A New Twist on Old Tricks: DuPont Expansions for Public Entities

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ABSTRACT

The typical managerial accounting or business finance textbook includes a discussion of the DuPont expansion as a subtopic in the presentation of financial ratios. Such expansions offer a convenient mechanism to decompose return on equity into ratios which highlight profitability, risk, and efficiency measures as an explanation of the overall return. Advanced forms of the DuPont expansion also permit the decomposition of returns into operating returns and financial returns. Unfortunately, over time many of these textbooks have eliminated the step-by-step calculations that lead to the final breakdowns and instead merely offer the final relationship. While this may be acceptable for many applications of the DuPont expansion, it limits the ability of business school graduates to apply the concept to new situations. This oversight is corrected for a particular public entity, the forensic crime laboratory, for which a different return on investment measure must be considered. It is demonstrated that the inclusion of more detail surrounding the basic calculations in accounting and finance textbooks presents a better opportunity for the development of critical thinking skills as managers apply techniques to new sectors for which the different objective functions guide managerial decisions.

INTRODUCTION

The decision to review the DuPont expansion technique as an application to the public sector was born of practicality rather than the result of a theoretical treatise. In recent years, the popularity of various television programs and cinematic depictions (e.g., *CSI* and *The Bone Collector*) has placed a great deal of attention on forensic sciences and their role in the criminal justice system. The veritable explosion of novels, television shows, and movies has heightened public awareness of laboratories and increased the expectations of judges and juries regarding the capabilities of science to provide irrefutable evidence in the determination of innocence or guilt. Those increased expectations have been matched by increased demands on laboratory services, yet have not been supported with corresponding increases in laboratory funding. Thus, the notoriety has heightened the severity of the economic problem for laboratories as they attempt to do more with less.

Two recent studies on the effectiveness and efficiency of forensic crime laboratories have presented the challenge for the business world to show the forensic industry how to manage its resources to best address the seemingly unlimited desires for its services. A European study QUADRUPOL (European Network of Forensic Science Institutes, 2003) began the process with an examination of four national laboratories. This groundwork study has been expanded with the

FORESIGHT study of North American laboratories (Houck, Riley, Speaker, & Witt, 2009). These studies each began with the collection of data on casework, financials, and personnel data and have asked the question as to how to use this data to guide the management of their resources. Pondering that question has shown that the answers may be rooted in routine business tools found in the introductory textbooks of accounting and finance that are taught to all business school students. However, the application of those base level business tools has been handcuffed by textbook presentations that overlook the detailed explanation of the arithmetic principles that underlie the final results. Business educators can easily overcome this oversight and create graduates with stronger critical thinking skills and the ability to apply these base skills to the not-for-profit firm or the public organization.[1]

The discussion that follows is organized with the initial introduction of the economic problem faced by the forensic science laboratory. This begins with the detailed description of the problem framed from the QUADRUPOL and FORESIGHT studies. Next, a brief consideration of the various forms of the DuPont expansion are presented, from the simplest form to the advanced DuPont expansion. From those presentations the common arithmetic clue is highlighted. Next, a discussion of the objective functions of the public and not-for-profit organizations is presented and contrasted to the for-profit development of the original DuPont expansion. An alternative measure for return on investment is presented and the technique attributed to DuPont's Donaldson Brown is applied to the specifics of the forensic laboratory. Concluding comments follow and wrap up the discussion with some suggestions for modest additions to current textbook treatments.

FORENSIC SCIENCE ECONOMIC REALITIES

The introductory comments suggest a broad potential interest in the application of ratio analysis to the not-for-profit and government sectors. While the comments that follow have a wider application of these tools,[2] the investigation originated with a specific organization, the forensic crime laboratory, and the discussion that follows will provide focused examples in that environment. Consider the issues addressed by each of two studies, QUADRUPOL and FORESIGHT, and the context for expanding the view of ratio analysis from the for-profit firms to other organizational forms will follow.

The European QUADRUPOL study (European Network of Forensic Science Institutes, 2003) initiated the process of looking at forensic science investigation as an industry to be studied. Forensic laboratories include both public and private laboratories, but the vast majority of laboratories are government facilities. The QUADRUPOL study was a voluntary study of four national laboratories in Europe in which the participating laboratories attempted to create a common nomenclature to describe and measure their functions and to determine industry standard metrics for performance. The data collection included information on casework in several investigative areas along with some budgetary and personnel data.

The National Institute of Justice's FORESIGHT project (Houck, Riley, Speaker, & Witt, 2009) attempted to replicate the European project for a larger sample of North American laboratories and to expand the data collected for much greater detail on laboratory financials, demographics, and a greater level of understanding of human resources employed throughout the laboratories. Once the data was collected, business faculty were consulted for possibilities regarding the evaluation of the data. The intent was the development of tools to enhance the

efficiency and effectiveness of forensic laboratories as they fulfill their role within the justice system.

The first step in the analysis was to identify the objectives of the organizations and seek commonalities to which industry-wide metrics might apply. After an examination of mission, vision, and values of the dozen laboratories in the initial year of the FORESIGHT study, several common themes emerged that led to a listing of goals. The Key Performance Indicators related to these goals are detailed in Speaker (2009a). These common goals permitted the evaluation of performances by individual laboratories to fall into a series of categorical measures similar to the financial ratio metrics described in managerial accounting and business finance textbooks. Some of those ratios, particularly asset management and productivity measures, were identical to what appeared in business textbooks. Measures of risk and profitability, however, needed replacement measures that were better connected with the objective function of a public enterprise.

Once the various metrics were identified, the problem remained as to how to connect this ratio information to overall performance. Typical textbook treatments include warnings to avoid the analysis of financial ratios in isolation because it is easy to manipulate a single ratio at the expense of other ratios and thus suffer unintended consequences.[3] The original DuPont expansions offer a case in point for just this issue. In his original decomposition (DuPont, 2010), Donaldson Brown recognized that it was possible to improve profitability by either higher productivity or by accepting higher risk and it was critical for investors to know the contribution made by each ratio to overall performance. Looking at overall profitability alone could miss the contributions of efficiency and risk.

Could a similar expansion be constructed that would provide a series of interconnected ratios to explain the performance of the forensic laboratory? To answer this question, it becomes necessary first to examine the process by which DuPont expansions have been formulated. Second, a replacement for return on equity must be found that represents the objective of the public laboratory. These are considered in turn through the next two sections.

SIMPLE AND ADVANCED DUPONT EXPANSIONS

Standard introductory textbook presentations of ratio analysis include two familiar DuPont expansions.[4] In the first expansion, return on equity (ROE) is expressed as the product of return on assets (ROA), a profitability/productivity measure and the ratio of total assets (TA) to common equity (CE), which is sometimes called the equity multiplier (EM).[5] Thus, the first DuPont expansion appears as depicted in expression (1).

$$ROE = ROA * EM \tag{1}$$

The second decomposition found in many of these introductory textbooks presents the breakdown of ROE into components representing profitability in the form of the profit margin (PM), the risk measure EM, and the total asset turnover (TATO), an efficiency measure. Expression (2) demonstrates that relationship.

$$ROE = PM * EM * TATO \tag{2}$$

While these expressions are commonly presented in introductory textbooks, it is rare for those same textbooks to take a step back and demonstrate how these relationships were derived.

That in itself is not a problem if the organization under review is a for-profit entity for which ROE represents the appropriate representation of return on investment. But if the examination is made of a not-for-profit firm or a public organization, then ROE is not the appropriate metric and the relationships from (1) and (2) are rendered meaningless. When the demonstration of these steps is skipped in our textbooks or our classroom presentations, an opportunity for extension to other arenas has been lost.

Consider what is gained when the derivations of (1) and (2) are added to our presentations. In each case, the decomposition is obtained by multiplying the definition of ROE by the number one. For the first expression, take the components of ROE equal to Net Income (NI) divided by CE and multiply by the number one in the form of TA/TA.

$$ROE = \frac{NI}{CE} = \frac{NI}{CE} * \frac{TA}{TA} = \frac{NI}{TA} * \frac{TA}{CE} = ROA * EM \tag{3}$$

And for the second decomposition, ROE is multiplied by the number one in two forms, TA/TA and Sales (S) over itself.

$$ROE = \frac{NI}{CE} * \frac{TA}{TA} * \frac{S}{S} = \frac{NI}{S} * \frac{TA}{CE} * \frac{S}{TA} = PM * EM * TATO \tag{4}$$

Further examination of advanced DuPont expansions (Burns, 2008)[6] reveals additional applications of this same technique.[7] And while the advanced DuPont expansion offers a much more complex breakdown as presented in (5), the decomposition was obtained using the same technique. In this expression, RNOA represents return on net operating assets, NFO represents net financial obligations, and NBC stands for net borrowing costs.

$$ROE = RNOA + \left(\frac{NFO}{CE}\right) * (RNOA - NBC) \tag{5}$$

When we fail to present this simple technique, opportunities are lost for the extension of similar analysis to new situations. Business school graduates will know the "punch lines" depicted in (1), (2), and (5), but will have lost the opportunity for the critical thinking extensions offered by (3), and (4).

PUBLIC SECTOR OBJECTIVE FUNCTIONS

Before applying this lesson to the public entity, consider metrics that will permit the measurement of the objectives of a public organization. Whether it is the forensic laboratory described above or another public concern, a general description of the mandate of these organizations is to produce as much of a good or service in its mission as funds permit. An appropriate return on investment relates the output of the public organization to the budget constraint. As a corollary, this maximization of the return on investment is equivalent to the minimization of average cost, the inverse of this ROI.

The difficult part of testing such a measure is coming up with an appropriate measure of the good or service provided by public sector organizations. In the particular case of the forensic crime laboratory, output measurement has been effectively addressed in Speaker (2009b). The QUADRUPOL and FORESIGHT studies defined the work product by investigative area (e.g.,

fingerprint identification, DNA Analysis, Firearms & Ballistics) and the unit of output as a processed case (CASE). For a given budgeted level of total expenditures (TOTEXP), laboratories could be compared within investigative areas as to how high was there ROI = CASE/TOTEXP or how low was their average cost = TOTEXP/CASE.

Secondary objectives include similar concerns to what is found in our familiar for-profit optimizations. As Donaldson Brown noted in the review of DuPont's potential acquisition of a portion of General Motors, there is a need to understand if the greater contribution to a company's returns is the product of higher efficiency or higher risk. The secondary issues for laboratories include concerns over risk, analytical process, market conditions, and productivity. Specifically, ratios would be most helpful to the organization if they reveal information regarding: the maintenance of quality as attention if directed towards lower costs; whether appropriate investment is made by capital expenditures for instrumentation; the realities of the local economic environment; or the productivity of human resources.

DECOMPOSITION OF RETURN ON INVESTMENT

Consider the ROI presented in the previous section and the concerns represented by the secondary objectives. Taken together this suggests that ROI = *f*(quality, analytical process, market conditions, efficiency). Armed with the details of the decomposition technique of the original DuPont expansions, a similar multiplication by the number one in various forms may be applied to arrive at a DuPont expansion for the forensic crime laboratory. Likewise, a similar technique may be applied to any public entity by following a similar process to define the product of service, consider the overall objective, and relate that main objective to the secondary concerns of the industry.

Taking ROI = CASE/TOTEXP as the starting point, Speaker (2009b) demonstrates that multiplying this measure by full-time equivalent employees (FTE) over itself, total labor expenditures (LEXP) over LEXP, and the number of tests performed (TEST) divided by TEST will yield a meaningful breakdown as is derived in equation (6).

$$ROI = \frac{CASE}{TOTEXP} * \frac{TEST}{TEST} * \frac{FTE}{FTE} * \frac{LEXP}{LEXP} = \frac{\frac{TEST}{FTE} * \frac{LEXP}{TOTEXP}}{\frac{LEXP}{FTE} * \frac{TEST}{CASE}} \quad (6)$$

This decomposition highlights each of the secondary factors as they contribute to the overall performance. It shows that return on investment improves if either numerator term is higher; that is, workers are more productive (higher TEST/FTE) or more resources are diverted towards present period needs (higher LEXP/TOTEXP at the expense of capital expenditures towards future production). Additionally, ROI improves if either denominator term decreases; namely, the laboratory has a lower average compensation (LEXP/FTE) or the laboratory is willing to risk quality via a lower testing intensity (TEST/CASE).

CONCLUSIONS

As more information is added to introductory courses, it is inevitable that some previously included items will be cut to make room for the additions. Combine that pressure with the temptation to avoid quantitative detail that may be of questionable value and it is easy to

see why some presentations have been abbreviated or eliminated altogether. The caution issued here involves a specific example of the DuPont expansion, a topic found in most introductory managerial accounting and business finance texts. Because the emphases of these courses tends to be with the for-profit world, it may appear that little has been lost when the analytical process has been removed from presentations in favor of the final relationship. While the loss is minimal for the application in the for-profit environment, the loss is severe when it comes to application to not-for-profit and government organizations. And, even though that oversight may be addressed in specific courses, such as government accounting, the lessons are lost to the more general business school populations for whom the only exposure is through base level courses.

ENDNOTES

[1] Common applications in the not-for-profit sector include the health care sector for which there are a large number of examples that might be considered. See for example (Love, Revere, & Black, 2008) or (Brooks, 2008).

[2] Articles dealing with the business of the forensic laboratory are few and far between with minimal attention to the accounting or finance issues of these entities. One of the few is (Koussiafes, 2004).

[3] See (Bielski, 2007) or (Milbourn & Haight, 2005) for more regarding the keys to ratio analysis in the overall evaluation of performance.

[4] Consider, for example, (Brigham & Houston, 2010) or (Gitman, 2009).

[5] Alternatively, the ratio TA/CE may be called a leverage ratio. The term equity multiplier is chosen here to avoid confusion with the leverage ratio measure in the advanced DuPont model.

[6] Alternatively, see (Halsey, 2001).

[7] Additionally, higher level textbook treatments provide additional detail on the advanced DuPont model. See for example (Lundholm & Sloan, 2007).

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