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Richard B. Carter
Iowa State University, rbcarter@iastate.edu

Troy J. Strader
Drake University, Troy.Strader@drake.edu

John J. Rozycki
Drake Univiversity, john.rozycki@drake.edu

Thomas H. Root
Drake Univiversity, TOM.ROOT@DRAKE.EDU

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Richard B. Carter

Iowa State University, rbcarter@iastate.edu

Troy J. Strader

Drake University, troy.strader@drake.edu

John J. Rozycki

Drake University, *john.rozycki@drake.edu*

Thomas H. Root

Drake University, *tom.root@drake.edu*

Abstract

Academic studies investigating the financial management of companies routinely segment data by broad industry groups to facilitate an "apples to apples" comparison and remove possible industry effects. One common segmentation method is to group all information technology (IT) companies into a single category. However, not all IT companies are created equal and their financial management differs greatly due to differences in cost structure, growth potential, products delivered, and general business model. In this study we address the differences between mature publicly-traded digital product and service (DPS) firms and information technology product (ITP) firms using equity market data from 1991-2011. We compare the characteristics of the two firm types and find that DPS firms are significantly less risky, less reliant on physical assets, and outperform the ITP firms. We also find that the market returns for ITP firms are more reactive to costs than DPS firms, yet the reaction to revenue changes appear to be similar. The overall conclusion is that DPS and ITP firms are different and should not be combined into a general information technology category when analyzing their financing needs or strategic decision making. Ignoring these differences will lead to inappropriate or misleading conclusions.

Keywords: Financial Management segmentation, Information Technology companies, Industry effects.

1. Introduction

Academic studies investigating the financial management of companies routinely segment data by broad industry groups to isolate the impact of business model differences such as cost structure, capital structure, impact of market risk, and other characteristics that differ by industry. This segmentation is intended to facilitate an "apples to apples" comparison of the impact of financial management decisions by removing possible industry effects. One common segmentation method is to aggregate group all information technology (IT) companies into a single category. However, not all IT companies are created equal and their financial management differs greatly due to differences in cost structure, growth potential, products delivered, and general business model. For example, a single IT category would result in a company manufacturing computer monitors being considered similar to an online auction company. This ignores the fact that manufacturing computer monitors involves significant variable cost per unit (materials and labor) as well as inventory and distribution costs, where an online auction company has no inventory and incurs very little cost to add new users once the website and support services have been established. The aggregation of all IT related firms into one category also ignores the impact of network externalities where the size of a network (user base) has a profound impact on the value new users receive when joining a large established online marketplace or community (Katz & Shapiro, 1985). Our study demonstrates that differences in the operational and financial characteristics of information technology products (ITP) and digital products and services (DPS) companies create the need to further segment the industry when conducting analysis of the financial management of IT related firms.

The literature contains numerous examples where over aggregation of the IT industry into one category may have hampered the effective applicability of the study's conclusions by ignoring important financial and operational differences across IT firms. There has been a long standing bias in the literature to simply segment IT firms from other industries, failing to recognize that differences in start-up costs, operational cost structure, and the importance of network externalities across IT firms has a significant impact on their financial management. The bias to ignore these differences is not a recent phenomenon and examples can be found throughout the literature.

Schultz and Zaman (2001) examined the actions of firm managers, underwriters, and venture capitalists to determine their motives for taking an Internet company public. The study identified a large sample of Internet firms that went public in the late 1990s and compared them with traditional company IPOs during the same time period. Internet firms were defined as companies that made most of their money online or by providing services to support other online business activities; it did not distinguish between the two. The study could have been extended to address the question of whether the decisions to go public differed for online service firms and IT product firms because they have significantly different cost structures and growth strategies.

Several additional studies of the same era also fail to differentiate between online service and product firms. Schill and Zhou (2001) compared investor valuation of Internet subsidiary carve-outs with that of the parent. They identified examples where the value of Internet carve-out holdings from a parent company exceeds the value of the entire parent by a large amount. Their sample was predominately composed of online service firms. Demers and Lewellen (2003) examined the impact of IPO underpricing on website traffic for Internet firms. The study did not distinguish between online service and product firms.

Ofek and Richardson (2003) investigated the rise and fall of Internet stock prices using a sample of 400 Internet sector firms. The Internet related firms in the sample included portals, infrastructure providers, online retailers, consultants, financial services, marketing and advertising services, and B2B commerce companies. Combining these firms into one broad category ignores the possibility that service-related Internet firms, and online product firms, may have exhibit different patterns for their stock prices during the unique Internet growth period in the late 1990s to early 2000s.

Gollotto, J. C., and Kim, S. (2003) empirically examined whether the ratio of research and development (R&D) spending to total sales had an impact on valuation of dot-com companies demonstrating that a higher ratio signals greater future growth potential. The sample of dot-com companies included both service and product firms. We believe that R&D for an IT product firm will differ quite significantly from the R&D costs associated with online services. If so, the results may have been the product of differences in R&D spending due to differences in business model, not growth potential. It would have been more insightful to investigate if the same pattern held true within different IT segments, or if differences in R&D were the result of differences in the business model.

More recently, Aoun and Heshmati (2008); Bruinshood and de Haan (2010) both conduct studies related to the capital structure of IT firms. Aoun and Heshmati utilize a sample of 1763 NASDAQ listed firms to examine the relationship between capital structure and the cost of capital. They specifically point to unique characteristics of the information and communication technology (ICT) sector such as strong network effects to justify their

segmentation. However, they do not recognize that the importance of network effects differs across the universe of ICT firms. The positive benefit of network externalities is much more pronounced for DPS firms than ITP firms. Failure to segment the data to account for this difference potentially diminishes the applicability of their results. Bruinshood and de Haan investigate the relationship between capital structure and historical market to book ratio for a sample of 754 firms from three countries. They segment their data into two types of firms, information and communication technology (ICT) and non ICT firms. Finally, Klobucnik and Sievers (2013) empirically test a valuation model for fast growth tech firms. They define their sample based upon the definition developed by Bhojraj and Lee (2002) that includes all biotechnology, computer, electronics, telecommunications, and computer programing and data processing firms.

We segment ITP firms from and DPS firms and demonstrate that there are fundamental differences in the financial characteristics of these firms which can make identical expectation analysis for both types problematic. We compare established firms in the two categories to identify differences in market risk, costs, market returns, and market reaction to increases (or decreases) in the number of shares available.

In the following sections we discuss the theoretical background for the study and identify testable hypotheses. We then describe the sample of ITP and DPS firms used in the study and the data collected for each type of firm. We conclude with a discussion of the results and provide a summary of study findings and identify some directions for future research.

2. Information Technology Products vs. Digital Products and Services: Theoretical Background and Hypotheses

In this section we discuss three critical differences between ITP and DPS firms: (1) initial investment fixed costs and ongoing variable costs, (2) revenues and relationships to costs, and (3) network externalities. Failure to acknowledge these differences when studying the financial management of IT firms lessens the knowledge gained and can potentially lead to incorrect conclusions related to the effective financial management of IT firms.

ITP firms are similar to traditional manufacturing firms producing, tangible products. They incur additional investment in tangible assets (property, plant and equipment) to enable them to increase their production capacity. Variable costs per unit remain relatively stable over time given that each product unit requires a certain amount of materials and labor. Owing to the tangible nature of its products, ITP firms also have to deal with significant investment in inventory and distribution costs. DPS firms, on the other hand, produce intangible products or services that can be delivered in a digital format (Hui and Chaun, 2002). They incur a large proportion of their total costs early on to either develop a software product or implement an online service. If the firm survives this initial introductory phase, it then enjoys the benefits of very low marginal costs as they expand their user base. In other words, DPS firms can be characterized as having more dramatic economies of scale demonstrating decreasing average costs as they expand their user base. Firms in both categories have significant up-front fixed costs, but DPS firms incur a higher proportion of their total costs for their initial up-front fixed cost investment. Low production and distribution costs are a key characteristic of online services and digital/information goods that impacts firm decision making and industry structure (Bakos, 1991; Bakos, 1998; Benjamin & Wigand, 1995; Rayport & Sviokla, 1995; Strader & Shaw, 1997).

ITP and DPS firms are also different in the timing of revenue and the relationship between revenues and costs as they grow. Given the tangible nature of their products, ITP firms should demonstrate a stronger relationship between their growth in costs and growth in revenue. Ceteris Paribus, the more units they produce, the more potential sales revenue they receive, but there is also additional investment in equipment. While they may have a small profit margin early on, inherent economies of scale allow the profit margin to increases sales growth. DPS firms may receive some revenue early on, but it is unlikely to cover their large initial investment. The binary, success or failure, characteristic of DPS firms makes them very risky early on. However, for those firms that are able to establish a large user base, the risk profile changes dramatically and subsequent return on investment can be very high. DPS firms are much more able to take advantage of the positive benefits associated with economies of scale as there is little additional investment as sales revenue grows. The negative or small initial profit margin will expand rapidly as increased sales are accompanied by extremely low additional costs. Overall, DPS firms can be viewed as being very risky early, but potentially producing high returns for those firms that establish a larger user base and survive the period where they are attempting to recover their initial investment.

Network externalities also play an important role in differentiating between the DPS and ITP firms and can have either a positive or a negative effect on firms (Srinivasan, Lilien, & Rangaswamy, 2004). Positive network externalities exist when the utility a consumer receives from using a product or service increases as the number of

other users increases (Katz & Shapiro, 1985). For example, the value of Twitter at its introduction was low because few people used it, but the value increased quickly as the system became more widely adopted. In many instances, the more current users a DPS firm has, the greater the utility received by the next user. While network externalities can benefit some ITP firms, it appears to be more important for DPS firms that do not produce a physical product. Srinivasan, et al. (2004) find that network externalities present a roadblock for new entrants, decreasing their survivability. However, network externalities increase survivability for "technologically intense" products and larger firms, and those with an installed base of customers. It has also been found that it is difficult to dislodge the incumbent in industries with positive consumption externalities and market lock-in once a critical mass of loyal consumers is reached (Viswanathan, 2005).

A potential consequence of markets with network externalities is the winner-take-all phenomenon (Yamamoto et al., 2002). For a number of reasons only a limited number of firms may provide the product/service that becomes the dominant design while the others have a very difficult time surviving. Given the size of eBay in the online auction industry, it is very difficult for newer smaller firms to directly compete against it. And once one product/service starts to become the dominant choice among users, its success accelerates as new users are more compelled to choose it because of its greater perceived utility. Though a number of firms may enter the market, only a limited number will succeed - relegating losers to *technology lockout* (Schilling, 1998). Research shows, with differences in cost structures and/or network externalities, the probability of success or failure can hang on the vagaries of consumers (Srinivasan et al., 2004).

The all-or-nothing nature of firms in the DPS industry is a product of high initial investment coupled with low operating costs as they grow. The role this cost structure plays in their survival is demonstrated by research on the timing of initial public offerings in the industry. There is a point where the separation of winners and losers occurs in the life cycle of DPS firms. Carter, Strader and Dark (2012) show that there is an optimal time for an initial public offering (IPO) and it is generally before the point where the winners and losers begin to separate. But after this separation, winners have gone public, received sufficient revenue to recover some of their early fixed investment costs, and can more or less "cruise." Losers will struggle and eventually disappear – with or without an IPO. For ITP firms, production of a physical product or service relies heavily on a constant array of inputs resulting in ongoing investment in property plant and equipment and variable operating costs. Even when ITP firms find it difficult to maintain a strong client base, they may still have the opportunity to adjust their inputs and increase their efficiency. Because of this ability to adjust, a point where winners and loser separate is not as inevitable as it is with DPS firms. The important overall point, however, is that the characteristics of successful DPS firms differ in many ways from the characteristics of successful ITP firms even though they are in a similar point in their life cycle. It is at this point that we conduct our analysis.

Given the discussion above, expected differences between mature DPS and ITP firms are described in the following hypotheses related to risk, firm characteristics, returns, and reaction to changes in shares outstanding. We use the term "mature" to describe established firms in these industries.

Mature DPS firms have developed and implemented their product/service, recouped the investment needed for their initial start-up, have very low operating or variable costs, and typically have a strong user base. Given these advantages we expect that DPS firms will be less risky compared to their ITP counterparts. DPS firms will have significantly lower levels of ongoing investment in fixed costs associated with new property plant and equipment needed to increase production. DPS firms will also have greater ability to cover their short-term obligations which do not increase with sales. These differences are described in the first four hypotheses.

Mature DPS firms have several advantages over mature ITP firms. They have very low operating costs, sales and/or transaction fee revenue coming from an established user base, and may also provide increased value to their customers as they grow and add new users. This leads to the first hypothesized difference between DPS and ITP firms.

H1. Mature DPS firms are less risky than mature ITP firms.

As described above, mature DPS firms have significant cost advantages over their ITP counterparts. The per unit operating costs are very low so the proportion of their total costs associated with variable costs is also very low. This means that a high proportion of total costs will be fixed. This leads to the following hypothesis.

H2. Mature DPS firms have higher fixed cost to total cost (FCTC) ratios than mature ITP firms.

Unlike mature DPS firms, ITP firms continue to require machinery, materials, and labor to produce their products as they grow. They must also have the capacity to pay for these ongoing costs. These differences are described in the following two hypotheses.

H3. Mature DPS firms have lower property, plant and equipment (PP&E) costs than mature ITP firms.
H4. Owing to the absence of tangible product inventory, mature DPS firms have lower current ratios than mature ITP firms.

Mature publicly-traded DPS firms have survived the initial difficulties of implementing their product/service and establishing a user base. The less successful DPS firms have most likely disappeared. Mature ITP companies will have varying levels of success. Therefore, investors should expect better overall performance (capital gains plus dividends) for the mature DPS firms which leads to the following hypothesis.

H5. Mature DPS firms outperform mature ITP firms.

ITP firms need capital to finance the expansion of their production capabilities. The market will scrutinize each of these projects to assess their potential to increase profits and improve competitive positions and market share. Large, established DPS firms do not require significant new resources to meet the needs of an expanding user base. Therefore, it can be expected that when ITP firms issue new shares there will be a potentially greater market reaction. Revenue characteristics, on the other hand, are similar for both firm types. ITP firm growth will lead to increases in sales and revenues. Increases in the number of DPS users will also increase their revenue through sales or transaction fees. Differences in ITP and DPS resource needs, and similarities in the revenue importance, lead to the final three hypotheses addressed in this study.

H6. The market reaction to share issuances by mature DPS firms is expected to be less than that of mature ITP firms (mature DPS firms also have fewer stock issuances).
H7. Mature DPS firms and mature ITP firms react similarly to changes in revenues.
H8. Mature ITP firms issue shares to pay for PP&E costs. Ceteris Paribus, the increased investment in PP&E will result in ITP firms issuing more shares.

3. Data

Given the goal of looking at established or mature firms, our sample started with firms with information technology-based products and services that issued an IPO before 1991 and survived for the next 21 years through 2011. This period encompasses years with both strong and weak overall financial markets and includes the emergence of a number of e-commerce firms, the dot.com bubble, and the recession of 2008. We found 113 DPS and ITP firms that were listed in the Compustat database that had Economic Sector Codes of 8000 (Information Technology). We then separated those firms that produced a physical product from those that primarily provided a digital product or service. The need for equity should be a critical decision and funds would be less likely to be left in cash. Because our hypotheses imply the need for equity is related to the implementation of projects, we isolated firms that sold additional stock. By examining the prospectus for each increase in equity in the Security and Exchange Commissions' EDGAR data base we were able to eliminate any increase related to stock splits or stock dividends. Using the EDGAR data base, we identified the primary product/service for each firm. The 113 firms included 52 ITP firms and 61 DPS firms, and yielded 2,373 firm-years.

The remaining data is from two additional sources: Standard and Poor's Research insight (Compustat) and the Center for Research in Security Prices (CRSP). EDGAR provides founding and IPO dates as well as other data missing from the other sources such as the impending equity sales. Compustat provides accounting data such as property, plant and equipment, book values, cost of goods sold, revenues, dividends, operating expenses, current assets, current and long-term liabilities, and total assets.

From CRSP we obtained individual firm equity share totals and monthly stock returns as well as the monthly market returns. From these data we calculated the annual change in equity shares due to issuances, the market adjusted return (MAR), and the standard deviation of MAR. MAR is the annual raw return for each firm less the contemporaneous CRSP equally-weighted market return and averaged over the period of study.

The following items are estimated at the beginning of the study: book-to-market ratios, long-term debt/total liabilities, property plant and equipment/total assets, the current ratio and dividends/share. The market

beta, the coefficient from a least-squares regression where the dependent variable is a chronological series of stock returns for the subject firm and the independent variable is the contemporaneous returns from a market portfolio, is estimated over using monthly returns over the five year period immediately preceding 1991. Both changes in equity shares and the fixed cost to total costs are annual averages. Descriptive statistics are provided in Table 1.

Table 1. Descriptive Statistics for
52 Publicly-Traded Information Technology Product (ITP) Firms and
61 Publicly-Traded Digital Product and Service (DPS) Firms
January 1, 1991 to December 31, 2011

(1)	(2)	(3)	(4)
Variables	Mean	Standard Deviation	Median
Panel A: Characteristic Variables			
Market Beta	0.62	0.66	0.65
Book-to-Market Value	0.59	0.53	0.65
Long-Term Debt/Total Liabilities	73%	29%	87%
Average Annual Change in Equity Shares	3%	4%	2.1%
Property Plant and Equipment/Assets	31%	18%	26%
Current Ratio	67%	25%	73%
Average Fixed Cost to Total Costs	81%	18%	88%
Market Adjusted Return (MAR)	15%	11%	10%
Dividends per Share	$0.31	$0.31	$0.21
Panel B: Control Variables			
Number of Shares (millions)	444.41	380.84	61.5
Market Value (millions)	$7,861	$6,711	$1,290
Total Assets (millions)	$133.60	$280.60	$42.60
Years: Founding to IPO	7.23	25.98	2
Standard Deviation of MAR	22.83	13.85	20

4. Methods and Results

Our earlier discussion indicates that digital product and service (DPS) firms and information technology product (ITP) firms differ in some key characteristics. As a first examination we compared the means and distributions for the characteristics using difference in means and Wilcoxon rank-sums tests – we also included the control variables in the analysis. The non-parametric test is included because of size differences in the samples and to control for the possibility that the distributions are non-normal. The results are found in Table 2 where the t-statistics and Z-statistics are found in columns (4) and (5), respectively. The results for the characteristic variables are found in Panel A and for the control variables in Panel B.

Table 2. Differences in Means and Distributions for
52 Publicly-Traded Information Technology Product (ITP) Firms and
61 Publicly-Traded Digital Product and Service (DPS) Firms
January 1, 1991 to December 31, 2011

(1)	(2)	(3)	(4)	(5)	(6)
Variables	Mean DPS Firms	Mean ITP Firms	Difference DPS-ITP	t Statistic[1]	Z Statistic - Wilcoxon Rank-Sums
Panel A: Characteristic Variables					
Market Beta	0.58	0.66	-0.08	1.95 **	1.8 *
Book-to-Market Value	0.64	0.53	0.11	2.09 **	2.04 **
Long-Term Debt/Total Liabilities 1991	84.10%	59.90%	24.20%	0.68	3.36 ***
Long-Term Debt/Total Liabilities 2011	82.40%	82.60%	-0.20%	-39	0.84
Average Change in Equity Shares	2.88%	3.23%	-0.35%	-0.21	1.42
Property Plant and Equipment/Assets	26%	37%	-10%	3.15 ***	3.15 ***
Current Ratio	57%	79%	-22%	5.08 ***	4.52 ***
Average Fixed Cost to Total Costs	85%	78%	7%	-2.02 **	1.32
Market Adjusted Return (MAR)	19%	11%	8%	2.02 **	1.74 *
Dividends per Share	$0.34	$0.28	$0.06	$0.97	$1.34
Panel B: Control Variables					
Number of Shares (millions)	501	381	120%	0.52	2.2 **
Market Value (millions)	$8,877	$6,711	$2,166	0.6	1.97 **
Total Assets (millions)	$134	$133	$1.41	0.4	1.06
Years: Founding to IPO	7.72	6.68	1.04	0.21	0.89
Standard Deviation of MAR	23.67%	21.89%	1.78%	0.68	1.08

[1]Significance at the 10%, 5% and 1% levels is indicated by 1, 2, and 3 asterisks, respectively.

As we predict that the established DPS firms are less risky than the ITP firms (H1), both the market beta (B) and the book-to-market (BTM) ratios provide significant support. B for DPS firms is lower than that for ITP firms (0.58 to 0.66) while their BTM ratios are significantly higher (0.64 to 0.53). The lower risk also should have a positive effect on the ability of DPS firms to raise long-term debt as a percentage of total liabilities (LTD). While this is born-out by the higher LTD for DPS compared to ITP firms early in the study (84.1% to 59.9%), the difference had completely dissipated by 2011 (82.4% to 82.6%). This may be an indication of the need for ITP firms to fund and recover both investment ("fixed") and operating ("variable") expenses over time.

Given the tangible nature of the ITP firms' products, we argue that they have larger levels of property, plant and equipment to total assets (PPE), higher current ratios (CUR), and lower fixed costs to total costs ratios (FCTC) than DPS firms (H2 – H4). In general, the results in Table 2 confirm these arguments. As predicted, PPE and CUR ratios for ITP firms (37% and 79%, respectively) significantly exceed those for the DPS firms (4% and 47%, respectively) at better than the 1% level of significance - for both the parametric and non-parametric statistics. Moreover, the difference in FCTC for DPS (85%) and ITP firms (78%) is consistent with a DPS firm struggling to gain market share. It may reflect a "cruising" state for mature DPS firms following the successful launch of online products and services. Having established themselves as the winner in a war for online customers, they have

received sufficient revenue to offset their initial investment and are anticipating the next innovation. However, there is no significant difference in the average change in equity shares (ΔSHRS) for ITP firms and DPS firms (3.23% to 2.88%) which indicates that neither firm type necessarily requires large increases in shares.

In an attempt to add further insight into the results for ΔSHRS we have included a graph in Figure 1. The figure is a comparison of the percentage change in PPE to the percentage change in ΔSHRS over the years of the study. The ratios for ITP and DPS firms are represented by the dashed and solid lines, respectively. The figure indicates that ITP firms are using equity to fund their increases in PPE.

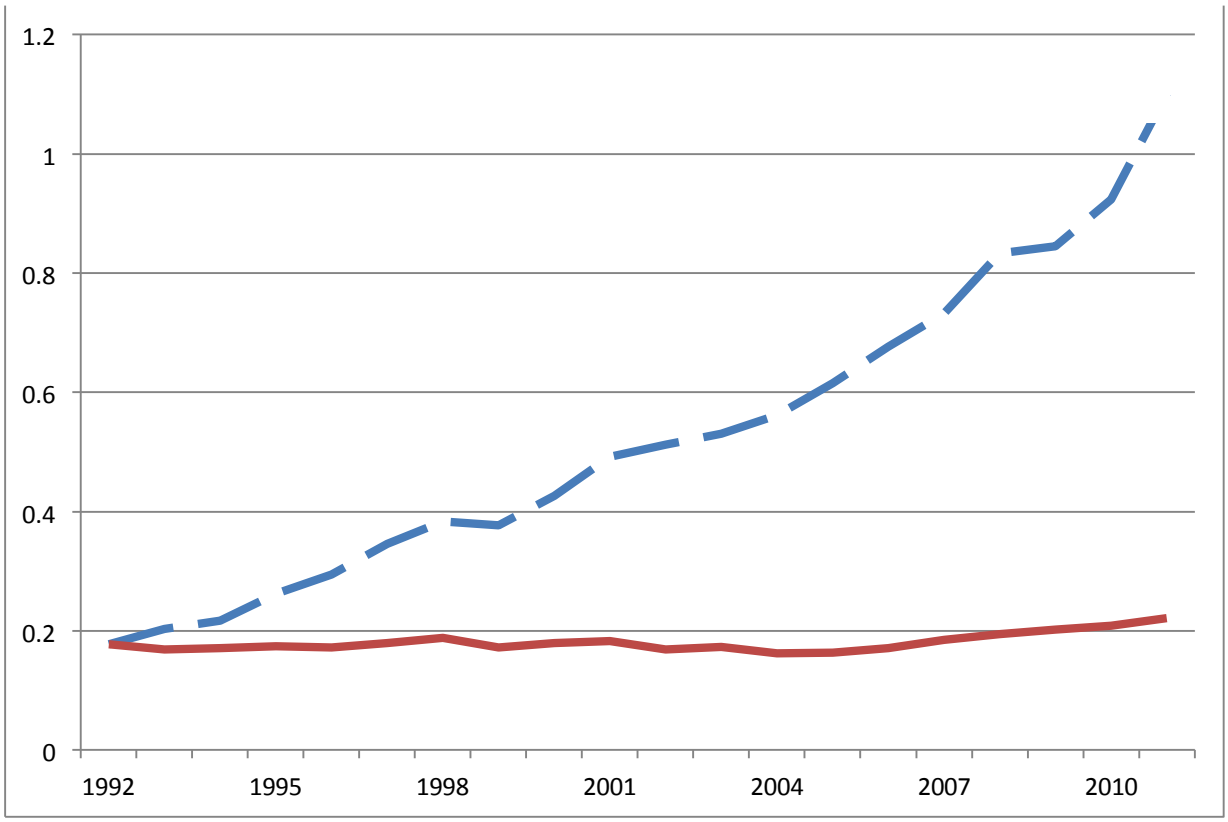

Figure 1. Ratio of Property, Plant & Equipment to Equity Shares for
52 Publicly-Traded ITP Firms and 61 Publicly-Traded DPS Firms
January 1, 1991 to December 31, 2011

Finally, in Table 2, we compare the market adjusted return (MAR) and the dividends per share (DIVS) as measures of performance for the mature DPS and ITP firms (H5). While the mean of their DIVS is larger for DPS firms than ITP firms, it is not significant. However, their market performance is significantly better at the 10% level for the Wilcoxon Z statistic and 5% for the t-statistic. DPS firms had a total of 19% MAR over the 21 years compared to 11% for ITP firms. In Figure 2 we display the ratios of the change in market value at the end of each year to the change in equity shares from the previous year for ITP firms (the dashed line) and DPS firms (the solid line). Except for a separation in the later years, the result is remarkably consistent for both firm types.

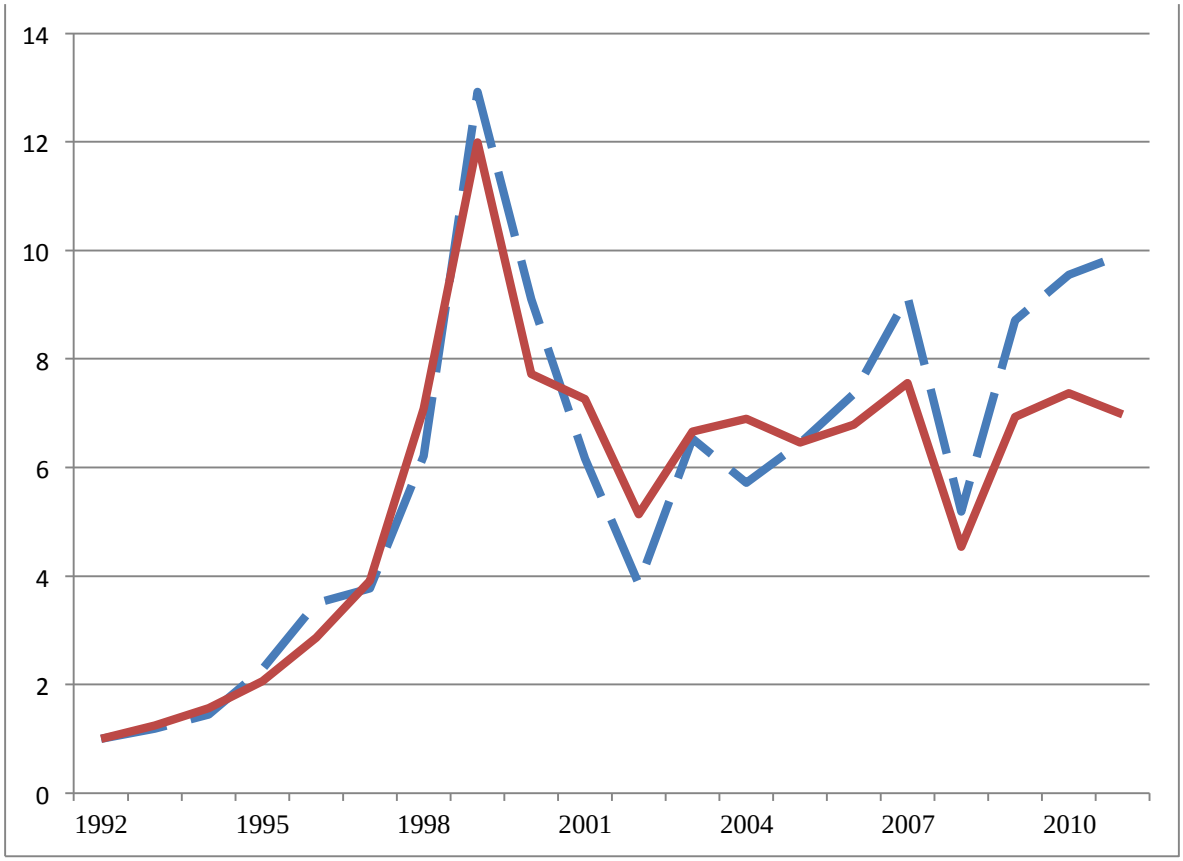

Figure 2. Ratio of the End-of-Year Market Value at Time t to Total Equity Shares Outstanding at Time t-1 for 52 Publicly-Traded Information Technology Product (ITP) Firms and 61 Publicly-Traded Digital Product and Service (DPS) Firms January 1, 1991 to December 31, 2011

In Table 3 we present the results of multinomial logistic regressions. The dependent variable (M3DPS) has three levels, where a two identifies a firm with both a digital service and a digital product, a one identifies those firms with either a digital service or a digital product, and a zero identifies firms with neither a digital product nor a digital service. We separated the diversified DPS firms from the more focused ones because of evidence that diversification may affect strategy (Simmonds, 2006). Moreover, the multinomial approach to a logistic regression was employed due to the nature of categorically distributed dependent variables. A multinomial logit regression assumes that a linear combination of the observed parameters can be used to determine the probability of each of the three outcomes of the dependent variable (Greene, 2002, pp. 740-747). This categorization provides a richer representation of the extent to which firms are involved in digital product and service activities. The first regression, found in Table 3 Column (2), includes results for the following characteristic independent variables: the ΔSHRS, CUR PPE, FCTC and MAR. The empirical model is shown in equation (1):

$$M3DPS=\beta_0+\beta_1*\Delta SHRS+\beta_2*CUR+\beta_3*PPE+\beta_4*FCVC+\beta_5*MAR+\varepsilon, \quad (1)$$

The results of the empirical model appear in Table 3 Column (2). A second regression including the control variables is found in Column (3).

Table 3. Multinomial Logistic Regression Using a Three Level Dependent Variable for
52 Publicly-Traded Information Technology Product (ITP) Firms and
61 Publicly-Traded Digital Product and Service (DPS) Firms
January 1, 1991 to December 31, 2011[1]

(1)	(2)		(3)	
Variables	Test Variables Only		Test & Control Variables	
	Parameter Estimate	X^2 Stat [2]	Parameter Estimate	X^2 Stat
Intercept	6.410	18.5763 ***	4.614	0.32
Intercept	3.370	5.7409 ***	1.378	0.03
Change in Shares from 1994 to 2011	-2.490	6.8733 ***	-2.448	5.78 **
Current Ratio	-4.377	21.0387 ***	-4.265	19.47 ***
Property Plant and Equipment/Total Assets	-3.807	8.9621 ***	-3.647	7.96 ***
Fixed Cost/Total Costs	2.515	5.616 **	2.171	4.00 **
Market Adjusted Return (MAR)	-1.052	1.1361	0.059	0.00
Duration: Founding to IPO Years			0.752	3.14 *
Natural Log Total Assets			0.235	0.04
Standard Deviation of MAR			-1.725	0.34
Likelihood Ratio		46.07 ***		49.08 ***
Wald Score		33.76 ***		35.93 ***

[1] 2 = Firm offers both Digital Service & Product, 1 = Firm offers either Digital Service or Product, 0 = Firm offers neither a Digital Service nor Product

[2] Significance at the 10%, 5% and 1% levels is indicated by 1, 2, and 3 asterisks, respectively.

Both regressions are significant at the 1% levels. Moreover, the results tend to corroborate the findings in the mean/distribution comparison. It appears that DPS firms tend to issue less shares, have relatively less current assets, less PPE, and higher FCTC than ITP firms. However, the superior performance for DPS firms, found in Table 2, has disappeared in the multivariate framework. A second regression contains the characteristic variables described above as well as three control variables: the natural log of total assets at year-end and averaged over the time period, the standard deviation of MAR over the time period for each firm, and the length of time from founding to IPO for each firm. The results of this regression are found in Table 3 Column (3).

The significant results for the characteristic variables in the second regression are consistent with those found in the first regression. However, there is a marginally significant and positive coefficient for the duration in years between a firm's founding and their IPO. This may reflect a more deliberate IPO timing choice for DPS firms than for ITP firms. This provides support for the notion by Carter et al. (2012) that DPS firms are more selective and deliberate in choosing the time to go public.

The next regression described in Table 4 is a piece-wise technique where the dependent variable is the natural logarithm of 1 plus the change in shares (LNΔSHRS). The piece-wise regression is a form of spline function where parameters can be estimated over breaks in the relationship between dependent and independent variables but as a continuous function (Greene, 2002, pp. 121-124). The independent variables include interaction terms with DPS dummy (DD), an indicator variable where a 1 indicates the firm has either a digital product or a digital service, and 0 otherwise. In this way we can assess differences in magnitudes of the relation between LNΔSHR and the characteristic variables for DPS and ITP firms but in a continuous, multivariate framework. We can also tell if

these differences are significant. The independent variables include the characteristic variables CUR, PPE and MAR. We also include DD as a separate independent variable. The empirical model is displayed in equation (2):

$$LN\Delta SHR = \beta_0 + \beta_1 * DD + \beta_2 * CUR + \beta_3 * DD * CUR + \beta_4 * PPE + \beta_5 * DD * PPE + \beta_6 * MAR + \beta_7 * DD * MAR + \varepsilon, \quad (2)$$

The signs and significance of the coefficients β_2, β_4 and β_6 indicate the nature of the relationship between each characteristic variable and LNΔSHR for ITP firms. The coefficients β_3, β_5 and β_7 indicate whether the difference in the relationship for ITP versus DPS firms is significant. Finally, it is the sum of the coefficients β_2 and β_3, β_4 and β_5, and β_6 and β_7 that reveal the sign and significance for the relationship between each characteristic variable and LNΔSHRS for DPS firms. A X^2 test is used to assess the significance of each sum of coefficients ($\beta_2 + \beta_3$, $\beta_4 + \beta_5$ and $\beta_6 + \beta_7$). The results of the regression with characteristic variables is in Table 4 Column (2) and a second regression, including the number of shares outstanding, B, and the interaction term DD*FCVC as a control variable is found in Column (3). It is important to note that the parameter estimates in Table 4 already reflect the summations of coefficients β_2 and β_3, β_4 and β_5 and β_6 and β_7.

Both regressions are significant at the 1% level (F statistics: 6.68 and 4.99) and the adjusted R^2s of 0.31 and 0.30 are reasonable given the range of data and limited sample size. In both regressions the current ratios have a negative and significant sign (at the 5% level or better) for the DPS firms but a positive sign for the ITP firms. Moreover, the change itself is significant. This provides support for hypothesis H4. While PPE is only significantly positive for the ITP firms, the change itself is significant and negative – suggesting, as we propose, that DPS firms do not issue shares to acquire physical assets (H2 and H3). Finally, the relation between MAR and share issuance is significant for both firm types, but again it is positive for ITP firms and negative for DPS firms which implies that markets respond less favorably to share issuance for DPS firms than they do for ITP firms. We believe this is support for H6 that markets treat ITP firm stock sales with greater scrutiny. The only control variable that is significant is the number of outstanding shares. Holding all else equal, the positive and significant sign suggests that firms with more shares are more likely to issue new ones.

The final analysis is a comparison of the impact of revenues and net income for each firm type. We predict that the market reaction to changes in revenues is similar for ITP and DPS firms but the costs are more important for ITP firms (H7 and H8). In Figures 3 and 4, we have displayed the cumulative ratios of MAR to the change in revenues (ΔREV) and the change in net income (ΔNI), respectively. The ITP firms are represented by the dashed lines in both figures. In Figure 3, MAR appears to be very responsive to the ΔREV for both the ITP and the DPS firms. Moreover, the Spearman correlations are 0.35 and 0.39, respectively – both significant at better than the 5% level. Figure 4 reveals that the results for the MAR to the ΔNI are dissimilar. While the ratio for ITP firms has a positive slope as it did for the ratio of MAR and ΔREV, the ratio for the DPS firms is nearly flat. The correlations between MAR and ΔNI are 0.33 and 0.02 for ITP firms and DPS firms, respectively, and only that for the ITP firms is significant (5% level). We would argue that this is support for hypothesis (H8). Issuing shares to finance investment in physical plant is more important for ITP firms.

Table 4. Piece-Wise Least Squares Regression for Change in Equity Shares for
52 Publicly-Traded Information Technology Product (ITP) Firms and
61 Publicly-Traded Digital Product and Service (DPS) Firms
January 1, 1991 to December 31, 2011

(1)	(2)		(3)	
Variable	Test Variables Only		Test & Control Variables	
	Parameter Estimate	t Stat[1] *X^2 Stat*[2]	Parameter Estimate	t Stat *X^2 Stat*
Intercept	-8.647	-1.69 *	-9.369	-2.86 ***
Digital Product & Service Firms (DPS) [0,1] (ON)	12.304	2.18 **	13.655	3.75 ***
Current Ratio: ITP Firms	7.487	1.48	7.722	2.53 ***
Current Ratio: DPS Firms	*-3.329*	*3.91* **	*-3.471*	*3.86* **
Significance: Break in Slope for Firm Types	-10.815	-1.99 **	-11.193	-2.96 ***
Property, Plant & Equipment: ITP Firms	5.729	1.61	5.666	2.11 **
Property, Plant & Equipment: DPS Firms	*-2.702*	*1.26*	*-3.211*	*1.68*
Significance: Break in Slope for Firm Types	-8.431	-1.98 **	-8.878	-2.05 **
Market Adjusted Return: ITP Firms	5.458	1.67 *	5.381	1.27
Market Adjusted Return: DPS Firms	*-2.288*	*3.84* **	*-2.214*	*3.07* *
Significance: Break in Slope for Firm Types	-7.746	-2.25 **	-7.594	-1.63
Shares Outstanding 1991-2011	1.961	2.47 **	2.035	6.76 ***
Years: Founding to IPO			-0.857	-1.15
Market Beta			0.770	0.45
Fixed Cost/Total Costs * ON			-2.218	-1.00
Adjusted R^2	0.313		0.300	
F Statistic	6.68***		4.99***	

[1]Significance at the 10%, 5% and 1% levels is indicated by 1, 2, and 3 asterisks, respectively.
[2]Chi square (X^2) statistics are in bold italics.

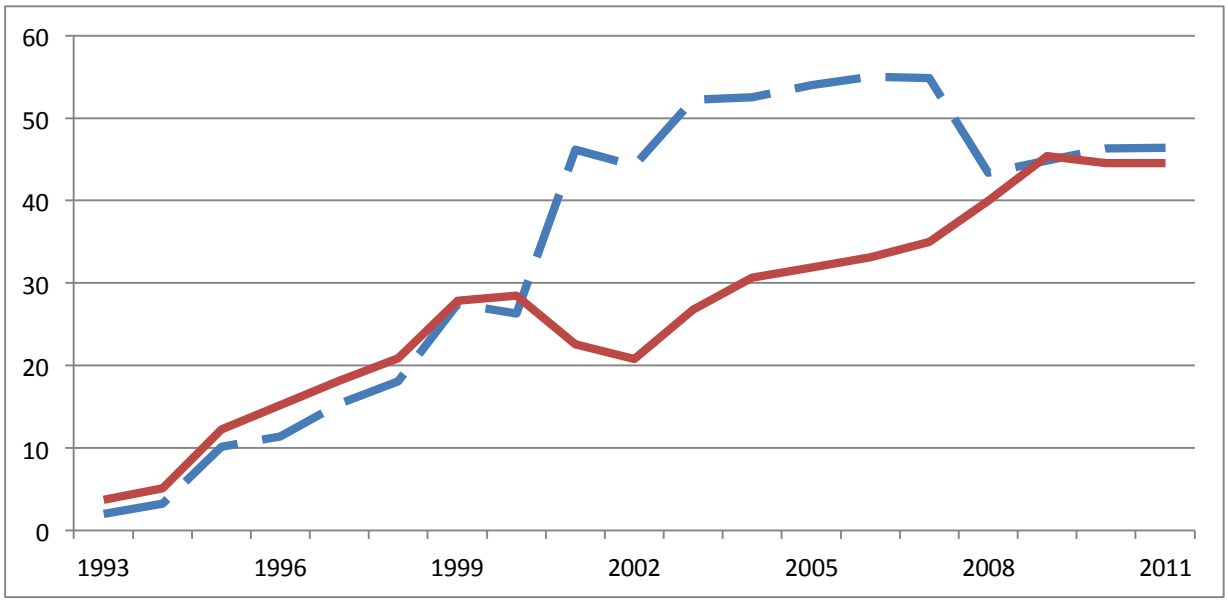

Figure 3. Ratio of Market Adjusted Return to the Change in Revenues (Lagged 1 Year) for
52 Publicly-Traded Information Technology Product (ITP) Firms and
61 Publicly-Traded Digital Product and Service (DPS) Firms
January 1, 1991 to December 31, 2011

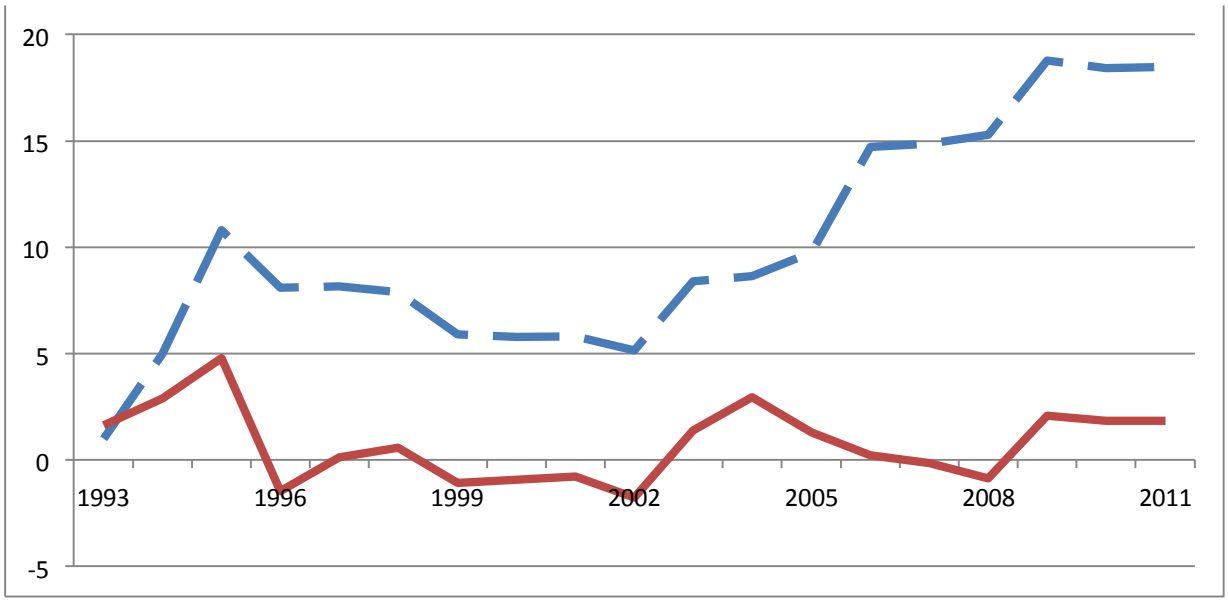

Figure 4. Ratio of Market Adjusted Return to the Change Net Income (Lagged 1 Year) for
52 Publicly-Traded Information Technology Product (ITP) Firms and
61 Publicly-Traded Digital Product and Service (DPS) Firms
January 1, 1991 to December 31, 2011

5. Summary and Conclusions

The research on digital product and service (DPS) firms and other information technology-based product (ITP) firms has often combined both firm types into one general information technology category when studying their characteristics, impact, and strategies. In this work we argue that they are not the same and to illustrate this we develop a series of empirical examinations of their characteristics and financial market performance to provide supporting evidence. It was necessary to compare mature, established, publicly-traded firms in these two categories to provide sufficient data for analysis.

We find that mature DPS firms are less risky, have lower current ratios, and have better market performance. Mature ITP firms, on the other hand, issue shares to cover more substantive costs like property plant and equipment and ongoing fixed and variable costs. Because their shares are used to finance assets, we argue and show that the market scrutinizes ITP company efforts to a greater extent than DPS firms. As a result, revenue changes appear to be equally important relative to the market reaction for both firm types, but costs are more important for ITP firms than for DPS firms. From these results, we can only conclude that ITP and DPS firms are fundamentally different and that any substantive analysis of these firm types should proceed accordingly.

Based upon the results of this study, two directions for future research were identified. Given that ITP firms issue shares to pay for ongoing investments, for what purposes do mature DPS firms use their available financial resources? One potential use would be to pursue horizontal integration growth strategies by acquiring companies that provide a digital product or service that complements their existing offerings or enables them to enter a new geographic market. How does the market react to DPS firm share issuances that are used to finance acquisitions? How do acquisitions impact share prices? And how do these acquisitions affect the value of the firm through profit growth, market share growth, or other forms of competitive advantage? Further, what impact does this acquisition activity have on consumers and industry structure in the broader global economy? The answers to these questions would be of interest to information technology researchers, DPS firm managers, financial analysts, and economists.

Another direction for future research would be to utilize the DPS versus ITP classification framework for studies of issues in other functional areas. For example, from a marketing perspective, should DPS and ITP firms use different promotion and pricing strategies? And do marketing strategies differ depending on which phase of the life cycle that a DPS or ITP firm is currently operating within? Answers to these questions would be of interest to marketing and information technology researchers as well as DPS and ITP company managers.

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