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Intellectual Property and the Role of Estimation in Financial Accounting and Mergers and Acquisitions

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Abstract

In this manuscript a review of the estimation theory proposes a solution to the problem of finding the economic (dollar) value of intellectual property rights. Specifically, during periods of acquisition and or mergers, the problem arises during acquisitions and mergers because firms have trademarks, patents and similar items which have value and are a significant part of the economic activities. Financial account often ignores the methods established earlier by experts in the field of financial accounting because they are inexpert in estimation methods and/or suggestions by agencies that rule and prescribe solutions to assess and estimate the value of intellectual property rights.

Since estimation methods are now commonplace in accounting, this manuscript suggests the use of these methods to place value on items such as patents, trademarks and similar items. In three cases, the manuscript produces viable and testable results that should bring financial account from pure guess or worse, avoiding the problem entirely. In addition, the author suggests alternative method by which one estimates the value of intellectual property rights. These additional methods should produce practical valuation methods which are based on science, data analysis and data analytics. No longer would analysts have to rely on the changing value of *Goodwill* to be a substitute for data science and account analytics.

Introduction

Reporting revenue from intellectual property (IP) is a problem of revenue recognition of assets which are usually not reported on financial statements of business firms, entities especially during periods of mergers and acquisitions. The methods of financial reporting by accountants in recognizing the value of IP in accomplishing revenue generation creates many financial reporting problems. The FASB rules for such activities are often ignored because they tend to be evasive or not fully informational in their usually structured rules. Recognizing future performance is a goal by which reporting methods are merely designed to recognize past cash movements and equivalents as part of the history of a firm but, also, to evaluate present performance by traditional reporting methods. We propose another method with the purpose of accounting for IP as a product of intellect that the law protects from unauthorized use by others. These items include patents, copyrights, trademarks and trade secrets are considered to be products of a revenue generating process or cost reducing process.

In this study, we define IP as it refers to creations of the intellect for which a monopoly is assigned to

designated owners by law [1]. Intellectual property rights (IPRs) are the protections granted to the creators of IP. Artistic works including music and literature, as well as discoveries, inventions, words, phrases, symbols, and designs can all be protected as intellectual property. Stated simply, a physicist and a musician both [1] One area can be characterized as the protection of distinctive signs, in particular trademarks (which distinguish the goods or services of one undertaking from those of other undertakings) and geographical indications (which identify a good as originating in a place where a given characteristic

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of the good is essentially attributable to its geographical origin). The protection of such distinctive signs aims to stimulate and ensure fair competition and to protect consumers, by enabling them to make informed choices between various goods and services. The protection may last indefinitely, provided the sign in question continues to be WTO [20].

Other types of industrial property are protected primarily to stimulate innovation, design and the creation of technology. In this category fall inventions (protected by patents), industrial designs and trade secrets. The social purpose is to provide protection by geographical origin). The protection of such distinctive signs aims to stimulate and ensure fair competition and to protect consumers, by enabling them to make informed choices between various goods and services. The protection may last indefinitely, provided the sign in question continues to be WTO (13) may have rights to their intellectual property but the nature of the property would be entirely different. The IP of “Albert Einstein” differs greatly than that of Leonard Bernstein but their creations are both IP and it does not matter that their family names have “stein” in their spelling. To sum up, works of Bernstein in music and Einstein in physics are both IP and include other items such as art, discoveries, inventions, word, phrases, symbols and designs. Laws can protect these items and accountants can evaluate their economic value to a firm or person who may have ownership of these items.

Intellectual property rights often are referred to as intangible assets are those properties and should be reported in the financial reports of firms. When deriving forecasts for firms with large amounts of intangible assets may and likely produce forecasts that are inaccurate and often lead to less than optimal financial decisions especially in mergers and acquisitions [6] Negative correlations exist among analysts forecast error and the level of intangible assets and results in impairments in estimates [15]. This conclusion infers that the level of uncertainty about future rates of return and earnings per share and the magnitude or level of intangible assets or intellectual property rights affects cash flow. With the great growth in technology development resulting in greater uncertainty as to the future growth in forecasting error. This is particularly important in research driven and high technology producers and obviously in the performing arts.

Previous manuscripts, by Brief and Owen [1, 7-9, 2], produced an ongoing accounting theory concerning the appropriate method by which accounting may report the

matching of costs with revenues and the realization of anticipated revenues with costs resulting from enterprise operations. Their conclusions stated that such methods that matching and realization are the same problem and they are both portions of the general estimation theory in financial accounting. More recently, Lev {2001} proposed methods to demonstrate how the field of cost/management accounting may handle the problems associated with the dilemma of reporting financial events of estimating non-physical assets also call IP rights. In addition, we construct a methodology to estimate the value of IP rights in such a manner that accountants and analysts are able to value the rights and be consistent with both accounting standards and financial decision makers when considering mergers and acquisition (M&A) (11, 12)

The Present Methodology

Previously accountants chose one of two methods to account for the value of IP rights which violated the accounting rule of the “lower of cost or market.” This standard simply said that assets are valued at the smaller of two methods to reflect their value and keep the convention of “conservatism.” This convention refers to in accounting as a policy of anticipating possible future losses but not future gains. This policy tends to understate rather than overstate net assets and net income, and therefore leading a firm to understate income. Our purpose is not to violate this policy but to insure in M&A decisions that income is estimated properly. Traditionally, when accountants think about intangible assets and their value, they view it as a residual. By residual, they mean a buyer is ready to value a firm in excess of the value of the tangible assets. This value referred to as *Goodwill*. [9]. This is not a perfect method, it does bring forth the notion that goodwill is determined as a residual and therefore contains some science in its evaluation. The associated question is whether the valuation of IP rights is properly assessed by this residual methods and how those affect the value of disparate pieces of IP rights. Hence, goodwill tends to be a vague valuation system that may justify the bringing of science into the process of justifying a high price for a firm’s asset value. The great challenge for accounting is to relate the IP rights with the estimate of future cash flow of a firm even if the estimate is subject to error. A trademark may be an intangible asset, The trade mark has value to a firm but this value is not usually expressed in terms of an economic unit (currency), but it still contains value because the firm may be able to exact a higher price for its products, services or

in the case of an M&A a higher value for the entire firm.

A second solution suggested but also makes no sense during M&A is to simply list the patents, trademarks and other examples of IP in the financial reports of firms. This initiative and suggestion of the financial accounting principles board (FASB) does not provide information concerning the economic value of IP rights for an entity during M&A and in the end may indicate to some that there is no value in these listed items. Stated differently, partial information may produce results that distort the value of IP rights and are not related at all to the “cost or market value” of the item being referenced. This methodology is no solution to a problem nor does it provide information to readers of financial reports and may in turn produce misinformation.

The Use of Estimation in Financial Accounting

The role of estimation in accounting problems is neither new nor is it difficult to reconstruct the focus of accounting on the relationship of revenues and costs in financial accounting. Both the realization and matching principles are basically the same estimation problem. No longer does an accountant emphasize a particular moment in time for matching or recognizing the costs and future revenues prior to the collection of cash. Now, accounting focuses on the overall rate of return for a firm but does not ignore the convention of “conservatism”. The practice of accounting evaluates the intrinsic value of IP rights for a firm for each of the right under consideration. That is, the principle of *Goodwill* is not to be used during M&A activity to account for the value of IP rights. IP may induce greater asset values but also effect the rate of return on assets by reducing that estimate because the denomination rate of return increases. Including earnings risk in estimating rates of return was studied but not thoroughly was debated previously [3, 4, 5]. The result was that including earnings risk may not fully reflect all risk in estimating earnings but at least reflects that portion of risk resulting from variation in earnings

Accounting, Financial Risk and Capital Structure

To explain and justify the method for estimating the value of IP rights, we consider an example whereby a firm wishes to purchase the assets (IP rights) of another by issuing new debt. As part of its equity holdings new debt (called financial leverage) will reduce the proportion of common equities to total capital stock. This, of course, will increase the effects of financial leverage on total financial

risk. In turn, the rate of return to common stockholders is related to the size of the surrogate measure of risk by some utility function for risk aversion. The motivation to use financial leverage instead of new common stock issuance is associated the cost of indebtedness. We define T as the sum of debt and common stock (assume preferred stock and other forms of equities and instruments are zero); S is the value of outstanding common stock and D is the amount of debt; and X amount of earnings of the firm in a future time period. X is a random variable with mean $E(X)$ and variance $V(X)$. The interest rate or cost per dollar of debt is less than the mean earnings per dollar of S is defined by

$$E(Y) = E(X)/S = E(X)/(T-D) \quad (1)$$

Note, Y is a random variable with mean $E(Y)$. In this model expected earnings per dollar ($E(Y)$) brings forth the definition of expected earnings with debt of

$$E(X') = E(X) - i D \text{ for } D > 0; \quad (2)$$

i = interest rate (cost of indebtedness) and $E(X') = E(X)$, for $D = 0$ (2')

The variance of total earnings is $V(X') = V(X)$ for $D \geq 0$ ($i D$ is a constant)

The financial decision to fund an acquisition in this case is an example of decision analysis where the decisions are to substitute debt for stock or not to substitute debt. The states of nature for this decision problem are defined by $E(X) > i D$ or $E(X) \leq i D$. The opportunity loss function (L) for this decision is

$$L = 0 \text{ for } (E(X) > i D) \text{ or } f(L) = \text{for } E(X) \leq i D \quad (3)$$

Where $f(L)$ describes an opportunity loss integral approximating management’s view towards choosing a non-optimal decision. No loss occurs when earnings are greater than $i D$ since management will benefit from leverage financing.

If one were to consider cash flow only to be greater than the cost of borrowing, the loss function would change and reflect the goal to consider borrowing rather than earnings. The basic structure of the acquisition decision model would not change except for substitution

of cash flow for earnings. To calculate the opportunity loss function associated with this model, we estimate some probability density function (PDF) that approximates the PDF for future earnings. Before speculating about the shape of the PDF, we consider that a normal or a T-distribution with a very large sample size as to approximate a standard normal distribution, the firm's opportunity loss becomes at breakeven (X_b)

$$X_b = E(X') - Z((S(X')) \quad (4)$$

Z refers to the normal fiducial deviate as a function of the mean, the standard normal fiducial deviate, its standard deviation, $S(X')$. The T-distribution at large sample will approximate the normal distribution and hence, we do not consider it further.

By rearrangement of (4), we find

$$Z_b = (I D) - E(X')/S(X') \quad (5),$$

which is in normal deviate form. Hence, we have the breakeven value of earning equal to the cost of indebtedness, I D. By substituting,

$$E(X) = E(X') - I d \quad (6)$$

We substituted debt for common stock. The size of the loss is known by a function $f(l)$ and $V(X)$ [the variance of X, i.e. future earnings related to the substitution of debt obligations for common stock. The next step is to determine the size and distribution of the loss function for the distribution of future earnings.

Probability Distribution of Earnings

Decision analysis and estimation theory use normally distributed data, but the use is complicated by the wide variety of choices of distributions that are available. First, the mean and/or variance or neither, may be considered a fixed quantity. If the variance is not known, the analysis may be done directly in terms of the variance, or its reciprocal (the precision). The reason for using the analysis in terms of precision is that the analysis in some cases is simplified. The analysis implemented here will be in univariate terms although multivariate applications are available. However, to begin we should consider the distribution of earning of corporations in the United States to see how we may begin.

The distribution of household and business incomes in the United States has become more unequal during the post-2008 dramatic jobs and economic recovery as the effects of the 2007-2008 recession reversed itself by 2009. The Congressional Budget Office [CBO] reported in November 2014 that the share of pre-tax income received by the top 1% of income payers rose from 13.3% in 2009 to 14.6% in 2011. Further, if the United States had the same income distribution it had in 1979, the bottom 80 percent of the population would have \$1 trillion or \$11,000 per family in addition. The top 1 percent would have \$1 trillion or \$750,000 less. By relying on Internal revenue service's data the share of pre-tax income received by the top 1% of income earners had returned to its pre-depression peak of about 23% of the pre-tax income. The analysis indicates that the distribution of business earnings as well as individual earnings changes due to external economic condition. Hence, there is substantial variation in the incomes of business and individuals and yields evidence that earnings estimates will vary and the distribution of income will change and often dramatically. During the 2009-2012 recovery period, the top 1% captured 91% of the real income growth per family with their pre-tax incomes growing 34.7% adjusted for inflation while the pre-tax incomes of the bottom 99% grew 0.8%. Measured from 2009-2015, the top 1% captured 52% of the total real income growth per family, indicating the recovery was becoming less "lopsided" in favor of higher income families. By 2015, the top 10% of income earners had a 50.5% share of the pre-tax income, almost at its highest levels ever in the United States.

Two pieces of US Federal Law in 2013 and 2012 did increase the tax obligations of higher income individuals and businesses, i.e., the Affordable Care Act In 2013, and the American Taxpayer Relief Act which in turn raised tax obligations for high income earners and their business income. We can expect due to the 2016 federal election which brought another government to rule the USA, one can expect over time that this trend in tax obligations will not continue. In a sense, we may surmise that income and earnings distribution will change over time. One may predict that the highest earning groups in the USA will benefit greatly and the most upper income groups will benefit the most. Many forecasters predict an economic explosion in the incomes of high income taxpayers and further inequality of income. Although we know little about the current tax proposals, we can expect a wider variation in earnings and the shape of the distribution

of earning will skew towards the highest earnings groups greatly.

Other factors that influence the distribution of earnings include the decline of organized labor unions; the lack of career opportunities of insufficiently skilled workers; technology change that requiring with greater education in technology; the notion that modern economic advance requires “superstars” who advance technology who are greatly rewarded for their innovations; and the of links between the corporate and financial sectors leading to a huge change in the positive direction in the capitalization of the US stock market. Furthermore, the “evangelical and conservative movements” greatly increased the power of right wing movements who have achieved dominance and will further the direction of income inequality towards the very highest economic group and large size economic units which will again according to plan an increase in the higher income wage earners in the US economy. In this study, we learn that the distribution of earning will vary greatly due to a great many factors beyond the level of control of corporate and business decision leaders. Last, changes in the global economy will further effect and change the distribution of earnings and, in turn, effect decisions made during the actions concerning how accounting will reflect the changes in financial reports especially after decision for a firm to merge acquire or sell, or do nothing

An Illustration of Evaluating IP Rights

In an acquisition, a firm wishes acquire through debt \$100,000 for stock in another firm where the second firm has equity of \$150,000. The borrowers interest rate 5 percent per year ($I = .05$), the expected earnings without debt is \$5,000. The variance \$500, 000 represent the size of the variability in the distribution of earnings [the square root of the variance would be \$707.11(the standard deviation)]. The debt service for the upcoming planning period (one year) is $.05 \times \$75,000 = \3750 then net earnings is $\$5,000 - \$3750 = \$1250$. Since the plan is to substitute debt for capital stock the optimal action in the face of uncertainty for the break-even fiducial limit is given as

$$Z_b = -E(X) / S(X) = 1250 / 707.11$$

In turn, the opportunity loss (often referred to as dollar value of risk). The monetary equivalent (M) will be equivalent to the following

$$M = 707.11 \text{ with } [Z_b = 1.77 \text{ and } 5000 \times 0.9616]$$

$$M = 5000 \times .9616 = \mathbf{\$4808} \text{ (without decimals; IP Rights)}$$

The value \$4808 is break even risk equivalent in monetary terms. Accounting now has a value which is estimate of the value which is useful as the monetary equivalent of IP rights.

Interpretation and Analysis

The evaluation in monetary terms presents a method to evaluate the a situation where in the acquisition of assets where the final value of the firm will include an economic interpretation of the value of assets of the acquiring firm a valuation of IP rights which is economic in character. By so doing, a managerial economist or business decision maker includes an estimation procedure for inclusion of those rights not produced in earlier accounting methods for providing financial reports. Although accounting traditionally did little or nothing to effectually value these assets, we followed suggestions by others.

The future is uncertain, however, there is some degree of predictability. Our example shows some risk and the gathering of additional information to revise our initial probabilities of is required for financial managers. Additional information for example, may reduce the (as measured by the variance in earnings. This would affect the value of the variance and in turn the monetary equivalent which estimates the value of IP rights. To understand better the effect of uncertainly explained by the size of the variance in earnings, we will consider a sensitivity analysis of the M (the monetary equivalent) as the values of the variance changes. [Note: Excel users the phrase “What if? To refer to sensitivity analysis] (Table 1)

Table of Monetary Equivalents					
				Normal	IP
E (X)	S (X)	Debt Cost	Z _b	Value	Rights \$
5000.00	500.00	3750.00	2.50	0.9938	4969
5000.00	600.00	3750.00	2.08	0.9812	4906
5000.00	700.00	3750.00	1.79	0.9633	4817
5000.00	707.11	3750.00	1.77	0.9616	4808
5000.00	800.00	3750.00	1.56	0.9406	4703
5000.00	900.00	3750.00	1.39	0.9177	4589
5000.00	1000.00	3750.00	1.25	0.8944	4472

To interpret the sensitivity analysis related to changes in the size of the variation in the distribution earnings we note that for variation in S (X), the estimated value changes. As S (X) increases in value, that is, the standard deviation increases and the value of IP rights decreases in value. This is exactly how one would expect to occur. The relationship between the value of IP rights and the variation in earnings should be and is inverse.

Let us consider another relationship between the cost of debt (the interest rate on borrowing, I,) the value of IP Rights.(Table 2)

Changes	Monetary Equivalents		Cost	Normal	\$IPR
	in	interest			
E (X)	S (X)	rate, i	Debt Cost	Z _b	Value
5000.00	707.11	0.030	4500.00	0.7602	3801
5000.00	707.11	0.035	5250.00	0.3618	1809
5000.00	707.11	0.045	6750.00	0.0067	33
5000.00	707.11	0.050	7500.00	0.0002	1
5000.00	707.11	0.055	8250.00	0.0000	0
5000.00	707.11	0.060	9000.00	0.0000	0
5000.00	707.11	0.065	9750.00	0.0000	0

Note in Table 2, the cost of debt rises dramatically when interest are increased by values of the interest rate (I = 0.05, one-half percent). The IP Rights values decrease dramatically as well. The highest value is \$3801 and decrease with the raise in indebtedness to a value of \$0. The model for evaluating the IP Rights is convincing since it takes into consideration the cost of borrowing or money equivalents as well as shown before in the reduction in the variation in the distribution of earnings.

Another method of evaluation is whether the substitution co corporate debt for stock equity is part of the goal of acquiring or merging with another economic entity or firm. In this application, the firm substitutes debt for equity in order to fund the acquisition with the purpose of finding the best financing method for the acquisition. Without providing additional detail to evaluate the IP rights (IPR). Consider Table 3 where the interest rate (the cost of borrowing substitutes for stock, but the interest rate were to increase. (Table 3)

The above table shows the monetary equivalent of IPR as both the debt/equity ratio increases, the debt cost increases and net profit after the deduction for debt payments declines. In Table 3 the IPR value decrease as the debt cost increase and the debt/equity ratio increases.

Last the dollar equivalent of IPR decreases as the net profit decreases. All this is expected.

Monetary Equivalents		vs.	Capital	Structure		
Debt/Equit	i*B	E (X) - i*B	S (X) = 707.11	Normal		
Debt	Ratio	Debt Cost	Net Profit	Z _b	Prob.	\$IPR
60000	0.40	3000.00	2000.00	2.83	0.9977	\$1,995
65000	0.43	3250.00	1750.00	2.47	0.9932	\$1,738
70000	0.47	3500.00	1500.00	2.12	0.9830	\$1,475
75000	0.50	3750.00	1250.00	1.77	0.9616	\$1,202
80000	0.53	4000.00	1000.00	1.41	0.9207	\$921
85000	0.57	4250.00	750.00	1.06	0.8554	\$642

Based on the analysis of Table 1 through 3, the results indicate that IPR evaluation is not only possible, but can be used in a wide variety of economic decisions under risk. All this is consistent with estimation theory in financial account [noted before] and managerial decisions under risk [10]. As in the earlier examples it is possible to extend the analysis to finding the optimum capital structure as well as the value of IPR. Last, the goal in the scenario stated in Table 3 is to eventually find the solution to finding the *Breakeven* of the monetary equivalent and net earnings less taxes. The solution in that case finds the value of IP rights at the optimum debt/equity ratio under normally distributed returns.

Alternatives to the Normal Distribution of Earnings

Future earnings may or may not be distributed according to a normal distribution nor can it be expected to remain that way in the distant future. The previous analyses assumed normally distributed earnings which may or not be true. There are several solutions offered in previous work which may result in better estimates of the IP rights in economic terms. These solution as suggested by [17, 10] may include determining the *exact* shape of the distribution of earning or by approximating the shape with the use of the variance and skewness in earnings.

For example, the expected rate of return from a merger or acquisition could be defined by:

$$E(K) = \left[\frac{\sum M_x - \sum M_c}{\sum M_x} \right] \left[1 + \left(\frac{\text{VAR}(\sum X)}{\sum M_x} \right) \right] \quad (7)$$

Where M_x and M_c are the expected values of random variables X , Y and C and $\text{VAR}(\sum X)$ the variance in the cash-inflow in all periods, X . If there is skewness

in the distribution of earning then (7) will include the skewness coefficient the equation/definition in (7) includes the concept of skewness in the definition, [See Jarrett 1983 and 1990]. Although the computation of the expected values become more complex as additional sources are included, the problems of estimating IPR are not without solution but may require additional effort.

Exact solutions or solutions involving knowledge of the exact distribution of earnings should provide in those cases solutions to the problem of estimating the value of IPR. If the distribution of earning is uniform and perhaps Chi-Square the solutions can easily be expressed. Previously, the solutions were explored in similar problems.

Conclusion

To conclude and summarize, the development of methods to account for and evaluate the assets that one classifies as Intellectual Property Rights is the focus of this manuscript. Previous methods utilized by financial accounting methods often ignored the basic problem of finding a monetary (economic) equivalent of IPR. Suggestions by various agencies both public and generated by private or professional financial associations or groups often ignored the basic problem. Simply listing items like patents and trademarks acquired in a merger or acquisition does not provide much information to analysts during these actions. Use of changes in *Goodwill* [18] also, do not substitute for sound estimation theory in financial accounting. In this study, estimation is utilized to arrive at useful estimates of the dollar value of IPR in three specific cases. In addition, the manuscript suggests additional estimation methods when future earnings are not necessarily normally distributed. They may be non-symmetric and knowledge of the variation and perhaps may be included in the process of estimation. Furthermore, if the distribution follows another model such as the uniform distribution or even approximated by another exact distribution, estimation methods are available to solve the problem in these instances.

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