Intellectual Property Economic Analysis Insights

Estimating Intellectual Property Income

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Introduction

The income approach provides a systematic framework to estimate intellectual property value, damage, or transfer price. This systematic framework is based on either (1) the direct capitalization or (2) the yield capitalization (i.e., the present value) of future economic income from the use, forbearance, license, or other exploitation of the intellectual property.

One of the most important—and complex—procedures in the income approach is the projection of economic income. Therefore, this discussion presents the different models that can be used to project intellectual property economic income.

According to the textbook *Valuation of Intellectual Property and Intangible Assets*, intellectual property value is based on three components:

1. the current and/or anticipated applications of the intellectual property,
2. logical extensions of the intellectual property, and
3. speculative extensions of the intellectual property.

The analyst may confer with the intellectual property owner/operator when considering the effects of these factors on future economic income:

- Economic climate—including the cyclicality of the business owner/operator of the subject intellectual property, the outlook of the relevant industry and economic sector, expected inflation trends, expected product/service demand, expected product/service pricing pressures, etc.
- Profitability—including consideration of the intellectual property owner/operator, income generation of patents, trademarks, hardware and software licensing royalties, customer lists, databases, infrastructures, industry position, and supply chains.
- Competition—strategies of owner/operators that use competing intellectual properties can limit the amount, duration, and trend of future economic income.
- Changes in capital investment—increased capital investments may be needed for new plant, property, and equipment in order to commercially exploit an intellectual product. Or, the intellectual property may involve a new streamlined production process that reduces expected expenditures for plant, property, and equipment.

The fundamental components of an intellectual property economic income projection include:

- the absolute amount of the future income stream,
- the growth (or decline) rate of the future income stream, and
- the timing of the future income stream.

The methods typically used in an intellectual property income projection include:

- extrapolation,
- tabula rasa,
- life cycle analyses,
- sensitivity/scenario analyses,
- simulation analyses—Monte Carlo, and
- judgmental methods.

Once the initial income projection is made, the next step in any income approach analysis involves the interpretation of the projection results. This procedure can be difficult due to the analytical complexity of some income projection methods. However, this interpretation/review procedure is important to the accuracy of the income projections. In this procedure, the analyst applies reasoned judgment to weight facts, perceived trends, and owner/operator-provided information in the process of finalizing the income projection. The analyst may spend considerable time and effort in preparing and supporting the intellectual property income projection.

Reliability of Income Projections

As with any analysis, the quality of the resources will influence the quality of the intellectual property income projection. The analyst will obtain or develop the most relevant information and data. The projection income or loss related to value/damages/transfer price is often developed by reference to information provided by the property owner/operator. That information may include historical profit and loss statements, financial projections and budgets, new product/project analyses, marketing forecasts, strategic plans, and so forth.

The information provided by the owner/operator is combined with the analyst's (1) independent research on the appropriate marketplace, (2) assessment of the economic outlook of the relevant industry and geographical region, and (3) understanding of the subject intellectual property and its income-generating potential.

Before preparing projections, the analyst will consider how the subject intellectual property generates income. An intellectual property can generate income in the following ways:

1. The use of the property.
2. The ownership of the property.
3. The forbearance of use of the property.

How an intellectual property generates income may influence the selection of the analytical method and/or the measure of economic income used in the analysis. The concept of an intellectual property generating income through its use is easy to understand. For example, the use of patents, copyrights, trademarks, and trade secrets is common in the operation of a going-concern business. In addition, the intellectual property owner can generate income by licensing the use of the property to other business operators. The typical intellectual property income projection will consider both:

1. operating income to the property operator and
2. licensing income to the property owner.

The analyst will examine the intellectual property historical income generation. However, historical income may or may not be a reasonable predictor of future income-generating capacity. In intellectual property licenses, sales, and other transfers, the investor is buying the future, not the past.

The analyst will also consider the time period over which to project income. The reliability of the projection may be affected by the selected time frame. This is because many intellectual properties may not have a residual value at the end of a discrete income projection period. For example, if a pharmaceutical product patent has 12 years remaining of its legal life, the analyst may consider the income potential over the remaining 12-year life. Depending on the facts and circumstances of the case, the periodicity of the projection period (i.e., monthly, quarterly, semiannual) may affect the analysis.

The projection of economic income can be subject to several types of forecast errors. First, projections of economic income are subject to bias, including (1) the use of owner/operator optimistic expectations and (2) the misuse of economic variables or comparative sale/license transaction data. For example, analysts often use royalty rate/license fee transactional data from arm's-length licenses of guideline intellectual property. Without the appropriate due diligence analysis and normalization adjustments, the guideline royalty rates may not be applicable to the subject analysis.

Second, income projections are subject to unintentional forecast errors (i.e., honest mistakes). It is relatively easy for an analyst to make an honest mistake with regard to an income projection variable. However, the resulting forecast error can have a material impact on the value/damage/transfer price conclusion.

Third, the economic conditions in effect at the time of the guideline sale/license transactions may not reflect the economic conditions in effect as of the analysis date. Accordingly, the analyst should consider adjusting guideline transactional data for changes in economic conditions.

Once all the income projection data (both qualitative and quantitative) are gathered, it is useful to assess the probability associated with each projection. This probability assessment procedure may be either explicit or implicit. This probability assessment procedure is useful in any income approach analysis for two reasons: (1) it helps ensure a complete itemization of all of the economic income variables/components of the projection and (2) it helps the analyst to convert qualitative factors into quantitative income projection variables. Consideration of probability-adjusted, risk-weighted values to each projection variable also involves the selection of alternative data inputs for the sensitivity analysis.

Alternative "Scenario" Income Projections

In an income approach analysis, economic income is often projected for many years. Depending on the purpose of the analysis, the projection period can be the term of a license, the property RUL, the period of expected income, or some other period. Almost certainly, the analyst's specific income projection will never actually be realized. For this reason, the analyst may analyze several alternative income projection scenarios. The most common alternative scenario analysis is to prepare and compare the "most likely," "best case," and "worst case" scenarios. The procedures related to the development of alternative income projection scenarios are discussed below.

First, the analyst will develop the "most likely" income projection scenario. In this scenario, the analyst will consider many factors affecting the projection including, but not limited to the following:

1. the general market conditions,
2. the most likely effect of the defined commercialization strategy of the subject intellectual property,
3. all relevant historical financial/operational information, and
4. the owner/operator's pro forma financial budgets or projections.

The result of the "most likely" scenario is the analyst's best estimate of income projection for the subject property.

Second, starting with the "most likely" scenario as a benchmark, the analyst will develop alternative income projection scenarios. The analyst should consider alternative general market conditions (such as inflation rates), competition environments, industry trends, and so on. The analyst may also consider alternative owner/operator intellectual property commercialization strategies in the income projection scenarios.

The analyst should consider: changes in intellectual property development/marketing management, the probability of achieving various levels of market penetration, the effect of various cost/volume/profit relationships, and so on. The development of alternative scenarios—with corresponding alternative income projections—allows the analyst to estimate (1) the maximum potential upside income projection as well as (2) the maximum potential downside income projection.

Extrapolation Methods

Income projection extrapolation methods are typically based on (1) the identification of historical trends and (2) the extrapolation of these trends into the future. Most extrapolation methods extend historical trends into the future based on the following relationships:

1. a linear relationship between projection variables,
2. a curvilinear relationship between projection variables, or
3. multivariate relationships between two or more projection variables.

The following section will present the practical implications of these three common relationships for purposes of extrapolating historical trends.

Linear Extrapolation Method

When two projection variables—let's call them X and Y—relate to one another (as in the equation below), we say that the relationship is linear and deterministic. A linear relationship can be illustrated by a simple supply curve example.

Supply decisions typically depend on profit potential. Because profit is the simple difference between revenue and production/operating costs, supply is likely to react to (1) changes in revenues and (2) changes in production/operating costs. Therefore, we can typically observe a linear relationship between (1) the quantity of a good/service supplied and (2) the price of the good/service. This linear relationship can be expressed mathematically in the following equation:

$$Y = ß_o + ß_1 X$$

where:

Y	=	the point on the fitted line that corresponds to a specific X value
$ß_o$ (Intercept)	=	the estimated value of variable Y when variable X is equal to 0
$ß_1$ (Slope)	=	the variable Y changes by ß1 each time variable X is increased or decreased by 1 unit, while holding all other variables constant
X	=	the independent projection variable

Let's assume that Sweet Heart is a producer of angioplasty devices. As a result of a patent infringement by one of its competitors, Sweet Heart is unable to use a new cost-saving component in the manufacture of its patented device. Further, let's assume that there is a recent breakthrough in medical procedures that would increase the demand for the Sweet Heart angioplasty device. As part of a damages calculation, let's assume the analyst will estimate the amount of cost-savings lost by Sweet Heart as a result of the patent infringement.

In this example, the analyst concluded that there is a linear relationship between cost savings and production volume. The analyst quantified that linear relationship as follows:

$$Y = ß_o + ß_1 X$$

where:

Y	=	dollar amount of cost savings
$ß_o$	=	\$50,000 (i.e., the Y intercept of the extrapolation line)
$ß_1$	=	2 (i.e., the slope of the extrapolation line)
X	=	number of units produced

Accordingly, the actual linear relationship between (1) cost savings and (2) amount of production volume (in units) is represented by the following expression:

$$Y = 50,000 + 2X$$

Based on the expected level of demand for the angioplasty device, the Sweet Heart marketing manager estimates various levels of production volume. Using (1) the linear extrapolation method and (2) the specific expression indicated above, the analyst estimates the amount of lost profits (i.e., lost cost savings) under various alternative production volume scenarios.

For example, if X = 100,000 units produced, then Y (dollar amount of cost savings) = \$250,000 and, if X = 150,000 units produced, then Y (dollar amount of cost savings = \$350,000.

Using the linear extrapolation method, the analyst first identifies the existence of a relationship between (1) the dependent variable and (2) the independent variable. In the linear extrapolation method, the analyst should be able to determine the line of "best fit." The line of "best fit" can be drawn on a graph of observed data points and will provide an estimate for the "true" relationship between the two (i.e., the dependent and the independent) variables. As the "best fit" extrapolation line, the analyst will typically select the line that minimizes the sum of the squares of all the vertical deviations.

The linear extrapolation method is particularly useful where there is a well-established historical relationship between the dependent variable and an independent variable. The linear extrapolation method may appear to be a simple method for projecting income. As with any income projection method, the naive application of the linear extrapolation method can result in forecast errors.

The application of the linear extrapolation method is sometimes limited. This is because more than one variable (such as industry, product, or service competition; owner/operator marketing strategies; or technological/functional obsolescence) may influence the projected income—that is, the dependent variable.

For example, let's assume that the income earned by BIG Pharmaceutical Company is influenced by both (1) the amount of company research and development (R&D) expenditures and (2) the level of expertise of the company scientists. Thus, if Y = company income and X = company R&D expenditures, then income is a function of (1) the slope of the extrapolation line times company R&D expenditures and (2) some level of fixed cost (i.e., the Y intercept of the extrapolation line) and (3) a disturbance factor (called the random variable). The disturbance factor incorporates the amount of intellectual property income resulting from the expertise of company scientists.

Based on this assumed set of facts, the equation below presents the linear relationship that an analyst can use to extrapolate the income earned by BIG Pharmaceutical Company.

$$Y = ß_o + ß_1X + u$$

where:

Y = income

ßo = the Y intercept of the extrapolation line

ß1 = the slope of the extrapolation line

X = company R&D expenditures

u = the random variable (in this example, company scientific expertise)

The analyst first plots the X and Y data points on a two-dimensional grid. The analyst can observe from this scatter diagram the degree (strength) and nature (form) of the historical relationship between X and Y variables.

However, in the equation presented above, the value of the Y variable is not entirely deterministic, or not completely determined by the independent X variable. In the above equation, Y is determined in part by the independent variable X and in part by the random disturbance term, *u*. Therefore, in the above example, BIG company revenues (i.e., the Y variable) are determined (1) in part by the amount of R&D expenditures (i.e., the X variable) and (2) in part by output or creative ability of the scientists employed (i.e., *u*). Since *u* is a random variable, there will not be a single value for the Y variable corresponding to a specific value for the X variable. Rather, there will be an entire probability distribution of Y variable values corresponding to any specific value for the X variable.

Accordingly, the application of the extrapolation method in an actual intellectual property income projection problem requires a rigorous and thorough analysis of the relationships between all of the income projection variables.

Multicollinearity

When projecting income using either an extrapolation method or a regression method, there is often more than one explanatory (or independent) variable that can predict the value of the dependent variable. When the association between the explanatory variables increases, the confidence we have in the estimated slope coefficients decreases. In other words, the greater the association between the X_1 and X_2 variables, the greater are the standard errors for each observation.

This means that when the association between the explanatory variables increases, our confidence in the estimated slope coefficients decreases. This is because their values depend more heavily on the particular observations that happen to be in the sample. Therefore, when the association between the X_1 and X_2 variables is very high (a condition called multicollinearity), the analyst may be better off including only one of the independent variables in the regression analysis (and ignoring the other independent variable).

For example, if (1) Y equals the BIG Pharmaceutical Company profit, (2) X_1 equals the number of scientists employed, and (3) X_2 equals the expense for the total scientist wages, it is likely that independent variables X_1 and X_2 will be highly associated. In this situation, a multicollinear relationship exits. The inclusion of both the X_1 and X_2 independent variables in a regression analysis could decrease the statistical significance of the regression results.

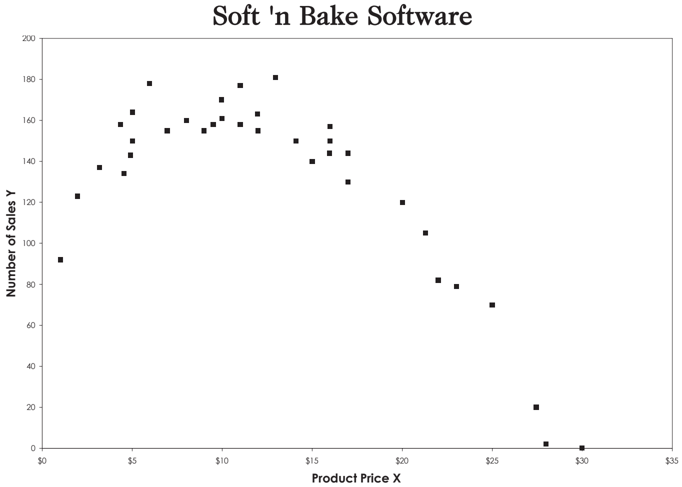
Curvilinear Extrapolation Method

The curvilinear extrapolation method is useful when a scatter diagram of data points indicates a nonlinear relationship between the dependent variable and the independent variable. In other words, the analyst needs to fit a curve (and not a straight line) to the observed data points. The curvilinear extrapolation method is based on a relationship between the dependent variable and one or more explanatory independent variables that is described by a polynomial function.

For example, let's assume that the company Soft 'n Bake, Inc. produces six types of computer software programs used to manage bakeries. Soft 'n Bake sells primarily Program F, the least expensive of all the software packages. The Soft 'n Bake marketing director thinks that Program F is purchased primarily by the local bakeries and by home bakers. The marketing director believes that the price of the software is a strong determinant of sales. She believes that as the software price increases, potential customers will perceive the need to see a product demonstration and meet with a Soft 'n Bake sales representative. The Soft 'n Bake market research department recently conducted a study on the usage of Program F to determine average product price and bakery sales.

The relationship between the software product price and the number of unit sales volume is illustrated below.

Number of Unit Sales and Product Price for Soft 'n Bake Software



This relationship does not appear to be linear. Rather, the relationship is curvilinear. The shape of the relationship is parabolic. The equation below is the formula for a parabola. This type of equation is often referred to as a quadratic function. In regression analysis, this type of equation is called a second-order polynomial equation with one independent variable.

$$Y = ß_0 + ß_1X + ß_2X_2$$

The curvilinear extrapolation method may be appropriate for projecting expected income when the data point scatter diagrams depict nonlinear shapes.

In some cases, the relationship between the independent variables themselves may not be linear. When that occurs, a graph of the relationship between the independent variables will depict a curve instead of a straight line. If there is a curvilinear relationship between two or more independent variables, then a simple linear extrapolation is not appropriate.

Rather, a curvilinear regression model may be appropriate to define the relationship between (1) the dependent (e.g., income projection) variable and (2) the independent variables. Polynomial regression can be used to fit a regression line to a curved set of data points. Contrary to the implications of its name, the curvilinear regression method uses a linear model to fit a curved line to a curved set of data points. Curvilinear regression uses various transformations of variables to achieve a fit to the regression line.

Multiple Regression-Based Extrapolation Method

Regression analysis is a quantitative procedure to assist in the estimation of functional relationships between quantitative variables. The analyst is attempting to predict the value of the Y variable given a specific value for the X variable.

By using regression analysis, the analyst can determine whether a relationship exists between the dependent and independent variables. A regression analysis will indicate both (1) the direction of change and (2) the amount of the change that can be expected in the dependent variable when the independent variable changes. Regression analysis also provides the means of assessing the magnitude of the sampling error of the dependent variable estimate. In other words, regression analysis may be used to make statistical inferences.

Since income projections may be quite complex, accuracy in the estimation of the dependent variable can often be achieved only if more than one explanatory variable is considered in the analysis. For example, the royalty rate paid to license a patent for a new pet care product may depend on several factors, including, (1) the exclusivity of use in a specific territory, (2) the price of the new pet care product in relation to the price of competitive products, (3) the market penetration of the subject patented product, and (4) the profitability of the patented product.

In multiple regression analysis, the dependent variable is linearly related to a set of explanatory or independent variables, as illustrated in the following equation:

$$Y = ß_0 + ß_1X + ß_2X_2 ....+ ß_kX_k$$

where:

Y	=	the dependent variable
$X_1, X_2........X_k$	=	the independent variables
$ß_0, ß_1, ß_2.......ß_k$	=	the parametric regression coefficients

Most multiple regression analyses with two or more independent variables involve too much calculation for a simple calculation. For this reason, the analyst will use a computer model that is designed for multiple regression analysis. A computer model can assist the analyst in projecting income for an intellectual property where two or more explanatory variables predict the value of a dependent variable. It may be helpful to refer to a principles of statistics textbook for a more in depth discussion of all of the factors involved in multiple regression analysis.

Extrapolation and regression analysis use historical observations to estimate future trends. These methods can be useful in projecting income related to an intellectual property value/damages/transfer price analysis. These statistical estimation methods, however, require a rigorous analysis of (1) each income projection variable and (2) the relationship of each variable to each other variable.

These statistical methods represent one set of tools an analyst can use to project the intellectual property income potential. As discussed below, there are a variety of nonstatistical methods an analyst can use to project income potential.

Tabula Rasa Methods

Tabula rasa is a Latin term that means "clean slate." The idea of tabula rasa derives from the 4th century BCE Greek philosopher Aristotle, who said, "The mind is a clean tablet upon which experience writes."

During the economic analysis (particularly a development stage property), the analyst may be presented with a tabula rasa. Let's assume, for example, that the subject analysis is to value a copyright that will be licensed or sold by the owner/developer to a third party. The copyright covers the content of video tapes and training manuals on how to operate a health club.

In the initial meeting with the owner/developer, the analyst learns that the owner never commercialized the copyrighted materials. In fact, there is no historical or projected financial information related to the subject intellectual property. The copyrighted materials were used exclusively by the owner/developer for internal training purposes with regard to the owner's health club. Nonetheless, the intellectual property owner/developer believes that the copyrighted materials could be commercialized in the health club industry and generate rental/royalty income.

The analyst is now faced with the question of where to begin. In this situation, there is effectively a clean slate. There is no income history and no available income projections related to the subject intellectual property.

The first procedure may be to conduct extensive discussions with the owner/developer. Next, the analyst may interview the health club employees who have used the copyrighted materials for internal training purposes. The analyst may begin the investigation with questions such as:

1. What are the intellectual property rights subject to analysis? What are the intellectual property components and functional attributes of the property?
2. What are the operational and/or economic benefits of the intellectual property to its the current owner? Are those benefits different from the benefits available to a third party buyer or licensee? Are those benefits different from the benefits expected by typical participants in the general marketplace for such an intellectual property?
3. What effect will a certain set of circumstances or events have on the utility of the intellectual property? How would the utility of the intellectual property change in response to changes in market conditions?
4. How is the utility of the intellectual property expected to change over time? Will it change at a slow and predictable pattern or will it change suddenly, based upon a particular event? What events could cause a change in the utility of the intellectual property? What is the expected operational and/or economic life of the intellectual property? How is that expected useful life measured? What are the operational/economic consequences of a longer or shorter useful life?
5. Should the subject intellectual property be analyzed as an individual, or discrete, economic entity? Or, should the subject property be analyzed as an integral part of a larger economic entity—for example, as part of a going-concern business enterprise? Does the utility of the subject intellectual property depend on the use of other assets or on the operation of a business enterprise?
6. What is the highest and best use of the intellectual property? How can the property's highest and best use be defined? How can a third-party buyer or licensee achieve the highest and best use of the intellectual property? Will there be an adequate economic return on the required investment by a third-party buyer or licensee?
7. What is the reasonable sale price, license fee, royalty rate, or transfer price for ownership or use of the subject intellectual property? Will the reasonable sale price/license fee be different for different potential buyers/licensees? Will the reasonable sale price/license fee be different for different potential uses of the subject intellectual property?

While this list of questions is not exhaustive, it gives the analyst a starting point for understanding the intellectual property and the factors that may affect its value.

The next procedure is to understand the marketplace in which the intellectual property will be used. The analyst should perform a detailed review of the industry in which it will operate. In particular, the analyst should consider all of the commercialization opportunities available within the industry. These commercialization opportunities include licensing the subject intellectual property through (1) geographic expansion—that is, in new territories; (2) industry expansion—that is, into new industries; and (3) product/service expansion—that is, into new products or services.

The analyst should examine the appropriate marketplace to determine if comparative intellectual properties have been commercialized. If so, the analyst may be able to gather information about the comparative properties in order to formulate income scenarios for the subject intellectual property.

Now that the analyst's "clean slate" is filling up with data and research, the next procedure is to use the data and research to prepare an income projection.

The analyst will likely use one or more of the income projection methods that will be discussed later. For example, the analyst may use product life cycle analysis. Such an analysis would be based on information obtained (1) from discussions with the owner/developer and/or (2) from research of comparative intellectual properties currently in the marketplace.

The analyst may use sensitivity analyses to test data and develop the best case, worst case, and most likely case scenarios with regard to income projections. The analyst may use simulation methods, such as Monte Carlo analysis, to test interrelated assumptions so as to determine their effect on value. The analyst may also use judgmental methods, such as rules of thumb to test the reasonableness of the income projection.

The tabula rasa method requires rigorous investigation and detailed questioning of the owner/developer and the users of the subject property. This is because the analyst is starting with a clean slate—that is, there is little or no historical information regarding the income-generating capacity of the intellectual property. This method may be combined with the other methods discussed below to assist the analyst in preparing an income projection.

Life Cycle Analyses

All intellectual properties are associated with some product or service. That product or service is the source of the economic benefits by which value can be measured. Therefore, it is necessary to associate the intellectual property with a product or service. The expected life of that product or service is an important variable to the estimation of intellectual property value.

First, the process of estimating the product/service life involves identifying all of the factors that bear on its income-producing life in a given competitive environment. Second, the process involves making a judgment as to which factors increase or decrease the product life/service and, thereby, increase or decrease the property's value.

Product life cycle theory assumes a typical pattern containing the five distinct stages listed below:

1. invention/development
2. introduction
3. growth
4. maturity
5. decline

During the introductory stage, sales volume is usually low. And the price of the product or service is usually high. Consumers may not be well informed as to the benefits associated with the new product/service, and a consumer education process may be required. Once proved, the product/service gains acceptance in the marketplace, and increased sales volume is generated. Product/service production techniques are improved as economies of scale from larger production volume are achieved.

With patent or other intellectual property protection, above-average profits can be expected from the product/service. Without patent protection, competitive pricing pressures during the growth stage may deteriorate the above-average profit margins that are typically enjoyed during the introductory stage. At the maturity stage, the overall market for the product/service is well established. At that stage, further market penetration by the product/service is expected to be slow.

At the maturity stage, competitive pricing pressure becomes significant, unless there is patent or other intellectual property protection. The decline stage can begin as advances in technology introduce new product or other intellectual property service offerings that erode demand for the established product/service. Competitive pricing pressure and reduced consumer demand can cause the product/service to take on the economic characteristics of a commodity.

Of course, few products/services exactly follow such a prescriptive cycle. And, the length of each stage in the product life cycle can vary from (1) as little as 18 months, as in the case of a consumer fad like the Pet Rock to (2) over 100 years, as in the case of gasoline-powered automobiles.

The term of the typical intellectual property life cycle varies (1) by industry and (2) by product/service. In addition, industry-specific innovations, customer market needs, and the level of competition may change during the intellectual property life cycle. Also, the function of the intellectual property may also change during its life. For example, the Coffee-mate brand of coffee whitener was originally developed as a powder for those unable to keep milk refrigerated. Later on, Coffee-mate was reformulated into a liquid form to meet the needs of weight-conscious coffee drinkers who prefer a milk substitute.

When estimating income, the analyst should consider both (1) the entire product life cycle and (2) the current stage of the product/service in its life cycle. For example, the analyst should consider: Is the product/service in a fast growing, introductory stage or in the crowded, commodity-oriented, decline stage? And, the analyst should consider how long the product/service will stay in each stage?

Sensitivity Analyses

Regardless of the type of valuation/damages/transfer price analysis, it is always difficult to project future events. And, the farther into the future the analyst projects, the less accurate these projections are likely to be. To help identify and quantify possible projection errors, analysts often conduct sensitivity analysis. In these sensitivity analyses, analysts change the assumptions underlying the subject income projections. Generally, the sensitivity analysis will result in "optimistic," "most likely," and "pessimistic" projections. A sensitivity analysis of these alternative projections can be synthesized into an overall income projection.

A sensitivity analysis can also be used to identify the elements of risk that are (1) most important and (2) least important to the analysis of the economic analysis. The income projections often serve as the foundation. The sensitivity analysis often aids in simplifying the analysis assumptions. In addition, sensitivity analysis is a useful tool for anticipating how a change in one analysis variable may affect other analysis variables in a complex income projection.

Income projections may vary significantly in response to changes in some parameters and may not vary very much in response to changes to other parameters. For example, a 20 percent change in the projected product/service unit price may result in a significant change in the income projection. On the other hand, a 20 percent change in projected advertising expense or R&D expense may have very little impact on the income projection.

The mathematical procedures for an income projection sensitivity analysis are simple. First, the analyst changes one variable in the income projection model and obtains a new income projection result. Second, the analyst records each new income projection result in order to generate a table listing the range of possible income projections.

There is one practical drawback to the type of sensitivity analysis where one analysis variable is changed while all other analysis variables are held constant. This drawback is that this is not a realistic premise in most income projections. As mentioned earlier, in the development or commercialization of intellectual properties, there are few truly linear relationships among the valuation variables. The true influence on an individual analysis variable depends on its interaction (or correlation coefficient) with all other analysis variables.

The Monte Carlo method described next accommodates this particular practical drawback. In a Monte Carlo analysis, all analysis variables are held constant—while each individual variable varies to change the income projection outcome.

Simulation Analyses

The Monte Carlo method is often used in an income projection sensitivity analysis. In each Monte Carlo simulation, one or more analysis variables are changed. An income projection is prepared based on each individual simulation. A probability is assigned to each individual simulation. And, the final income projection outcome is the mathematical expectation (i.e., the weighted average) of the results of each simulation. Monte Carlo simulation is particularly useful in predicting the overall outcome of a series of related events when the probability of each component event is known.

Accordingly, the Monte Carlo analysis can be used to assist in the projection of intellectual property income. In each simulation, the analyst will create a scenario by changing such projected variables as: revenue, cost of goods sold, depreciation expense, income taxes, and rate of return. In each simulation, all the analysis variables are simultaneously adjusted according to individual probability distributions.

The product of the various simulations is an overall distribution of possible income projection outcomes. However, the Monte Carlo method involves time-consuming and costly calculations. And, use of the Monte Carlo method is constrained by the difficulties in establishing the necessary probability distribution.

The name "Monte Carlo" was coined during the Manhattan Project of World War II. This name was selected because of the similarity of statistical simulation to games of chance. At that time, Monte Carlo, the capital of Monaco, was the center of gambling in the world. In this analogy, the "game" is the income projection, and the analyst may "win" a solution for the particular projection problem.

To understand how Monte Carlo analysis works, let's consider a valuation analysis where the analyst uses Monte Carlo analysis in the discounted cash flow projection. Let's assume that we will value a trade secret using the discounted cash flow method. Let's further assume the following:

1. No current income projections are available regarding the trade secret.
2. Historical financial information exists regarding the use of the trade secret, but the historical information does not indicate a stable trend of income.

3. Both historical revenues and expenses related to the trade secret seem to fluctuate within a range.
4. Expected long-term growth rates are better estimated by a range than by a single point estimate.

Monte Carlo analysis can address these income projection issues. The parameters of the income projection variables are defined independently by year, using a triangular shaped distribution in which the "best" estimate is weighted in the distribution. Random variables are generated independently for each variable for each period. The pattern of each variable may vary. For instance, revenues may be high in one year, low in the next, then low again, and so forth. By running many trials, and by compiling the results, Monte Carlo analysis offers insight into the distribution of possible trade secret values.

Monte Carlo analysis allows a range of values for each variable (i.e., revenues, cost of sales, operating expenses, etc.), with the best estimate for each variable weighted more heavily. The model then generates random values for each variable from within a range, following the same probability distribution as the input range for each variable. The model then calculates a quantitative result based on the particular collection of values for each variable in that specific trial. The range for each variable is identified as low, best, and high.

The selection of the range of possible values for each variable depends on the nature of the data. When owner/operator projections for each variable are not available, then the mean and the standard deviation of each variable is typically based on historical data.

Judgmental Methods

Depending (1) on the commercialization history of the subject intellectual property or (2) on the state of the industry in which the property is used, there may not be enough data either to develop an historical trend or to develop a pro forma income projection. Also, even in cases where adequate information is available, the analyst may not have enough time to generate a detailed comparison of alternative income projections.

In such instances, simple "rules of thumb" methods may be useful tools for the preliminary analysis of an intellectual property. The rules of thumb often distill the actual economic value drivers into a simplified relationship. Often, an experienced analyst can use a rule of thumb to prepare a preliminary value estimate. Of course, the experienced analyst will have to rely on practiced judgment to assess the reasonableness of the rule of thumb.

The analyst should confirm that the so-called "rule of thumb" is both (1) widely accepted in the subject industry and (2) ultimately extracted from (albeit simplistically) empirical transactional data. It is noteworthy that rules of thumb will not withstand a contrarian examination in a court of law. In addition, the results of a rule of thumb analysis would not be appropriate as the basis for decision making regarding an actual investment, transaction, or financing arrangement.

Nonetheless, let's consider the illustrative use of a rule of thumb. Let's say there are three new copyrighted software products at Research-Tech. The company is negotiating a license of its newly developed products with Market-Tech, a major software marketing company. The orientation of Research-Tech is more toward academic research and computer software development than it is toward marketing. On the other hand, Market-Tech's specialty is the marketing and distribution of the software products on a global basis. Research-Tech is trying to estimate the appropriate profit split related to the transfer of its product copyrights to Market-Tech.

One often-cited norm, or rule of thumb, for calculating royalties is the so-called "25 percent criterion." This rule of thumb states that the majority of the incremental profits created by the license, or about three quarters, ought to go to the licensee—while the licensor should receive royalties totaling 25 percent of the incremental profit.

The rationale for this rule of thumb profit split is because the licensee company, in this case Market-Tech, makes the capital investment, carries the heat of the marketing battle, and bears the investment risk. The licensor, it is argued, is only the passive collector of royalties and fees—should the venture succeed. The licensor's risks are limited to receiving no royalties in the event of failure.

The fact remains, however, that such rules of thumb have no economic basis. They have no theoretical justification apart from the observation that the party that bears the higher risk (Market-Tech in the above example) should be eligible for a larger share of the incremental value created by the intellectual property transfer. In actual practice, the facts and circumstances surrounding the license agreement will determine if the split is 25/75 percent or 40/60 percent.

Summary and Conclusion

The income approach is often used to estimate future economic benefits in intellectual property value/damages/transfer price analyses. There are many individual methods available within the income approach. All of these methods, however, involve some type of income projection.

The income projection methods include statistical methods such as regression analysis, qualitative methods such as the rule of thumb methods, and many other alternative methods. Which income projection method, or combination of methods, should be used will depend on: (1) the facts and circumstances of the assignment, (2) the analyst's professional judgment, and (3) the quantity and quality of available data regarding the subject intellectual property.

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