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Lenos Trigeorgis & Sophocles Ioulianou

Bank of Cyprus Chair Professor of Finance, University of Cyprus, Nicosia, Cyprus

Published online: 09 Mar 2012.

To cite this article: Lenos Trigeorgis & Sophocles Ioulianou (2013) Valuing a high-tech growth company: the case of EchoStar Communications Corporation, The European Journal of Finance, 19:7-8, 734-759, DOI: 10.1080/1351847X.2011.640343

To link to this article: http://dx.doi.org/10.1080/1351847X.2011.640343

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Valuing a high-tech growth company: the case of EchoStar Communications Corporation

Lenos Trigeorgis* and Sophocles Ioulianou

Bank of Cyprus Chair Professor of Finance, University of Cyprus, Nicosia, Cyprus

(Received 2 November 2011; final version received 9 November 2011)

This article uses real options to value a high-tech company with significant growth option potential. The case of EchoStar Communications Corporation is used as an illustration. The company’s growth opportunities are modeled and valued as a portfolio of growth options, namely options to expand its pay television, equipment, and internet services. Expansion of the main business can occur geographically (in the USA, internationally, and through partnerships) or through cross-selling of new products and services to its customer base. The internet business can expand via switching to digital subscriber line and through partnerships. The underlying asset (business) for the expansion options is the ‘base’ discounted cash flow (DCF), after removing the constant growth rate in the terminal-value DCF assumption. The options-based estimate of present value of growth opportunities (PVGO) value substitutes for the terminal growth DCF estimate. We show that our options-based portfolio PVGO provides a better estimate of the firm’s growth prospects than the terminal growth DCF assumption.

Keywords: general; capital budgeting; stock valuation; contingent pricing

1. Introduction

Firms can increase their shareholder value by taking advantage of their strengths and opportunities as well as by recognizing their weaknesses and threats from the environment they operate in. Markets are volatile and technological changes and competitive threats can be disruptive. The strategic positioning of a firm is vulnerable not just to the actions of its direct competitors but also to unanticipated moves made by new entrants. Alternative products or entirely new technologies can modify the very competitive landscape the firm operates under. Moreover, the increased power of customers and suppliers is forcing firms to be more proactive.

Traditionally, discounted cash flow (DCF) methods have been used by academics, managers, and analysts to determine how much a firm is worth. Net present value (NPV), payback, profitability index, and internal rate of return (IRR) are some of the more widely used DCF techniques (Brigham, Gapenski, and Ehrhardt 1999). The DCF techniques have been popular because the decision rules (if a proposed project should be accepted or rejected) and criteria are theory based, straightforward, and easy to use. However, DCF methods are based on rigid assumptions that ignore the management of embedded flexibility in investment opportunities. Brealey, Myers, and Allen (2011) argued that real options are valuable sources of flexibility that are inherent in or can be built into corporate assets. The value of such options is generally not captured by the standard DCF approach. Therefore, an alternative method, real options valuation (ROV), has emerged. This

*Corresponding author. Email: lenos@ucy.ac.cy

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method uses options pricing (Black and Scholes 1973) and treats firm opportunities as portfolios of corporate real options. Real options theory suggests that a firm has the opportunity (not the obligation) to act and revise future decisions (e.g. to expand, abandon, rescale, shut down, and restart) at a later stage when more information is available.

In light of these challenges, we develop a new conceptual approach based on real options theory (Dixit and Pindyck 1994; Trigeorgis 1996), which considers a firm’s growth opportunities in an uncertain environment as a portfolio of corporate real options that is actively managed by the firm. In this article, we show how a real options analysis can help provide a more reliable estimate of the value of a growth company and address several strategic questions that are important for corporate success in dynamic and volatile industries, such as the following: What is the value of growth opportunities in a business (beyond the value of cash flows from assets in place)? What is the contribution of each expansion option to the overall firm value? When is the right time for investing in or exiting from a business?

We illustrate how real options analysis can be realistically applied in an actual case of a high-tech growth company, EchoStar Communications Corporation (EchoStar). This application has value both as an illustrative case study and as an exposition of relevant tools and techniques. The company’s growth opportunities are modeled and valued as a portfolio of growth options, namely options to expand its pay television (TV), equipment, and internet services. Our analysis indicates that the market did not fully capture the value of the future prospects of this high-growth company and was not valuing its stock price correctly. Based on this analysis, performed as of 9 October 2004, EchoStar was underpriced at the time.¹

A firm’s growth opportunities and its strategic prospects in the industry are invariably reflected in the stock market prices. Not all stocks generate the same earnings stream or have the same growth potential. Growth stocks (e.g. in high-tech, biotech, pharmaceuticals, or information technology) typically yield high price–earnings (P/E) and market-to-book ratios. It is precisely the intangible and strategic value of their growth opportunities that determines most of the market value of such high-tech firms in a continuously changing environment. A proper analysis of the strategic growth value is more difficult to capture than what P/E ratio, book-to-market ratio or other multiples might suggest. An underlying theory that can incorporate the strategic option characteristics of a firm’s growth opportunities is available.² There is already an appreciation in the market for the firm’s bundle of corporate real options (present value of growth opportunities or PVGO). Industries with higher volatility (such as information technology, pharmaceuticals, and consumer electronics) tend to have more valuable growth opportunities and a higher proportion of PVGO to price, on average, than more stable, established industries (such as transportation, chemicals, and electric power). The former industries involve more unexpected technological changes and competitive moves. As the firm’s or the industry’s dynamic path unfolds, the management must be better prepared to exercise, adapt, or revise future investment decisions. The market appropriately rewards with higher market valuations those firms better able to cope with change, capitalizing on the upside potential while mitigating the downside risk.

The new insights and valuation tools from modern corporate finance based on real options theory can help the management to more fully appreciate the value of corporate capabilities to enhance the firm’s adaptability and strategic positioning in a competitive and volatile environment (Trigeorgis 1996; Smit and Trigeorgis 2004). A firm’s overall value consists of the value of expected future cash flows from existing businesses and the value of future growth options (PVGO). The impact of volatility on these two value components is different. Traditionally, managers used to perceive risk as a penalty which decreases a firm’s current value. Real options theory helps elucidate that uncertainty provides a window of opportunity that enhances the value of a firm’s future
opportunities. Mr Ergen, EchoStar’s CEO, commented that his company was making ‘small bets’ on broadband technology, such as on its relationship with SBC Communications Inc. EchoStar was launching a satellite with broadband capability and some satellite spectrum was expected to be available in the next few years. ‘We are treading water because we don’t know how it’s all going to turn out,’ he said, as if uncertainty was his company’s ally.3

Surveys of managerial use of capital budgeting methods indicate predominant use of DCF and lesser use of real options and other practices. Graham and Harvey (2001) conducted a survey of 398 CFOs, 75% of whom reported ‘always or almost always’ using NPV, with 25% of the CFOs reporting using real options methods. In the survey, firms reported of ‘always or almost always’ using many other methods as well, including IRR, payback, and P/E multiples. Ryan and Ryan (2002) found that 85% of the firms that were interviewed used NPV ‘always or often’ and that methods such as real options and simulation were used by less than 15% of the firms. Copeland and Howe (2002) reported 27% of the CFOs using the real options approach. The survey evidence suggests that firms commonly use multiple capital budgeting methods in making decisions, weighing the results using some subjective judgment. There is also evidence that firms may be adjusting their application of DCF methods to account indirectly for the impact of real options through heuristics. McDonald (2000) found that using a higher hurdle rate, in practice, has an equivalent effect as attempting to optimally delay an investment. Similarly, using a lower hurdle rate in certain strategic situations is equivalent to accounting for subsequent growth or strategic opportunities.

Recent research confirms that stock valuation is significantly affected by individual analyst forecast or model accuracy. Loh and Mian (2006) and Gleason, Johnson, and Li (2009) provided evidence that stock recommendations are more effective and profitable for analysts who are better at forecasting short-term earnings than long-term ones. Demirakos, Strong, and Walker (2004, 2009), examining a database of analysts’ stock reports, found that analysts’ P/E-based models outperform DCF models in target price accuracy and that this effect is mitigated by the difficulty of the valuation task.

Glaum and Friedrich (2006) documented increased use of the DCF analysis in European telecom analysts’ reports after the late 1990s. Deloof, De Maeseneire, and Inghelbrecht (2009) studied the valuation choices of French underwriters documenting that they use the DCF analysis to support initial public offering (IPO) offer prices. All-star unaffiliated underwriters in the US markets tend to be less optimistically biased and less willing to follow a firm in the period following an IPO with significant underpricing (Bradley, Clarke, and Cooney 2009). Interview research by Imam, Barker, and Clubb (2008) also suggests a shift among UK analysts toward the use of more analytical valuation models.

Apart from the above academic work, in July 2010, two opinions from the Delaware Court of Chancery offer important guidance for the preparation and use of the DCF analysis in appraisal and merger-related proceedings.4 In the first case, Vice Chancellor Leo E. Strine Jr. arrived at an appraised value of a merger based on the determinations of the terminal growth rate, the equity risk premium (RP), and beta. In the second case, he concluded that the proxy statement for a proposed merger was misleading with respect to its explanation of how a discount rate was determined. The present article, as an illustrative case study backed up by well-developed recent tools and techniques based on real options analysis, sheds additional light on the limitations of current DCF methods and offers useful comparative practical prescriptions (e.g. options-based PVGO versus terminal growth DCF estimates).

The remainder of the article is organized as follows. The next section provides a brief literature review. Section 3 provides a brief background on the company, while Section 4 describes the
industry and competitor situation. Section 5 discusses EchoStar’s financial condition and basic DCF analysis. Section 6 describes the growth prospects of the company, and Section 7 presents options analysis of growth opportunities. The final section concludes.

2. Brief literature review

A number of academics have conducted several empirical studies to examine the ability of real options analysis to explain observed market prices in a variety of contexts. Paddock, Siegel, and Smith (1988) examined oil tract leases and found that real options prices are closer to market prices for oil lease tracts than DCF estimates. Quigg (1993) and Cunningham (2006), in their examination of real estate prices, found that flexibility has a significant impact on land prices and that greater price uncertainty slows down development and raises prices, consistent with real options prediction. Moel and Tufano (2002) studied managerial decisions involved in the closing and opening of gold mines that are consistent with optimal behavior in the exercise of real options. Berger, Ofek, and Swary (1996) examined whether abandonment value is reflected in market prices. Based on the idea that the value of a firm should be the DCF of existing operations plus the option value of abandoning, they found that manufacturing firms with more abandonment value and more flexible assets have higher prices. Caballero and Pindyck (1996) and Abel and Eberly (2002) found evidence in investing data that irreversibility of investment affects the decision to invest in the first place.

Spencer-Young and Durand (2004) examined the difference between the NPV and ROV estimates of game lodge concessions in South African national parks. They concluded that the difference between winning bids for concessions and mean concession values is related to the real option value of the concessions. Presumably, winning bidders pay more than what the traditional NPV method would justify due to a ‘feeling’ the bidders have about the concessions’ actual value. The authors support the use of ROV, in practice, and recommend that bidders should use it to value concessions as it can lead to more accurate values. More recently, Clark, Gadad, and Rousseau (2010) examined divestitures by 144 UK firms and tested whether and how accurately investors price the firm’s option to abandon assets in exchange for their exit value. They found that investors do price the abandonment option but that they do so imperfectly because the exit price is private information.

Despite the above empirical evidence supporting the incorporation of the impact of real options into market prices, actual company valuations using real options methods have been rather limited due to the complexity involved and the interactions among portfolios of corporate real options. Among the few exceptions, Trigeorgis (1990) described a real options application in a natural resource investment project at British Petroleum. Kemna (1993) discussed insights gained from three actual cases of real options application with Shell group planning: a timing option in the offshore industry, a growth option in the manufacturing industry, and an abandonment option in the refinery industry. Schwartz and Moon (2000) used real options methodology to value Amazon, while Schwartz and Moon (2001) valued eBay taking account of the option value to walk away from an unprofitable operation. They found that estimated real option values are closer to the observed prices of these companies. Lint and Pennings (2001) provided a case study of new product development at Philips Electronics. Kenyon and Cheliotis (2002) valued a dark fiber investment that generates no revenue at present but may do so at some unknown time in the future (when prices drop in an uncertain environment).

Merck & Co.’s opportunity to create a venture in the early 1990s is another application of ROV. Bowman and Moskowitz (2001) described how Merck was interested in entering a new line of
business and contemplated purchasing a new technology from a small biotech company. Because the biotech firm had patented the technology, Merck had to license the new technology in order to use it in the development of its new product line. However, Merck was facing considerable uncertainty from this new venture: on the one hand, it was not certain that a product could, in fact, be developed from the venture since the technology was in a preliminary stage; on the other hand, even if developed, the product’s commercial potential could not be predicted with a fair amount of accuracy. The biotech firm was willing to sell the patent to Merck, because the option would be more valuable in the hands of the latter due to its superior capabilities and better market access. Merck used ROV to plan and evaluate this investment opportunity: the opportunity represented a call option for Merck as it gave it the right – but not obligation – to roll out the product in exchange for paying a premium. A more institution-wide use of ROV-based management at Merck is described in Nichols (1994).

According to Venkatesan (2005), ROV has gained increasing support in the corporate world, with some of the largest companies being noted to have applied ROV. Boyer et al. (2003) referred to Airbus, General Electric, Hewlett Packard, Intel, and Toshiba as companies that have used ROV. According to Teach (2003), Enron was considered an ‘innovative user’ of ROV and its concepts. Mauboussin (1999) discussed how Enron saw the volatility in electricity prices more as an opportunity than as a risk and, accordingly, the firm used ROV to plan its investments in the power industry. Park (2002) further suggested that real options have gained wide acceptance as a tool for making strategic investment decisions, reporting that 27% of Fortune 500 companies have used this approach in their strategic planning.

Trigeorgis (2005) discussed a comprehensive example and other illustrative applications of real options in various industries, reviewing the key lessons and implications of real options thinking for flexible decision-making. Benninga and Tolkowsky (2002) illustrated how a real options decision framework can add flexibility to the capital budgeting process, using R&D in the pharmaceutical industry as an illustration. Karsak and Ozogul (2002) discussed how the value of expansion flexibility can be captured in the manufacturing process through ROV. Davis (2002) cautioned that increasing market volatility can destroy growth option value for firms holding ‘quality’ options. Miller and Park (2002) surveyed other research works in the area of real options.

More recently, Copeland (2010) discussed situations where traditional NPV forces false mutual exclusivity among alternatives and illustrated how modularity of project design can be more valuable than large economies of scale. Arnold and Shockley (2010) argued that real options analysis is justified in any situation where investors want managers to maximize NPV. Sick and Gamba (2010) discussed organizational issues that impede adoption of real options strategies and analytical techniques. More articles on ROV and practical applications can be found in several recent special issues on real options. Related works on growth options and strategy from a real options perspective include Kester (1984), Luehrman (1988), Bowman and Hurry (1993), Smith and Triantis (1994), Trigeorgis (1996), and Teece, Pisano, and Schuen (1997). Related works on technology valuation and strategy include McGahan (1994), Grenadier and Weiss (1997), and McGrath and MacMillan (2000).
planning to help predict how competition will play out. But with competition emerging and evolving more rapidly than ever, supplementing game theory with real options analysis can help companies to be more flexible in how they react. What this all adds up to is a portfolio of corporate real options, each with a value that will change along with the company’s developing markets. Those who manage this portfolio most effectively will be in the best position to realize their company’s growth potential. The present case application is an illustration of how one can practically assess the value of such a portfolio of corporate growth options.

3. Company description

EchoStar, founded in 1980, has been a leading provider of satellite-delivered digital TV services to customers across the USA through its digital information sky highway DISH Network. In 2004, the company conducted substantially all of its operations through its subsidiaries and operated through two principal business units: the DISH Network and EchoStar Technologies Corporation (ETC). The DISH Network provided various services, including video, audio, and data channels, interactive TV channels, digital video recording, high-definition television (HDTV), international programming, professional installation, and 24-hour customer service.

EchoStar started offering subscription TV services on the DISH Network in March 1996. As of the time of the analysis (October 2004), the company had approximately 10 million subscribers. EchoStar launched its first satellite in 1995 and it had nine in-orbit satellites that enabled it to offer over 1000 video and audio channels to consumers across the USA. Through its wholly owned subsidiary, ETC, the company designed and developed direct broadcast satellite (DBS) set-top boxes, antennas, and other digital equipment for the DISH Network. ETC also designed, developed, and distributed similar equipment for international satellite service providers.

In 1987, foreseeing changing technology in the satellite TV industry, EchoStar filed for a DBS license with the Federal Communication Commission (FCC). Its platform of nine orbits enabled the company to effectively access virtually every household in the USA. Throughout its 24-year history (and just eight years after launching the DISH Network), EchoStar had demonstrated its innovative capability by achieving significant industry innovations: it was the first company to develop a ultra high frequency (UHF) remote control, offer an integrated receiver descrambler for C-band satellite TV, a nationwide installation network dedicated solely to satellite TV systems, a satellite receiver with built-in digital video recording, and local channels to local markets in all states of America.

EchoStar had deployed substantial resources over the previous decade to develop the EchoStar DBS System. The DBS System consisted of the company’s FCC-allocated DBS spectrum, its nine in-orbit satellites, EchoStar receiver systems, digital broadcast operations centers, customer service facilities, and other assets utilized in its operations. Its several programming packages to consumers included a number of popular digital video channels. Satellite-delivered local channels were also available separately in 110 of the largest markets in the USA. EchoStar also offered an expanded basic cable package plus a digital music service, movie packages, and foreign-language programming packages. It offered approximately 60 foreign-language channels. The company continued to expand its offerings to include interactive services. DISH Network customers could purchase or lease receivers with built-in hard disk drives that permitted viewers to pause and record live programs without the need for videotape. EchoStar offered receivers capable of storing up to 180 hours of programming and expected to increase storage capacity on future receiver models. The company also offered receivers that provided a variety of interactive TV (iTV) services and applications.
Independent distributors, retailers, and consumer electronics stores were selling EchoStar receiver systems and were soliciting orders for DISH Network programming services. While the company was also selling receiver systems and programming directly, independent retailers were responsible for most of its sales. These independent retailers were primarily local retailers who specialized in TV and home entertainment systems. EchoStar’s distribution channels included a national network of retailers including Costco, Sears, Wal-Mart, and certain regional consumer electronic chains. In addition, RadioShack was selling EchoStar receiver systems and DISH Network programming services through its 5200 corporate stores and in approximately 1000 dealer franchise stores throughout the USA. EchoStar had a strong market presence with ethnic programming to various select groups, giving it a loyal customer base.

The main source of the company’s revenues was pay-TV subscriber-related revenue (TV). In October 2004, this accounted for approximately 94.5% of total revenues. Equipment sales (EQ) accounted for about 5%, while 0.5% came from internet subscriptions (INT). Figure 1 presents a summary of conditional parameter estimates specific to each division, namely each division’s weight (%), its long-term growth rate in terminal value (g), beta (adjusted), the divisional risk premium (RP), and the weighted average cost of capital (WACC) for each division. The last row presents the (market-weighted) average estimates (e.g. g of 4.5%, adjusted beta of 1.55, RP of 8.5%, and WACC of 10.6%) which are being used in the DCF analysis.9

EchoStar’s success was based on a number of strengths. EchoStar had benefited from its robust business model and the reputation of its management. The company’s business model focused on growing EchoStar’s loyal subscriber base, while management’s reputation helped create greater shareholder confidence in the company. EchoStar’s subscriber base had been experiencing substantial growth (15.3% in the previous year), while further increases were anticipated over the coming years. EchoStar was expected to have 11.3 million subscribers by 2007. This growing subscriber base enabled the company to sustain profitability.

EchoStar enjoyed a capital cost advantage over many of its competitors. Its cost leadership enabled it to provide low-cost services so that potential customers could buy EchoStar services ahead of competitors, enabling the company to expand its market share. EchoStar had a number of distribution agreements that benefited its subscriber acquisition efforts. The company had distribution agreements with Radio Shack, Wal-Mart, and CompUSA, among others.

<table>
<thead>
<tr>
<th>Division</th>
<th>Weight (w%)</th>
<th>L-t g (TV)</th>
<th>β (adj)</th>
<th>RP(=β*5.5%)</th>
<th>WACC</th>
</tr>
</thead>
<tbody>
<tr>
<td>TV</td>
<td>94.5%</td>
<td>4.5%</td>
<td>1.56</td>
<td>8.6%</td>
<td>10.6%</td>
</tr>
<tr>
<td>Equipment</td>
<td>5.0%</td>
<td>3.5%</td>
<td>1.32</td>
<td>7.3%</td>
<td>9.7%</td>
</tr>
<tr>
<td>Internet</td>
<td>0.5%</td>
<td>6.5%</td>
<td>1.90</td>
<td>10.5%</td>
<td>11.9%</td>
</tr>
<tr>
<td>Avg/Total</td>
<td>100%</td>
<td>4.5%</td>
<td>1.55</td>
<td>8.5%</td>
<td>10.6%</td>
</tr>
</tbody>
</table>

Figure 1. Parameter estimates by division/business.
Notes: Long-term growth (L-tg) estimates were obtained based on averages of analyst reports on the TV, equipment, and internet sectors. Beta (β) estimates were obtained as industry-weighted averages of these sectors based on recent 30 monthly returns of each company in the sector using the CAPM. Betas were ‘adjusted’ by taking 2/3 of the actual beta estimates +1/3 × 1. Divisional risk premia (RP) were derived from these beta estimates assuming a market RP of 5%. WACC data were based on analyst reports. Debt/firm value ratio was estimated at 29.7% and the 10-year risk-free (US Treasury bond) interest rate was estimated at 4.2%.
These distribution agreements helped EchoStar sign up more subscribers at a lower cost compared with other traditional methods of subscriber acquisition.

ETC was selling digital satellite receivers internationally, either directly to TV service operators or to independent distributors worldwide. This created a source of additional business for EchoStar as well as synergies that directly benefited the DISH Network. For example, the company’s satellite receivers were designed around the Digital Video Broadcasting standard, widely used in Europe and Asia. The same employees who designed EchoStar receiver systems for the DISH Network were also involved in designing set-top boxes sold to international TV customers. EchoStar benefited when ETC’s international projects resulted in improvements in design and economies of scale in the production of EchoStar receiver systems for the DISH Network.

EchoStar had a lot of opportunities, which embedded expansion options for the company. The development of broadband technologies represented a significant opportunity for EchoStar to generate increased revenues in the future. The company’s strategy in the broadband sector was to offer satellite-based platforms in rural areas and wireless technologies (such as Wi-Fi) in urban areas. The emergence of these technologies enabled the company to offer a consistent level of service to both rural and urban areas. EchoStar faced the challenge to develop its offerings in this area and make sure that they were superior to those of the rivals. The media industry’s consolidation trend might potentially benefit EchoStar if it could continue to operate on a stand-alone basis. Media industry consolidation might provide opportunities for EchoStar to acquire some of its own industry rivals in order to expand both its reach and subscriber base.

In October 2004, there were over 20 million subscribers of DBS and other direct-to-home satellite services in the USA. It was estimated that there were more than 90 million TV subscribers in the USA, and there continued to be a significant unsatisfied demand for high-quality, reasonably priced TV programming services. EchoStar could target some of this untapped market potential in order to capture a greater share of the market and increase its subscriber base. Internationally, direct-to-home satellite services were particularly attractive for countries without an extensive cable infrastructure. EchoStar might actively solicit new business for its pay-TV services and ETC division to diversify its revenue stream away from the US market.

EchoStar had several weaknesses. It had a customer churn rate of 1–2%, so it should increase subscriber acquisition efforts in order to capture new subscribers to replace those lost. This would result in increased costs that would restrain company profits. EchoStar spent a lot of money in its efforts to acquire new subscribers. The company needed to maintain an aggressive promotional effort in order to sign up more subscribers. EchoStar’s subscriber acquisition costs usually arose from promotional activities, such as free installation promotions. These costs had to be incurred in order for EchoStar to generate increased revenues in the medium and long term.

The company was also facing a number of threats. It faced competition from a number of industry rivals, including DirecTV (DTV), Comcast Corp. (CMCSA), and Time Warner Cable Inc. (TWX). The acquisition of DTV’s parent company (Hughes Electronics) by the News Corporation (NWS) was expected to intensify competition in the DBS TV market. NWS had significant interests in satellite and cable TV operations all over the globe. Piracy also represented a significant threat to EchoStar’s business. EchoStar’s international revenue depended largely on the success of international operators, which depended on the level of consumer acceptance of direct-to-home satellite TV products and the intensity of competition for international subscription TV subscribers. EchoStar’s business was also susceptible to weakness in the US and global economy.
4. Industry and competitor analysis

Many were skeptical in the early days of the cable industry as to who would pay for TV services. By 2004, demand for pay-TV services had stimulated investments in network infrastructure and product offerings worldwide. In the USA, the Telecommunications Act of 1996 removed barriers to entry into cable operations by phone companies. For a time, telecom companies welcomed the opportunity to enter new markets. However, despite some initial cross-industry movement, most companies stayed with what they knew best.

In spite of controlling large networks, one of the challenges that incumbent phone companies had to face in providing cable services was a lack of control of TV programming, which proved costly to acquire. Cable service providers, which also operated their own networks, though in smaller scope, enjoyed closer relationships with TV, movie, and other media entertainment producers. Cable operators realized that network expansion would be necessary to confront phone companies. Investments in upgrading infrastructure and cable systems facilities in the USA had risen to more than $75 billion since 1996. The new two-way capable cable networks allowed operators to offer advanced services, such as broadband internet access, digital video, video on demand (VOD), and competitive telephone services. Cable systems provided greater bandwidth than the traditional copper lines of phone companies. This advantage allowed cable system operators to gain the lead in the deployment of high-speed broadband internet access. Outside North America, where cable infrastructure was less developed, few cable operators, such as NTL and UGC, were able to offer advanced services. Even in the more developed regions of Europe, cable operators were slower than their US counterparts in upgrading to the two-way broadband networks.

Most regions of the world relied more on satellite delivery, a more effective means for providing services to rural and remote areas. Satellite delivery, however, lost its cost-effectiveness in more populated areas. Some satellite delivery services were being improved to offer two-way access. Both cable and satellite operators worldwide were counting on the increasing demand for broadband internet access to be a major growth driver. Cable companies were running ahead of competition from the digital subscriber line (DSL) services offered by incumbent local phone companies and a host of telecom upstarts. Satellite broadband delivery, though advantageous for rural areas inaccessible by other means, had not yet provided serious competition for cable or DSL providers. Cable companies, phone companies, and satellite providers competed head-to-head to provide broadband internet access and pay-TV programming.

This trend suggested that people worldwide were shifting to satellite TV. Satellite providers were reporting hefty gains, while the cable industry profitability had declined. Consumers were expected to see aggressive marketing promotions in the years ahead as companies fought for customers. Competition came down to service and price: cable companies offered VOD features, high-speed internet access, and in some cases, telephone services. Satellite providers offered all-digital service and channel packages that were often cheaper and broader than digital cable. Advantages included digital picture, HDTV, more choices, and a user-friendly channel guide.

Satellite TV had grown substantially since 1999 when Congress allowed providers to offer local channels. By mid-2004, it accounted for one-fourth of all households in the USA that subscribed to pay-TV services. DTV, USA’s largest satellite TV provider, was in over 150 markets, while EchoStar was in over 140 markets. By mid-2004, satellite providers had a combined net gain of about 1.6 million subscribers, increasing the total to 23 million subscribers. EchoStar alone surpassed 10 million customers. Part of its growth was due to expansion into new markets,
primarily rural areas, as well as competitive pricing. While cable customers had to pay extra for digital service, satellite providers had been quicker with more innovative technology, such as interactive services and digital video recorders.

About 80% of TV households in the USA subscribed to some sort of pay-TV service at the time. While cable was expected to face flat to modest growth, satellite was expected to grow steadily until it completed local market launches. A key advantage of cable over satellite had been broadband internet service. Although both satellite providers had marketing relationships with telephone companies that offered DSL lines, they were not truly bundled services.

Porter’s ‘five forces’ (1979, 1980, 2008) help characterize the dynamic state of this industry at the time. The power of potential entrants was high in the broadcasting and cable TV industry. Barriers to entry were low, technological innovation was rapid, time to market was short, and intellectual property and patents were difficult to protect. Success of first movers could attract large software and content providers. Following the economic downturn surrounding the internet bubble of 2002, it became easier for competitors from other industries to enter into broadcasting and cable TV by purchasing smaller or struggling companies. Microsoft and AOL, for example, had complementary businesses and sufficient resources to enter the industry rapidly. Telecom and utility companies could leverage their large installed infrastructures by changing their business models through their core competencies in distribution and economies of scale to enter the industry.

The power of alternative products was medium to high. Standard TV, home video, pay per view, and internet via PC addressed most viewers’ needs and wants. The development of a widely recognized new product or service was crucial for EchoStar to demonstrate the value of iTV. There were various types of suppliers in this industry with high power. E-commerce and interactive advertising suppliers were the most powerful since they owned the infrastructure and had strong relationships with potential buyers. Content and application providers were important players since they provided the programs and applications that viewers demanded. Advertisers that sponsored most of the content on TV also had power since advertising might lead to follow-on investments and sponsorships. Finally, there were other suppliers, such as middleware providers, real-time developers, and manufacturers, who provided the needed hardware and software.

The power of customers, viewers, and subscribers was medium to low. Customers had some flexibility to switch among established mediums such as broadcast TV, cable TV, and satellite TV. They had some bargaining power via the ability to choose the service provider. But aggressive pricing by service providers and the inability of consumers to act as a single buying entity left end customers with little power.

Industry rivalry was an important force in the industry. As most parties in the industry’s value chain possessed medium to high power, industry rivalry was rather high. The relative power varied in the different segments, with suppliers generally holding substantial power, while individual viewers had little power. The strong interdependencies in the value chain, the absence of an accepted technological standard for software and hardware integration, and the uncertainty about revenue distribution between the different satellite TV features allowed for different market visions. Companies that shared a given vision created partnerships to develop an end-to-end product, producing a value chain where products were differentiated.

The growth of pay-TV services depended on these developments. Cable companies had to complete system upgrades, DBS operators had to deploy iTV services, and TV programmers had to embed interactivity into their content. Their power on the development of the whole industry was substantial. Pressure from customers, aggressive competition, and new added value could provide incentives to transition to iTV. Demonstrating added value to the end customer was a key issue that companies involved in the launch of iTV needed to address.
EchoStar’s capital costs were about one-third of those of the cable providers, giving it an advantage in offering discount pricing. Its base subscription services provided a relatively stable cash flow stream, while its fully digital products offered a competitive advantage in non-two-way cable markets and rural areas where it was expensive for cable providers to build cable infrastructure.

Figure 2 summarizes the specific industries in which EchoStar’s main competitors operated, with the big conglomerates operating in many different industries in the broader sector. EchoStar’s main direct competitors in cable and satellite TV services were DirecTV (DTV) and CMCSA. Other indirect competitors included NWS, TWX, and Viacom Inc. (VIA), as well as Yahoo! Inc. in the internet.

5. Financial condition and DCF analysis

Figure 3 summarizes comparable key statistics and financial performance for EchoStar (over the previous four years), some of its main competitors, and the industry/sector and market averages. By the end of 2004, EchoStar’s 10 million subscribers helped generate revenues of about $7 billion, up 22% from 2003 ($5.7 billion). This primarily reflected DISH Network’s subscriber growth. This 22% annual revenue growth compared favorably with that of the sector and market. Subscriber acquisition costs and subscriber-related expenses, such as programming and marketing campaigns, however, rose by more than 30%. In net, gross profit margin dropped to 32% from 39% in the previous years, below that of the competitors and the industry. Operating profit (EBIT), estimated at $558 million, was 20% lower than that in the previous year. Operating margin also dropped slightly to 8%, below that of the industry.

EchoStar’s net income remained at approximately the same level as that in the previous year ($203 million compared with $224.5 million in 2003), showing significant cash flow improvement (especially given the losses in the previous years). This compared favorably with that of DTV and CMCSA, taking account of its lower size and revenue base. Profit margin dropped slightly to about 3% (from 3.9% in the previous year), still fine compared with that of its direct competitors (DTV and CMCSA) but lower than that of the industry, sector, and overall market. In terms of accounting profitability, EchoStar’s return on assets (ROA) dropped to 1.22, still better than that of its direct competitors, but lower than the industry and sector averages. In terms of market valuation, however, the company enjoyed P/E and price/cash flow ratios well above those of its main competitors and industry, an indication that the market was already recognizing its significant growth potential.

The firm’s financial condition was moderate compared with industry standards. Its cash balance position ($1.72 billion) seemed sufficient and compared favorably with that of DTV and CMCSA relative to its size. EchoStar’s current assets to liabilities ratio (CA/CL) continued to decline (to
<table>
<thead>
<tr>
<th>Indicator</th>
<th>2001</th>
<th>2002</th>
<th>2003</th>
<th>2004*</th>
<th>DISH</th>
<th>DTV</th>
<th>CMCSA</th>
<th>TWX</th>
<th>Industry</th>
<th>Sector</th>
<th>Market</th>
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<tr>
<td>Revenues ($b)</td>
<td>4.00</td>
<td>4.82</td>
<td>5.74</td>
<td>7.00</td>
<td>10.66</td>
<td>19.26</td>
<td>41.42</td>
<td>0.31</td>
<td>26.6%/16.6%</td>
<td>23.8%/13.4%</td>
<td>19.1%/10.8%</td>
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<tr>
<td>Growth (%)</td>
<td>20.5%</td>
<td>19.0%</td>
<td>20.0%</td>
<td>22.0%</td>
<td>29.0%</td>
<td>15.0%</td>
<td>13.8%</td>
<td>1.8%</td>
<td>16.6%</td>
<td>13.4%</td>
<td>10.8%</td>
</tr>
<tr>
<td>Gross Margin (%)</td>
<td>35.90%</td>
<td>39.10%</td>
<td>39.20%</td>
<td>31.60%</td>
<td>42.12%</td>
<td>58.72%</td>
<td>39.30%</td>
<td>41.93%</td>
<td>43.47%</td>
<td>47.88%</td>
<td></td>
</tr>
<tr>
<td>SG&amp;A/Sales (%)</td>
<td>23.60%</td>
<td>21.90%</td>
<td>19.90%</td>
<td>17.09%</td>
<td>35.35%</td>
<td>25.88%</td>
<td>23.21%</td>
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<tr>
<td>EBITDA (EBIT + D&amp;A) ($b)</td>
<td>0.21</td>
<td>-0.33</td>
<td>0.79</td>
<td>1.02</td>
<td>594</td>
<td>7.03</td>
<td>11.497</td>
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<td>Operating Profit (EBIT) ($m)</td>
<td>212.30</td>
<td>452.00</td>
<td>707.60</td>
<td>557.94</td>
<td>-160.60</td>
<td>2,381.00</td>
<td>5,840.00</td>
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<tr>
<td>Operating Margin (%)</td>
<td>5.51%</td>
<td>5.20%</td>
<td>9.30%</td>
<td>8.00%</td>
<td>-1.51%</td>
<td>14.00%</td>
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<td>Net Income (Avl to Common) ($m)</td>
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<td>-850.00</td>
<td>224.50</td>
<td>203.00</td>
<td>-113.30</td>
<td>557.00</td>
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<td>Profit margin (%)</td>
<td>5.31%</td>
<td>5.20%</td>
<td>9.30%</td>
<td>8.00%</td>
<td>-1.51%</td>
<td>14.00%</td>
<td>14.10%</td>
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<tr>
<td>Capital Ex/Sales (%)</td>
<td>15.93%</td>
<td>17.63%</td>
<td>3.91%</td>
<td>3.91%</td>
<td>-1.06%</td>
<td>2.89%</td>
<td>10.19%</td>
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<td>CF from Operations ($m)</td>
<td>62.0</td>
<td>-477.0</td>
<td>622.0</td>
<td>895.0</td>
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<td>3,490.0</td>
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<td>Free Cash Flow ($b)</td>
<td>-879.0</td>
<td>-732.0</td>
<td>-1,309.0</td>
<td>224.0</td>
<td>NA</td>
<td>-0.4</td>
<td>3.2</td>
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<td>Interest Expense ($m)</td>
<td>274.0</td>
<td>370.0</td>
<td>487.0</td>
<td>360.0</td>
<td>487.0</td>
<td>360.0</td>
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<tr>
<td>Debt ($b)</td>
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<td>5.36</td>
<td>5.50</td>
<td>6.00</td>
<td>5.50</td>
<td>6.00</td>
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<td>Debt/Equity (Book) (%)</td>
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<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>28.00%</td>
<td>62.00%</td>
<td>41.80%</td>
<td>51.00%</td>
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<td>Cash ($b)</td>
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<td>1.48</td>
<td>1.29</td>
<td>1.72</td>
<td>1.72</td>
<td>1.93</td>
<td>3.08</td>
<td>6.23</td>
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<td>WC (&lt;CA-CL) ($b)</td>
<td>2.4</td>
<td>2.1</td>
<td>2.1</td>
<td>0.6</td>
<td>3.8</td>
<td>-4.2</td>
<td>0.0</td>
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<tr>
<td>Current Ratio (CA/CL)</td>
<td>3.11</td>
<td>2.76</td>
<td>1.86</td>
<td>1.32</td>
<td>1.78</td>
<td>0.51</td>
<td>1.00</td>
<td>1.45</td>
<td>1.80</td>
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<tr>
<td>Interest Coverage Ratio (EBIT/Interest)</td>
<td>0.53</td>
<td>0.89</td>
<td>1.26</td>
<td>1.04</td>
<td>-1.66</td>
<td>1.38</td>
<td>8.63</td>
<td>3.94</td>
<td>8.01</td>
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<td>Market Cap ($b)</td>
<td>12.79</td>
<td>10.40</td>
<td>16.10</td>
<td>14.2</td>
<td>23.0</td>
<td>63.5</td>
<td>77.2</td>
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<td>Enterprise Value ($b)</td>
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<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>19.80</td>
<td>20.2</td>
<td>23.8</td>
<td>86.1</td>
<td>95.3</td>
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<tr>
<td>Market Cap / EBITDA</td>
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<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>9.80</td>
<td>9.60</td>
<td>13.48</td>
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<td>EPS</td>
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<td>-1.76</td>
<td>0.46</td>
<td>0.45</td>
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<td>P/E</td>
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<td>-12.25</td>
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<td>70.05</td>
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<td>115.29</td>
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<td>27.42</td>
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<td>P/CF</td>
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<td>9.69</td>
<td>14.92</td>
<td>29.91</td>
<td>NA</td>
<td>13.14</td>
<td>7.80</td>
<td>15.54</td>
<td>16.21</td>
<td>15.81</td>
<td></td>
</tr>
<tr>
<td>Market/Book</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>19.80</td>
<td>20.2</td>
<td>23.8</td>
<td>86.1</td>
<td>95.3</td>
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<tr>
<td>ROA</td>
<td>-3.86</td>
<td>-6.95</td>
<td>3.24</td>
<td>1.22</td>
<td>-0.96</td>
<td>0.55</td>
<td>3.52</td>
<td>1.55</td>
<td>6.21</td>
<td>7.12</td>
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<tr>
<td>Beta (adj)</td>
<td>1.55</td>
<td>1.44</td>
<td>0.90</td>
<td>1.70</td>
<td>1.48</td>
<td>0.98</td>
<td>1.00</td>
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</table>

Figure 3. Echostar’s financial performance: comparable key statistics and indicators.
Note: *In 2004 are estimates as of October 2004. EPS, earnings per share; ROE, return on equity.
L. Trigeorgis and S. Ioulianou

Panel A. Performance of EchoStar vs. Cable TV and S&P Over 5-year Period

![Chart showing performance comparison between EchoStar, Cable TV, and S&P over a 5-year period.](image)

Panel B. Performance of EchoStar vs. Media Over Previous Year

![Chart showing performance comparison between EchoStar and Media over the previous year.](image)

Figure 4. Performance of EchoStar versus industry, sector, and market. (a) Performance of EchoStar versus cable TV and S&P over five-year period; (b) performance of EchoStar versus media over the previous year.

13%), but remained within industry norms. Its interest coverage ratio was low compared with the norms in the industry, alerting that the company should control its interest expense and borrowings.

The company’s operating and financial performance based on these ratios was mixed compared with that of its main competitors and the sector. Although EchoStar outperformed the sector over a longer (five-year) horizon, its price performance in 2004 compared with that in the previous year showed signs of potential undervaluation relative to the sector (Figure 4). Nevertheless, the company’s prospects and growth options needed to be examined more carefully in order to reach rational conclusions about its proper market valuation at the time.

The following analysis depends on a basic DCF analysis as a starting basis. Figure 5 provides a summary of our DCF analysis for EchoStar. It is based on analysts’ 22% growth projections of total revenues over the next five years along with an estimate of residual-year revenue, assumed to grow subsequently at an average long-term growth rate (g) of 4.5% (the average estimate by analysts). The derived free cash flow projections are shown in the last row (including the residual
These are discounted at an average company WACC of 10.6% (based on the company’s adjusted beta estimate of 1.55, its 29.7% debt/firm value ratio, and a 4.2% risk-free rate). This results in a total DCF value of $19.7 billion and total firm value of $20.4 billion. After adjusting for total debt ($6 billion), this results in an equity value of $14.4 billion or $31.71 per share. This is close to the prevailing price of $31.30 as of 9 October 2004. Interestingly, it is as if the market priced the company using DCF with an implied average long-term growth rate of 4.5%.

It is noteworthy that almost 80% of the DCF valuation derived from the terminal (residual) value, primarily driven by the implicit DCF long-term growth assumption of $g = 4.5%$. Hence, one’s confidence in the standard DCF valuation hinges on whether this long-term growth rate assumption appropriately reflected and captured the value of the portfolio of EchoStar’s growth options. Conceptually, we will remove the impact of the long-term growth rate estimate through the terminal-value DCF assumption (obtaining the ‘base DCF’ value) and then replace it with an explicit accounting of the firm’s portfolio of growth options embedded in each of its business areas over the long term.

Figure 6 summarizes the results of our DCF analysis, separating the ‘base DCF’ part from the growth component. At an average growth rate of 4.5%, the DCF analysis results in a total firm value of $20.41 billion. By subtracting the outstanding debt of $6 billion, we get the equity value of $14.41 billion or $31.71 per share. The third column shows the base DCF, that is, the value of
sustaining operations without any further growth (setting $g = 0\%$ and Capex at the depreciation rate). The difference between these two values is the growth value (PVGO) implied by the market ($7.79$ billion or $17.16$ per share). That is, the implied growth potential is about $38\%$.

Figure 7 breaks down EchoStar’s DCF ($g = 4.5\%$) and base DCF ($g = 0\%$) values by division. As of 9 October 2004, the TV division had a DCF value of about $19.3$ billion or $30$ per share ($12$ billion or $14$ per share base DCF without growth). Equipment was valued at $1$ billion or $1.6$ per share ($0.6$ billion or $0.7$ per share base DCF without growth), and Internet was estimated at $0.1$ billion or $0.16$ per share ($0.01$ billion or $0.07$ per share assuming no growth). The total company DCF of $20.41$ billion (resulting in a $31.71$ per share DCF estimate) provides a lower bound to the true worth of EchoStar’s equity as it does not adequately reflect the option value of its growth (expansion) opportunities embedded in each of its three business divisions, especially the substantial growth potential of its new Internet division. We describe these growth opportunities next. To determine the correct worth of these growth opportunities, a proper bottom-up real options analysis is carried out in the following section.

### EchoStar’s growth prospects

EchoStar had been systematically developing its growth options through a series of investments in the previous years. A number of key events are noteworthy in terms of understanding the company’s development and future prospects. In December 1995, EchoStar took the first step for its worldwide expansion by launching its first satellite, EchoStar I, from Xichang, China. In November 1998, EchoStar acquired the $110^\circ$ west longitude orbital slot from NWS and MCI World Communications, another significant step positioning itself for future growth. In August 2002, EchoStar’s DISH Network satellite TV systems were made available at Wal-Mart stores nationwide. In July 2003, EchoStar reached an agreement with Qwest to offer satellite services as part of a communication bundle. EchoStar and SBC Communications Inc (SBC) forged a strategic partnership to offer SBC DISH Network TV service.

In February 2004, EchoStar announced plans with RadioShack to partner with Sirius satellite radio service and a bundling agreement with Sprint services. In March 2004, the DISH Network
reached a long-term agreement with Viacom on rights to carry CBS, MTV, and other channels. It also launched partnership with SBC, selling a four-way bundle that included video. In July 2004, the DISH Network and a RadioShack franchise retailer teamed with the town of Center, Colorado, to convert approximately 600 municipally owned cable customers to the DISH Network satellite TV.

In August 2004, EchoStar and SBC teamed up to launch an online movie-on-demand service. Channeling video content through the internet could avoid the spectrum constraints of broadcast TV. In addition, EchoStar and CenturyTel signed a Strategic Partnership Agreement to offer CenturyTel and DISH TV Services to households in 22 states served by CenturyTel. This would allow CenturyTel to offer its customers multi-channel digital TV as part of its full suite of bundled product and service offerings. Also, the TV Guide Channel had been launched on the DISH Network, bringing its customers a guide to ‘what’s on’ and providing EchoStar with a valuable medium through which to communicate with customers.

By September 2004, the DISH Network had expanded its offerings of local TV channels by satellite TV to regions of Virginia and Florida, expanding local channel availability to 150 markets, including all 50 states, Puerto Rico, and DC. At that time, EchoStar announced it would seek to expand relationships with current and future telecom partners that focus on meeting customer demand for single-bill, bundled services.

By all indications, as of October 2004, EchoStar would continue its expanding course by taking advantage of similar growth opportunities embedded in each of its three divisions. The option map shown in Figure 8 serves to summarize what were then EchoStar’s future growth opportunities by division. The value of growth or expansion options shown in the option map is incremental, going beyond the value of cash flows from sustaining existing (steady-state) operations captured in base DCF. The company’s base DCF incorporates the cash flow value from its existing businesses and from its strategic plan commitments over the short term (next five years). Beyond the five-year horizon, the management can exploit a range of future growth opportunities, embedded in each of its divisions. The future growth or expansion opportunities are examined separately below for each of the three business areas (divisions), as each has different characteristics and prospects.

6.1 Expand TV services (TV)

EchoStar’s opportunities to expand its TV business were expected mainly to come from geographic expansion of its content and from cross-selling of new services to its existing TV customer base. This option to expand EchoStar’s businesses is depicted in the top branch in the option map shown in Figure 8. At the time, its primary operation, pay-TV services, accounted for 94.5% of its total business revenues. This area focused on providing on-demand TV programs, games, and related services (iTV). The DISH Network offered the lowest all-digital TV price in America and continually looked for ways to offer new services, such as HDTV, and bring more programming choices to its existing TV customer base in the USA. The company also offered receivers that provided a variety of new iTV services and applications to its existing customers.

EchoStar planned to use Broadcom’s phase shift keying (8PSK) technology across its newest line of DISH Network satellite TV receivers and Dish Player-DVR products. Broadcom’s 8PSK was an advanced modulation and coding technology that was able to increase information throughput by 35% in a given radio frequency link with no additional power requirements. This capability would allow EchoStar’s DISH Network to provide more programming services to existing subscribers using current dish antennas. With the help of Broadcom code technology in its new line of satellite set-top boxes, the DISH Network could also expand its available video and audio
Figure 8. Option map for EchoStar’s growth (expansion) opportunities.
programming services to include local stations. Bandwidth HDTV programming could be utilized to expand to additional geographic areas in the USA (both on its own and via partnerships) as well as internationally. Besides its four movie packages (which included up to 10 movie channels per package), EchoStar offered approximately 60 foreign-language channels, including Spanish, Arabic, South Asian, Hindu, Russian, Chinese, Greek, and other languages generating valuable options to expand internationally.

In the USA, EchoStar sought to develop and expand relationships with current and future telecom partners to meet customer demand for single-bill, bundled services as a means of attracting more subscribers. Customers across the USA had embraced the convenience and cost savings provided through such partnerships generating a valuable option to expand TV services through partnerships. For example, the partnership with SBC Communications Inc., announced in 2003, promised to deliver significant strategic and marketing benefits for both EchoStar and SBC. EchoStar would acquire a powerful sales and marketing channel for its DISH Network satellite TV service. EchoStar and SBC also planned to develop set-top boxes that were able to combine the features of satellite TV, digital video recording, broadband, home networking, and telecom services, moving to truly integrated telecom and entertainment services providing greater interactivity, features, and functionality for their consumers.

### 6.2 Expand equipment (EQ)

EchoStar’s opportunity to expand the equipment business was also expected to mainly come from geographic expansion and from introduction of new equipment products. The equipment division at the time accounted for about 5% of company operations and consisted of selling HDTVs, receivers, antennas, set-top boxes, and accessories. Growth prospects in equipment were driven by TV expansion opportunities so effectively the two divisions gained their expansion value from the same source. The option to expand EchoStar’s equipment business is depicted in the second branch of the option map shown in Figure 8. Again, growth opportunities could come from geographic expansion and from sales of new products to existing and new customers. Geographic expansion could be achieved either through partnerships or by expanding the businesses on their own. In the first stage, geographic expansion was focused primarily in the USA, particularly regarding the coverage of rural areas and ethnic groups. Within the following five years (and up to year 10), the company had an option to expand its equipment business internationally, covering more countries overseas driven by the international expansion of TV services.

### 6.3 Expand internet (INT)

This new business area, broadband internet connectivity (both dial-up and DSL), was at its infancy stage, accounting for only 0.5% of company revenues. However, it represented a valuable early-stage growth option. It was providing the promise of tremendous growth potential for the company. EchoStar’s opportunity to expand would come mainly from two sources: (a) partnerships using broadband connectivity and (b) switching existing customers from dial-up to DSL. The option to expand EchoStar’s internet segment is depicted in the third branch of the option map shown in Figure 8. Specifically, the internet broadband business opportunity represented the most significant growth option. In the next five years (years 1–5, i.e. 2005–2009), EchoStar had the opportunity to expand its broadband internet services through partnerships and switch its small dial-up connection customer base to DSL. Within the subsequent five years (years 5–10, i.e. 2009–2014), the company
at the time had a follow-on option to further expand its broadband internet (DSL) services by adding broadband satellite capacity, both locally and internationally.

7. Options analysis of growth opportunities

Based on the DCF analysis conducted earlier, we arrived at a total firm value for EchoStar of $20.4 billion (resulting, after appropriate balance-sheet adjustments, in an equity value of $14.4 billion or $31.71 per share) as of 9 October 2004. This DCF value includes the company’s existing committed plans at the time to expand over the next five years and a terminal value (assuming a residual average long-term growth rate of 4.5%) subsequently. Our approach here is to obtain a better estimate of the firm’s long-term growth option value by first removing the impact of the long-term growth rate through the terminal-value DCF assumption (obtaining the ‘base DCF’ value) and then replacing it with an explicit accounting of the firm’s portfolio of growth options embedded in each of its three business areas after year 5 (as shown in the option map in Figure 8).

To obtain the ‘base DCF’ value of the company based on its existing plans at the time (assuming a no-future-growth policy), we back out (set to zero) this residual growth and set capital expenditures equal to the level of depreciation expenses under a sustainable no-growth policy. The ‘base’ (no-growth) DCF enterprise value of the company as a whole \( V_0 - I_0 \) is estimated to be about $12.57 billion. The base underlying asset value for the company \( V_0 \) used to obtain a better estimate of the value of the various divisions and their business expansion options is $16.42 billion.12 Figure 9 summarizes the parameter estimates for the main option value drivers for implementing the option map shown in Figure 8 and obtaining valuation results.

Our bottom-up options analysis takes into account management’s plans to develop its main strategic expansion options around its most important business areas discussed above (along with an option to abandon/sell this relatively young firm for a salvage value of $4 billion in five years if things do not go well). As shown in Figure 9, the option to further develop and expand EchoStar’s existing business within a five-year period was modeled using an estimated free cash flow (FCF) value growth rate \( g \) of 10% and business volatility \( \sigma \) of 30%. The RP was estimated to be 8.5% and the 10-year risk-free rate \( r \) was estimated to be 4.2% during the relevant period. Overall company expansion was expected to be achieved through discretionary investment outlays of about $4.73 billion over the next five years. An estimated $8.8 billion investment was needed subsequently based on current investment projections. An additional $4.5 billion would be needed within the next 10 years if the company pursued international expansion of its TV and equipment operations as well as expansion of its broadband internet (DSL) business. The above

<table>
<thead>
<tr>
<th>Variable</th>
<th>Estimate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Initial Value (V)</td>
<td>$16.42b</td>
</tr>
<tr>
<td>Growth in PV (g)</td>
<td>10.0%</td>
</tr>
<tr>
<td>Risk premium (RP)</td>
<td>8.5%</td>
</tr>
<tr>
<td>Payout (δ)</td>
<td>2.7%</td>
</tr>
<tr>
<td>Volatility (σ)</td>
<td>30%</td>
</tr>
<tr>
<td>Investment cost (I)</td>
<td>-$13.3b</td>
</tr>
</tbody>
</table>

Figure 9. Option value variables and parameter estimates. Note: Option maturity \( T \) 5–10 years; risk-free rate \( r \) 4.2%.
A number of consistency checks were applied throughout the valuation process. For example, the expansion (growth) factors used were subject to several tests of consistency. First, the expansion factors shown in Figure 10 were set proportional to the conditional growth rates for each division (based on projections of growth by other analyst sources). When these conditional growth rates are averaged across divisions, they result in the average long-term company growth rate of 4.5%. The expansion factors are also such that when the growth (expansion) options are ‘committed’, our expanded-NPV (options) analysis reduces to our DCF valuation of $14.4 billion for the whole company. Finally, when each division’s options are committed, the individual DCF estimate for that division is obtained. In the latter procedure, the option to abandon is ‘disabled’ in order to achieve consistency with the traditional NPV estimate.

The option valuation results are shown at the top of each option node in Figure 8. The initial value of the business, estimated as the present value (PV) of free cash flows from the existing TV, equipment, and internet business, is about $16.42 billion. The value to expand the TV division is estimated at about $4.72 billion or $10.4 per share, to expand the equipment division $0.98 billion or $0.22 per share, and to expand the internet business $3.92 billion or $8.6 per share. The total value of growth opportunities (PVGO) in all the three areas is $9.63 billion or $21.2 per share and the total firm value is estimated at $23.73 billion as of 9 October 2004. After subtracting net debt, the ROV method estimates the share price at the time to be $40.13.

In terms of value breakdown, the value of the option to expand the TV business comes from two sources: the option to expand geographically is estimated at $4.05 billion, while the option to sell more TV services to existing customers (cross-selling) is estimated at $0.67 billion. The option to expand geographically can be broken down into the sum of the option to expand on its own in the US market ($3.02 billion) and the value to expand through partnerships ($1.03 billion).
The option to expand in the USA is much higher as it also takes into account the fact that after five years there is an embedded follow-on option of expanding internationally (\$2.8 billion).

EchoStar’s option to expand the equipment division similarly comes from two sources: the option to expand geographically (\$0.84 billion) and the option to extend its product mix by selling new products (\$0.13 billion). Geographic expansion involves the sum of the option to expand through partnerships (\$0.09 billion) and the option to expand its equipment business to the USA on its own (\$0.75 billion). The last option has greater value as it embeds the follow-on option to expand the equipment business internationally (\$0.76 billion). The company’s option to expand its broadband internet business is worth \$3.92 billion. This value is the sum of the option to offer more broadband services through partnerships (\$3.91 billion) and to switch its current dial-up customers to DSL (\$0.01 billion). The option to provide broadband internet services through partnerships includes a follow-on option to expand the provision of DSL connectivity between years 5–10 (\$3 billion).

Total company value using ROV is estimated at \$23.73 billion or \$40.13 per share compared with the DCF estimate of \$20.41 billion or \$31.71 per share (assuming 4.5% long-term growth rate) as of 9 October 2004. Figure 11 summarizes our valuation results by division. Our value estimate for the TV division is \$18.1 billion or \$28.33 per share, close to the DCF estimate of \$19.3 billion or \$30 per share. Our option valuation of equipment division is around \$1.7 billion or \$3.11 per share, while our DCF estimate is \$1 billion or \$1.60 per share. The internet valuation, around \$4 billion or \$8.72 per share, shows the greatest disparity from the DCF estimates (\$0.1 billion or \$0.16 per share). This confirms that the young internet division is heavily undervalued by DCF as most of its value comes from future growth opportunities rather than from current subscription levels. Although the proportions that each division contributes to company’s revenues are 94.5% for TV, 5% for equipment, and only 0.5% for the internet, in value terms they represent 70% for TV, 8% for equipment, and 22% for the internet. The latter represents the beneficial upside potential of the uncertain internet business, contrary to traditional DCF thinking.

8. Conclusions

This article discussed the use of real options methodology in valuing a high-tech company with significant growth option potential. The company’s growth potential was viewed and valued as a portfolio of growth (expansion) options. The starting point was to perform a standard DCF analysis. The growth part improperly handled in the terminal-value assumption was removed and replaced by an explicit modeling of the firm’s portfolio of growth options embedded in its various divisions. Our DCF analysis (based on FCF, using a 4.5% average long-term growth rate) resulted in a value for the company of about \$20.4 billion or \$31.71 per share, around the prevailing price of \$31.30 on 9 October 2004. The in-depth real options analysis was based on modeling
EchoStar’s growth (expansion) opportunities as shown in the option map in Figure 8. The option valuation resulted in total company value of $23.7 billion or $40.13 per share. In terms of value breakdown, most uncertainty concerned the value of the internet division where the option and DCF estimates diverged the most. The DCF analysis has been shown to have serious weakness in that it significantly undervalues such out-of-the-money options.

EchoStar, operating in a more established though competitive line of business (TV and equipment), started a new business (internet) in an uncertain environment. This actually represented investment in an asset that it could develop and expand now or later, depending on market conditions. This was an option that the firm could develop or expand if demand developed sufficiently. EchoStar similarly had other expansion options in other businesses. Ignoring the available options and valuing the entire firm based on today’s expectation of prices and demand conditions using the DCF approach can lead to significant undervaluation of both the options and the firm. If the management understands how to value a new start-up line of business as an option, it can take better advantage of the upside potential behind uncertain conditions, exploit possible strategic partnerships, or evaluate more effectively potential M&A bids on its future path.

If EchoStar’s management valued its new internet start-up business using the standard DCF approach, misleading conclusions would be reached. Depending on current prices, the existing level of demand, expected growth, and the costs of expanding the business line, the management would make explicit assumptions and form expectations concerning the timing and scale of expansion and the resulting expected future cash inflows. The value of the start-up business would be obtained by discounting these expected cash flows and adding them up (net of the expected costs). Given that the new start-up business is more volatile, a higher discount rate would likely be used by naively following the DCF methodology. A higher discount rate would lead to a lower estimated value for the internet start-up asset. This is a gross mistake.

This undervaluation occurs because the DCF approach ignores the flexibility that EchoStar’s management has regarding whether and when to exercise its option to expand the internet division, which was in its infancy. As such out-of-the-money options are more valuable when there is more future uncertainty about market demand conditions or technology, the internet start-up is more valuable when demand is unknown and more volatile. The DCF approach erroneously suggests that the greater the uncertainty over future demand, the lower the investment in new start-ups should be. ROV, by contrast, prescribes the opposite: higher volatility means higher upside potential value for the start-up business and thus more investment in the start-up. By treating a start-up business as an out-of-the-money option, we can value it correctly using ROV; moreover, we can also determine when is the best time to invest in the development or expansion of the new business. Developing or expanding a new business is like exercising a call option, where the exercise price is the cost of development or expansion. The greater the uncertainty over demand, prices, competitive conditions, or technology, the longer the firm should wait keeping alive its option to develop it and the more valuable the option to develop the business is.

The ROV view of investment can also help EchoStar’s management account for flexibility in its expansion plans for the existing TV and equipment divisions. Should the firm commit itself to large amounts of investment right upfront or should it retain flexibility by investing in stages, keeping its options whether or not to grow open? Although many industries struggle with this dilemma, it is particularly important for technology firms, such as EchoStar, whose expansion plans must balance the advantages of expanding mature divisions at once to exploit cost savings from economies of scale versus the advantages of investing gradually to maintain adjustment flexibility. If EchoStar makes a large irreversible investment in a mature division and then demand grows slowly or shrinks, it will suffer losses from a capital investment it does not need. When
the growth of demand is uncertain, there is a trade-off between investing big due to economies of scale versus the flexibility that is gained by proceeding in stages as needed. The DCF approach favors the big investment, but this does not mean that it is the better or even the more economical alternative. ROV can do a better job to assess the importance of the flexibility that smaller, staged additions to existing business would provide.\textsuperscript{13}

High-tech firms increasingly find that the value of flexibility can be large and that standard DCF methods that ignore this flexibility can be very misleading. Managers also understand that successful investment in uncertain technological businesses often creates strategic benefits as the initial investment may lead to follow-on opportunities or other extensions or applications. In fact, some investments are pursued primarily because they provide the possibility of opening up future growth prospects that might otherwise be unavailable to the firm. The DCF approach misses the value of such multi-stage or compound-like options as well. In general, ROV is a better tool for firm valuation than the DCF method as it recognizes and explicitly values the flexibility in investment opportunities and the importance of future growth options and other strategic considerations. Effective ROV and management favorably alter the probability distribution of the returns of the firm’s portfolio of investment opportunities by skewing it to the right. The firm’s upside potential is consequently improved, while the downside risk is limited.

In our valuation of EchoStar, our ROV of the firm’s growth potential was about $9.6 billion, compared with $7.8 billion factored in by the market (based on the DCF approach) at the time. That is, the market seemed to underprice the company’s growth prospects at the time of valuation. Based on the above analysis, we estimate that the company’s total options-based value was about $23.7 billion or $40 per share. This was about $9 per share above the then prevailing price of $31.30 (or the DCF estimate of $31.70). Hence, our ROV analysis indicates that EchoStar’s share was significantly undervalued as of 9 October 2004. Perhaps, the comparative analysis of ROV versus DCF approach might be better understood today than in 2004.

History has proven us right as the following ‘reprise’ of how things have actually panned out for EchoStar suggests.\textsuperscript{14} By January 2007, EchoStar’s share price rose to our target estimate of $40 per share and remained above this level subsequently. The events that followed confirm the growth option potential revealed in our analysis. Two months later, in January 2005, EchoStar bought the broadcasting assets of the troubled HDTV satellite provider Voom. On 29 April, EchoStar announced that it would expand its HDTV programming by adding the first 10 of 21 original Voom channels and mirror the channels on a CONUS slot. The DISH Network proceeded to add CNN HD in Spanish along with other packages in its Latino HD lineup. On 25 September 2007, EchoStar agreed to acquire Sling Media Inc., a leading firm in the digital lifestyle space which had achieved an international distribution of its software in over 5000 retail stores in 11 countries. EchoStar’s acquisition of Sling Media enabled it to offer and develop new innovative products and services for its existing subscribers, as well as its new digital media consumers and strategic partners. Through these strategic expansion moves, EchoStar reaffirmed its growth options path underlying our analysis.\textsuperscript{15}

Notes

1. We value EchoStar as of 9 October 2004. The company was publicly traded on NASDAQ under the symbol ‘DISH’.
2. See, for example, Business Week (1999) and International Herald Tribune (1999).
5. ROV has also been used for valuing public projects and investments. For example, Kitabatake (2002) conducted an ex ante evaluation of a large-scale road construction project in the Minami Alps forest estimating the market value of the underlying project and its volatility using historical data from similar projects. This involves identifying related market-evaluated goods and services.

6. Coy (1999) explained how Enron capitalized on electricity price volatility by building less-efficient but flexible power plants. The plants were left idle during periods of low or moderate electricity prices and were put into operation only when electricity prices peaked or went sufficiently high. The ‘peak’ power plants were seen as options to be switched on only when prices went up. Enron was not obliged to commit itself to investing at any point in time but did so at peak periods when clearly profitable.

7. See, for example, Financial Management special issue on Real Options (Autumn 1993); The Engineering Economist special issues on Real Options (2002, 2005); Review of Financial Economics special issue on Real Options (vol. 13, nos. 3–4, 2005); Multinational Finance Journal special issues on Real Options (vol. 14, nos. 1–2 and nos. 3–4, 2010); European Journal of Finance special issue on Real Options (forthcoming, 2011).

8. Information about EchoStar was collected by the authors as of the time of valuation in October 2004 (and is valid as of that date) through various sources: Bloomberg, CnnMoney, EchoStar.com, Financial Times, GoogleFinance, Reuters, SEC, ThomsonOneAnalytics, Yahoo!Finance, and several analyst reports on the company.

9. The long-term growth estimates were obtained based on averages of analyst reports on the TV, equipment, and internet sectors. Beta estimates were obtained as industry-weighted averages for these sectors based on most recent 30 monthly returns of each company in the sector using the capital asset pricing model (CAPM). Betas were ‘adjusted’ by taking 2/3 of the actual beta estimates + 1/3 × 1 as betas tend toward 1 over time (see Brealey, Myers, and Allen 2011). Divisional RP were derived from these beta estimates assuming a market RP of 5.5%. WACC data were based on analyst reports. Debt/firm value ratio was estimated at 29.7% and the 10-year risk-free (US Treasury bond) interest rate was estimated at 4.2%.

10. Porter’s ‘five forces’ are a framework for industry analysis and business strategy developed by Porter (1979, 1980). These forces are as follows: new market entrants, substitute products (including technology change), suppliers, the power of buyers/customers, and existing competitive rivalry. Porter (2008) discusses common misunderstandings, providing practical guidance for users of the framework, and its implications for strategy today.

11. In 2002 (March to September), there was a sharp drop in stock prices on stock exchanges across the USA, Canada, Asia, and Europe. This downturn was characterized as the ‘internet bubble’ bursting as a number of internet companies (e.g. Webvan, Exodus Communications, and Pets.com) went bankrupt, while others (Amazon.com, e-Bay, and Yahoo!) lost substantial value. An outbreak of accounting scandals (Enron, Arthur Andersen, Adelphia, and WorldCom) expedited the fall as numerous firms were forced to restate earnings and investor confidence suffered.

12. Base DCF or NPV0 = V0 – I0; therefore, V0 = Base DCF + I0 = 12.57 + 3.85 = $16.42 billion, where I0 = IS/(1 + r)3 = 4.73/1.04253 = $3.85 billion.

13. For further discussion on these trade-offs and the advantages of ROV versus DCF see Dixit and Pindyck (1995).

14. These results were presented at the 10th Annual International Conference on Real Options at Columbia University, New York, in June 2006. The confirmation of the validity of our valuation was revealed in the marketplace subsequently.

15. January 2008 marked the most important event in EchoStar’s life. DISH Network business was demerged from the equipment, technology, and infrastructure side of the business creating two separate companies: DISH Network Corporation, consisting mainly of the DISH Network business, and EchoStar Broadcasting Corporation, which retained ownership of the technology side including the satellites, Sling Media, and the set-top box development arm. Dish Network Corporation, the larger of the two companies, focuses on programming, service, and marketing of satellite TV, while EchoStar Corporation runs a majority of the satellites and other signal infrastructure. DISH Network Corporation’s and EchoStar Broadcasting Corporation’s common stocks are now publicly traded on NASDAQ under the symbols ‘DISH’ and ‘SATS’, respectively.

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