

The Valuation of Startups in New Markets: an Applied Case in Asteroid Mining

Scott Pepis

Statistician, Osprey Financial Group

Jacob Evans

Financial Planning Assn

Pieter de Jong

Department of Accounting and Finance

Coggin College of Business

University of North Florida

USA

Abstract

This case study aims to educate students on how to properly evaluate startup companies in new, unproven, and speculative markets. Private equity valuations are notoriously difficult due to the lack of available financial information. We will introduce valuation techniques that could be applied to many startup firms; and in order to provide adequate context for this assignment, we introduce students to the emerging asteroid mining industry. In addition to the valuation of asteroid mining firms, we will also address ways for investors to select the most viable investment option for a 10 to 20-year horizon. We will focus on the asteroid mining industry because this industry provides the best framework for this case study; the industry is in its infancy; and has relatively few startups with very little to no publicly available financial data or historical data. Students will have to use critical thinking and creativity to determine the value for these firms and the financial solvency for the industry as a whole.

Keywords: Startups, New Markets, Valuation Techniques, Private Equity

1. The Emerging Space Industry

Although a relatively new phenomenon, investment in space startups has been skyrocketing; accumulating \$13.3 billion in investment since 2000, with approximately 75% of that investment occurring in the last 5 years. For example, in 2015, there were more dollars invested from venture capital firms in space companies than in the last 15 years combined. As space companies have received more investment, barriers to entry in the space market have been reduced. According to Goldman Sachs, on a cost per kg to low earth orbit basis, the cost associated with rocket launches has decreased by 90% over the last decade. Similarly, the costs associated with someone traveling into space have decreased from \$35 million to \$250 thousand.

1.2. Asteroid Mining

Asteroid mining companies aim to mine near-earth asteroids for valuable commodities. Whereas there is undeniable economic benefit in mining M-Type asteroids for precious and basic metals, there are only two startup asteroid mining firms; and they primarily aim to mine C-Type asteroids for H₂O: Planetary Resources and Deep Space Industries. Based off their independent research, both companies consider water as an ideal space propellant, with the ideal chemical compounds to allow space vessels to travel long distances at relatively favorable costs. Although water is a renewable resource on earth, the current amount is considered insufficient to sustain human life and allow for scalable space-travel and off-earth colonization. As investment in space startups has increased, so has investment in those two companies. Although both companies have differing business strategies and visions for the future, both have received a combined \$68.26 million in funding. Noteworthy investors include *Space Angels*, *Founders Fund*, and Larry Page, the co-founder of Google. Though the investment in asteroid mining companies is quite substantial, the projected costs of making asteroid mining a reality remain uncertain. If launch costs continually decrease as various companies, such as SpaceX, continually strive to make reusable rockets more efficient, then it will be much more economically feasible for humans to enter space on a more frequent basis.

However, the economic feasibility associated with asteroid mining extends far beyond the cost to enter space. Another important factor concerning economic feasibility are the necessary research and development costs to produce machinery that can mine asteroids in space. Before being cancelled in June 2017, the cost of the *Asteroid Redirect Mission* was estimated to be \$2.6 billion by the *Glenn Research Center*. In light of such estimates, although the asteroid mining industry is in the early phases of raising capital, the prospect of developing the necessary machinery to mine asteroids appears economically feasible, especially as space machinery and robotics continues to become more efficient and cost-effective.

2. Startup Firms in the Asteroid Mining Industry

2.1. Planetary Resources

Originally founded in 2009 as Arkyd Astronautics, Planetary Resources has emerged to become the most well-known of the two companies looking to mine asteroids. The company has successfully launched two different satellites into orbit in 2015 and again in 2018, and they are continuing to develop what will eventually become the spacecraft sent to scan and evaluate potential asteroids for mining. Planetary Resources, Inc.'s ultimate goals include developing spacecraft capable of detecting, targeting, and eventually mining asteroids for deposits of water and precious metals. The company sees the ability to mine water in space as being the answer to one of the most difficult challenges for companies entering arenas of space commerce. This, of course, is the cost associated with having to come back to Earth to refuel. The cost to operate in space is exacerbated by the need to re-enter Earth's orbit to refuel, and Planetary Resources has decided to offer a solution to this problem by making the fuel available for re-supply in space. The company envisions a landscape where commercial space interests can access refueling stations in space that are likened to today's gas stations found here on Earth. This would have a tremendous impact on the ability of companies to enter into markets like space tourism, satellite construction, maintenance, repair, and even contract work for agencies like NASA.

Furthering this idea, the company has ambitions to process metals and mine in space and make them available for construction projects in Low Earth Orbit (LEO). The company has already launched two small prototype satellites that have allowed them to demonstrate and further develop their instruments. Their first objective is to send satellites capable of scanning asteroids for valuable deposits using an assortment of imaging technology, as well as probes that will be sent to make contact with the asteroid and will report back to Earth the asteroid's composite. This has put the company in a unique position as the type of technology they are putting together also has advantages when directed towards Earth.

As the hunt for nonrenewable natural resources intensifies, it becomes more important to locate and estimate the remaining quantities of precious metal and mineral deposits. As it becomes more affordable for companies to launch satellites into space, one of the natural developments is the interest in scanning the planet for further analysis of its makeup. Planetary Resources has said they intend to make the use of their equipment commercially available for thermo graphic imaging. Their stated timeline is to have this product, known as Ceres, functional in 2020. Ceres is intended to a constellation of ten satellites positioned around the planet in LEO. The satellites will provide data on the composition of our planet, as well as provide real time data in fields like agriculture and weather.

Planetary Resources has been party to six major points of investment, including being the recipient of multiple grants. According to available information, the total amount raised to date is \$49.26M. This amount was raised from January 2013 to November 2016. New reports as of 2018 indicate the company failed in securing what would be a 7th round of funding from what was described as a global mining company. As a result, the company reported it was forced to lay off undisclosed number of workers (The company was said to have around 70 employees in 2017). While the funding failure does not speak positively towards the company's health, it is certainly worth taking note another area of the company that speaks to the overall health of the organization: the founding members. Planetary Resources was the founded by Eric C. Anderson and Peter Diamandis. Both individuals have esteemed careers in the fields of aeronautics and astronautics. Eric Anderson and Peter Diamandis also founded Space Adventures, which is the world's first space tourism company.

2.2. Deep Space Industries

Deep Space Industries (DSI) is another example of a company centered around the concept of asteroid mining. The company was founded in 2013, is privately-held, and is developing spacecraft designed around the exploration and extraction of resources from asteroids.

Similar to Planetary Resources, it is trying to make its instruments with commercial applications for present day business as well. The more present ambition centers around developing the capabilities needed to refuel communications satellites in space, while a more long-term ambition is to construct satellites in space using materials mined and processed from asteroids. These are quite similar to the intentions expressed by Planetary Resources, even if the companies are approaching their objectives with different strategies. Planetary Resources seems willing to forge ahead and consume losses along the way, while DSI seems to be following the script of “frugal start-up” closely. DSI has been awarded multiple small grants and several contracts from NASA for ancillary services.

The company also develops components for use by other companies on their rockets and satellites. One such product is a modular propulsion system for cubesats that uses water as propellant. This comes with a price of approximately \$200,000. The company also markets two upcoming products available within the next two years as being a bipropellant propulsion module for satellites and a fully-built deep space exploration spacecraft. Their final listed product for sale is simulated surface dust of space objects. Part of the research and development in creating these space instruments is being able to correctly identify the composites of space surfaces and Deep Space Industries markets variations simulated space materials.

Deep Space Industries has only secured approximately half of the total funding seen in the investment rounds for Planetary Resources. In fact, DSI only received a total of \$1M between its first two rounds of angel investment in 2015 and 2017. It then received \$18M in a seed round in 2017, with the major investors of this round to include *Light Speed Innovations*, *Metatron Global*, Richard Treitel, *Space Angels*, and *Technoport*. When comparing the abilities to secure funding of these two companies, it appears that Planetary Resources is better positioned; but it should not be overlooked or undervalued the fact that DSI currently has multiple products already being offered with verified sales contracts with other companies.

The company has locations in California, Florida, and Luxembourg, and is currently headed by Mr. Bill Miller. What makes this notable is that Mr. Miller is a general partner of *Space Angels Network*, which is the largest angel fund in the space industry. Mr. Miller’s long tenure as an angel investor and business strategist will be of value as the company continues to mature. Of particular note when reviewing the individuals who make up DSI’s team is that many of them have been parts of projects with other organizations that display a track record of successful launch missions to space. DSI is comprised of individuals who can draw on real-world expertise and experience when addressing the challenges of designing and launching satellites into orbit.

3. Valuation Methodologies to Consider

The following analysis provides students with various valuation approaches to consider when valuing startup companies in unproven markets. In addition to expounding upon what our noted valuation methodologies are, we apply each valuation approach to value Planetary Resources and Deep Space Industries. By applying numerous valuation techniques, we considered their analysis appropriately diversified; thus, not being confined to the limitations of a single valuation approach.

3.1. Venture Capital Method

The Venture Capital Method (also known as the “First Chicago Method” or “VC Method”) is one of the premier valuation techniques for assessing the fair value of pre-revenue startups. The VC Method is attractive for venture capital, seed investors because the technique is simple, and relies upon relatively few inputs. Moreover, it does not require historical information for the company being valued, as opposed to discounted free cash flow analysis. The VC Method arrives at a fair value of the firm by taking the projected terminal (or “exit”) value and discounting it to the present period. Since startups have no historical data and are typically private entities, a weighted average cost of capital is not applicable. Therefore, the discount rate is typically an assumed required rate of return from the initial investors.

To execute the VC Method, analysts begin by calculating the firm’s terminal value. To do so, analysts multiply the firm’s projected P/E multiple by its forecasted annualized earnings. The next step is to find an appropriate required rate of return for the firm. With regards to arriving at an appropriate discount rate, investors in startup companies typically require much higher rates of return than investors in established and proven companies. Analysts typically look for market average required rates of return to use as their baseline assumption.

As one's forecasts go farther into the future, the discount rate typically decreases, as the company becomes profitable and established, thus reducing its overall risk profile. After arriving at an appropriate rate of return, analysts can calculate the firm's present value. This is accomplished by dividing the firm's terminal value by $1 +$ the firm's required rate of return, raised to the firm's forecasted exit year.

Once the present value of the firm is calculated, analysts need to calculate the required ownership percentage. This is accomplished by first calculating the equity stake, which is computed by dividing the firm's initial investment by the firm's present value. Once the equity stake is calculated, analysts can calculate the total number of shares by dividing the current number of shares outstanding by $1 -$ the equity stake. After doing so, analysts subtract current outstanding shares from total outstanding shares to arrive at the number of shares owned by venture capital firms. Once this value is calculated, analysts divide the initial investment by the number of venture capital owned shares to arrive at a fair value per share.

3.2. Comparable Discounted Free Cash Flow Analysis

Although utilizing a startup company's financial statements for discounted free cash flow analysis is a woefully speculative undertaking, analysts may consider discounting the projected free cash flows of more established firms with relatively similar business models to arrive at an average fair value per share; especially if the startup in question will likely have a similar financial profile once it reaches the similar firms' current ages. However, for startup companies in new industries, finding "comparables" can be quite a challenge. Therefore, analysts are to carefully consider the business model of the company being valued, and create a pool of companies that, collectively, encompass the startup's business model. For example, if one wanted to value a startup company in the new space mining industry, they would create a pool of companies engaged in either mining or space exploration. Analysts must also be aware that the maturity of the comparables must be reflected in the startup's valuation horizon.

Once the analysts have arrived at a fair value per share for all the comparable companies, the next step is to calculate the average fair value per share and compare that to the startup's current share price. If the startup company's share price is below the average fair value of their competitors, then the startup is an attractive investment.

3.3. Qualitative Analysis

Another means by which analysts can value startup companies is to look at the qualitative factors for the company. By doing so, analysts may be able to prevent unnecessary numerical forecasts, and focus more on the intangible growth prospects for a company. If a start-up is one of the first companies in an emerging industry, then its market share is quite important. In order to arrive at a private company's market share, analysts analyze the company's total raised funding relative to all of their competitors. The more funding the company has received relative to its industry, the more favorable the positioning.

Although the company's market share is not an intangible metric, it does provide the basis for qualitative analysis to be effectively measured. Analysts may consider how much funding the company has received since its first fundraising round and consider the results as a proxy of management and marketing effectiveness. Moreover, analysts should also consider the credentials of the management for the company being valued and determine how qualified management is for the company's industry. With regards to management's historical performance, factors to consider include, but are not limited to: education, experience with startup companies, changes in historical post money valuations, company vision, and the economic feasibility of their recommended business model.

4. Sample Analysis

In our valuation of Planetary Resources and Deep Space Industries, we decided to utilize a 70/30 blend of venture capital and relative discounted free cash flow valuation, respectively. We weighted the VC Method at 70% because it relies upon what little financial data is readily available for Planetary Resources and Deep Space Industries. In the interest of diversifying our valuation process, we also decided to utilize a relative discounted free cash flow analysis. The pool of comparable companies was chosen primarily due to the similarities of their business models with asteroid mining. The comparables consisted of companies engaged in mining, satellite manufacturing, space exploration, and space robotics.

By arriving at a fair value per share for each company, we were able to use the average fair value per share of all the comparable companies as a benchmark against Planetary Resources’ and Deep Space Industries’ current share prices. Once we utilized each approach, we arrived at a weighted average upside for Planetary Resources and Deep Space Industries of 379.5% and 5394.7%, respectively. Many of the inputs we used in our valuation models were the same for both companies; except for each firm’s current share price, current outstanding shares, and funding raised to date. According to our calculations, on a quantitative basis, Deep Space Industries is a more attractive investment by a factor of 14.21X. We largely attribute this to Planetary Resources’ current share price of \$23.72 being 25.5X more expensive than Deep Space Industries’ share price of \$0.93. In the exhibits featured below, analysts can see the inputs and formulas we used for our calculations.

Exhibit 4.1: Planetary Resources Venture Capital Valuation

	A	B	C
1	Planetary Resources VC Valuation		
2			Formulas (If Applicable)
3	Annual Net Income (At Exit Date)	\$1,000,000,000.00	
4	Exit Year	10	
5	PE(multiple)	15	
6	Required Rate of Return	50.00%	
7	Value of firm	\$260,122,948.74	<-- =(B3*B5)/((1+B6)^B4)
8			
9	Initial Investment	\$49,260,000.00	
10	Equity Stake	18.94%	<-- =B9/B7
11			
12	Current Outstanding Shares	2076728	<-- =B9/B16
13	Total Outstanding Shares	2561876	<-- =B12/(1-B10)
14	VC Owns # Shares	485148	<-- =B13-B12
15	Share Price	\$101.54	<-- =B9/B14
16	Current Share Price	\$23.72	
17	Growth Opportunity	328.06%	<-- =B15/B16-1

Exhibit 4.2: Deep Space Industries Venture Capital Valuation

	A	B	C
1	Deep Space Industries VC Valuation		
2			Formulas (If Applicable)
3	Annual Net Income (At Exit Date)	\$1,000,000,000.00	
4	Exit Year	10	
5	PE(multiple)	15	
6	Required Rate of Return	50.00%	
7	Value of firm	\$260,122,948.74	<-- =(B3*B5)/((1+B6)^B4)
8			
9	Initial Investment	\$19,000,000.00	
10	Equity Stake	7.30%	<-- =B9/B7
11			
12	Current Outstanding Shares	20000000	
13	Total Outstanding Shares	21575959	<-- =B12/(1-B10)
14	VC Owns # Shares	1575959	<-- =B13-B12
15	Share Price	\$12.06	<-- =B9/B14
16	Current Share Price	\$0.93	
17	Growth Opportunity	1196.36%	<-- =B15/B16-1

Exhibit 4.3: Relative Discounted Free Cash Flow Analysis

	A	B	C	D
1	Relative Discounted Free Cash Flow Analysis			
2	Industry of Relevance	Company	Fair Value Per Share	
3	Mining	Barrick Gold	\$3.97	
4	Mining	BHP Billiton Ltd.	\$37.57	
5	Space Exploration	Orbital ATK	\$87.93	
6	Space Exploration	Aerojet Rocketdyne Holdings	\$7.05	
7	Space Exploration	Lockheed Martin	\$431.57	
8	Space Exploration	Boeing	\$285.15	
9				
10				Formulas (If Applicable)
11		Average Fair Value of Similar Firms:	\$142.20	<-- =AVERAGE(C3:C8)
12				
13		Planetary Resources Current Price:	\$23.72	
14		Planetary Resources Upside %:	499.51%	<-- =C11/C13-1
15				
16		Deep Space Industries Current Price:	\$0.93	
17		Deep Space Industries Upside %:	15190.68%	<-- =C11/C16-1

Exhibit 4.4: Blended Valuation

	A	B	C
1	Blended Upside		
2			
3	Planetary Resources Current Share Price	\$23.72	
4	Deep Space Industries Current Share Price	\$0.93	
5			
6	Planetary Resources Upside (Using VC Method)	328%	
7	Deep Space Industries (Using VC Method)	1196%	
8			
9	Planetary Resources (Using Relative DCF)	499.51%	
10	Deep Space Industries (Using Relative DCF)	15190.68%	
11			
12		Weighting	
13	VC Method	70%	
14	Relative Discounted Free Cash Flow Method	30%	
15			
16		Weighted Average Growth Opportunity	Formula
17	Planetary Resources	379.5%	<-- =B6*B13+B9*B14
18	Deep Space Industries	5394.7%	<-- =B7*B13+B10*B14
19			
20		Fair Value Per Share	
21	Planetary Resources	\$113.74	<-- =B3*(1+B17)
22	Deep Space Industries	\$51.10	<-- =B4*(1+B18)

After valuing the companies on a quantitative basis, we also wanted to consider the companies' intangible characteristics.

On a qualitative basis, we consider both companies effectively managed. We arrived at this conclusion primarily through analyzing the credentials of each company's management and considering their ability to raise capital. With regards to funds raised to date, Planetary Resources has raised \$49.26 million, far outsizing Deep Space Industries fundraising of \$19 million. However, if viewed within the context of when each company began receiving investments, a much different picture emerges. Planetary Resources and Deep Space Industries began raising capital on 9/21/2012 and 11/16/2015, respectively. Thus, Planetary Resources has been fund raising for 67 months, as opposed to Deep Space Industries, which has only raised capital for 29 months.

Upon dividing the number of months each firm has been raising capital by its total funds raised to date, we observed that Deep Space Industries is more effective at raising capital; accumulating, on average, \$1.52 million of capital a month, as opposed to Planetary Resources, which has only raised an average of \$1.36 million a month. With all factors considered, we consider Deep Space Industries a more favorable investment opportunity than Planetary Resources.

5. Case Study Assignment

Exercise 1: Select an industry in a new field of technology that consists of several startup firms. This implies that you would have to research novel technological ideas in fields that you might not be familiar with. A good place to start would be to browse through Science journals or trade magazines.

Exercise 2: After you have decided on the industry, select the two startups that you believe are the pioneers in that industry. You would need to check their websites and all available information to make that determination.

Exercise 3: Using all available data, formulate an appropriate valuation methodology for those two startup firms in the industry of your choice.

Exercise 4: Argue which of the two companies is more favorably valued for a 10-20-year time horizon.

Exercise 5: Document all your findings and turn in a Word document with the standard formatting. Make sure that you include the following information: 1) an overview of the current economic landscape and your selected industry; 2) provide arguments for your selection of the two startup firms in your industry; 3) a synopsis of both firms (core strengths and weaknesses, management team, major funding sources, biggest players etc.); 4) valuation of the two startups and your selection of the prime investment opportunity and 5) arguments for your top startup selection.

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