

The 787 Dreamliner: Will it be a Dream or Nightmare for Boeing Co.

Lisa A. Schwartz, Wingate University
Jeremy Busby, Wingate University

The 787 Dreamliner has been touted as the aircraft of the future, but the program has been hampered with development problems, delays and most recently, fires. Boeing has spent billions in research and development and for a new facility in Charleston, SC to produce the aircraft. This study analyzes the potential value Boeing could earn on the 787 program. Assuming orders and deliveries materialize as expected, Boeing could achieve upwards of \$50 billion over the next 20 years. Markets appear optimistic about Boeing and the 787 program. An analysis of abnormal stock returns shows the recent bad news about the 787 only temporarily affected Boeing's stock price. As long as the 787 remains problem-free, the future of Boeing appears to be promising.

INTRODUCTION

The Boeing Company has been a prominent commercial and military aerospace company for nearly one hundred years. Their most recent commercial aircraft is the 787 Dreamliner. This new aircraft is unprecedented in the aircraft industry as it is composed of new lightweight material and the latest technological advancements. Issues and delays overwhelmed the 787 program from the beginning and have caused concern about the future for this expensive product line. Recent battery fires caused the FAA to temporarily ground the entire fleet of 787 aircraft. Boeing has invested billions of dollars into this program and cannot afford for the 787 to fail. This paper will evaluate the value of the 787 program under different future delivery scenarios. It will also examine the market reaction to the announcements of the multiple problems in early 2013.

HISTORY

In 2002, Boeing abandoned plans to develop a high-speed commercial aircraft and focused on creating a fuel efficient model named the 7E7. (Masters 2007) In 2004, the groundbreaking aircraft, named the 787 was detailed in the annual report. The aircraft was considered to be the plane of the future as it would be more comfortable, have more carrying capacity, and use the latest technologies all while being more fuel efficient than any other aircraft of its size. They estimated that the first 787 would be delivered by the year 2008. Research and development of this new aircraft was put into full effect for several years to ensure that the 787 would be ready for its product launch. Several investments were made during early stages of the program to make sure it could be manufactured at a speed that would match the anticipated demand for the aircraft. (Boeing.com)

The 2005 and 2006 annual reports indicate that all was going according to plan and the aircraft would meet all expectations. Demand for the 787 was extraordinary and just two years after the initial reveal they had 448 orders. (Annual Report 2006) Orders continued on this accelerated path and Boeing achieved a significant commercial aircraft milestone by surpassing 800 orders within the first three years, but problems began to surface. (Boeing.com)

Due to issues with suppliers, the first flight attempt was pushed back to second quarter of 2008 and the first deliveries were pushed back to 2009. The 2008 annual report revealed employee strikes coupled with more bugs forced Boeing to push the test flight to the second quarter of 2009 and first deliveries to the year 2010. Also, they were unable to sell three 787 aircraft used in test flights due to significant required modifications for the planes. The delays and difficulties were summed up by Boeing in the 2010 annual report which states, "Operational issues, including delays or defects in supplier components, the inability to efficiently and cost-effectively incorporate design changes into production aircraft, and aircraft performance issues, could result in additional expenses or lower program revenues." Boeing finally delivered three aircraft in 2011. Progress continued into the next year with 46 more aircraft delivered while the production rate at the 787 facilities improved. (Boeing.com)

The year 2013 started with trouble as the 787 incurred several problems within just a few days. On January 7, a 787 suffered an electrical fire. The next day, January 8, a 787 experienced a fuel leak. On January 9, another 787 incurred major flight issues (Boeing.com). All of these issues were major concerns for the airline industry and after several days of evaluation, the FAA decided to ground all 787's until problems were properly diagnosed and modifications made. All 787 deliveries were suspended during this time. The lithium battery was identified as the cause of the fires and was redesigned and improved. On April 19 2013, the FAA approved the battery modifications and allowed the 787 to return to flight and deliveries to resume. (Boeing.com)

The purpose of this study is to evaluate the 787 program. It will calculate the research and development costs Boeing has invested from the beginning of the program. It will estimate future delivery schedules and use these to determine future cash flows and overall project value. Finally, the paper will analyze the stock price reaction to the recent 787 announcements to assess how the markets are reacting to the developments in the 787 program.

RESEARCH AND DEVELOPMENT COSTS AND CAPITAL EXPENDITURES

The 787 program was originally named the 7E7 in early development years. In tracing historical R&D costs, annual reports begin naming 787 in 2004. To estimate annual and total R&D costs for the 787 program, details were obtained from Boeing annual reports 2003-2012. Commercial R&D is reported, along with explanation of which programs were under development. In 2003-2005, increases in R&D were designated as 787. Starting in 2006, increases in R&D were split between the 787 and 747.

R&D estimates are presented in Table 1. The 787 R&D cost is designated in 2004 as the increase in commercial R&D from 2003-2004. The increase from 2004-2005 is due to the 787 program, so annual R&D for 2005 is assumed to be the R&D from 2004 plus 100% of the additional expenses in 2005. Starting in 2006, the R&D for that year is assumed to be the R&D expense from the previous year plus 75% of the increase in R&D costs with the remaining 25% for the 747 and other commercial programs. In 2009, Boeing reclassified three unsellable aircraft from production to R&D. This reclassification increased R&D by \$2.7 billion. R&D for 2009 is assumed to be R&D from 2008 plus \$2.7 billion. In 2010, R&D is again assumed to be previous

year's R&D plus 75% of increase (decrease) in R&D. Total R&D for the 787 program from 2004 to 2012 is estimated at \$17.6 billion.

A second estimate of 787 R&D uses a percentage of total commercial R&D. Total commercial R&D from 2003-2012 is \$24.2 billion. Gates (2011, 9 24) estimates 787 R&D as 75% of total commercial R&D. Using that methodology, 787 R&D would be estimated at \$18.1 billion. These estimates do not include capital expenditures.

According to Boeing's annual report 2011, Boeing paid \$1 billion for Vought Aircraft Industries 787 business. A study conducted by Miley & Associates (2010) on the economic impact of the 787 plant in Charleston lists the investment cost for the new facility as \$1.025 billion. The total capital expenditures costs in Charleston for 787 are approximately \$2 billion. Gates (2011, 9 24) estimates total capital expenditures as \$3 billion. Combining the R&D with the capital expenditures provides an estimate of total investment costs of approximately \$21 billion.

CAPITAL BUDGET

The capital budget forecasts the total revenue earned by the product line and subtracts the costs of the program, including taxes. Depreciation is not utilized as Boeing does not breakout depreciation by product line and does not report depreciation in the Net Income Statement as shown on S&P Capital IQ. The final cash flows are discounted using two different rates to determine the present value of the future cash flows. Using current borrowing costs and equity returns, the weighted average cost of capital is estimated at approximately 7% (6.88%). The estimate may be lower than anticipated due to very low borrowing costs. Since the discount rate also represents the rate of return a project needs to earn, a second estimate of 10% is also assumed.

PRICE

The list price for the 787 Dreamliner is quoted as \$207 to \$244 million dollars, depending on model (Boeing.com). After examining the aircraft industry and its pricing techniques, it was determined that this price is likely overstated. According to Forbes (Fontevecchia 2013, 5 21) the new aircraft will likely sell for \$116 million dollars. Bloomberg (Black 2013, 6 14) also reinforces that the final price for the 787 is well below what Boeing has listed. Wall Street Journal (Michaels 2012, 7 9) explains how prices can be estimated using unfilled orders vs. backlog dollar value for all commercial aircraft. This technique was applied to determine the expected price of 787, see Table 2. The analysis estimates an approximate 51% discount from list price for all commercial aircraft. This outcome supports the Forbes and Bloomberg articles which both indicated that Boeing would have a final selling price about half the amount listed on the Boeing website. Utilizing these computations, the initial price for the 787 is estimated at approximately \$116 million dollars.

The initial price is adjusted for inflation and general price increases. Using the 777 as a model, the list price increased annually 4.5% from 2008 to June 2013, Baciú (2010, 4 18) and Boeing.com. Inflation is estimated to be 3% using data from The Bureau of Labor Statistics. The 777 price increase net of inflation is 1.5% per year. It is assumed that the actual sales price will increase at the same rate as the published list price, so overall price appreciation of the 787 is assumed to be 4.5% annually (3% inflation, 1.5% appreciation) throughout the program.

COST

According to Boeing Annual Reports 2010, 2011 and a Wall Street Journal (Michaels 2012, 7 9) article, the cost incurred to manufacture the 787 is close to the list price of the aircraft. This indicates that it costs approximately \$200 million to produce a 787 Dreamliner. The production cost is expected to decline over time as production becomes more efficient. Analysts suggest that whenever Boeing doubles its production rate the overall cost of producing the new plane is cut by about 25% (Fontevchia 2013, 5 21) (Kearney 2013, 6 2).

A production rate is forecast after examining the improvements of the production rate that have already occurred, researching what Boeing predicts the future rate to be and observing estimates produced by outside analyst. The initial year of production generated 2.5 planes per month and it is assumed that it would take Boeing six more years to reach what is predicted to be maximum production of 16 planes per month. The production rate is increased by 1 to 3 planes per month each year. Once the assumed production rate was estimated, the cost is cut using a formula that reduces cost by 25% every time the production rate doubles. This eventually leads to the cost per plane of \$105 million. The estimated tax rate for the capital budget is 25%, based off the most recent tax rate as reported on S&P Capital IQ.

DELIVERIES

The price, cost, and taxes are all controlled variables and do not change from one capital budget to the other. These factors are held constant to evaluate the total value of the 787 program at different rates of deliveries. In the 2008 Annual Report, Boeing states that they plan to deliver 3,500 aircraft within the first twenty years of the 787 product life. This number will provide the basis for the delivery forecasts.

Annual deliveries are estimated using simulation (see Table 3 for parameters). The delivery trend from previous Boeing aircraft models is used to establish the simulation parameters. The delivery trend is calculated as a percent of the total deliveries produced in a particular year. These percentages were broken into different sections throughout the aircraft lifespan. The first six years of deliveries rapidly build until a more stable pattern emerges. A uniform distribution was used for the early years and the upper and lower boundaries were based off trends of other Boeing aircraft.

A standard distribution was utilized for the middle years of deliveries. Research on other models indicated that each year following the beginning section averaged approximately 5% of the total deliveries with a 1.2% standard deviation. The number of deliveries each year was randomly selected within the boundaries. The number of deliveries had to fall within two standard deviations of the mean. Two distributions of total deliveries were estimated. The first distribution of total deliveries was based off Boeing expectations with a mean of 3,500 and standard deviation of 100 planes. The second distribution of total deliveries assumes Boeing over-predicted deliveries and that total deliveries were more variable. The mean was set at 2,750 with a standard deviation of 350.

The end years of the 787 program were estimated using a lump sum valuation. Previous aircraft models indicate approximately 20 to 30 aircraft are delivered in the final few years of the program. The present value of the final deliveries was estimated at \$775 million at 7% discount rate and \$385 million at 10% discount rate. Since these cash flows are so far into the future, it

was determined that this was the simplest method for estimating the winding down of the 787 aircraft program.

RESULTS

To estimate project value, operating cash flow is estimated over the life of the program and discounted using either 7% or 10%. A set of 100 present value estimates were produced in order to correspond with Boeing's predicted market deliveries of 3,500 aircraft with a standard deviation of 100 units. The set of program estimated values using 7% discount rate are shown in Figure 1, Panel A. The present values for this simulation fall between \$60 and \$80 billion dollars. Approximately 90% percent of the present values fall within \$65 to \$75 billion. After accounting for approximately \$20 billion in R&D and capital expenditures, Boeing could net of \$45 to \$55 billion dollars on the 787 program.

An additional 100 simulations were produced using a discount rate of 10% (see Figure 1, Panel B). The value of the program in this scenario ranges between \$40 and \$50 billion dollars. This shows Boeing could net \$20 to \$30 billion after accounting for capital expenditures and R&D costs.

Figure 2 displays the value of program relative to total deliveries. The trend line formulas suggest that the value of the 787 program will increase \$15.2 million to \$24.4 million for each additional aircraft produced. For each additional 100 aircraft delivered, the program value increases by \$1.5 billion to \$2.4 billion.

The total number of deliveries may vary more than Boeing anticipates if more problems are uncovered or customers lose confidence in the aircraft. A second set of simulations were run using 2,750 total deliveries as the mean and a standard deviation of 350 units (See Figure 3). Panel A illustrates the distribution of results using a 7% range from \$30 billion – \$80 billion dollars, with over 50% of the scenarios at \$50 to \$65 billion dollars. This indicates that after accounting for capital expenditures and R&D, the 787 could yield between \$10 and \$70 billion, with \$30 to \$45 billion as a more likely outcome.

Using a discount rate of 10%, another 100 simulations were run and produced present values ranging from \$20 billion to \$50 billion dollars (see Figure 3 Panel B). The bulk of the present values calculated in these simulations fell within \$25 to \$40 billion dollars. This set of simulations suggests that after accounting for capital expenditures and R&D, the program could net as little as \$5 billion.

Figure 4 displays the present values of the 787 program as the total deliveries increase. The trend line formula indicates the value of the program increases by \$13.8 million to \$21.8 million per aircraft. So, an increase of 100 aircraft could add \$1.4 billion to \$2.2 billion in program value.

The results of this analysis indicate that the discount rate as well as total deliveries has a major impact on the value of the 787 program. Under some scenarios, the value could be \$50+ billion after investment costs. In other scenarios, the value is only \$5 billion. Boeing has been confident that deliveries can reach 3,500 in 20 years, but problems with the aircraft can affect confidence in the program and may result in lower than anticipated sales. If costs are not reduced as assumed or if other problems are unveiled, the program could go from adding billions in value to actually negative value.

STOCK ANALYSIS

If investors believe customers are starting to lose confidence in the 787, it would show up in stock prices. To understand how investors are reacting to the 787 news, an analysis of recent stock price reactions is performed to see if investors are optimistic or pessimistic about Boeing. The first quarter of 2013 contained multiple news announcements concerning the 787 aircraft.

Event study methodology is used to evaluate abnormal returns on days that news was being released about the 787 problems. There are multiple news releases during the event period, so the analysis will not have a single event day as in a traditional event study. Abnormal returns on each of the news release days are analyzed for significance.

The market model estimation period is January 3, 2012 to December 31, 2012. A second market model was estimated using data from January 4, 2010 to December 31, 2012. There was minimal difference between the models, so it is not reported in the paper. Data on returns for Boeing and a valued weighted NYSE index were downloaded from CRSP.

$$R_t = a + b \cdot RM_t + e_t$$

Where t = estimation period days

$$N=250$$

Using the market model alpha and beta, expected returns were calculated for Boeing for January 1, 2013 to March 31, 2013. Abnormal returns for the event period were calculated as the actual return minus the expected return.

$$AR = R_h - (a + b \cdot RM_h)$$

Where h = event period days

Significance of abnormal returns was calculated using methodology presented in Corrado (2012).

$$\text{Var}(AR) = \sigma_e^2 * \left\{ 1 + 1/N + \left[\frac{(RM_h - \mu_1)^2}{\sum_{t=1}^N (RM_t - \mu_2)^2} \right] \right\}$$

Where : μ_1 = mean return on market for event period

μ_2 = mean return on market for estimation period

Σ = summation for estimation period

$$AR / \text{Standard deviation}(AR) \sim t_{N-2}$$

Abnormal and cumulative abnormal returns are presented in Table 4. Days with significant abnormal returns, both positive and negative, are indicated in the table with p-values. Also included in Table 4 are major news announcements. Results show most days with significant abnormal returns also have significant news events. Expected abnormal returns would be negative for “bad” news announcements and positive for “good” news events. Most abnormal returns are as expected. A large unexpected positive abnormal return, 3.3%, happened on January 9, 2012 after a third bad news announcement. Also on that day, Boeing strongly defended the 787 and Qatar Airways, Ltd. also expressed support for the aircraft. The largest negative abnormal return, -3.2%, was on January 16 when the FAA announced it was grounding

all 787 aircraft. The abnormal returns show that markets reacted strongly to the news releases about the 787 aircraft.

To analyze if the effects are limited to Boeing stock or due to industry impacts, a similar analysis was constructed on European Aeronautic Defence and Space Company (EADS), parent company of Airbus and main commercial aircraft competitor to Boeing. EADS stock data was not available on CRSP, since it trades primarily on Euronext Paris, but was attainable on S&P Capital IQ. The market index used was Euronext 100 Index, which was also obtained from S&P Capital IQ. The choice of a European market index was due to time differences between US markets and European markets.

EADS had a significant positive abnormal return on January 9, 2013. A news search did not find any significant news concerning Airbus on that day; however, Boeing also had a significant positive abnormal return on January 9, 2013. The market trading time differences do now allow a direct comparison, but it is notable that both companies had significant stock price movements around the first 787 announcements. The only other significant EADS abnormal returns were on February 27, 2013 and February 28, 2013 after Airbus announced an increase in profits.

Figure 5 graphs abnormal and cumulative abnormal returns for both companies. The pattern of negative cumulative abnormal returns shows the impact of the 787 problems (Panel A). In mid-February 2013, as the battery problems were being addressed, the cumulative abnormal returns reversed. By March the stock reversed to cumulative positive abnormal returns. The stock has shown no long term impact due to the 787 problems and markets appear to be bullish on Boeing.

To discern if the pattern of Boeing's abnormal and cumulative returns were company or industry related, a similar graph was made using EADS abnormal and cumulative abnormal returns (see Panel B). The cumulative abnormal returns for EADS show a distinctly different pattern than Boeing in early 2013. While Boeing's cumulative return was getting increasingly negative through early February, EADS was growing. Both companies show increasing cumulative abnormal returns in March 2013. This suggests that the negative abnormal returns for Boeing in early 2013 were due to company problems and not industry issues. Having made significant progress toward resolving the 787 battery issue, Boeing's stock started to grow in a similar pattern to Airbus.

CONCLUSIONS

The 787 Dreamliner aircraft program has been wrought with problems since the beginning. The delays and production problems led to aircraft that could not be sold and delays in delivering the first planes to customers. Problems with battery fires led the FAA to ground all 787 aircraft and halted deliveries of new aircraft. Most recently on July 12, 2013 an Ethiopian Airlines 787 experienced a fire as it was parked at a gate at Heathrow Airport. (Wall 2013, 7 12)

Even with these issues, the 787 stands to generate significant value for Boeing over the next 20 years. The results show that if Boeing can deliver the anticipated number of 787 aircraft, the program could generate \$20 to \$50 billion in value after investment costs, assuming a 7% rate of return is appropriate for the program. If the rate of return is closer to 10% and deliveries are lower than anticipated, the value drops to as low as \$5 billion. If the recent problems cause delays or order cancellations, this could wipe out much of the value. If the program is successful, investors will benefit, but if it is a failure, investors could suffer large losses.

The stock price reaction shows that the markets did react to the bad news about the 787, but did not continue to penalize the stock once it became clear that the battery problems could be solved and the aircraft would begin flying again. Investors seem to be bullish about the value of the program to Boeing. If Boeing can address the recent fire problems quickly, the markets should continue to support the price of Boeing stock. The recent news; however; indicates that all the bugs in the 787 Dreamliner have not been remedied. There may continue to be problems as more aircraft are delivered and flown more frequently.

Boeing has the opportunity to achieve great value from the 787 Dreamliner. Investors seem to believe that it will generate significant value for Boeing. As long as problems are addressed swiftly and customers are satisfied with the aircraft, it could be a hugely successful project.

REFERENCES

- Baciu, Julia (2010, 4 18) 2006 Boeing 777-200LR. Topspeed.com. Retrieved from <http://www.topspeed.com/aviation/aviation-reviews/boeing/2006-boeing-777-200lr-ar87989.html>
- Black, Thomas (2013, 6 14) Boeing seen reaping \$6 billion a year on 787 output boost. Bloomberg. Retrieved from <http://www.bloomberg.com/news/2013-06-13/boeing-seen-reaping-6-billion-a-year-on-787-output-boost.html>
- Boeing.com. The Boeing Company Annual Reports (2003-2012).
- Boeing.com. Current Market Outlook. Retrieved from <http://www.boeing.com/boeing/commercial/cmo/index.page>
- Boeing.com. Orders and Deliveries. Retrieved from <http://active.boeing.com/commercial/orders/index.cfm?content=displaystandardreport.cfm&pageid=m25065&RequestTimeout=20000>
<http://active.boeing.com/commercial/orders/index.cfm?content=displaystandardreport.cfm&pageid=m25065&RequestTimeout=20000>
- Boeing.com. Boeing South Carolina. Retrieved from www.boeing.com/commercial/charleston/index.html
- Bureau of Labor Statistics. Retrieved from <http://www.bls.gov/>
- Charlotte Business Journal Staff (2012, 11 15) Boeing 787 boosts production rate at SC plant. *Charlotte Business Journal*. Retrieved from <http://www.bizjournals.com/charlotte/blog/morning-edition/2012/11/boeing-787-boosts-production-rate-at.html>
- Corrado, Charles J. (2011) Event studies: A methodology review. *Accounting and Finance*. 51, 207-234.
- Fontevicchia, Agustino. (2013, 5 21) Boeing bleeding cash as 787 Dreamliners cost \$200M but sell for \$116M but productivity is improving. Forbes. Retrieved from <http://www.forbes.com/sites/afontevicchia/2013/05/21/boeing-bleeding-cash-as-787-dreamliners-cost-200m-but-sell-for-116m-but-productivity-is-improving/>
- Gates, Dominic; (2011, 9, 24) Boeing celebrates 787 delivery as program's costs top \$32 billion. The Seattle Times. Retrieved from http://seattletimes.com/html/business/technology/2016310102_boeing25.html
- Kearney, Brendan. (2013, 6 2) Investment analysts like what they see at Boeing's North Charleston plant. The Post and Courier. Retrieved from

<http://www.postandcourier.com/article/20130602/PC05/130609912/1268/investment-analysts-like-what-they-see-at-boeing-x2019-s-north-charleston-plant&source=RSS>

Masters, Coco. (2007) How Boeing Got Going. *Time*, 170 (11), special section 1-6

Michaels, Daniel. (2012, 7 9) The secret price of a jet airliner. *The Wall Street Journal*. Retrieved from
<http://online.wsj.com/article/SB10001424052702303649504577494862829051078.html>

Miley & Associates (2010) *The Economic Impact of Boeing in South Carolina*. Columbia, SC, prepared for The Alliance for South Carolina's Future.

Levin, Alan & Ray, S. (2013, 1 17) Boeing 787 Dreamliner is Grounded Worldwide by Regulators. *Bloomberg.com*. Retrieved from <http://www.bloomberg.com/news/2013-01-16/boeing-787-dreamliner-fleet-grounded-by-u-s-after-emergency.html>

NBC News staff (2013, 9 1). Boeing 787 suffers third mishap in as many days. *NBCNews.com*. Retrieved from <http://www.nbcnews.com/business/boeing-787-suffers-third-mishap-many-days-1B7906402>

Negishi, Mayumi, & Saito, M. (2013, 1 15) Boeing Dreamliner makes emergency landing in Japan. *NBCNews.com*. Retrieved from
<http://worldnews.nbcnews.com/news/2013/01/15/16533328-boeing-787-dreamliner-makes-emergency-landing-in-japan?lite>

Ranasinghe, Dhara. (2013, 1 16) Boeing 787s grounded by two Japanese airlines. *NBCNews.com*. Retrieved from <http://www.nbcnews.com/business/boeing-787s-grounded-two-japanese-airlines-1B7991426>

Tate, Curtis. (2013, 1 12) Dreamliner probe may lead to key supplier. *The Charlotte Observer*, pp. 1A, 4A.

The Alliance for South Carolina's Future (2010) *The Economic Impact of Boeing in South Carolina*. Columbia, SC: Miley & Associates.

Wall, Robert. (2013, 7 12) Boeing Dreamliner Fire Shuts Heathrow as Second 787 Aborts Trip. *Bloomberg.com*. Retrieved from <http://www.bloomberg.com/news/2013-07-12/london-heathrow-suspends-flights-after-fire-involving-boeing-787.html>

Table 1: Estimated Research and Development for 787 (in \$millions)

	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Commercial R&D	676	941	1,302	2,390	2,962	2,838	5,383	2,975	2,715	2,049
Annual Increase in R&D		265	361	1,088	572	(124)	2,545	(2,408)	(260)	(666)
Increase related to 787		265	361	816	429	(93)	2,700	(1,806)	(195)	(500)
Annual 787 R&D		265	626	1,442	1,871	1,778	4,478	2,672	2,477	1,978
Cumulative Total R&D		265	891	2,333	4,204	5,982	10,460	13,132	15,609	17,587

* Starting in 2006, 75% of increase is estimated to be for the 787 and remaining 25% for the 747.

* 2009 R&D includes \$2,700 that was reclassified production costs for 3 test aircraft unable to be sold

Table 2: Backlog Calculation

737	Orders	List Price	Value of Orders
737-700	219	74.8	16381.2
737-700BBJ	4	74.8	299.2
737-700C	2	748	1496
737-800	1295	89.1	115384.5
737-800A	17	89.1	1514.7
737-800BBJ	3	89.1	267.3
737-900BBJ	1	94.6	94.6
737-900ER	362	94.6	34245.2
737-MAX	1235	100	123500

747	Orders	List Price	Value of Orders
747-8	26	351.4	9136.4
747-8F	33	352	11616

767	Orders	List Price	Value of Orders
767-2C	4	160.2	640.8
767-300ER	8	182.8	1462.4
767-300F	51	185.4	9455.4

777	Orders	List Price	Value of Orders
777-200ER	3	258.8	776.4
777-200LR	4	291.2	1164.8
777-300ER	288	315	90720
777F	52	295.7	15376.4

787	Orders	List Price	Value of Orders
787-8	485	206.8	100298
787-9	355	243.6	86478

Total Value of Unfilled Orders at List Price	620,307.30
Commercial Backlog as Reported in Annual Report	317,287.00
Discount From List Price	51%

Table 3: Simulation Distribution Inputs**Known Deliveries**

Year	Actual Deliveries
1	3
2	46

Uniform Distribution

Year	Lower Bound	Upper Bound
3	1.50%	4.00%
4	2.00%	4.50%
5	2.50%	5.50%
6	1.50%	5.00%

Standard Distribution

Year	Mean	Standard Dev.
7	5.00%	1.20%
to	5.00%	1.20%
~20	5.00%	1.20%

Lump Sum Valuation

Year	PV at 7%	PV at 10%
20+	\$775,000,000	\$385,000,000

Total Deliveries

	Mean	Standard Dev.
Dist. 1	3,500	100
Dist. 2	2,750	350

Table 4: Boeing Abnormal and Cumulative Abnormal Returns

Date	Abnormal Return	Cumulative Abnormal Return	p-value	Major News Releases
1/2/2013	-0.0004	-0.0004	0.9616	
1/3/2013	0.0065	0.0061	0.4493	
1/4/2013	-0.0043	0.0018	0.6216	
1/7/2013	-0.0166	-0.0148	0.0539	Battery fire on JAL plane
1/8/2013	-0.0237	-0.0385	0.0063 *	Fuel leak on JAL plane
1/9/2013	0.0328	-0.0057	0.0002 *	Brake system indicator light problem on JAL plane. Boeing expresses confidence in 787
1/10/2013	-0.0028	-0.0085	0.7431	
1/11/2013	-0.0248	-0.0333	0.0043 *	FAA opens probe
1/14/2013	0.0185	-0.0148	0.0319 *	NTSB releases 2nd update on battery fire
1/15/2013	0.0021	-0.0127	0.8082	Smoke indicator and burning smell cause emergency landing for All Nippon plane
1/16/2013	-0.0318	-0.0445	0.0003 *	FAA grounds all 787s
1/17/2013	0.0068	-0.0377	0.4304	
1/18/2013	-0.0068	-0.0445	0.4316	
1/22/2013	-0.0174	-0.0619	0.0439 *	Jan 20 FAA releases 3rd update on battery fire
1/23/2013	0.0026	-0.0592	0.7585	
1/24/2013	0.0108	-0.0484	0.2084	
1/25/2013	-0.0087	-0.0571	0.3116	
1/28/2013	-0.0114	-0.0685	0.1875	
1/29/2013	-0.0094	-0.0778	0.2762	
1/30/2013	0.0174	-0.0604	0.0442 *	Boeing announces no significant profit impact from 787 problems
1/31/2013	-0.0083	-0.0687	0.3348	
2/1/2013	0.0051	-0.0636	0.5529	
2/4/2013	0.0148	-0.0489	0.0879	
2/5/2013	0.0013	-0.0476	0.8814	
2/6/2013	0.0036	-0.0440	0.6789	
2/7/2013	0.0177	-0.0263	0.0404 *	Restart of 787 test flights allowed
2/8/2013	-0.0153	-0.0416	0.0766	
2/11/2013	-0.0076	-0.0492	0.3766	
2/12/2013	-0.0015	-0.0507	0.8638	
2/13/2013	-0.0100	-0.0607	0.2444	
2/14/2013	0.0014	-0.0593	0.8742	

* Abnormal returns significant at .05 level

Table 4 Continued: Boeing Abnormal and Cumulative Abnormal Returns

2/15/2013	0.0035	-0.0558	0.6839	
2/19/2013	-0.0117	-0.0675	0.1746	
2/20/2013	0.0148	-0.0527	0.0873	
2/21/2013	0.0229	-0.0298	0.0084 *	Boeing proposes battery fix
2/22/2013	0.0004	-0.0294	0.9597	
2/25/2013	-0.0026	-0.0320	0.7621	
2/26/2013	0.0026	-0.0295	0.7656	
2/27/2013	0.0098	-0.0197	0.2587	
2/28/2013	-0.0051	-0.0248	0.5533	
3/1/2013	0.0038	-0.0210	0.6601	
3/4/2013	-0.0059	-0.0270	0.4897	
3/5/2013	0.0126	-0.0144	0.1450	
3/6/2013	0.0035	-0.0109	0.6849	
3/7/2013	0.0231	0.0122	0.0076 *	NTSB releases Interim Factual Report
3/8/2013	-0.0028	0.0094	0.7478	
3/11/2013	0.0186	0.0280	0.0315 *	Commercial Aircraft demand higher
3/12/2013	0.0166	0.0447	0.0540	
3/13/2013	0.0063	0.0510	0.4612	
3/14/2013	-0.0078	0.0433	0.3680	
3/15/2013	0.0228	0.0661	0.0084 *	777 News event
3/18/2013	-0.0081	0.0580	0.3470	
3/19/2013	0.0072	0.0651	0.4055	
3/20/2013	-0.0085	0.0566	0.3231	
3/21/2013	-0.0048	0.0518	0.5743	
3/22/2013	0.0005	0.0523	0.9533	
3/25/2013	0.0037	0.0560	0.6685	
3/26/2013	0.0132	0.0692	0.1254	
3/27/2013	-0.0039	0.0653	0.6524	
3/28/2013	-0.0082	0.0571	0.3413	

* Abnormal returns significant at .05 level

Figure 1: Disbribution of Program Values with Mean Deliveries of 3,500

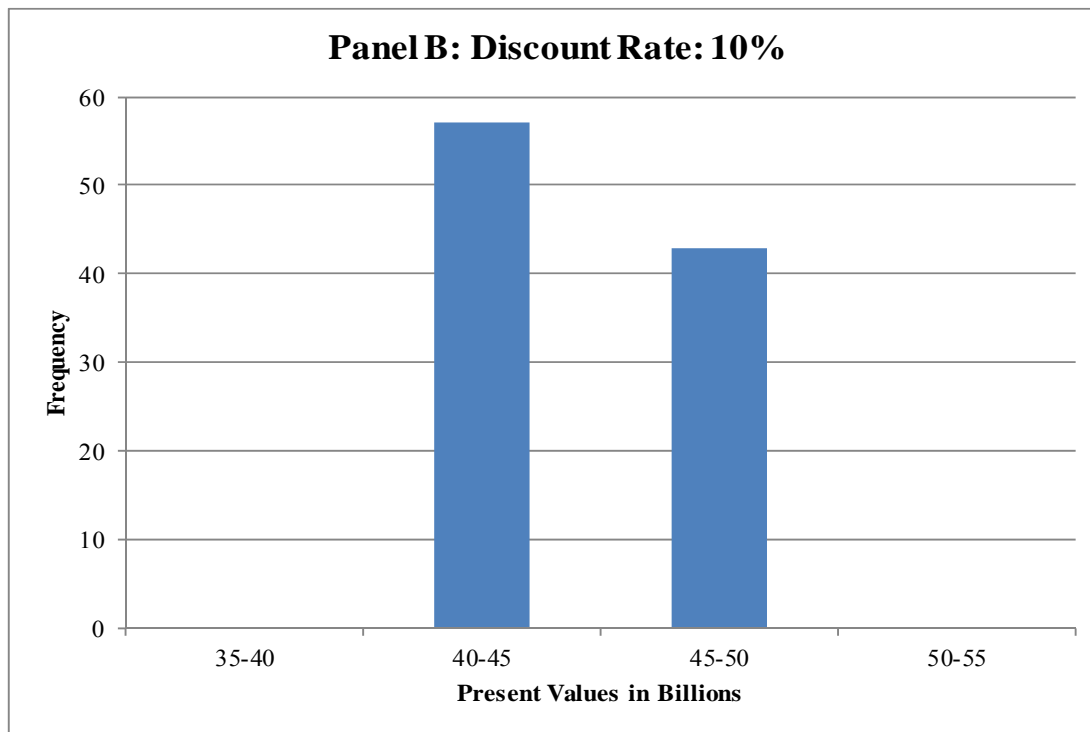
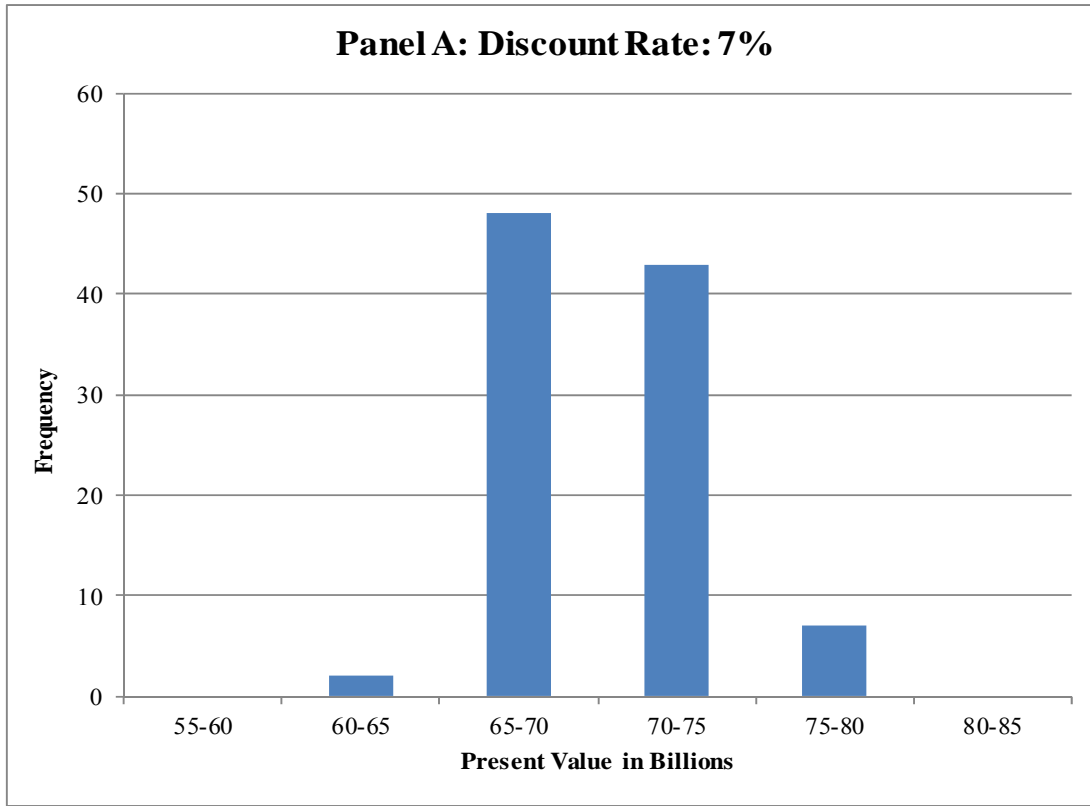


Figure 2: Program Value Relative to Total Deliveries (Mean 3,500)

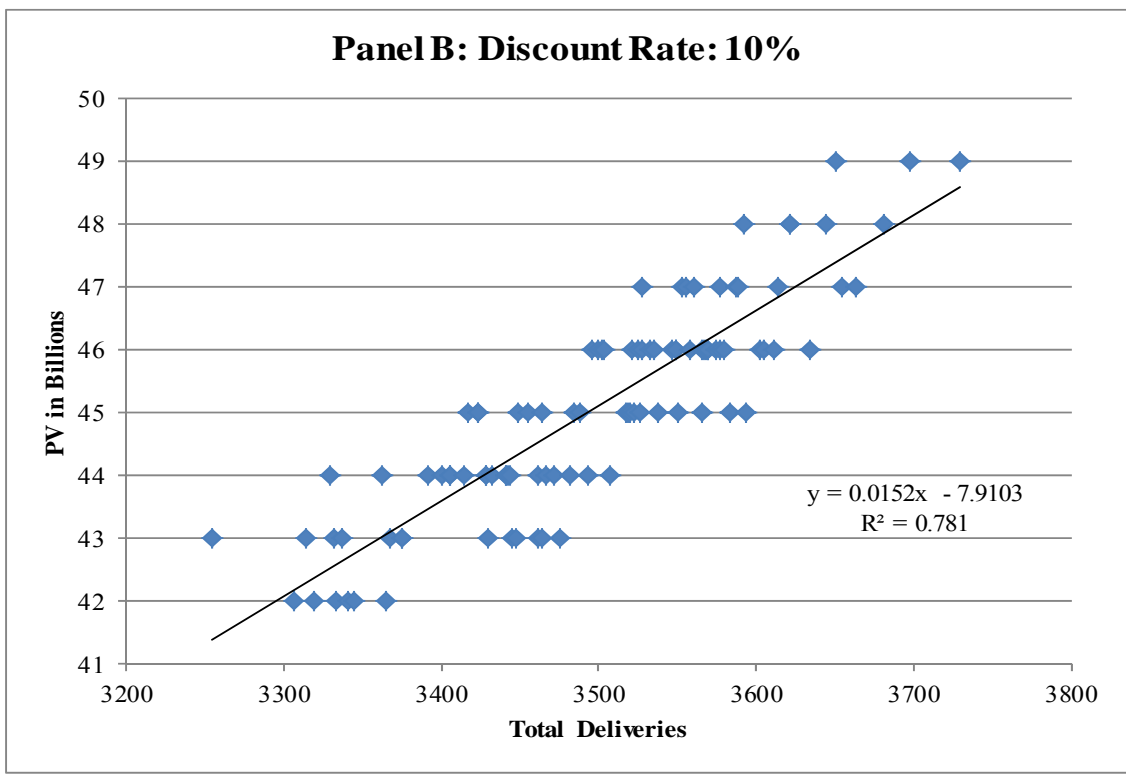
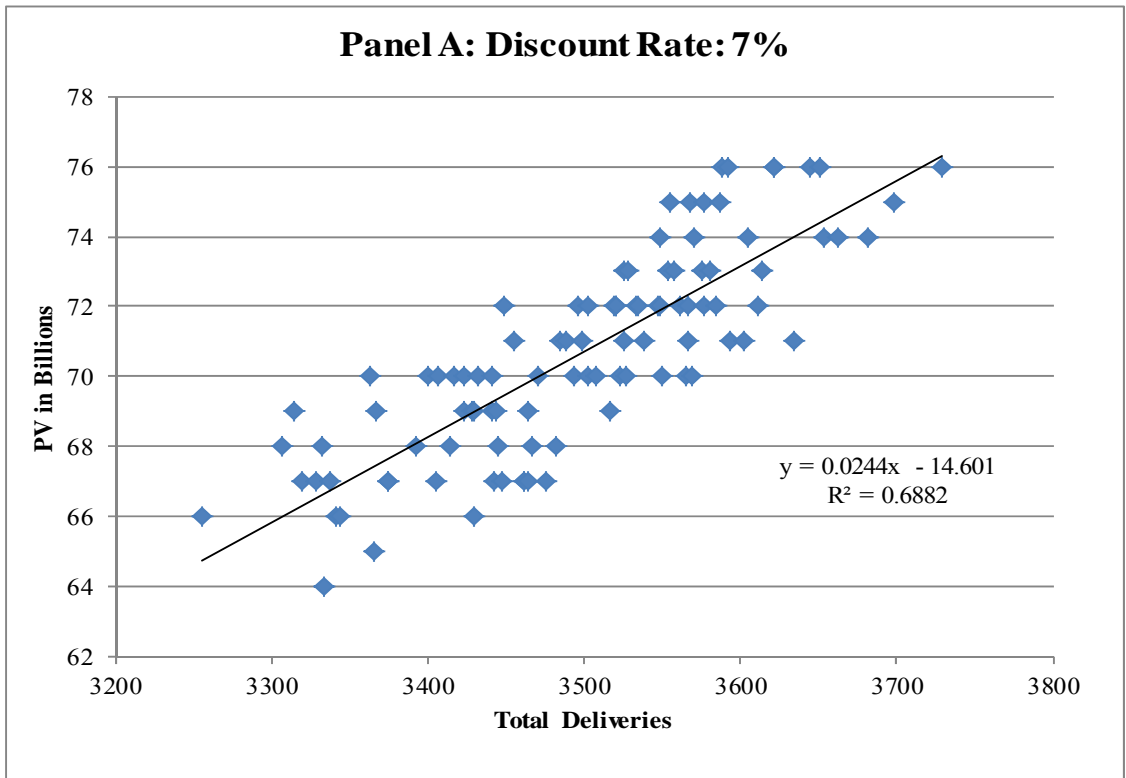


Figure 3: Distribution of Program Value with Mean Deliveries of 2,750

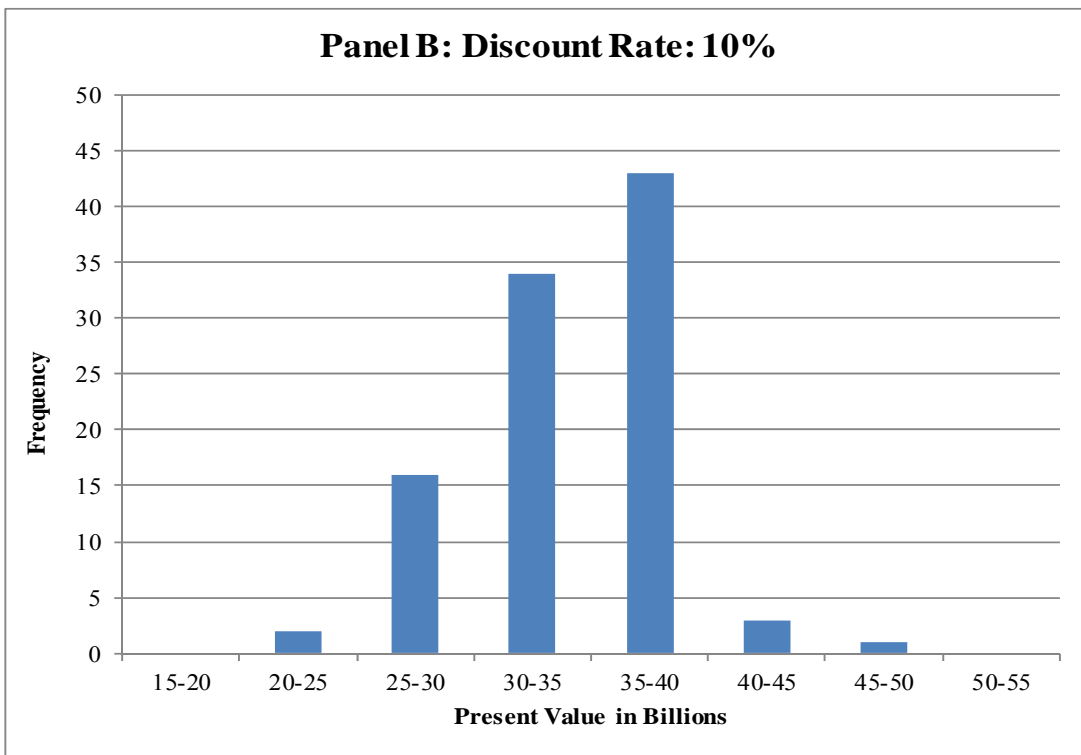
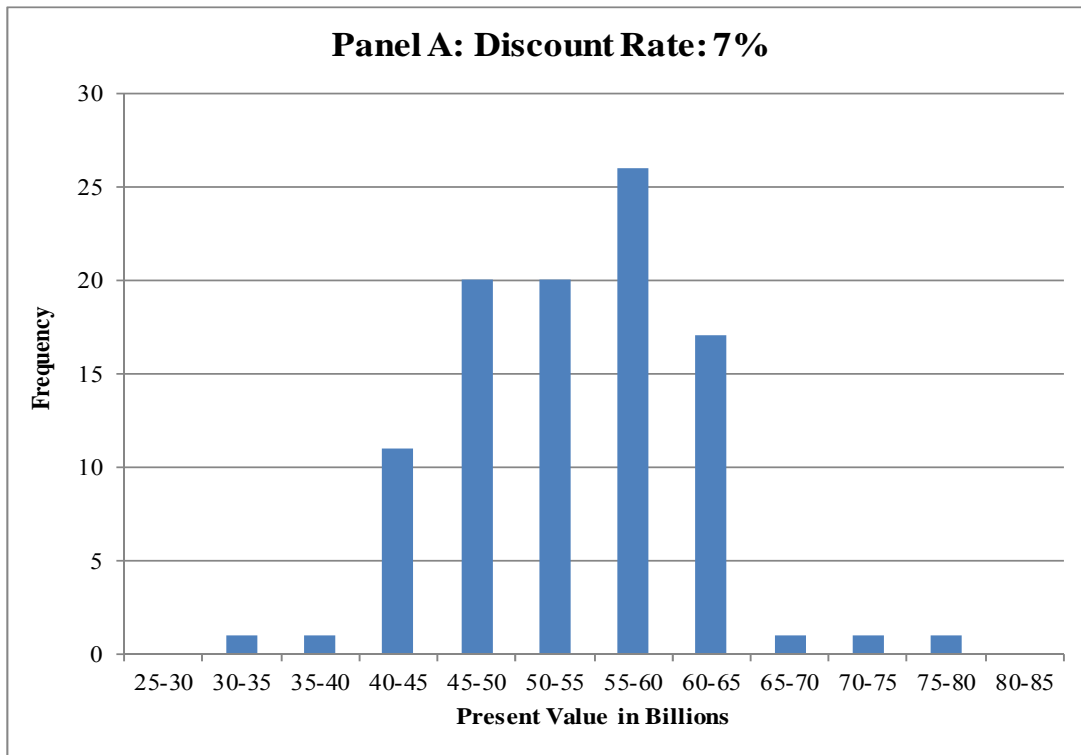


Figure 4: Program Value Relative to Total Deliveries (Mean 2,750)

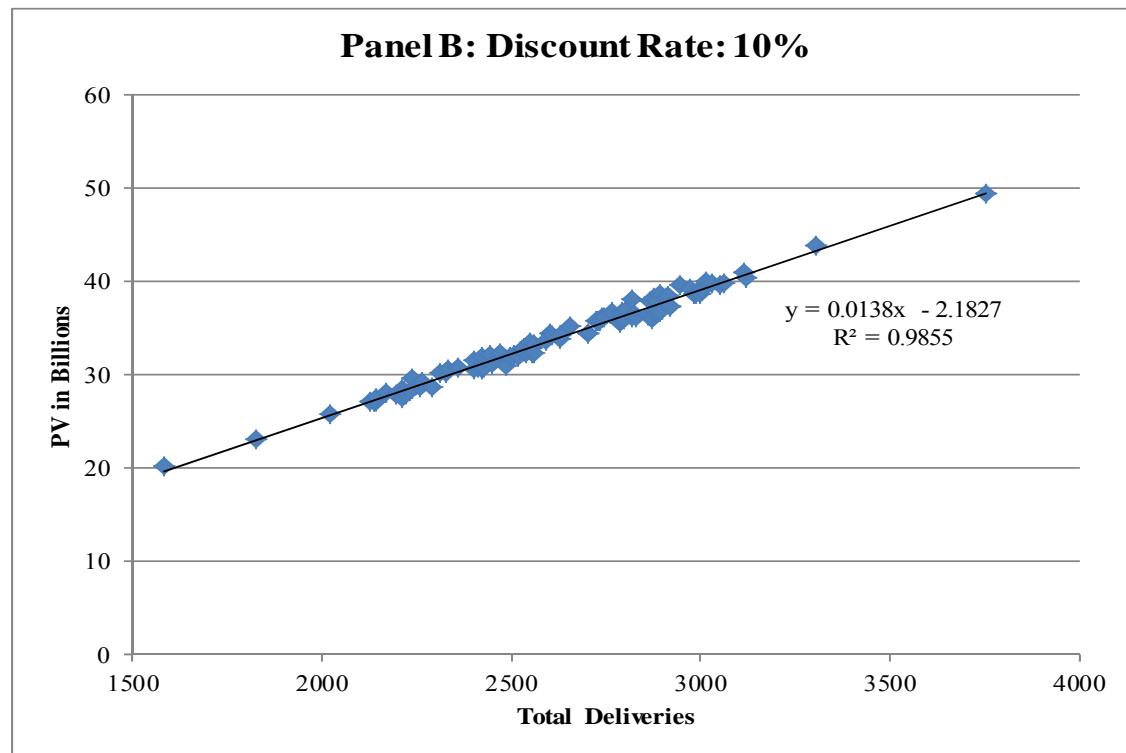
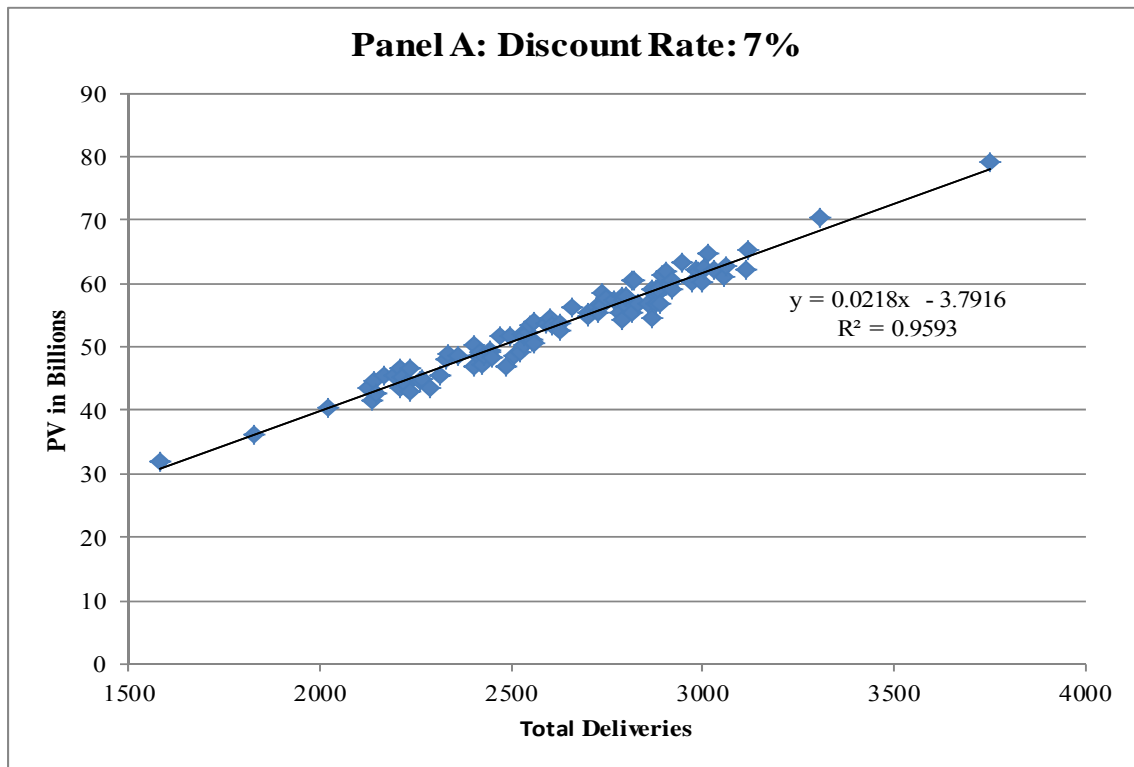


Figure 5: Abnormal Returns and Cumulative Abnormal Returns

