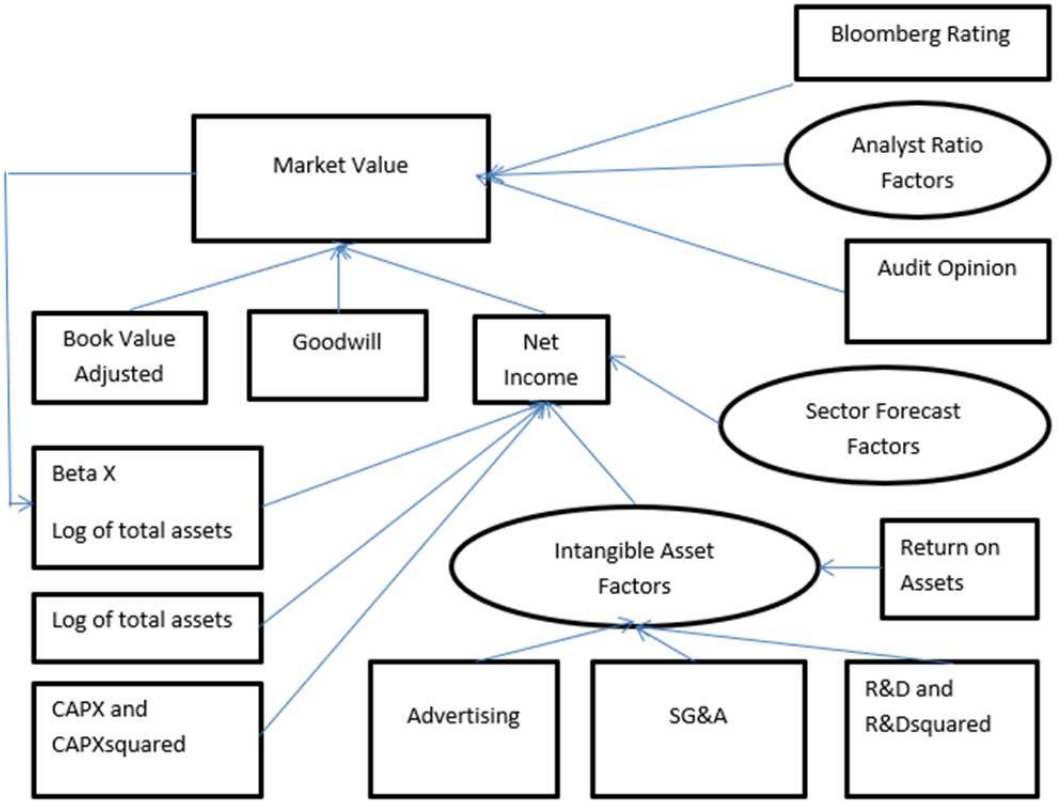



Figure 2 summarizes the Figure 1 components.

**FIGURE 2**
**INFORMATION ECONOMICS PATH (SEM) DIAGRAM**



**Research Questions**

The literature and theory sections motivate the five research questions of the study. 1) Are internal tangible assets drivers of net income? 2) What is the internally-generated intangible asset impact (if it exists?) for firm valuation analyses? This second question is an open issue, and therefore, no prediction will be made about their significance or the direction of their effect. 3) Do factors to external firms, such as analyst ratings, commonly used ratios and audit opinions, impact firm value? 4) Do industry forecasts impact net income? 5) Does a structural equation system provide accounting information economics explanatory power? An articulation of the hypotheses follows:

***H1a:*** *Tangible assets significantly impact firm net income.*

***H2a:*** *Internally developed intangible assets significantly impact firm net income.*

***H3a:*** *Factors external to a company significantly impact firm value.*

***H4a:*** *Industry forecasts significantly impact firm net income.*

***H5a:*** *Structural equation systems provide significant accounting information economics explanatory power.*

## EMPIRICAL PROCEDURES

As previously discussed, firm information economics have supply and demand features. The independent variables defining the features are typically described as endogenous (e.g. size), of which some of these variables are dependent in nature (e.g. firm market value). This study investigates information economics (see Figure 2) using two methodologies for purposes of comparison, robustness and addressing latent variable characteristics. In the first methodology, the simultaneous regression system approach will utilize two equations. In the first simultaneous regression equation, the dependent variable will be market value of the clean surplus relation (Feltham & Ohlson, 1995). Net income will be the dependent variable of the second simultaneous regression equation.

The second approach is a structural equation system (SEM) analysis (Hinson &Utke, 2019; Schreiber et al., 2006), which begins with a path diagram formulation based on Figure 2. As discussed, the initial assumption will be that one does not know what constitutes internally-generated firm intangible assets. Therefore, the SEM will include a latent variable for an internally-generated intangible asset value, which makes the SEM design unique and potentially worthwhile. In both methodologies, the design works from a clean surplus firm (Feltham & Ohlson, 1995) value framework of Figure 2. In each case, the research objective will be to identify driving factors of firm value and relevant variables.

**Simultaneous Equation Regressions**

The first regression equation (1) is based upon the clean surplus formulation (Feltham & Ohlson, 1995). Control indicator variables are also included, in order to address the year by year differences and industry dummy effects. RatioF1 and RatioF2 are generated by a factor analysis (details are available upon request) of ratios used by analysts (See Appendix for ratio descriptions). Three factors > 1, but 2 and 3 are similar, and therefore, only 2 are used. Equation (1) follows:

$$\begin{aligned} MValue = {} & A_0 + A_1*BVadjt\text{-}1 + A_2*GW + A_3*NI + A_4*CAudit + A_5*Buy + A_6*Hold + A_7*Sell \\ & + A_8*RatioF1 + A_9*RatioF2 + e \end{aligned} \quad (1)$$

where:

MValue = Market Value,
BVadjt-1 = Beginning Book Value less Goodwill,

GW = Goodwill,
NI = Net Income,
CAudit = Clean Audit Opinion =1 otherwise 0,
Buy = Buy Rating =1 otherwise 0,
Hold = Hold Rating =1 otherwise 0,
Sell = Sell Rating =1 otherwise 0,
RatioF1 = Financial Ratios Factor 1,
RatioF2 = Financial Ratios Factor 2, and
e = Error.
$A_0$, $A_1$, $A_2$, $A_3$, $A_4$, $A_5$, $A_6$, $A_7$, $A_8$, and $A_9$ are regression coefficients.

Equation (2) is a break-out of drivers of net income, which are assets-in-place and growth option[3]. The log of total assets represents both the effect of assets-in-place and proxies for a size effect. A risk factor (Berk & DeMarzo, 2020) for investor-expected return may affect net income and is captured in equation (2) by an interaction term of Beta times the log of total assets. CAudit is an indicator variable of 1 for clean audit and zero otherwise. Buy, Hold and Sell represent Bloomberg recommendations. Capital expenditures are growth options upon the tangible assets. Tangible capital expenditures are presumed to have increasing or (decreasing) returns to scale as expressed by capital expenditure squared (Hirshleifer, 1958). RatioF1 and RatioF2 are generated from a factor analysis of firm ratios (details are available upon request). Industry forecasts are selected from consumer staples, industrial, and information technologies representing the three most influential segments[4]. Equation (2) is:

$$NI = B_0 + B_1*TAL + B_2*TALBeta + B_3*CAPX + B_4*CAPX2 + B_5*IntanF1 + B_6*IntanF2 + B_7*N2 + B_8*N6 + B_9*N7 + e \quad (2)$$

where:
NI = Net Income,
TAL = Log of Total Assets (book value),
TALBeta = Firm Beta times Log of Total Assets (book value),
CAPX = Capital Expenditure,
CAPX2 = CAPX Squared,
F1 = Financial Ratio Factor 1,
F2 = Financial Ratio Factor 2,
N2, N6, N7 = Industry Segment Earnings Forecasts (by SIC), and
e = Error.
$B_0$, $B_1$, $B_2$, $B_3$, $B_4$, $B_5$, $B_6$, $B_7$, $B_8$, and $B_9$ are regression coefficients.

**SEM Empirical Development**

SEM (Hinson & Utke, 2019; Schreiber et al., 2006) is comprised of measurement model variables (e.g. book value assets) and constructs (e.g., firm market value, net income and internally generated intangible asset value). In order to test hypotheses with SEM, we utilize the aforementioned firm value model shown in Figure 2.

In this current study, firm value is modelled as a causal function of internally-generated intangible value. The literature review has covered these factors. In Figure 2, an internally-generated intangible asset (Feng & Baruch, 2011; Penman, 2009) value is in an "oval" shape, which indicates a latent variable (i.e., not known explicitly) that represents a factor function of other variables such as R&D (Jones, 1995), SG&A (Vitorino, 2014), advertising and return on assets (Coccia, 2009). In order to investigate the internally-generated intangible value, the study analyzes a firm market value structural equation model.

## EMPIRICAL WORK

### Sample Description

The sample comes from 2010 through 2014, which is an economic expansion period, where internally-generated intangible assets (Penman, 2009; Feng & Baruch, 2011) appear to indicate greater importance (Feng & Baruch, 2011). The sample excludes financial intermediary firms (SIC code from 6000 to 6999), due to their extensive regulations and leverage characteristics. Also, their market value is not likely to be similarly impacted by R&D and tangible asset investments as are other firms in the economy.

The sample distribution by one-digit SIC code is shown in Table 1. As Table 1 indicates, most firms are manufacturing (i.e. about 70 percent) from SIC 2 and 3. This composition should not be surprising, because R&D is a required variable (Jones, 1995). Table 2 presents the descriptive statistics of the variable utilized in the system equations. Both the variable means and the standard deviations do not appear to be out of the ordinary. All variables utilized in the analyses are required to be present. Negative income less 5 standard deviations is winsorized out due to the big-bath potential. The balance sheet data of goodwill and adjusted stockholders' equity observations are winsorized at plus and minus 10 standard deviations, so as to minimize potential agency problems. The beta observations are winsorized at plus and minus 10 standard deviations to eliminate extreme capital asset pricing model situations. Extremely high leverage (above 10 standard deviations) is eliminated due to the prospect of unusual financing circumstances.

**TABLE 1**
**INDUSTRY STATISTIC (n = 2746)**

*Industry Statistics*

| Industry | Observations | Percent |
|---|---|---|
| 0 | 6 | 0.22 |
| 1 | 16 | 0.58 |
| 2 | 644 | 23.45 |
| 3 | 1695 | 61.73 |
| 4 | 50 | 1.82 |
| 5 | 44 | 1.60 |
| 7 | 235 | 8.56 |
| 8 | 56 | 2.04 |

Industry is one digit SIC.

**TABLE 2**
**DESCRIPTIVE STATISTICS OF 2,746 OBSERVATIONS**

| Variable | Mean | Std. Dev. | Minimum | Maximum |
|---|---|---|---|---|
| Mktval | 8292.18 | 26934.45 | 0.03 | 292702.94 |
| BV0adj | 1903.89 | 7264.00 | -15167.00 | 90446.00 |
| GW | 866.50 | 3738.32 | 0 | 57562.00 |
| NI | 484.93 | 1871.77 | -1017.31 | 23150.00 |
| TAL | 6.19 | 2.53 | -2.24 | 12.18 |
| Beta | 1.09 | 1.21 | -19.96 | 12.42 |
| RD | 290.21 | 1095.90 | -0.52 | 11537.00 |
| CAPX | 312.39 | 1349.20 | 0.00 | 18468.11 |
| PrdInfo | 0.03 | 0.09 | 0 | 2.95 |
| MgtInfo | 0.60 | 3.79 | 0.01 | 169.53 |
| ROA | -0.05 | 0.50 | -11.29 | 1.27 |

**A Summary of Hypotheses Findings**

The alternative hypotheses are generally significant with some detailed variations. Notably, the simultaneous equation and SEM (Hinson & Utke, 2019; Schreiber et al.,2006) have statistical significance. Another key finding is that latent intangible asset variables are drivers of net income. Hypothesis details are discussed in the following two sections.

**Simultaneous Regression Equation Findings**

Table 3 reports simultaneous regression findings for equation (1) and equation (2). Both the equations have respectable R squares for market research. All of the independent variables have t statistics that are acceptable at conventional levels. Firm ratio variables RatioF1 and RatioF2 negative coefficients are significant at conventional levels ($\alpha$=.01), which indicates a mitigating effect upon firm value. Only the Hold rating had a significant positive coefficient, which is consistent with good stable performance in the sample. In the interests of being concise, variable descriptions are listed in an Appendix.

With regards to tangible asset variables, the proxy for firm return of beta times size has a positive coefficient, which indicates that net income associates directly with a systematic risk and size interaction. Firms with higher capital expenditures exhibit higher net income. On the other hand, the negative coefficient for the squared CAPX suggests decreasing scale effects. With regards to internally generally intangible assets, the findings indicate that they do significantly impact net income in a positive manner. The findings indicate significant effects (at conventional levels) upon market value for purchased goodwill intangible assets.

**TABLE 3**
**SIMULTANEOUS REGRESSION EQUATIONS (n=2746)**

| | Clean Surplus | | Prospect Theory | |
|---|---|---|---|---|
| **Variables** | **MktValue (Eq. 1)** | **NI (Eq. 2)** | **MktValue (Eq. 1)** | **NI (Eq. 2)** |
| Intercept | -2208.26 | -203.47* | -3927.09& | -0.92* |
| $BVadj_{t-1}$ | 0.30* | | -159.60* | |
| $GW_t$ | 0.96* | | -605.75* | |
| $NI_t$ | 10.90* | | 710.42* | |
| CAudit | 1845.56* | | 3527.28* | |
| Rfactor1 | -426.52# | | -426.52# | |
| Rfactor2 | -415.86# | | -415.86# | |
| Buy | 576.82 | | 546.93 | |
| Hold | 1130.00# | | 1249.03# | |
| Sell | 850.32 | | 162.05 | |
| Tal | | 59.11* | | 0.27* |
| TalBeta | | 12.83* | | -0.01* |
| CAPX | | 0.73* | | -0.00* |
| CAPX2 | | -0.00* | | 0.00* |
| IntanF1 | | 1002.32* | | 0.02 |
| IntanF2 | | 233.61* | | -0.18* |
| N2 | | 129.36* | | -0.02# |
| N6 | | 8.52 | | -0.01 |
| N7 | | 19.72# | | -0.01 |
| Industrydummies | Included | | Included | |
| Year indicators | Included | Included | Included | Included |
| Adj. $R^2$ | .88 | .60 | .68 | .27 |

**SEM Results**

Hypothesized path relations from Figure 2 are calculated with SAS Proc Calis, and the results are shown in Table 4. The Standardardized RMR is 0.07 for the clean surplus formulation, which represents a good result of explanatory power. The prospect theory Standardardized RMR is approximately the same at 0.06 significance. The coefficient results are generally consistent with the previously discussed simultaneous equation regression findings, but there are design differences. In particular, the SEM (Schreiber et al., 2006) formulation has an internally-generated intangible asset latent variable that is a function of firm variables. As a variable, Intan has a positive significant effect upon net income, and the firm variables are significant as well as hypothesized as drivers of Intan variable.

**TABLE 4**
**SEM COVARIANCE STRUCTURE ANALYSIS: MAXIMUM LIKELIHOOD ESTIMATION**

**STANDARDIZED RESULTS FOR PATH LIST (n=2,746)**

| Path | | | Clean Surplus | t Value | Prospect Theory | t Value |
|---|---|---|---|---|---|---|
| **Mktvalf** | <=== | **cleanA** | 0.02969 | 57.67* | 0.05395 | 61.43* |
| **Mktvalf** | <=== | **Rfactor1** | -0.00210 | -0.29 | 0.01334 | 61.55* |
| **Mktvalf** | <=== | **Rfactor2** | -0.01934 | -2.63# | -0.02392 | -61.79* |
| **Mktvalf** | <=== | **BEV0adj** | 0.06933 | 7.51* | 0.38821 | 34.03* |
| **Mktvalf** | <=== | **GW** | 0.17166 | 20.59* | 0.55442 | 53.65* |
| **Mktvalf** | <=== | **NI** | 0.80632 | 129.3* | 0.03203 | 2.85* |
| **Mktvalf** | <=== | **IS** | 0.00802 | 57.78* | 0.00249 | 61.63* |
| **Mktvalf** | <=== | **IH** | 0.02638 | 57.88* | 0.02570 | 61.68* |
| **Mktvalf** | <=== | **IB** | 0.01944 | 57.82* | 0.01751 | 61.67* |
| **NI** | <=== | **TAL** | 0.07167 | 5.01* | 0.54141 | 30.76* |
| **NI** | <=== | **Talbeta** | -0.00100 | -0.08 | -0.04346 | -2.47# |
| **NI** | <=== | **CAPX** | 0.32651 | 24.57* | -0.06549 | -3.38* |
| **Intan** | <=== | **RD** | 0.60315 | 62.17* | 0.60315 | 62.17* |
| **Intan** | <=== | **ROA** | 0.02832 | 1.79& | 0.02832 | 1.79& |
| **Intan** | <=== | **PrdInfo** | 0.06166 | 64.26* | 0.06166 | 61.26* |
| **Intan** | <=== | **MgtInfo** | -0.03902 | -2.47* | -0.03902 | -2.47* |
| **NI** | <=== | **Intan** | 0.57379 | 55.60* | -0.05731 | NA |
| **NI** | <=== | **F2** | 0.01445 | 1.06 | 0.05544 | 2.92* |
| **NI** | <=== | **F6** | 0.01870 | 1.36 | 0.00467 | 0.24 |
| **NI** | <=== | **f7** | 0.06388 | 4.80* | -0.00136 | -0.07 |

**Sensitivity Analyses**

Does size (by market or book value) and/or risk matter? The market size subsamples analyses are shown in Tables 5 and 6. The subsample above the median generally has higher explanatory power for the regression equations. Most of the regression and path variables share similar significances. A notable regression finding exception is that the analyst recommendations are significant for the subsample below the median. However, the path analysis also has significance for the analyst recommendations.

**TABLE 5**
**SIMULTANEOUS REGRESSION EQUATIONS (n=2746)**

| Variables | Below Median MarketValue(n=1373) MktValue (Eq. 1) | NI (Eq. 2) | Above Median Market Value (n=1373) MktValue (Eq. 1) | NI (Eq. 2) |
|---|---|---|---|---|
| Intercept | -34.95& | -2.62* | -894.74 | -2472.94* |
| $BVadj_{t-1}$ | 0.43* | | 0.34* | |
| $GW_t$ | 0.97* | | 0.86* | |
| $NI_t$ | 0.82* | | 10.83* | |
| CAudit | 1.84 | | 3240.87* | |
| Rfactor1 | 2.92 | | -1313.79* | |
| Rfactor2 | -0.27 | | -220.16 | |
| Buy | 108.16* | | -1827.55 | |
| Hold | 97.08* | | -1535.60 | |
| Sell | 34.92* | | 77.41 | |
| Tal | | 1.59* | | 362.92* |
| TalBeta | | -0.37# | | 15.58* |
| CAPX | | -0.12 | | 0.38* |
| CAPX2 | | -0.00 | | -0.00* |
| IntanF1 | | 1.23 | | 1001.66* |
| IntanF2 | | -4.54* | | 911.95* |
| N2 | | 1.68# | | 185.38* |
| N6 | | -0.65 | | 30.52 |
| N7 | | -0.14 | | 40.81# |
| Industry dummies | Included | | Included | |
| Year indicators | Included | Included | Included | Included |
| Adj. $R^2$ | .49 | .04 | .87 | .61 |

**TABLE 6**
**SEM COVARIANCE STRUCTURE ANALYSIS: MAXIMUM LIKELIHOOD ESTIMATION STANDARDIZED RESULTS FOR PATH LIST OF MARKET VALUE SUBSAMPLES BELOW (N=1,373) AND ABOVE (N=1,373) THE MEDIAN**

| Path | | | Below Median | t Value | Above Median | t Value |
|---|---|---|---|---|---|---|
| **Mktvalf** | <=== | **cleanA** | 0.00050 | 0.03 | 0.04329 | 40.66* |
| **Mktvalf** | <=== | **Rfactor1** | 0.01789 | 0.93 | -0.01085 | -1.00 |
| **Mktvalf** | <=== | **Rfactor2** | 0.00053 | 0.03 | -0.01005 | -0.92 |
| **Mktvalf** | <=== | **BEV0adj** | 0.36381 | 18.40* | 0.06721 | 5.06* |
| **Mktvalf** | <=== | **GW** | 0.31789 | 16.63* | 0.16841 | 13.92* |
| **Mktvalf** | <=== | **NI** | 0.18245 | 9.59* | 0.80678 | 87.37* |
| **Mktvalf** | <=== | **IS** | 0.05028 | 2.52# | 0.00188 | 40.78* |
| **Mktvalf** | <=== | **IH** | 0.24760 | 10.79* | -0.01581 | -40.74* |
| **Mktvalf** | <=== | **IB** | 0.34680 | 15.41* | -0.02028 | -40.74* |
| **NI** | <=== | **TAL** | 0.06047 | 1.85& | 0.16804 | 7.59* |
| **NI** | <=== | **Talbeta** | -0.06748 | -2.16# | 0.00121 | 0.95 |
| **NI** | <=== | **CAPX** | -0.10107 | -3.45* | 0.28004 | 13.12* |
| **Intan** | <=== | **RD** | 0.29219 | 11.84* | 0.57415 | 39.41* |
| **Intan** | <=== | **ROA** | 0.07083 | 2.62* | -0.00068 | -43.62* |
| **Intan** | <=== | **PrdInfo** | 0.03107 | 0.91 | 0.27508 | 43.66* |
| **Intan** | <=== | **MgtInfo** | -0.03094 | -0.47* | -0.25325 | -11.28* |
| **NI** | <=== | **Intan** | 0.05099 | 1.88& | 0.52200 | 32.84* |
| **NI** | <=== | **F2** | 0.05612 | 1.91& | 0.02090 | 1.01 |
| **NI** | <=== | **F6** | -0.01245 | -0.41 | 0.03448 | 1.70& |
| **NI** | <=== | **f7** | -0.01659 | -0.56 | 0.09574 | 4.77* |

Book size subsample findings are reported in Tables 7 and 8. The overall explanatory power is higher for the above-the-median book value subsample. The core clean surplus (Feltham & Ohlson, 2011) variables have consistent significances for the above- and below-median-book value subsamples. For particular variables, the above-the-median subsample path analysis is more likely to have significance than the below-the-median subsample.

**TABLE 7**
**SIMULTANEOUS REGRESSION EQUATIONS (n=2746)**

| Variables | Below Median Book Value(n=1373) MktValue (Eq. 1) | NI (Eq. 2) | Above Median Book Value (n=1373) MktValue (Eq. 1) | NI (Eq. 2) |
|---|---|---|---|---|
| Intercept | 0.43 | -4.73 | -3836.11 | -3089.18* |
| $BVadj_{t-1}$ | 1.51* | | 0.34* | |
| $GW_t$ | 2.41* | | 0.85* | |
| $NI_t$ | 1.58* | | 0.82* | |
| CAudit | 10.63 | | 10.82* | |
| Rfactor1 | 1.08 | | 2.92 | |
| Rfactor2 | 7.21 | | -0.27 | |
| Buy | 119.74* | | -1291.55 | |
| Hold | 103.78* | | -914.25 | |
| Sell | -48.77 | | 276.92* | |
| Tal | | 0.88 | | 443.12* |
| TalBeta | | -0.20 | | 16.00* |
| CAPX | | 0.79* | | 0.28* |
| CAPX2 | | -0.00 | | -0.00# |
| IntanF1 | | -2.04* | | 1349.36* |
| IntanF2 | | -8.74* | | -4.54* |
| N2 | | 0.63 | | 151.53* |
| N6 | | -0.38 | | 16.11 |
| N7 | | -0.21 | | 38.62# |
| Industry dummies | Included | | Included | |
| Year indicators | Included | Included | Included | Included |
| Adj. $R^2$ | .35 | .12 | .87 | .63 |

**TABLE 8**
**SEM COVARIANCE STRUCTURE ANALYSIS: MAXIMUM LIKELIHOOD ESTIMATION STANDARDIZED RESULTS FOR PATH LIST OF BOOK VALUE SUBSAMPLES BELOW (N=1,373) AND ABOVE (N=1,373) THE MEDIAN**

| Path | | | Below Median | t Value | Above Median | t Value |
|---|---|---|---|---|---|---|
| **Mktvalf** | <=== | **cleanA** | 10.34386 | 0.49 | 0.04218 | 40.69* |
| **Mktvalf** | <=== | **Rfactor1** | 1.47303 | 0.20 | -0.01420 | -1.30 |
| **Mktvalf** | <=== | **Rfactor2** | 9.30657 | 1.23 | 0.00281 | 0.26 |
| **Mktvalf** | <=== | **BEV0adj** | 1.46501 | 14.73* | 0.06817 | 5.12* |
| **Mktvalf** | <=== | **GW** | 2.52310 | 9.25* | 0.16930 | 13.94* |
| **Mktvalf** | <=== | **NI** | 1.50792 | 5.73* | 0.80446 | 86.12* |
| **Mktvalf** | <=== | **IS** | -26.43300 | -0.57 | -0.00035 | -40.79* |
| **Mktvalf** | <=== | **IH** | 111.08463 | 4.85* | -0.01341 | -40.77* |
| **Mktvalf** | <=== | **IB** | 129.37191 | 6.89* | -0.01909 | -40.77* |
| **NI** | <=== | **TAL** | 0.96050 | 1.51 | 0.19609 | 8.58* |
| **NI** | <=== | **Talbeta** | -0.19157 | -1.28 | 0.00330 | 0.18 |
| **NI** | <=== | **CAPX** | 0.51849 | 4.74* | 0.26395 | 12.05* |
| **Intan** | <=== | **RD** | 0.65703 | 10.82* | 0.57339 | 39.34* |
| **Intan** | <=== | **ROA** | 5.29849 | 3.20* | 0.01643 | 43.67* |
| **Intan** | <=== | **PrdInfo** | -7.11989 | -0.63 | 0.12795 | 44.25* |
| **Intan** | <=== | **MgtInfo** | -0.03730 | -0.13 | -0.02560 | -43.61* |
| **NI** | <=== | **Intan** | -0.05923 | -3.24* | 0.50940 | 31.60* |
| **NI** | <=== | **F2** | 0.84156 | 1.12 | 0.01220 | 0.59 |
| **NI** | <=== | **F6** | 0.07589 | 0.16 | 0.03229 | 1.60 |
| **NI** | <=== | **f7** | -0.19718 | -0.64 | 0.09300 | 4.72* |

Risk subsamples are taken above- and below-the-median stock market beta. The findings are shown in Tables 9 and 10. Both above- and below-the-median subsamples have respectable explanatory power. Generally, the variable significances are consistent between the below- and above-the-median subsamples. A notable exception for the above-the-median subsample is that tangible assets did not impact income in the path analysis.

**TABLE 9**
**SIMULTANEOUS REGRESSION EQUATIONS (n=2746)**

| Variables | Below Median Beta Value(n=1373) MktValue (Eq. 1) | NI (Eq. 2) | Above Beta Market Value (n=1373) MktValue (Eq. 1) | NI (Eq. 2) |
|---|---|---|---|---|
| Intercept | -3290.61 | -107.21 | -779.66 | -301.09* |
| $BVadj_{t-1}$ | 0.25* | | 0.70* | |
| $GW_t$ | 0.72* | | 1.57* | |
| $NI_t$ | 12.02* | | 6.58* | |
| CAudit | 2540.73* | | 922.02# | |
| Rfactor1 | -210.32 | | -528.18* | |
| Rfactor2 | -376.54 | | 279.64& | |
| Buy | 661.71 | | 390.73 | |
| Hold | 1404.54 | | 371.60 | |
| Sell | 3611.82 | | -372.12 | |
| Tal | | 46.07* | | 103.94* |
| TalBeta | | 15.47* | | -12.12# |
| CAPX | | 1.24* | | 0.47* |
| CAPX2 | | -0.00* | | -0.00& |
| IntanF1 | | 1257.17* | | 412.39* |
| IntanF2 | | -8.74* | | 89.08 |
| N2 | | 152.06* | | -12.47 |
| N6 | | 33.53 | | -4.31 |
| N7 | | 32.80* | | 15.20 |
| Industry dummies | Included | | Included | |
| Year indicators | Included | Included | Included | Included |
| Adj. $R^2$ | .89 | .68 | .88 | .50 |

**TABLE 10**
**SEM COVARIANCE STRUCTURE ANALYSIS: MAXIMUM LIKELIHOOD ESTIMATION STANDARDIZED RESULTS FOR PATH LIST OF BETA SUBSAMPLES BELOW (N=1,373) AND ABOVE (N=1,373) THE MEDIAN**

| Path | | | Below Median | t Value | Above Median | t Value |
|---|---|---|---|---|---|---|
| **Mktvalf** | <=== | **cleanA** | 0.02970 | 40.57* | 0.01883 | 43.59* |
| **Mktvalf** | <=== | **Rfactor1** | 0.00339 | 0.73 | -0.03832 | -3.73* |
| **Mktvalf** | <=== | **Rfactor2** | 0.00779 | 0.43 | 0.01277 | 1.25 |
| **Mktvalf** | <=== | **BEV0adj** | 0.05214 | 4.15* | 0.26975 | 20.28* |
| **Mktvalf** | <=== | **GW** | 0.12723 | 10.96* | 0.31611 | 28.87* |
| **Mktvalf** | <=== | **NI** | 0.84623 | 112.3* | 0.55739 | 45.38* |
| **Mktvalf** | <=== | **IS** | 0.01527 | 40.60* | -0.00048 | -43.73* |
| **Mktvalf** | <=== | **IH** | 0.02932 | 40.73* | 0.01307 | 1.28 |
| **Mktvalf** | <=== | **IB** | 0.02688 | 40.63* | 0.01586 | 43.77* |
| **NI** | <=== | **TAL** | 0.10804 | 5.11* | 0.01571 | 0.77 |
| **NI** | <=== | **Talbeta** | 0.03145 | 1.71& | -0.02665 | -1.43 |
| **NI** | <=== | **CAPX** | 0.27540 | 13.21* | 0.44579 | 27.97* |
| **Intan** | <=== | **RD** | 0.59297 | 42.06* | 0.64889 | 54.12* |
| **Intan** | <=== | **ROA** | 0.03194 | 1.42 | 0.02722 | 1.25 |
| **Intan** | <=== | **PrdInfo** | 0.07461 | 43.42* | 0.00975 | 42.92* |
| **Intan** | <=== | **MgtInfo** | -0.05365 | -2.39# | -0.00542 | -0.25 |
| **NI** | <=== | **Intan** | 0.56840 | 37.65* | 0.55103 | 39.05* |
| **NI** | <=== | **F2** | 0.02743 | 1.38 | -0.02434 | -1.40 |
| **NI** | <=== | **F6** | 0.03543 | 1.82& | -0.00426 | -0.23 |
| **NI** | <=== | **f7** | 0.10287 | 5.50* | 0.00985 | 0.55 |

See Table 11 for a summary comparison of the significance of variables across the subsamples and main sample for the simultaneous equation models. The clean surplus (Feltham & Ohlson, 1995) core variables are significant, as are the tangible variables upon net income. Findings indicate differences in the intangible variable significance. The Size variable matters and thus does the concept. Here, the specific conclusion is that above-the-median size subsample has higher significance. The SEM (Hinson & Utke, 2019; Schreiber et al., 2006) findings were significant across the board for the clean surplus variables. The tangible assets had significant effect upon net income except for the interaction variable TAL times Beta. The latent intangible variable always has a significant effect on net income.

**TABLE 11**
**SIGNIFICANT COMPARISONS**

| Variables | Clean Surplus | Below Median Market Value | Above Median Market Value | Below Median Beta | Above Median Beta |
|---|---|---|---|---|---|
| $BVadj_{t-1}$ | 0.30* | 0.43* | 0.34* | 0.25* | 0.70* |
| $GW_t$ | 0.96* | 0.97* | 0.86* | 0.72* | 1.57* |
| $NI_t$ | 10.90* | 0.82* | 10.83* | 12.02* | 6.58* |
| CAudit | 1845.56* | 1.84 | 3240.87* | 2540.73* | 922.02# |
| Rfactor1 | -426.52# | 2.92 | -1313.79* | -210.32 | -528.18* |
| Rfactor2 | -415.86# | -0.27 | -220.16 | -376.54 | 279.64& |
| Buy | 576.82 | 108.16* | -1827.55 | 661.71 | 390.73 |
| Hold | 1130.00# | 97.08* | -1535.60 | 1404.54 | 371.60 |
| Sell | 850.32 | 34.92* | 77.41 | 3611.82 | -372.12 |
| Tal | 59.11* | 1.59* | 362.92* | 46.07* | 103.94* |
| TalBeta | 12.83* | -0.37# | 15.58* | 15.47* | -12.12# |
| CAPX | 0.73* | -0.12 | 0.38* | 1.24* | 0.47* |
| CAPX2 | -0.00* | -0.00 | -0.00* | -0.00* | -0.00& |
| IntanF1 | 1002.32* | 1.23 | 1001.66* | 1257.17* | 412.39* |
| IntanF2 | 233.61* | -4.54* | 911.95* | -8.74* | 89.08 |
| N2 | 129.36* | 1.68# | 185.38* | 152.06* | -12.47 |
| N6 | 8.52 | -0.65 | 30.52 | 33.53 | -4.31 |
| N7 | 19.72# | -0.14 | 40.81# | 32.80* | 15.20 |

## CONCLUSIONS

This research study is a formulation and testing of a firm supply and demand information economics framework. This analysis creates a path diagram based upon both internal and external factors to a company. It incorporates firm tangible and intangible asset information. Two empirical approaches investigate the information economics theoretical framework. One methodology is the simultaneous equation regression and the other is SEM analysis. The findings are consistent for both methods, providing robustness. One particular advancement on the research frontier is the SEM used to describe the effects of unknown hypothesized intangible assets. In this study, the intangible asset latent variable has a significant effect upon net income. This study has one limitation in its general application, because not all firms develop internally-generated intangible assets in the same manner. Small firms may have robustness issues. Future research may explore differences between firms and industries. One advantage of this information economics approach is that the researchers can add additional new features as research begs the question without having to create or justify any idiosyncratic situation.

## ENDNOTES

1. The premise of positivism originated by Auguste Comte (Comte & Bridges, 2009) is that natural phenomena govern sociological processes.
2. A hand sample of the firms was investigated for the advertising and SG&A variables, because of a concern that the advertising variable might be included in the selling component of the SG&A of the Research Insight data. The hand sample utilized the XBRL tag data of the 10K reports. The data check indicated that the advertising expense is a unique number not contained in the SG&A variable.

3. Lang and Litzenberger's (1989) adaption of Modigliani and Miller's (1966) limited growth model is the theoretical basis.
4. Consumer Discretionary, Consumer Staples, Energy, Financials, Health Care, Industrial, Information Technologies, Materials, Telecommunications Services, Utilities

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## APPENDIX

### VARIABLE DESCRIPTIONS

**Activity Ratios**
Inventory turnover = cost of goods sold ÷ average inventory
Receivables turnover =net revenue ÷ average receivables
Payables turnover = purchases# ÷ average payables
Asset turnover= net revenues ÷ average total assets

**Liquidity Ratios**
Current ratio= current assets ÷ current liabilities
Quick ratio=(cash + short-term marketable securities + accounts receivable) ÷ current liabilities
Cash ratio=(cash + short-term marketable securities) ÷ current liabilities

**Solvency Ratios**
Debt-to-assets ratio= total liabilities ÷ total assets
Debt-to-capital ratio= total debt# ÷ (total debt# + total shareholder's equity)
Debt-to-equity ratio= total debt# ÷ total shareholder's equity
Interest coverage ratio= earnings before interest and taxes# ÷ interest payments

**Profitability Ratios**
Gross profit margin= gross income ÷ net revenue
Operating profit margin= operating income ÷ net revenue
Net profit margin= net income ÷ net revenue
Return on assets (ROA)= net income ÷ total assets
Return on equity (ROE)= net income ÷ total stockholder's equity
Earnings Per Share = Net Income / Number of Common Shares Outstanding
#calculated terms:
Purchases= cost of goods sold + ending inventory – beginning inventory
total debt= notes payable + current portion of long-term debt + long-term debt
earnings before interest and taxes= net income + income taxes + interest expense

Mktvalft is market value. BV0adjt-1 is (book value less GWt ) at time t-1. GW0t-1 is beginning goodwill. NIt is net income. RD is R&D. MgtInfo is SG&A divided by revenue. PrdInfo is the ratio of advertising expense divided by revenue. ROA is return on equity of net income over assets.

CAudit is clean audit. Rfactor1 and Rfactor2 are factor weightings of ratios commonly used by analysts. Buy, Hold and Sell are Bloomberg recommendations. CAPXt is the capital expenditures. CAPX2t is the square of firm capital expenditures. TAL is log of total assets. Beta is systematic firm beta. IntanF1 and IntanF2 are factor weightings of aforementioned firm variables. N2, N6, N7 are industry segment earnings forecasts (by SIC). Industry dummies are for 1 digit SICs. Year Dummy is in the year of. Dollars at time t, unless otherwise noted.
* signifies a t-statistic (α=.01), # signifies a t-statistic (α=.05) and & signifies a t-statistic (α=.10).