

# 代表著作摘要及貢獻

## **The effects of asset-light strategy on competitive advantage in the telephone communications industry**

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### **Abstract**

This article examines how asset-light operations create competitive advantage in the telephone communications industry. Competitive advantage is defined as the ability of a firm to generate returns above its synthetic normal return. Three regression models are developed to describe the relationships between asset-light operations and competitive advantage. This empirical study provides several insights: (1) Asset-light operations significantly contribute to competitive advantage in the telephone communications industry, but this effect is more critical in the wireless communications industry than among landline-based firms. (2) Firms with more light assets tend to have a lower book value of tangible resources. (3) Firms involving R&D and emphasising asset-light operations focus more on operational cost reduction than efficient management of their fixed assets. The last result indicates that telephone communications companies have been competing in 'light' operating assets rather than 'light' fixed assets.

### **Contribution**

This article *uses non-traditional methods of research on technology and strategic management to provide depth and capture application of information technology. This paper attempts to test new models, which could offer new insights into emerging concepts for understanding digital strategies and for developing a model approach to measuring competitive advantage in digital technology research.*

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# The effects of asset-light strategy on competitive advantage in the telephone communications industry

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This study investigates how asset-light operations generate competitive advantage in the telephone communications industry. Competitive advantage is defined as the ability of a firm to generate returns above its synthetic normal return. Three regression models are developed to describe the relationships between asset-light operations and competitive advantage. This empirical study provides several insights: (1) Asset-light operations significantly contribute to competitive advantage in the telephone communications industry, but this effect is more critical in the wireless communications industry than among landline-based firms. (2) Firms with more light assets tend to have a lower book value of tangible resources. (3) Firms involving R&D and emphasising asset-light operations focus more on operational cost reduction than efficient management of their fixed assets. The last result indicates that telephone communications companies have been competing in 'light' operating assets rather than 'light' fixed assets.

**Keywords:** competitiveness; business and corporate strategy, evaluation study; information and communications

## 1. Introduction

With the all-pervasiveness of the Internet, customers are increasingly using their telephone service to transmit data, video, graphics, and other electronic material. Images and video transmission require more capacity (bandwidth) than voices necessitating facilities-based telecommunications carriers to expand and upgraded their networks. At the same time, facility-resale operators have been growing rapidly (Federal Communications Committee 2010). These businesses lease bulk-rate transmission capacity from facility-based carriers and thereby provide services to individuals or group customers at competitive prices.

Global telecommunications spending as a share of global GDP increased from 2.5% in 1990 to 4.8% in 2009 and is predicted to reach 5.9% by 2013 (The Insight Research Corporation 2010). According to this forecast, landline service revenues are expected to grow at a much slower rate than wireless service revenues. Yet both sub-industries face significant challenges.

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To confront shortening product cycles and growing time-to-market pressures, many telecommunications companies hope to generate advantage by keeping their tangible assets 'light'. For example, rather than investing in infrastructure, landline carriers are creating and delivering high-speed broadband through more efficient Internet Protocol (IP) packet delivery. In short, the operators expect to reap operational and infrastructure savings by deploying new IP-based services. To take another example, many incumbent carriers do not replace circuit-switched network elements when upgrading their networks. Instead they implement the new IP-based services on an overlay network, thereby avoiding a large sunk cost (The Insight Research Corporation 2010).

In this business environment, firms prefer not to own fixed network assets (or to own as few as possible). Instead they acquire or rent the use of infrastructure from facility-based telephone communications carriers (Telecomasia 2009). AT&T, for example, adopted an 'asset-light' global strategy, renting underlying transport (wavelengths or fibre IRUs) to take advantage of low prices (Convergedigest 2002). China Mobile (whose market value exceeded that of Microsoft in 2007, making it the largest firm in the world) expanded its coverage in China using the asset-light strategy (Sun et al. 2003, Chapter 3). Meanwhile, virtual-network mobile operators are providing wireless services without investing in network infrastructure.

Among those firms in the telecommunications industry that have declared an asset-light strategy, not all demonstrate improved performance. The Vanco Group, a British virtual network operator, pioneered the strategy of owning no network infrastructure. This firm, whose only activities are providing management services and reselling networks from other telecommunications suppliers, nearly failed to meet its obligations in 2008. Even Vodafone, although it possesses the world's largest mobile telecommunications network in terms of turnover, is facing serious challenges. The firm made a foray into the European broadband market with a centralised asset-light strategy (buying wholesale bandwidth instead of building or owning infrastructure), but has been struggling in the face of intense competition (Global Insight 2006).

How then can telecommunications companies employ a 'light' strategy to gain competitive advantage and superior returns? What are the features of 'light' operations, and which ones are most important? Does the effect of an asset-light strategy on firm performance differ between the fast-growing wireless communications industry and the more stable landline industry? The present study addresses these questions for firms in the telecommunications industry by investigating the features of asset-light strategies and the effect of such a strategy on competitive advantage.

## **2. Theoretical background**

This paper introduces two indicators concerning asset-light operations: the value of light assets and the 'degree of asset lightness'. The value of light assets, expressed in dollar terms, indicates the firm's total value including both tangible physical assets and intangible assets generated by the firm's unique resources and capabilities. The degree of asset lightness, a ratio, measures the firm's ability to generate intangible value with the physical assets in place. This section begins with a review of the theoretical relationship between competitive advantage and firm performance. It then describes a valuation model based on firm performance to estimate the value of light assets and the degree of asset lightness.

### **2.1. *Competitive advantage versus firm performance***

Competitive advantage, a quality that leads to superior performance, is an outcome of the interactions between a firm's physical resources and its managing capabilities (Mahoney 1995).

An asset-light strategy aims at minimising physical resources while making effective use of what remains to increase the profitability of the firm. The present paper quantifies competitive advantage as the ability of a firm to generate returns above its normal returns (Peteraf 1993; Barney 2002), given the tangible resources employed.

The resource-based view (RBV) specifies that resources are important antecedents to a firm's overall performance (Wernerfelt 1984; Barney 1991) as well as the source of sustainable competitive heterogeneity between and among firms (Hoopes, Madsen, and Walker 2003). The RBV framework has been of great value to the strategic management field, and to marketing researchers who investigate the sources of sustainable competitive advantage and organisational survival (Kraatz and Zajac 2001; Srivastava, Fahey, and Christensen 2001; Adner and Zemsky 2006). Despite its rapid diffusion throughout the strategy and marketing literature, however, the RBV has been challenged as a tautological theory on the grounds that its central claim 'sustainable advantage generates superior performance' cannot be objectively tested (Priem and Butler 2001).

To reconcile the tautological fallacy of the RBV, Powell (2001, 2002, 2003) suggested a Bayesian epistemological approach to redefine the deterministic, unidirectional proposition as a probabilistic inference: 'Sustainable competitive advantage is more probable in firms that have already achieved sustained superior performance.' That is, the plausibility of a firm's competitive advantage is conditional upon evidence of superior performance. Tang and Liou (2010) generalised Powell's probabilistic inference as an antecedent of a firm's resource-bundle configuration and dynamic learning capability. They postulated that while a firm's competitive advantage, resource configuration, and learning capability generally cannot be comprehended by outsiders, any superior performance generated by the firm can be captured by financial indicators. In brief, this line of reasoning suggests that firm performance can reveal its own causes.

Liou, Tang and Huang (2008) developed an 'asset-light business model', by decomposing the DuPont equation into nine accounting items and four dimensions of resources and capabilities. A later article (Tang and Liou 2010) refers to this classification as the firm's 'resource configuration'. Both articles suggest using the resource configurations of firms to mediate competitive advantage and performance. Tang and Liou (2010) also proposed that the causal path from competitive advantage to performance is competitive advantage → resource configuration → performance. That is, they suggested tracing the competitive advantage and resource configuration (both unobservable) by examining performance-related indicators (observables). However, their model does not specify the strategy used by firms to accumulate their resource bundles and capabilities.

Nevertheless, corporate strategies determine the resource commitments needed to achieve competitive advantage (Wernerfelt and Karnani 1987; Collis 1990). Therefore, the present study incorporates strategy into the competitive advantage and performance causal path as follows: corporate strategy → competitive advantage → resource configuration → performance. Thus, objective performance indicators could be used to examine the effectiveness of a strategy on competitive advantage as well as performance. Section 3 develops a model capable of fairly evaluating the asset-light operations of a firm.

The value of a competitive advantage is magnified by effective use of a firm's infrastructure and tangible assets (Ichniowski, Shaw, and Prennushi 1997; Peteraf and Reed 2007). Financial statements, which report the outcome of the resource allocations determined by corporate strategy, reveal the resources and managing capabilities of the firm. For example, the cost advantage brought by Dell's 'direct business model' is revealed in the firm's high inventory turnover rate, which results in a low cost-of-goods-sold and inventory cost (Rivikin and Porter 1999). To take another example, Zara generates competitive advantage from an extremely quick response system. Its high profit margin, low working capital to sales ratio, and high asset turnover all contribute to Zara's high

return on equity (Ghemawat 2004; Ghemawat and Nueno 2006). These cases show that financial variables can reveal the features of a competitive advantage resulting from corporate strategy. Therefore, this paper uses financial variables to illustrate the features of competitive advantage arising from an asset-light strategy.

## **2.2. *Defining competitive advantage as gaining abnormal returns***

The mainstream of strategic management research has suggested that intra-industry performance differences are attributable to competitive advantage (Porter 1980, 1985; Ghemawat 1986; Barney 1991; Amit and Schoemaker 1993). A firm with competitive advantage over other firms (Porter 1985; Kay 1993; Brandenburger and Stuart 1996) is recognised by either generating greater-than-expected value from the resources it employs (Peteraf 1993; Barney 2002) or by outperforming its rivals on certain behavioural measures (Ghemawat and Rivkin 1999; Saloner, Shepard, and Podolny 2001; Hunt 2002). These viewpoints define competitive advantage as the excess earnings over the firm's internal opportunity cost or the costs of a comparable eminence in the industry. The excess value generated by competitive advantage is variously termed 'above-average returns' (Schoemaker 1990), 'abnormal profits' (Peteraf 1993), or economic rent (Barney 1991; Conner 1991). To be associated with competitive advantage, the excess value should result from within-firm features (Silverman 2002) and be sustainable over a long period of time (Wiggins and Ruefli 2002).

According to Lev (2001), 'Abnormal profits, dominant competitive positions and sometimes even temporary monopolies are achieved by the sound deployment of intangibles, along with other types of assets.' If a firm's assets are defined as resources that can increase its net cash inflow by increasing revenues and/or decreasing cost (Damodaran 2001, 72), then any positive earnings generated from the firm's strategic resources could be seen as the firm's asset inputs. However, intangible resources are not usually valued on accounting books because they are considered non-market goods. Therefore, the excess returns due to all off-balance-sheet assets can be interpreted as the specific return from intangible strategic resources.

The asset-light strategy pursues capital efficiency by focusing equity investment on those areas that attain the best returns for investors (Maly and Palter 2002). The term 'asset-light' implies a high ratio of intangible strategic resources (light assets) relative to tangible (heavy) assets. In the present study, a firm's 'normal' returns are defined to exclude the costs of off-balance-sheet intangible assets. If a firm has a competitive advantage, its book returns will be greater than its 'normal' returns; in other words, the excess returns will be positive.

Book returns are commonly used to denote the presence or absence of competitive advantage (Hunt 2002, 266; Grant 2008, 46; Tang and Liou 2010). From the probabilistic viewpoint, firms that enjoy book returns higher than their 'normal' return are more likely to have a competitive advantage. Under this definition, we measure the excess value generated by competitive advantage by subtracting the 'normal' returns from the firm's actual book returns.

## **3. The asset-light valuation model**

An abnormal return is defined as the excess return obtained by a firm above the opportunity cost of the resources employed. In a competitive market, the revenues obtained by the firm are the minimum value perceived by its customers. In this sense, revenue provides a market measurement of outputs. However, the firm's book value usually fails to reveal all firm resources. As the book value is based on generally accepted accounting principles, it underestimates the inputs used by the

firm to generate the revenue. For example, empirical studies have demonstrated that the economic benefits of advertising extend over one year (e.g. Hirschey 1982; Hirschey and Weygandt 1985; Chauvin and Hirschey 1993). In addition, both advertising and R&D spending are known to have positive effects on firm value (e.g. Doukas and Switzer 1992; Chauvin and Hirschey 1993; Szewczyk, Tsetsekos, and Zantout 1996; Abrahams and Sidhu 1998; Chan, Lakonishok, and Sougiannis 2001; Eberhart, Maxwell, and Siddique 2004). Such intangible resources have been individually recognised as important contributions to the competitive advantage of firms (Collins, Maydew, and Weiss 1997; Lev and Zarowin 1999). If these off-balance-sheet intangible assets were incorporated into the total assets, the firm's opportunity cost would be higher than it appears on the books, and the normal rate of return would be lower than the book rate of return.

The present study uses return on invested capital (*ROIC*) as the book rate of return. The *ROIC* is an important measure of earnings efficiency; it represents management's ability to advance and sustain shareholder value (Cao, Jiang, and Koller 2006) and indicates the presence or absence of a firm's competitive advantage (Tang and Liou 2010). It is calculated as the net operating profit less adjusted taxes (*NOPLAT*) divided by the invested capital (*IC*):

$$ROIC = \frac{NOPLAT}{IC} \tag{1}$$

where  $NOPLAT = EBIT \times (1 - t) + \text{deferred income tax (if it exists)}$ ;

$$\begin{aligned} IC &= \text{Net fixed assets} + \text{net working capital} + \text{other assets} \\ &= \text{Total assets} - \text{non-interest bearing short-term debt.} \end{aligned}$$

The weighted average cost of capital (*WACC*) denotes the opportunity cost of resources deployed to generate future returns. Firms with a *ROIC* greater than the *WACC* are defined as performing well. *WACC* reflects the risk associated with funding resources if the market is efficient. If the product and factor markets are perfectly competitive, then a firm can only generate a return sufficient to cover its opportunity cost: the *WACC* plus the risk-free return. A firm is earning excess returns when its *ROIC* exceeds the *WACC* plus the risk-free return. If these excess returns persist, they can be attributed to the off-balance-sheet resources of the firm.

Thus,  $ROIC - WACC - r$  denotes the benefits created by unique resources and capabilities accumulated from the firm's previous investment in intangible assets. Hereafter, I call these accumulated intangible resources and capabilities 'light assets' to distinguish them from the tangible or 'heavy' assets on the balance sheet. Diverse levels of excess returns across an industry signify heterogeneity of the 'light assets', and can explain why some firms outperform others as a result of competitive advantage.

A firm can either deposit its money to receive a risk-free interest rate ( $r$ ), or it can invest in heavy and light assets to earn a return of *ROIC*. If it chooses the latter course, the *ROIC* (output) of its investment must be greater than the input cost plus the risk-free rate. If we assume that the firm has an infinite life with a fixed annual rate of return, then the firm value, estimated by its excess returns on heavy and light assets should not be less than the total book value of the fixed annual deposits. That is,

$$\frac{ICA}{(ROIC - WACC)} \geq \frac{ICB}{r}, \tag{2}$$

where *ICA* and *ICB* represent the real value and book value of the deployed assets respectively.

*WACC* is the minimum return that a firm must earn on existing invested capital. It can be calculated by multiplying the cost of each capital component by a weight reflecting the proportions

of various funding sources (common equity, straight debt, warrants and stock options) used by the component. Therefore,

$$WACC = \frac{D}{D + E} \times R_d \times (1 - t) + \frac{E}{D + E} \times R_e. \tag{3}$$

where  $R_d$  = cost of debt,  $R_e$  = cost of equity,  $D$  = debt, and  $E$  = equity (Appendix shows the formula and data sources used to calculate  $R_d$  and  $R_e$ ).

Rearranging Equation (2), the real value of the invested capital can be obtained by

$$ICA \geq \left( \frac{ROIC - WACC}{r} \right) \times ICB \tag{4}$$

or equivalently

$$ICA \geq \frac{1}{r} \times ICB \times (ROIC - WACC). \tag{5}$$

Equations (4) and (5) reveal that as the ratio of excess return to the risk-free rate ( $ROIC - WACC$ )/ $r$  increases, so does the real value of the invested resources.

Equation (6) gives a lower bound for superior performance:

$$ICA - ICB = \frac{1}{r} \times ICB \times (ROIC - WACC) - ICB. \tag{6}$$

Equation (6) also defines the value of the light assets as the difference between the real value and the book value, or in other words the excess benefits generated by the  $ICA$  over the  $ICB$ . As a result, we can write down the following ‘asset-light valuation model’:

$$LA = ICA - ICB = \frac{ICB \times (ROIC - WACC - r)}{r}. \tag{7}$$

where  $LA$  denotes the value of the light assets and  $(ROIC - WACC - r)$  is the rate of return on light assets ( $ROLA$ ). Adding goodwill ( $GW$ ) and intangibles ( $IA$ ) on books to Equation (7), the value of the light assets ( $LA$ ) becomes

$$LA = \frac{1}{r} \times ICB \times (ROIC - WACC - r) + GW + IA. \tag{8}$$

The term  $(ROIC - WACC)$  in Equation (8) can be restated as the net operating profit less adjusted taxes, minus the operating cost, divided by the invested capital:  $(NOPLAT - WACC \times IC)/IC$ . Note that  $(NOPLAT - WACC \times IC)$  is exactly the economic value added ( $EVA$ ) of the firm. Thus, the asset-light valuation model developed in the present study is consistent with the concept of economic value added.

#### 4. The relationship between asset-light operations and performance

The book value of assets is the invested capital ( $IC$ ). This measure includes only tangible assets, goodwill, and the intangible assets on the balance sheet. It excludes the value of the firm’s unique resources, and any capabilities accumulated from past operations that continue contributing to the net profits of the firm. Consider a ‘synthetic’ definition of total assets that includes both physical assets on the balance sheet and light assets,  $ICB + LA$ . The rate of return on these ‘synthetic’ total



assets is the intrinsic return due to all deployed tangible and intangible resources. Hereafter we name this concept the shadow return (*SR*). It is calculated as *NOPLAT* divided by *ICB + LA*:

$$SR = \frac{NOPLAT}{(ICB + LA)} \tag{9}$$

We know that  $ROIC = NOPLAT/IC$  and  $IC = ICB$ . Therefore, if  $LA > 0$ , it follows that  $(ICB + LA)$  is greater than  $IC$ , and that  $ROIC$  is greater than  $SR$ . On the other hand, if  $LA < 0$ , then  $(ICB + LA)$  is less than  $IC$  and  $ROIC$  is less than  $SR$ . Since competitive advantage is defined as having abnormal returns, the excess return on competitive advantage (*CA*) can be measured as the difference between the book rate of return and *SR*:

$$\begin{aligned} CA &= ROIC - SR = \frac{NOPLAT}{IC} - \frac{NOPLAT}{ICB + LA} \\ &= NOPLAT \left( \frac{ICB + LA}{IC(ICB + LA)} - \frac{IC}{IC(ICB + LA)} \right) \\ &= ROIC \left( \frac{ICB + LA - IC}{ICB + LA} \right) \end{aligned}$$

Assuming that  $IC = ICB$  (i.e. the goodwill and intangibles on the balance sheet are negligible), this equation can be rewritten as follows:

$$CA = ROIC - SR = ROIC \times \left( \frac{LA}{ICB + LA} \right). \tag{10}$$

Dividing Equation (10) by *ROIC*, we obtain a relationship between light assets, *ROIC*, and *SR*:

$$\begin{aligned} 1 - \frac{SR}{ROIC} &= \frac{LA}{ICB + LA} \\ \Rightarrow \frac{SR}{ROIC} &= 1 - \frac{LA}{ICB + LA} = \frac{ICB}{ICB + LA} \\ \Rightarrow \frac{ROIC}{SR} &= \frac{ICB + LA}{ICB} \\ \Rightarrow ROIC &= \left( 1 + \frac{LA}{ICB} \right) \times SR \\ &= SR(1 + DAL) \end{aligned} \tag{11}$$

Equation (11) illustrates that the ratio of light assets to tangible assets (*DAL*, the degree of asset lightness) is positively related to *ROIC*. Thus, for a given shadow rate of return, firms that are more asset-light tend to have more competitive advantage.

By re-writing Equation (11) as Equation (12), we obtain one more relationship: at a fixed shadow rate of return, firms with a larger proportion of light assets require fewer tangible assets to produce the same net profit.

$$\begin{aligned} NOPLAT &= (ICB + LA) \times SR \\ LA &= \frac{NOPLAT}{SR} - ICB \end{aligned} \tag{12}$$

Furthermore, since *ROIC* ignores *LA* from the denominator, it is greater than *SR* should *LA* be positive. The difference between *ROIC* and *SR* quantifies superior performance (competitive

advantage) from an asset-light strategy. Equation (13) states that *ROIC* equals *SR* plus an abnormal return from the degree of asset lightness (*DAL*).

$$\begin{aligned} ROIC &= SR(1 + DAL) \\ \Rightarrow ROIC - SR &= SR \times DAL \end{aligned} \tag{13}$$

## 5. Empirical study

In the COMPUSTAT database, wireless and landline telephone communications firms are assigned the Standard Industrial Codes (SICs) #4812 (radiotelephone communications) and #4813 (all types of telephone communications other than radiotelephone) respectively. Firms in the first sub-industry are primarily engaged in providing two-way radiotelephone communication services such as cellular telephone networks. Firms in the second sub-industry are primarily engaged in furnishing voice and data communication, but not radiotelephone and telephone answering services.

### 5.1. *The sample data*

Companies that have a sustained competitive advantage should generate a stable or increasing *ROIC* over long periods. Spanos and Lioukas (2001, 923) noted the difficulty of observing such a trend: ‘The time period ... is admittedly short (i.e. previous three years) to account for any business cycle effects or transient problems. It is important to note, however, that a longer time-frame (e.g. five instead of three years) could endanger the reliability of responses.’ Furthermore, the reaction speed and aggressiveness of modern firms may undermine the long-term effectiveness of an advantage position. Thus, firm-specific advantages are often not sustainable but temporary in nature (D’Aveni, Dagnino, and Smith 2008). The present study follows Tang and Liou’s (2010) approach, examining asset-light operations in the telephone communications industry over a recent three-year period. The growth rates of world per capita GDP decreased in 2005 comparative to 2004 (−0.48%), increased in 2006 (0.44), and slightly declined in 2007 (−0.07%) (World Bank 2011).

During the period 2005–2007, there were 105 radiotelephone communications companies and 123 telephone communications companies in the Standard and Poor’s COMPUSTAT database. Hereafter, we label the two sub-industries ‘radiotelephone’ and ‘telephone’ industry. Forty-five companies in each category were excluded because of missing data. In addition, we excluded two firms whose ratios of light assets to tangible assets were more than three standard deviations from the sub-industry mean. The resulting dataset contains 59 and 77 firms in the radiotelephone and telephone industries respectively.

The descriptive statistics in Table 1 indicate that on average, tangible assets and operational profits are larger and more diverse in the telephone industry than in the radiotelephone industry. The telephone industry is more infrastructure-based, with heavy sunk costs.

### 5.2. *The value of light assets*

Light assets in the radiotelephone industry ranged from −US\$17.47 billion (Sprint Nextel Corp., US) to US\$108.60 billion (China Mobile Ltd, Hong Kong), while in the telephone industry light assets ranged from −US\$13,267 billion (Cantv-Ca Nac Telefonos, Venezuela) to US\$53.42 billion (France Telecom). Twenty-two radiotelephone companies and 55 telephone companies show

Table 1. Descriptive statistics of the sample companies.

Parameter	Minimum	Maximum	Mean	Standard deviation
Radiotelephone communications industry (SIC Code: 4812)				
ICB (US\$ billion)	0.0016	105.96	9.5346	17.92
NOPAT (US\$ billion)	-0.1839	17.09	1.1211	2.61
ROIC	-0.9037	0.62	0.0879	0.17
LA (US\$ billion)	-17.4679	108.6	5.4969	20.25
LA/ICB (times)	-23.3639	7.82	-0.0085	3.84
Shadow rate of returns	0.0686	0.27	0.1025	0.03
Telephone communications, except radiotelephone industry (SIC Code: 4813)				
ICB (US\$ billion)	0.0101	1459.08	34.1825	167.42
NOPAT (US\$ billion)	-0.181	310.47	5.4323	35.31
ROIC	-0.2098	0.27	0.0522	0.09
LA (US\$ billion)	-13267.16	53.42	-172.0982	1512.08
LA/ICB (times)	-9.0928	3.12	-0.9967	2.02
Shadow rate of returns	0.0424	0.23	0.1064	0.03

Note: Appendix provides formulas used to calculate the variables in the table for individual company.

negative light assets. Powell and Arregle (2007) suggest that firms compete on two axes: the axis of competitive advantage and the axis of errors or competitive disadvantage. Companies with negative light assets are competing on the axis of competitive disadvantage, meaning that they under-utilise existing tangible assets for value creation. For example, Nippon Telegraph and Telephone Corp (NTT), the largest and oldest landline-based telecom company in Japan, has negative light assets (-US\$107.73 billion) due to an average *ROIC* ( $4.1\% < (WACC + \text{riskfree rate}) = 7.7\%$ ) that is low compared to the value of its heavy assets ( $ICB = \text{US}\$105 \text{ billion}$ ). Examining its cost structure more closely, we find that depreciation and amortisation on its deployed fixed assets eroded on average nearly 20% of its annual revenues. That is, given the fixed assets it employed, NTT should have generated more revenues to obtain abnormal return. In contrast, NTT DoCoMo, NTT's spin-off wireless subsidiary, had a slightly lower ratio of depreciation and amortisation to revenues (15.8%) than NTT. NTT DoCoMo generated a high *ROIC* ( $9.1\% > (WACC + \text{riskfree rate}) = 8.7\%$ ) and had positive light assets (US\$9.14 billion).

### 5.3. The degree of asset lightness (*DAL*)

The ratio of light assets to heavy assets ( $LA/ICB$ ) (hereafter called the degree of asset lightness, or *DAL* for short) measures a firm's ability to create intangible value from its tangible assets. A firm with *DAL* greater than one demonstrates a rate of value creation greater than the tangible assets deployed. The difference in the average *DAL* values observed in the radiotelephone industry (-0.008) and the telephone industry (-1.0) is significant ( $z_{x1-x2} = 7.61 > 3.37$ ) at the significant level of 0.001. The average *DAL* is negative in both sub-industries, signifying that most telecom companies manage their asset-light operations poorly.

Table 2 ranks the top five communications companies in the two sub-industries by *DAL*, and lists their average *ROIC*, value of light assets and value of tangible assets during the period 2005–2007. Many of these companies are based in Europe. This evidence suggests that the European telecommunications companies are effectively using their tangible assets to confront the high license fees in the region.

Table 2. Top 5 telephone communications firms ranked by average degree of asset light during 2005–2007.

Company	Country	LA/ICB	ROIC	ICB	LA
Radiotelephone communications industry (SIC Code: 4812)					
Pilipino Telephone	The Philippines	7.82	0.62	0.41	3.20
Mobistar	Belgium	6.02	0.35	1.02	6.12
Mobilezone Holding	Switzerland	4.25	0.28	0.07	0.29
Digicom Bhd	Switzerland	3.02	0.23	1.12	3.41
Partner Communications	Israel	2.50	0.19	0.85	2.23
Telephone communications industry, except radiotelephone (SIC Code: 4813)					
Telekomunikasi	Indonesia	3.12	0.24	7.36	23.37
Belgacom	Belgium	2.61	0.19	6.70	17.06
Telkom	South Africa	2.28	0.20	7.92	18.12
Swisscom	Switzerland	1.66	0.14	10.44	16.48
Telmex	Mexico	1.37	0.16	20.36	26.32

LA/ICB, degree of asset light = asset-light valuation/tangible assets (times); ROIC, return on invested capital; ICB, tangible assets (in US\$ billion); and LA, asset-light valuation (in US\$ billion).

The top asset-light companies in the radiotelephone and telephone industries are both located in emerging markets. Pilipino, the Philippines’ third largest cellular mobile telephone service provider, offers prepaid GSM (global system for mobile communication) services. Its asset-light value was 7.8 times greater than its *ICB* because the ratio of depreciation expenses to revenues was only 4%. Telekomunikasi, the largest integrated telecom operator in Indonesia, also provides a wide range of prepaid services. Its asset-light value was 3.1 times greater than its *ICB* with very low selling, general and administration expenses relative to revenues (9%).

Vodafone provides an example of a company with positive light assets but a *DAL* less than one. The firm holds significant light assets (US\$86.1 billion), indicating that it competes on the axis of competitive advantage. However, the fact that its *DAL* is less than one (0.81) implies that the company is having problems pursuing the asset-light strategy. Vodafone is one of the world’s leading providers of mobile telecom services, providing mobile voice and data communication services to individual and enterprise customers in a global context. This multinational communications company has had problems such as poor performance in Japan (Wray 2005), a questionable business structure associated with holding diversified assets globally (Rasmussen 2010), and customers unsatisfied with poor network performance in Australia (Moses 2010).

**5.4. The regression models**

This section examines the effects of the asset-light strategy on competitive advantage. Model 1, which refers to Equation (11), examines the effect of asset-light operations (*DAL*) on firm performance (*ROIC*) with shadow rate of return (*SR*) and *ICB* as the control variables. Model 2, which refers to Equation (12), investigates the relationship between the value of light assets (*LA*) and the scale of physical inputs (*ICB*) using *SR* and *DAL* as control variables. Model 3, which refers to Equation (13), infers the resources accumulated from asset-light operations by examining the relationship between *DAL* and performance-related indicators included in the resource configuration (Tang and Liou 2010).

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Both Model 1 and Model 2 are formally based on a dataset of 136 observations. However, only 35 of these observations reported R&D expenditures. We can either drop R&D from the independent variables to include more observations in the model, or retain R&D but discard the 101 observations without R&D data. We take the view that given the rapid pace of technological development, R&D is a critical variable driving competitive advantage in the telecom industry. Accordingly, we keep R&D in Model 3, which examines the features of asset lightness among telecommunications carriers.

A dummy variable is used to classify firms into the radiotelephone ( $D = 0$ ) and telephone ( $D = 1$ ) sub-industries. Interactive variables are deleted if they are highly correlated with their corresponding independent variables. The variance inflation factors (VIF) show that there is no multicollinearity in any of the models.

Cook distance tests show that each model has some observations that deviate greatly from the regression line ( $D > 1$  according to Cook and Weisber 1982), and therefore, have a large influence on the results. To overcome this vulnerability to outliers, we apply Huber’s M-estimator (Huber 1973, 1981) to find the relationship between the degree of asset lightness and competitive-advantage related variables. The M-estimation is not robust with respect to leverage points, but it is still used extensively in cases where it can be assumed that the bias introduced by outliers is mainly in the response direction (Chen 2002). Table 3 lists the three M-estimation regression models, and Table 4 presents their results.

The  $R^2$  of Model 1 is 0.94, indicating that *DAL* and shadow rate of return are crucial factors in predicting firm performance. The results of Model 1 show that *DAL* has a significant positive effect on *ROIC*. However, the importance of this factor is higher in the radiotelephone industry (0.047) than in the telephone industry ( $0.047 - 0.003 = 0.044$ ) at a significance level of 0.1. In addition, the relationship between *ICB* and *ROIC* is insignificant.

The results of Model 2 ( $R^2 = 0.26$ ) show that the value of light assets (*LA*) is negatively correlated with *ICB* ( $-8.91$ ). In addition, the impact of degree of asset lightness on the value of light assets is significantly higher in the telephone industry ( $1.20 + 23.92 = 25.12$ ) than in the radiotelephone industry (1.20). Indeed, the latter factor is not significant. This result signifies that asset-light operations create more value in the telephone industry than in the radiotelephone industry. Defining the value of light assets as the abnormal return times tangible assets, this result is predictable since the average value of tangible assets is more than three times larger in the landline industry (see Table 1).

The results of Model 3 ( $R^2 = 0.55$ ) show that *DAL* is negatively correlated with all expense variables: cost of sales/sales ( $-8.12$ ), R&D expenses/sales ( $-23.86$ ), SG&A expenses/sales ( $-7.07$ ) and depreciation expenses/sales ( $-13.63$ ). In addition, *DAL* is positively correlated with

Table 3. The asset-light operation regression model.

Model 1	$ROIC = a_{10} + a_{11} \left( \frac{LA}{ICB} \right) + a_{12}(SR) + a_{13}ICB + a_{14}D + a_{15}D \left( \frac{LA}{ICB} \right) + \varepsilon_1$
Model 2	$LA = a_{20} + a_{21} \left( \frac{LA}{ICB} \right) + a_{22}SR + a_{23}ICB + a_{24}D + a_{25}D \left( \frac{LA}{ICB} \right) + \varepsilon_2$
Model 3	$\left( \frac{LA}{ICB} \right) = a_{30} + a_{31}ART + a_{32}APT + a_{33}INVT + a_{34}PPET + a_{35}COS + a_{36}R\&D + a_{37}SG\&A + a_{38}Dep + a_{39}Tax + a_{3a}D + \varepsilon_3$

Table 4. Robust regression analysis results.

Dependent variable	Model 1	Model 2
	ROIC	LA
Constant	-0.015***	88.77***
LA/ICB	0.047***	1.20
SR	1.036***	-335.80
ICB	0	-8.91***
D (0 = Radio communications; 1 = Telephone communications)	0.003 <sup>†</sup>	33.56***
D × (LA/ICB)	-0.003***	23.92***
Adjusted R <sup>2</sup>	0.94	0.26
Model 3. Dependent variable: Degree of asset light (LA/ICB)		
Intercept	6.58***	
Account receivable turnover	0.18 <sup>†</sup>	
Account payable turnover	0.004	
Fixed asset turnover	0.30	
Inventory turnover	-0.002**	
Cost of sales/sales	-8.12***	
R&D expenses/sales	-23.86**	
SG&A expenses/sales	-7.07***	
Depreciation/sales	-13.63**	
Tax/sales	-4.97	
D (0 = Radio communications; 1 = Telephone communications)	-0.24	Adjusted R <sup>2</sup> = 0.55

\* $P < 0.05$ ; \*\* $P < 0.01$ ; \*\*\* $P < 0.001$ ; <sup>†</sup> $P < 0.1$

accounts receivable turnover (0.18) at a significance level of 0.1. A large receivables turnover represents a firm’s bargaining power with customers, or its ability to generate cash from its customers. Both of the top asset-light companies in the radiotelephone and telephone industries offer prepaid services to their customers and thus enjoy a very short cash collection period compared to other firms.

Fixed asset turnover, which represents the firm’s ability in managing its fixed assets, is insignificantly correlated with *DAL*. However, there is a significant negative correlation between inventory turnover and *DAL* (-0.002). Inventory turnover is calculated as a firm’s total revenue divided by its inventory. A large inventory turnover might be due to large revenues generated from large-scale fixed assets, and therefore, be associated with asset-heavy firms.

In summary, the results of Model 3 show that low operational expenses contribute to *DAL* while management of fixed assets and inventory does not. This analysis uncovers the fact that the asset-light operations of most telecommunications companies have focused on reducing operational expenses rather than managing their fixed assets effectively.

## 6. Discussion

This study has examined the features and effects of asset-light operations in the telephone communications industry. In accordance with the RBV, we attribute competitive advantage to the heterogeneous resources and capabilities of firms. Although a firm’s unique resources and capabilities contribute to its net profits, the value of these resources and capabilities are excluded from

the balance sheet. The asset-light valuation model employed here determines how these intangible factors are associated with competitive advantage; assuming that a competitive advantage brings abnormal returns to the firm that possesses it.

The telecommunications industry is characterised by economies of scale, and many global telecommunications companies have large facilities. Effective use of their tangible assets is essential for these companies to pursue net profits. Model 1 in the empirical study examines the effect of an asset-light strategy on firm performance, a common proxy of competitive advantage. Results show that the degree of asset lightness is significantly and positively related to competitive advantage. However, Model 1 did not find a significant correlation between scale and performance. This result indicates that scale is *not* an important source of competitive advantage once most players in the field have become large enough to benefit from economies of scale. The ratio of asset-light operations to asset-heavy operations provides a better explanation for performance heterogeneity, and is more critical in the wireless communications industry than among landline-based firms. This finding is consistent with the results of Model 3, in which we find that competitive advantage is associated more with effective cost savings than with effective utilisation of tangible assets. Relative to wireless operators, landline operators have heavier infrastructure and more tangible network resources, so bear more expenses in maintenance and replacement. Since the revenue per user from traditional landline voice communications is decreasing, wired carriers have had to generate revenues from innovative products in order to share the fixed instalments of tangible facilities such as IP-based services. In this manner, wired operators can benefit greatly from asset-light operations.

Model 2 found a negative correlation between the value of light assets and the value of tangible assets. Telecommunications is an infrastructure industry: the firm's physical network is an essential input and plays a decisive role in the market. However, as the scale of the network increases, depreciation of these tangible assets starts eroding the profit margin in a competitive market. In our context, for example, there is heavy competition between NTT and other traditional facility-based telephone communications companies. Thus, being appropriately 'light' has become an essential component of competitive advantage in the telecommunications industry.

Model 3 explores the features of asset lightness in telecommunications firms involving R&D. This study found that the degree of lightness is significantly associated with a firm's bargaining power with customers and with lowering operational expenses per dollar sale such as cost of sales, R&D, administration, and depreciation and amortisation. A firm's ability to manage physical assets was either irrelevant to (in the case of fixed asset turnover) or negatively associated with (in the case of inventory turnover) the degree of asset lightness. Facility-based companies are usually urged to confront competition by investing in tangible assets (Hori and Mizuno 2009), and they normally expect revenue increases in return. The telecommunications sector is one of the most innovative and capital-intensive sectors of the economy, but is also highly volatile. Leading telecommunications companies have invested heavily in landlines, fibre optics, exchange facilities, and mobile network assets. These companies would suffer from heavy sunk costs should their increased revenues be insufficient to recover the capital expenditures. For example, Sprint Nextel, the third largest wireless carrier in the US, did not increase its revenue in 2005 because its market share and unit profit per customer decreased during the same period.

The results of Model 3 signify that for telecommunications carriers, the most critical factor in the competitive advantage associated with an asset-light strategy is lower costs. A low unit cost, calculated as the total cost divided by total revenue, can be the outcome of either large revenue generated by a high unit price, or a low unit cost and a large quantity sold. These are in accordance with the genetic strategies suggested by Porter (1980, 1985). Since shrinking average revenue per

user is a common phenomenon in the worldwide telecommunications industry, lowering the unit cost is critical to generating competitive advantage. Little evidence shows that the firms' capabilities with managing physical assets contribute to competitive advantage in this industry. In the US market, shrinking revenue per user and large investment in infrastructure and marketing have driven many carriers into consolidation (Silverman and Witting 2009). Telecommunications companies have been competing on the axis of 'light' operating cost rather than 'light' fixed assets.

## 7. Conclusion

To investigate how asset-light operations generate competitive advantage in the telephone communications industry, this paper tests three empirical models corresponding to three equations derived from asset-light valuation model. The results show that firms emphasising asset-light operations not only outperform others but also require fewer tangible assets. In addition, firms involving R&D and emphasising asset-light operations focus more on operational cost reduction than efficient management of their fixed assets.

The research described in this paper has several limitations. First, the evolving 2G/2.5G and 3G technologies might turn out to be core sources of asset-light revenue for the wireless telecommunications industry. However, the proportion of customers using 3G (CDMA, WCDMA) telephones as opposed to 2/G2.5G (GSM) telephones is not available in the COMPUSTAT database. Second, although competitive advantage is a dynamic variable, the empirical study in the present paper was based on a cross-sectional analysis using three-year average data. Longitudinal studies might help determine whether an asset-light strategy affects competitive advantage to the same degree when the environment changes. Finally, this study examined the contributing factors of an asset-light strategy based on financial data. This approach is supply-driven, since financial data do not expose the consumers' valuation of products or services. Thus, the asset-light valuation model might underestimate the value of light assets by excluding customer equity. Future research could include non-financial data to identify the demand-side factors contributing to an effective asset-light strategy.

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**Appendix.**

Table A1. Descriptions of financial terms.

Financial terms	Descriptions	Formula
IC:	Invested capital	$IC = \text{Total assets} - (\text{Account payable} + \text{Other current liabilities})$
ICB:	Book value of the assets deployed	$ICB = \text{Total asset} - \text{Intangible assets on the balance sheet}$
LA:	Light assets	$LA = 1/r \times ICB \times (ROIC - WACC - r) + \text{Intangible assets on the balance sheet}$
LAICB:	Light assets to tangible assets ratio	$LAICB = LA/ICB$
NOPLAT:	Net operating profits less adjusted taxes	$NOPLAT = EBIT \times (1 - t)$
ROIC:	Return on invested capital	$ROIC = \frac{NOPLAT}{IC}$
$R_d$	Cost of debt	$R_d = \text{Interest expenses}/(\text{Short-term debts} + \text{Long-term debts})$
$R_e$	Cost of equity	$R_e = \text{Risk-free interest rate} + \text{Beta} \times \text{Risk premium}$ where: Risk premium = 0.0388 (geometric average premium during 1928–2008, for stocks over treasury bonds; Damodaran 2010) Risk-free interest rate = 0.0453 (based upon 2003–2008 average Treasury bill rate) Beta are derived from COMPUSTAT database for each company (using 2003–2008 three-year average)
SR:	Shadow rate of return	$SR = NOPLAT / (ICB + LA)$
$t$	Income tax rate	$t = \text{tax expenses}/\text{pre-tax income}$
WACC:	Weighted average cost of capital	$WACC = \frac{Debts}{Debts + Equity} \times R_d \times (1 - t) + \frac{Equity}{Debts + Equity} \times R_e$

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<input type="checkbox"/>	83	<a href="#">INT J SHIP TRANS LOG</a>	1756-6517	25	1.000	1.000	0.130	23		0.00001	0.014
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<input type="checkbox"/>	85	<a href="#">INT SMALL BUS J</a>	0266-2426	582	0.927	1.748	0.483	29	6.9	0.00088	0.356
<input type="checkbox"/>	86	<a href="#">MANAGE ACCOUNT RES</a>	1044-5005	816	0.925		0.100	20	>10.0	0.00070	
<input type="checkbox"/>	87	<a href="#">J OCCUP ORGAN PSYCH</a>	0963-1798	1762	0.882	2.259	0.358	53	9.1	0.00306	0.815
<input type="checkbox"/>	87	<a href="#">MANAGE INT REV</a>	0938-8249	877	0.882		0.242	33	9.0	0.00146	
<input type="checkbox"/>	89	<a href="#">INT J HUM RESOUR MAN</a>	0958-5192	2281	0.869	1.610	0.048	146	7.1	0.00431	0.369
<input type="checkbox"/>	90	<a href="#">ORGAN DYN</a>	0090-2616	1291	0.862	0.979	0.083	36	>10.0	0.00074	0.264
<input type="checkbox"/>	91	<a href="#">INT J SELECT ASSESS</a>	0965-075X	737	0.859	1.361	0.136	44	7.8	0.00152	0.426
<input type="checkbox"/>	92	<a href="#">KNOWL MAN RES PRACT</a>	1477-8238	172	0.855		0.071	28	4.2	0.00037	
<input type="checkbox"/>	93	<a href="#">ACTION RES-LONDON</a>	1476-7503	143	0.846		0.316	19	4.2	0.00057	
<input type="checkbox"/>	93	<a href="#">J SERV MANAGE</a>	1757-5818	26	0.846	0.846	0.138	29		0.00003	0.057
<input type="checkbox"/>	95	<a href="#">INTERFACES</a>	0092-2102	1261	0.826	1.115	0.152	33	>10.0	0.00211	0.568
<input type="checkbox"/>	95	<a href="#">SERV BUS</a>	1862-8516	72	0.826	1.016	0.350	20		0.00022	0.176
<input type="checkbox"/>	97	<a href="#">J SPORT MANAGE</a>	0888-4773	357	0.797	1.220	0.033	30	7.5	0.00066	0.265
<input type="checkbox"/>	98	<a href="#">J E EUR MANAG STUD</a>	0949-6181	55	0.781		0.071	14		0.00007	
<input type="checkbox"/>	99	<a href="#">RES TECHNOL MANAGE</a>	0895-6308	706	0.754	1.091	0.067	30	8.9	0.00081	0.252
<input type="checkbox"/>	100	<a href="#">J ENG TECHNOL MANAGE</a>	0923-4748	525	0.737	1.413	0.000	12	8.4	0.00060	0.337



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