

# THE INVALIDITY OF PROFIT=F(PRODUCT QUALITY) PIMS VALIDATION OF MARKETING GAMES

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## ABSTRACT

*Research that purports to validate simulations should itself be valid. A current stream of research puts forth as game validation criteria “laws” drawn from the Profit Impact of Market Strategies (PIMS) project. One PIMS-based “law” is that the most important determinant of company performance is product quality. The present study invalidates that PIMS profit=f(product quality) criterion based on empirical findings from the PIMS project itself, PIMS companies being nonrepresentative, the ultimate infeasibility of simulating fundamental PIMS concepts and executions, and the invalidity in several vital respects of the methodology applying that invalid “validation” criterion.*

## INTRODUCTION

Research that purports to validate simulations should itself be valid. This fundamental requirement is not met by a stream of purported business game validation research based on the Profit Impact of Market Strategies (PIMS) project that has been given prominence by the Association for Business Simulation and Experiential Learning (ABSEL) and by the premier journal, *Simulation & Gaming*. Here, the third study in that stream is shown to be invalid, the evidence for that invalidity being found mainly in the PIMS project itself. Faria and Wellington (F&W, 2005b, p. 118) uncritically and invalidly found their purported validation on this quote: “In the long run, the most important single factor affecting a business unit’s performance is the quality of its products and services, relative to those of competitors.” (Buzzell & Gale 1987, p. 7) This profit=f(product quality) premise, though, is demonstrably not the “universal law” that F&W (p. 120) and others claim. Invalidation of F&W “validation” criterion here is based on PIMS concepts and definitions, PIMS-based empirical studies, and the invalidity in several vital respects of F&W’s methodology.

## INVALID PRECURSOR STUDIES

Four ABSEL papers (Green & Faria 1995, Faria & Wellington 2004, Faria & Wellington 2005b, Wellington & Faria 2006) and two *Simulation & Gaming* articles (Neal 1999, Faria & Wellington 2005a [republishing the 1995, 2004, and 2005b ABSEL papers]) have been published purporting to validate simulation games against PIMS

criteria. Neal (1999) is a replication and extension of Green and Faria (1995).

Green and Faria (1995) derived their criterion from a conclusion they attribute to Schoeffler (1993). Ostensibly, “...80 percent of the variance in a company’s performance can be explained by its environment” (p. 34). They interpret Schoeffler’s finding to mean that the effectiveness of a marketing strategy is largely independent of competitors’ strategies. In other words, “...successful strategies in a particular marketplace/economic environment will continue to be successful in similar environments—even if competition is changed” (p. 34). Subsequently, Neal (1999) seemed to confirm “...the results of Green and Faria in that the strategies continued to be successful in an environment with different competitors” (p. 118). Those researchers’ interpretation of PIMS, however, is incorrect. Schoeffler (the originator of PIMS) himself makes clear the correct meaning: “When we try to understand the variance between [very profitable and very unprofitable businesses], the laws of the marketplace account for up to 80 percent of that variance. This means that the characteristics of the served market, of the business itself, *and of its competitors* constitute about 80 percent of the reasons for success or failure...” (Schoeffler 1983, p. 23-4, italics added). Schoeffler’s (i.e., the PIMS) “marketplace” does not exclude competitors, as interpreted by Green and Faria (1995) and Neal (1999); the marketplace expressly includes competitors. This fact is sufficient to invalidate the competitor-independence criterion for simulation game validation. Abundant complementary evidence, including at least 36 published empirical PIMS-based studies finding statistically significant relative-to-competitor effects, of that criterion’s invalidity is presented in Dickinson (2003).

A second (invalid) PIMS criterion was prescribed by Faria and Wellington (2005b). They quote Buzzell & Gale (1987, p. 8): “Market share and profitability are strongly related.” (p. 333) and add, “...it would be easy to examine the market share/profitability relationship that occurs in simulated competitions to check whether the outcomes conform to the PIMS findings.” (p. 333) However, at least 14 published empirical studies—a majority of them using PIMS data—demonstrate that profit is *not* related to market share. See Dickinson (2006) for references and additional contradictory evidence.

The present study establishes the invalidity of F&W’s (2005) profit=f(product quality) ostensible validation criterion.

## PIMS-BASED CONTRADICTIONARY EVIDENCE

Buzzell and Gale's (1987, p. 7) gross generalization—which constitutes F&W's invalid prescription—nonwithstanding, there is an abundance of empirical evidence *within the PIMS data base* that product quality is *not* the most important determinant of company performance, some of that contradictory evidence published by Buzzell himself. (Robert D. Buzzell was an early research director of the PIMS project.) “In contrast to previous studies, our [PIMS-based] findings indicate that product quality *does not have a consistently direct effect on business unit ROI*...Overall, this implies that, at least in some businesses, product quality is *not intrinsically valuable* and plans or strategies aimed solely at the attainment of a high quality position may be ill conceived. (Phillips, Chang, & Buzzell 1983, p. 41, italics and bold added) “Looking first at results for  $H_1$ , it may be seen that higher relative product quality has a direct positive influence on ROI in only three of the six types of businesses studied.” (Phillips, Chang, & Buzzell 1983, p. 26)

For PIMS consumer goods businesses (the predominant type of business in contemporary simulation games), Jacobson and Aaker (1985, p. 19) found ROI to be negatively related to relative quality (multiple regression coefficient -0.005, not significant). Woo and Cooper (1981) divided PIMS companies into product-market-industry clusters. Discriminating between effective (ROI  $\geq 20\%$ ) low market share ( $\leq 20\%$ ) businesses and ineffective (ROI  $\leq 20\%$ ) low market share businesses, for their cluster III they found ROI to be negatively related to relative product quality (p. 311). Based on 460 PIMS businesses that “...resemble those of the entire data base...” (p. 122), Wagner (1984) concluded, “...even substantial shifts in relative product quality...do not much affect the odds of ROI improvement.” (p. 127)

Numerous PIMS-based studies have found ROI to be positively related to relative product quality, but also product quality being far from the most important explainer as F&W put forth. In Woo and Cooper's cluster VI, relative product quality was the tenth most important variable discriminating between effective and ineffective low market share companies (1981, p. 311). Hawkins, Best, and Lillis (1987) found relative product quality tied for the fifth most important explainer of their “marketing productivity” index for PIMS consumer durables companies and tied for sixth most important for PIMS consumer nondurables companies.

PIMS and other evidence (see “Then There Is Reality” below) clearly establishes that the profit=f(product quality) relationship is not a “principle” or “marketplace law” or validation criterion to which simulation games should be held.

## NONREPRESENTATIVENESS OF PIMS COMPANIES

That companies comprising the PIMS data base are a nonrepresentative sample is widely recognized. “These [i.e., PIMS] companies obviously do not constitute a representative sample of all business firms.” (Buzzell 1981, p. 45) “The participating [PIMS] firms are not representative...” (Jacobson & Aaker 1985, p. 13) All of the (invalid) PIMS-validation-criteria publications (see “Invalid Precursor Studies” above and Table 1 below) would have simulation games be validated against a PIMS-professed nonrepresentative sample of businesses.

## PIMS-INVALID UNIT OF ANALYSIS

F&W illustrate the application of their PIMS-invalid product quality criterion using the *Compete* (Faria, Nulsen, & Roussos 1994) marketing game. F&W label their unit of analysis thusly: “Each participating *Compete* company is divided into three SBUs. One product line SBU of each company sells large screen televisions (TSTs), a second SBU produces and sells computerized video editors (CVEs), while the third SBU produces and sells a laser game line of products (SSLs).” (p. 119) F&W's SBUs are defined on the basis of product line only and their analyses are, accordingly, of these individual product lines plus, in some unspecified manner, the three combined (see F&W, Table 1, p. 120). (Note that the three *Compete* products are consumer durables, one of the industries where Phillips, Chang, and Buzzell [1983] found ROI to *not* be directly related to relative product quality.)

PIMS, however, does not recognize strategic business units *per se*. By PIMS definition, the concept of business unit is inextricably a function of both the business and its target customers or “served market.” Specifically, “A business unit, according to the PIMS definition...serves a clearly defined set of customers, in a reasonably self-contained geographic area...The reasoning behind this definition is that it represents the smallest subdivision of a company for which it would be sensible to develop a distinct, separate strategy.” (Buzzell & Gale 1987, p. 32, italics theirs) “The served market is a central concept in all of our analyses...” (Buzzell & Gale 1987, p. 33, italics added).

F&W's SBUs do not reflect (1) the “clearly defined set of customers” or (2) the “self-contained geographic area” requirements of the PIMS definition (though these are typically present in the structure of contemporary games). See “PIMS-Invalid F&W Rationale” and “PIMS-Invalid Aggregation Over Served Markets” below. More sweepingly, the ignoring of the vital PIMS “served market” element is alone sufficient to invalidate all of the published works listed in Table 1.

**Table 1: PIMS Invalidation of Published Works on the Basis of SBU Definition**

PIMS-Invalid “Validation” Criterion	“The served market is a central concept in all of our analyses because...”
Profit=f(market share) (Faria and Wellington 2004)	A business unit’s <i>market share</i> is measured in relation to its served market...
Independence of strategy effectiveness from competitors’ strategies (Green and Faria 1995, Neal 1999, Faria and Wellington 2005a)	The identity and market shares of leading <i>competitors</i> are determined by the scope of the served market.
Profit=f(product quality) (Faria and Wellington 2005b)	Assessments of the <i>relative quality</i> of a business unit’s products and services are made in relation to competitors in the served market.”
	Buzzell and Gale 1987, p. 33, italics theirs

**PIMS-INVALID DEFINITION OF PRODUCT QUALITY**

In the context of the game they used to illustrate the application of their PIMS-invalid profit=f(product quality) criterion, F&W state that, “[*Compete*] Companies could improve the quality of their products through successful R&D efforts.” (p. 119) Otherwise, there is no indication that anything but the *Compete* index of product quality was used in their analyses. That index, as is also the case with the *NewShoes* (Terpening, Helgeson, & Ursic 2004, p. 35) and *Marketing Management Experience* (Dickinson 2006a, p. 6-2) games, is a single numeric variable the value of which increases with increasing expenditures on research and development. Tractable as such a simple index may be, it bears no resemblance to the PIMS measure of relative perceived product quality; i.e., it is PIMS-invalid.

First, the PIMS protocol requires managers to estimate perceived product quality on behalf of their customers! Second, manager-on-behalf-of-customer estimates of perceived product quality are not for individual products, but for some amorphous group of product lines grouped together in no particular specified manner. The product quality indices in the three games just cited are for individual products, e.g., “The product quality report identifies the current product quality level for each of your products...” (Faria, Nulsen, & Roussos 1994, p. 68) PIMS company managers do not estimate product quality for individual products. Third, the PIMS product quality measure in fact is not a measure of the quality of products, but of *sales* (as a percent of business unit sales) of “superior” products minus *sales* of “inferior” products. (Phillips, Chang, & Buzzell 1983, p. 27; Buzzell & Gale 1987, p. 105; Hawkins, Best, & Lillis 1987, p. 4)

**INFEASIBILITY OF SIMULATING PIMS PRODUCT QUALITY**

It seems infeasible, if not altogether impossible, that PIMS perceived relative product quality could ever be captured in a simulation game. PIMS would require that game participants estimate product quality as perceived by target customers. But on what basis would such estimates be founded?

As stated above, PIMS product quality is estimated by company management. In today’s business simulation games—e.g., *NewShoes*, *Compete*, the *Marketing Management Experience*—management is *informed* of product quality, management does not estimate product quality: “You [the game participant] will be notified whenever a product improvement occurs.” (Faria, Nulsen, & Roussos 1994, p. 37) In future business games, it may be feasible to have game participants estimate (rather than be informed of) their product quality. However, it is questionable that those estimates could be in any meaningful way incorporated into a game’s software algorithms. Capturing F&W’s invalid criterion using PIMS-valid management estimates would mean that game managers could improve their profit just by high-balling their estimates of product quality! In reality there is a disconnect between (even PIMS company) management’s estimate of product quality and product quality that in fact operates in the market environment. Simply, any real market environment is oblivious to management’s estimates.

It might be argued that in simulation games profit should be related to product quality regardless of how the latter is operationalized. That, however, would be to divorce the criterion from PIMS, the ostensible source of the criterion.

## A PIMS-INVALID PARAMETER VALUE

The cornerstone (and only) hypothesis tested by F&W is, “H1: Product quality and company ROI will be strongly and positively correlated (Pearson’s  $r > .5$ ) in a simulation game competition.” (2005b, p. 119) Further, from F&W (2005b, p. 119): “The selection of Pearson’s  $r > .5$  is based on the assertion by Buzzell and Gale (1987, p. 7) that product quality and ROI are strongly correlated and on Cohen and Cohen (1983, p. 61) who state that Pearson’s  $r$  values of .50 or more are considered ‘strong effect sizes’...”

As just quoted, F&W provide a specific citation—Buzzell and Gale (1987, p. 7)—for their hypothesis. There is no statement by Buzzell and Gale (1987, p. 7) to the effect that product quality and ROI are strongly correlated (much less that they are correlated at a bivariate correlation value of 0.5).

Moreover, whatever the specific parameter value F&W imagine to have been stated by Buzzell and Gale, Buzzell and Gale clearly make their gross qualitative observation regarding the importance of product quality in the context of multivariate analyses, not bivariate correlation analyses. Their Appendix B (1987, pp. 273-284) presents 12 multiple regression models in which relative product quality is specified along with 21 additional explaining variables. Cohen and Cohen (1983, p. 61) make their statement relating correlation values with qualitative labels of small, medium, and large (not “strong,” despite F&W’s use of quotation marks) in their Chapter 2, “*Bivariate Correlation and Regression.*” (italics added) Buzzell and Gale do state that “...relative perceived quality and profitability are strongly related” (1987, p. 107). F&W’s interpretation that Buzzell and Gales “strongly related” equates to Cohen and Cohen’s large bivariate correlation is invalid. Buzzell and Gale do not make the “strongly correlated” statement in the first place and any conclusions Buzzell and Gale may offer are clearly based on multivariate analyses and not the bivariate type of analyses of Cohen and Cohen.

Multivariate analyses, such as the many PIMS multiple regressions, of course, are founded on intercorrelations among all variables, intercorrelations which are not reflected in a single bivariate correlation. For the present PIMS-invalid  $\text{profit} = f(\text{product quality})$  criterion, the importance of recognizing collinearity is underscored by the material and statistically significant correlation between relative product quality and relative sales force expenditures (0.25), relative advertising/promotion expenditure (0.39) and relative % sales new products (0.37) Phillips, Chang, & Buzzell (1983, p. 39, Table 7) report for consumer durables businesses.

In a correlation matrix for major profit influences over the entire PIMS data base, Buzzell and Gale (1987, p. 276) report a bivariate correlation value of 0.27 between product quality and ROI. But even adoption of that bivariate correlation as a validation parameter for simulation games would be folly.

## THE (PIMS) FOLLY OF ANY SINGLE PARAMETER VALUE

As documented above, there is no basis in PIMS for F&W imposing on simulation games a validation criterion of any bivariate correlation between return on investment and product quality and, further, no basis in PIMS for F&W’s specific and invalid specification of a bivariate correlation value of 0.5. The bivariate correlation value of 0.5 is without basis in PIMS.

More generally, no single parameter value is likely to be somehow valid across the gamut of real business environments and, accordingly, across games simulating those real businesses environments. Consider the many multiple regression analyses presented by Buzzell and Gale (1987, pp. 273-284) in their Appendix B. Several of the analyses estimate regression models for various subsets of the PIMS database. One such analysis (p. 277) compares consumer product manufacturers, industrial product manufacturers, and service and distribution companies. The estimated regression coefficient for relative quality for consumer manufacturers is 0.05, for industrial manufacturers is 0.13, and for service and distribution companies is 0.25. All coefficients are statistically significant. Clearly, though, the effect of relative product quality on return on investment varies substantially from one type of industry to another, for example the service and distribution coefficient (0.25) being five times greater than the consumer manufacturers coefficient (0.05). It is clear from within the PIMS data that *any single parameter value* for the effect of product quality on profitability is invalid.

## INVALID STATISTICAL HYPOTHESIS TEST

F&W illustrate the application of their invalid criterion by reporting Pearson bivariate correlations and statistically testing those correlations (2005b, p. 120). Four correlations—for each of three individual products and one for all of the products combined—are reported and tested. They observe that “The results shown in Table 1 indicate that three of the four correlations between the SBU’s relative product quality and ROI were significant...While the correlation between relative product quality and ROI is highly significant within the TST and SSL SBUs, it is only moderately significant within the CVE SBU.” (2005b, p. 120)

The specific conceptual hypothesis posed by F&W (p. 119) stipulates “Pearson’s  $r > .5$ ” as the population correlation to be tested. Yet the actual statistical test conducted by F&W via SPSS P.C. Version 10 (p. 120) was not of a 0.5 population parameter, but of zero. Three of the four correlation values in F&W’s Table 1 (p. 120) are less than 0.5. Had F&W conducted the appropriate statistical test—a one-tailed test of a 0.5 population parameter— $p$ -values for those three correlations would have been *greater than fifty percent*. Specifically, the respective correct  $p$ -values for the four correlations are 0.012 (correlation=.576), 0.684

(.470), 0.999+ (.119), and 0.999+ (.230). For three of the four tests, the theorized Pearson correlation of at least 0.5 would very conclusively have *not* been supported.

### **PIMS-INVALID F&W RATIONALE**

Regarding the single one of the four reported correlations that is actually statistically significant, F&W rationalize that, “While the relationship between product quality and ROI was strong overall across all companies and SBUs, when examining outcomes within SBUs the findings vary...This may not be surprising, nor is this finding contrary to those reported by PIMS. PIMS does not report findings within similar industries, but reports findings across all companies regardless of products sold or markets served.” (2005b, p. 120)

As with nearly every aspect of their several invalid published studies, this interpretation of PIMS is patently incorrect. The PIMS unit of observation is a strategic business unit (including the vital “served market” element as explained above), not the company or F&W’s “All SBUs.” “The unit of observation in PIMS is a strategic business unit...” (Schoeffler 1983, p. 23-2) Jacobson and Aaker (1985) used PIMS data to debunk the profit=f(market share) marketplace “law” put forth (invalidly, see Dickinson 2006b) by Faria and Wellington (2004). “PIMS data are based on reports of over 2,000 business units that are components of the over 200 corporations participating in the PIMS project.” (pp. 12-13) That is, on average in the PIMS data base there are approximately 10 SBUs per reporting company and it is data for those great many SBUs, not companies, that is the basis for PIMS analyses.

As to F&W’s claim that PIMS does not report findings within similar industries, in fact PIMS defines eight distinct industry types: consumer durable goods, capital good, industrial components, consumer nondurable goods, supplies, raw/semi-finished raw materials, services, retail distribution (Abell and Hammond 1979, p. 292). Even the most casual perusal of PIMS-based publications reveals findings reported separately within each of these industry types (e.g., Buzzell & Gale 1987, p. 277, Buzzell & Wiersma 1981a and 1981b, Farris & Buzzell 1979, Jacobson & Aaker 1985 and 1987, Phillips, Chang, & Buzzell 1983). “When one examines the impact of the various explanatory variables on ROI, it quickly becomes apparent that the impact differs from group to group.” (Schoeffler 1978, p. 113)

### **PIMS-INVALID AGGREGATION OVER SERVED MARKETS**

F&W’s product-line SBUs are PIMS-invalid as is their aggregating their product-line SBUs to a company-wide level. Their analyses, too, do not distinguish among the three market areas comprising the *Compete* marketplace:

“Importantly for you as the marketing managers of your companies, the lifestyle differences that exist

across your three market areas, as discussed here, have resulted in differing product, price, and promotional preferences within each of the regions. As such, it is necessary for your company to develop a unique marketing mix for each region. In other words, a marketing strategy that works well in one region, may not work well in another. Treat each region as a separate, or unique, market segment.” (*Compete* manual, 2006, p. 15 underline theirs).

“...we say that each business unit in a company should have its own distinct, separate strategy...” (Buzzell & Gale 1987, p. 32) F&W’s aggregating data across the *Compete* market areas is PIMS-invalid.

### **QUESTIONABLE AGGREGATION OVER TIME**

F&W analyzed data from 152 simulation companies and explain that, “Given 152 student simulation companies there were 456 potential SBUs available for analysis [since there are three potential SBUs per company]. However, five of the companies elected not to market the SSL line meaning that data for only 451 SBUs were available for analysis.” (p. 119) The correlations in Table 1 (p. 120) for all SBUs combined, indeed, are reportedly based on 451 observations, with roughly one-third that number of observations for the respective separate SBUs. From this information, each simulation company appears only once in the data analyzed by F&W.

*Compete*, though, is a longitudinal game; a competition progresses across several periods. There are profit (ROI) and product quality values for *each* of the competition periods. F&W do not mention the multiple-period characteristic of a *Compete* competition. More pointedly, they do not describe how data for the multiple periods were somehow distilled into a single observation for each company. Possibly F&W aggregated or averaged the multiple-period values resulting into a single set of values for each company. The PIMS project prescribes no such aggregation or averaging and in this respect, additionally, F&W’s “validity” criterion is PIMS-invalid. Possibly F&W used, say, only final competition period data, thereby ignoring a large majority of available data.

### **PIMS-INVALID INVESTMENT**

F&W’s definition of investment: “...each *Compete* firm begins with an equal level of plant and equipment (valued at \$50 million on each firm’s beginning balance sheet) and this was designated as each firm’s total investment...” (p. 119) In PIMS, though, investment is defined as plant and equipment (net) plus working capital (net). (Buzzell & Gale 1987, p. 37) F&W’s definition (1) does not account for depreciation and (2) does not include net working capital. Accordingly, F&W’s definition of ROI is PIMS-invalid.

**THEN THERE IS REALITY**

The reality of the marketplace is that McDonald's and Ruth's Chris Steak House coexist and both are successful. Swatch and Rolex coexist and both are successful. There are countless examples of lower quality products, services, and enterprises that are profitable. Perhaps the most prominent example is Wal-Mart, the world's largest retailer (US\$312.4 billion sales in 2005, *Detroit Free Press*, April 20, 2006, p. 2A) and the largest private employer in the United States (1.3 million employees, *Detroit Free Press*, April 26, 2006, p. 2E). While unarguably successful, Wal-Mart fairs poorly in customers' ratings of product quality compared with five other discount retailers. A survey of 31,000 *Consumer Reports* subscribers ranked Wal-Mart 4.5/6, 3.5/5, 4.5/5, 3/4, 3.5/4, 5/6, 5.5/6, and 5/6 across eight product categories, respectively (July 2002, p. 12). By F&W's invalid marketplace "law" Wal-Mart cannot exist. By F&W's PIMS-invalid criterion, there is no place in simulation games for the lower quality yet profitable strategies that are everywhere in the real world.

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