Revenue Growth and Capital Structure Constraints in Equity Crowd Funded (ECF) Enterprises

Paul Vroomen ¹, Subhas Desa ²

April 2015

Abstract

Title III of the JOBS Act of 2012 creates a new class of private equity investment known as equity crowd funding (ECF), widely expected to provide a new source of financing for small and medium enterprises which have had limited financing options in the past. Our analysis shows that the set of enterprises that qualify for ECF is, however, rather severely constrained by the returns required from such investments. We apply mean-variance portfolio theory to identify the expected returns required of ECF assets. To do this we construct the capital market line of established equity markets by empirically identifying the expected return and standard deviation of three private equity investment classes: equity buy-out, venture capital and angel investments. We then analyze the systematic risk of ECF assets relative to these other private equity classes, to estimate the standard deviation of the ECF asset class which we then apply to the capital market line to determine the commensurate expected return for ECF assets. We then define three enterprise classes that are likely candidates for equity crowd funding: low capitalization start-ups, high capitalization start-ups and single event projects. We build parameterized models for typical representatives of each enterprise class, using a set of parameters that together define the expected return of each representative enterprise. The target ECF expected return is then imposed as a constraint on these models. The constrained models enable us to identify the feasible region for the model parameters. We study the two parameters that are the primary determinants of value: revenue (and consequently earnings) growth and capital structure (as represented by percentage equity ownership of ECF investors) and illustrate the feasible regions with selected revenue growth and equity ownership values for the three enterprise classes.

¹. Corresponding author; email: pvroomen@soe.ucsc.edu; phone: (831) 227 0758. Technology and Information Management Department, Baskin School of Engineering, University of California, Santa Cruz

². Technology and Information Management Department, Baskin School of Engineering, University of California, Santa Cruz
1. Introduction:

In April 2012 President Barack Obama signed the JOBS Act into law, after it passed through both Houses of Congress with broad bipartisan support and strong backing from industry and business lobbies (1). The Act eases a broad set of constraints primarily arising from the Securities Act of 1933 that apply to early stage companies seeking financing through the sale of securities to the public (2). Title III of the Act opens up an entirely new path for early stage company financing, namely equity crowd funding (ECF).

The term “crowd funding” in this paper means the process of raising funding for companies, projects, charities and events (collectively “enterprises”) by aggregating small amounts of individual investments from a large number of people, usually using an Internet website (herein called a crowd funding platform or CFP) to reach potential investors and consummate transactions (3). Equity crowd funding, as distinct from patronage crowd funding, refers to a crowd funding process in which investors receive equity in the entity that is seeking funding. Patronage crowd funding, in contrast, means that investors prepay for products or receive early access to products, discounts on products, early access to information, or other such non-financial returns for their investment.

All existing equity CFPs for non-accredited investors are based in countries other than the USA. Equity crowd funding for non-accredited investors does not currently exist in the US because, despite passage of the JOBS Act, it remains illegal for companies to publicly offer securities for sale to non-accredited investors unless the company has filed for exemption under Regulation D of the Securities Act, which enables the company to sell securities to up to 35 non-accredited investors (4). Non-accredited investors, as defined by the SEC (5), have net assets less than $1M or household annual income less than $300,000 per year.

According to the US Census Bureau, 97.4% of US households had income below $250,000 per year in 2009 (6) implying that a significant untapped pool of potential financing could be opened up by the JOBS Act. Title III of the JOBS Act essentially creates a new exemption for enterprises seeking public financing by enabling a company to publicly sell up to $1M per year of securities to an unlimited number of non-accredited investors, but restricts the amount that such non-accredited investors can invest to 5% of the investor’s annual income or net worth if net worth is less than $100,000 or annual income is less than $100,000 per year, or 10% of the investor’s net worth or annual income if net worth is greater than $100,000 or annual income is greater than $100,000 per year. Congress mandated the Securities and Exchange Commission (SEC) to write the regulations that would govern such sales of securities to non-accredited investors. This process is currently underway. Until the SEC formally approves the rules, the Securities Act of 1933 is not amended by the JOBS Act, which makes public sales of securities in privately held enterprises to non-accredited investors illegal (7).
We expect however that the SEC will eventually publish rules for ECF investors and issuers, making this class of private equity financing legal in the US, thereby opening new financing options for smaller US companies that have not had ready access to equity financing in the past.

We are concerned in this paper with the identification of the financial performance requirements that this new class of private equity financing places on enterprises. Very little research has been done on the performance requirements of ECF funded enterprises, most likely due to the fact that the Act was only voted through Congress in 2012. We find that the returns constraints required by finance theory appear to be significantly more severe than some promoters of Title III may have realized (8) and limits the set of enterprises that qualify for ECF financing.

2. Organization of this paper:

Section 3 defines the research issues addressed by the paper. Section 4 outlines the theory and process applied. Section 5 identifies the internal rate of return (IRR) performance of public and private equity investments, enabling construction of the capital market line for the overall equities market. Section 6 analyzes the implications of the expected IRR on a portfolio of private equity investments, enabling determination of the returns performance required of individual companies comprising an ECF portfolio. Section 7 defines three enterprise classes that are likely candidates for equity crowd funding. Section 8 defines parameterized models for each of the enterprise classes and determines the feasible region required for the two parameters that are the primary determinants of value: revenue growth and return on invested capital. Section 9 summarizes conclusions and discusses further work. Appendix A1 contains details of the models used for this analysis.

3. Research Issues:

The primary research issue addressed in this paper is to determine the feasible region for the two key parameters that determine value for ECF investments: revenue growth and return on invested capital (9). This feasible region identifies the performance requirements for enterprises that can be expected to successfully seek financing through ECF.

To do this we have addressed several component research issues. Firstly we identify the historical IRR for selected private equity investments from which the capital market line of the private equities market can be constructed. Secondly, the systematic risk of ECF investments is analyzed and compared to the risk of other equity investments, thereby enabling estimation of the expected return required of ECF investments commensurate with their systematic risk. Thirdly, recognizing that the derived expected return for the ECF market is the return on a portfolio, the distribution of returns of individual companies in established private equity markets is analyzed to identify the expected return required of surviving individual investments in these portfolios. These individual
company returns are derived for the venture capital and angel markets and applied as a proxy to the ECF market, yielding expected returns for individual ECF investments. The fourth objective is then to apply these individual investment expected returns to identify the feasible region for revenue growth and return on invested capital of three enterprise classes that are likely to fall within the feasible region for ECF funding. We do this by constraining parameterized models of typical representative enterprises in each class with the expected returns for individual ECF investments and determining the feasible region for the two key parameters, revenue growth and equity ownership, which we treat as the variable parameters of the models.

4. Theory and Process:

Theory:

We apply several theoretical concepts in this analysis. To determine valuation of enterprises, we apply discounted future cash flow. The capital market line is calculated using mean-variance theory and specifically the Markowitz model. Efficient market concepts are applied to investigate whether private equity markets are indeed efficient.

Throughout this paper, we use Internal Rate of Return (IRR) as the return metric, since: 1) discounted future cash flow models are widely used in practice to evaluate private equity investments (9,10) and IRR directly measures the return on cash flows; 2) IRR explicitly includes the time dependency of returns; 3) IRR is an explicit measure of return on capital invested.

We calculate IRR numerically from quarterly cash flows as follows:

\[ NPV_n = \sum_{i=1}^{n} \frac{C_i}{(1+r)^{p_i}} = 0 \]  

Equation [1]

Where:

\( r \) = Internal Rate of Return (IRR) per year, in decimal form
\( i \) = quarter 1, 2, 3…n,
\( C_i \) = cash flow in quarter i,
\( n \) = the quarter for which \( r \) is being calculated,
\( p_i \) = quarter i expressed in years
\( NPV_n \) = net present value, which is set to zero to calculate \( r \).

The enterprise class models discussed in section 8 provide the quarterly cash flow for each model based on revenue growth. Revenue growth is therefore one of the two independent variables that we use for determining enterprise performance. To calculate the return on capital invested, we apply the resultant cash flow for each model to the ECF fraction of the company’s capital structure, using equation [1], to calculate IRR for the ECF investors. The resultant IRR is then compared to the target IRR derived in section 5 to determine whether the enterprise model lies within the feasible region.
We apply mean-variance portfolio theory to determine the target IRR for the ECF market. We do this by deriving the capital market line for the private equities market. We then estimate the risk (as represented by standard deviation) of the ECF market and apply this to the capital market line to determine the required expected IRR for the ECF market commensurate with the risk of ECF investments.

We therefore first identify the ECF market’s systematic risk. We do this by reviewing the risk factors that comprise systematic risk for private equity investments and then estimate a risk premium for the ECF market by comparison to other private equity markets whose standard deviation, and therefore systematic risk, are known.

We derive the capital market line of the equities market by determining the expected returns and standard deviations of existing equity markets, namely equity buy-out, venture capital and angel investor markets. We treat these markets as “macro” securities in a portfolio that defines the overall equities market. A critical underlying assumption in this approach is that the private equity macro securities are efficient portfolios that lie on the efficient frontier of the equities market, meaning that they are subject to an equilibrium process which continuously drives prices to an equilibrium value through the risk averse (seek lowest risk for a given return) and non-satiative (seek highest return for a given risk) behavior of rational investors.

It is necessary therefore to examine whether the private equity market is efficient, primarily because private equities are illiquid. The unrestricted buying and selling of liquid assets is a well-established mechanism for forcing equilibrium. Therefore, the lack of liquidity in private equity markets naturally leads to concerns about their efficiency.

We argue that the net asset value (NAV) of private equity investments reflect their efficient market value. An efficient market is one in which all available information is fully reflected in asset prices (II). Notationally, this means that:

\[ E(P_{j,t+1} | \phi_t) = (1 + E(R_{j,t+1} | \phi_t))p_{j,t} \]

Where capitalized variables are random variables, E is the expected value operator and:

- \( p_{j,t} \) = price of asset \( j \) at time \( t \)
- \( R_{j,t+1} \) = return of asset \( j \) at time \( t+1 \)
- \( P_{j,t+1} \) = price of asset \( j \) at time \( t+1 \)
- \( \phi_t \) = the set of available information at time \( t \) that is fully reflected in price \( p_{j,t} \)

Such efficient markets also show the following characteristics:

If \( x_{j,t+1} = p_{j,t+1} - E(P_{j,t+1} | \phi_t) \), then \( E(x_{j,t+1} | \phi_t) = 0 \)

Alternatively, if \( z_{j,t+1} = r_{j,t+1} - E(R_{j,t+1} | \phi_t) \), then \( E(z_{j,t+1} | \phi_t) = 0 \)
Therefore, for a private equity market to be efficient, if the market is trading in \( n \) assets based on \( \phi_t \) and if \( \alpha_j(\phi_t) \) is the NAV of each asset at time \( t \), then the total excess market value generated by this market at time \( t+1 \) is:

\[
V_{t+1} = \sum_{j=1}^{n} \alpha_j(\phi_t)[r_{j,t+1} - E(R_{j,t+1}|\phi_t)]
\]

But, since \( r_{j,t+1} - E(R_{j,t+1}|\phi_t) = 0 \Rightarrow V_{t+1} = 0 \)

At the time of investment, \( t_I \), and of exit, \( t_E \), the market in private equity securities is competitive, enabling the usual open buying and selling mechanism to operate and thereby force equilibrium. This drives \( r_{j,t+1} - E(R_{j,t+1}|\phi_t) \) to zero at time \( t = t_I \) and \( t = t_E \) for each \( \alpha_j(\phi_t) \). Further, companies that have received private equity financing are subject to scrutiny by their investors, the investors are subject to scrutiny by their partners and the partners are subject to scrutiny by their limited partners in the case of venture capital and private equity buy-out firms. Any tendency to inflate the NAV of assets by the general partners of a venture capital fund, for example, would be countered by the limited partners who want to know the true value of their investments. This dynamic tension results in similar forces driving toward equilibrium as exist in liquid markets. We therefore argue that this continual multi-level scrutiny forces each \( \alpha_j(\phi_t) \) in the private equity market to equilibrium at all times, just as the liquidity of public markets force public securities to their equilibrium prices. We conclude therefore that \( V_{t+1} = 0 \) at any time, \( t \), in the private equity markets as well.

This conclusion means that the expected returns and standard deviations of the equity buy-out, venture capital and angel investor markets lie on the efficient frontier of the overall equities market. We can then apply these data points to construct the efficient frontier for the private equities market by fitting the data points to a quadratic function in accordance with the quadratic relationship between standard deviation and expected return required by the optimization process in the Markowitz model (12). The Markowitz model minimizes portfolio variance under the required constraints as follows:

\[
\min_w \frac{1}{2} w'Vw \quad \text{s.t.} \quad w'E = \mu; \quad w'1 = 1
\]

Where:

\( w \) = vector of \( n \) weights for each security in the portfolio  
\( E \) = vector of \( n \) mean returns for each security in the portfolio  
\( V \) = the \( n \times n \) variance-covariance matrix  
\( 1 \) = identity vector of length \( n \)

To solve this optimization problem we take the derivative of the Lagrangian and set it to zero to find the minimum. This can be solved for \( w \). Plugging the result into the constraint equations solves for the Lagrangian multipliers. Once these are known, the
weights and minimum variance point can be calculated. This yields the following solution:

\[
var(R^p) = \frac{C\mu^2 - 2B\mu + A}{AC - B^2}
\]

Equation [2]

\[
w = V^{-1} \frac{E(C\mu-B) + 1(A-B\mu)}{(AC-B^2)}
\]

Equation [3]

Where:

\(var(R^p)\) = minimum variance of portfolio IRR for expected return of \(\mu\)

\(A = E'V^{-1}E; \) \(B = E'V^{-1}1; \) \(C = 1'V^{-1}1\)

The solution to the Markowitz model illustrates the quadratic relationship that exists between standard deviation and the expected return of the portfolio. We also know that any linear combination of efficient portfolios yields another data point on the efficient frontier (10). For example, the venture capital market is actually a combination of late stage, early stage and some small amount of seed equity investments all of which lie on the efficient frontier of the private equity market. The same can be said for angel investments, which are a combination of primarily early stage and seed investments with some late stage private equity investments.

We then build models for three types of enterprises in the context of the constraints required by the JOBS Act: 1) Low Capitalization start-ups that require less than $1M per year with revenue starting within two years of the initial investment; 2) High Capitalization start-ups that require more than $1M per year in funding and require 2 years or more to begin revenue shipments; 3) Single Event Projects that require funding for an event or a single product, such as writing a book or staging a sports event, where the time from initial funding to returns is between 6 and 24 months.

The models are parameterized, enabling variation of parameters for sensitivity analysis. We analyze the two parameters that primarily influence company value, revenue growth and capital structure (9) to identify the feasible region for these parameters when the models are constrained to the expected returns for individual ECF investments.

5. Risk-Adjusted Returns for Private Equity Investments:

5.1. Return metrics for private equity:

The performance of private equity buy-out funds and venture capital funds has been studied intensively and a broad literature is available on this subject. Da Rin, et al, (13) provide a comprehensive survey of the state of research on venture capital returns. Healthy debate continues about how to accurately measure private equity fund returns, resulting in a wide dispersion of results proposed in the literature.
The following factors contribute to the wide disparity reported in the literature:

1) The value of a mature investment is difficult to determine accurately. Mature investments are assets that are 10 years old or more, remain on fund books at their net asset value (NAV) and have had no cash flows in 2 years or more. Some researchers simply write off such assets, resulting in a reduction in returns of as much as 7% (14). Others regard the NAV as correct. In this paper we adopt the view that the NAV of mature investments is accurate, as the multiple layers of scrutiny that apply to VC investments will tend to force the NAV to its efficient market value. We conclude, for example, that the NAV of such mature investments reflects the value of the remaining assets, such as patents, owned by the company.

2) Since no formal reporting requirements exist for VC funds, reporting is voluntary. Consequently not all investments that are written off or have failed are reported, resulting in selection bias in the available data. Researchers have developed differing strategies to compensate for this selection bias, resulting in further disparity. In this paper we adopt the view that the VC industry reports accurately reflect the true performance of VC investments, as the VC industry is dependent on industry performance data to raise funds from LPs, who in turn do deep due diligence on VC fund performances, thereby incentivizing the industry to report accurately.

3) The terms of some VC investments result in investment of committed capital over time rather than in one lump sum. This results in a difference between weighting returns based on committed capital or NAV. Debate continues as to which of these is more accurate. Such weighting difference can impact the resultant IRR by as much as 2% (14). We again assume that the NAV is the fair reflection of the value of VC investments.

4) Debate continues also as to whether gross or net return is the appropriate measure for performance of VC funds. Clearly, limited partners (LPs) are primarily interested in the IRR of the cash on cash multiple delivered to LPs by the fund. But since carried interest varies over a range of 15% to 35%, this is not an accurate measure of VC industry performance as a fund whose carried interest is 35% has to provide 20% more returns than a fund whose carried interest is 15% for the same LP IRR. In this paper we apply net returns to LPs as the accurate measure of VC performance, regarding the carried interest and management fee as necessary costs of such investments.

The returns reported by private equity fund practitioners through industry associations, however, tend to be less dispersed and focus on IRR, cash-on-cash multiples or public market equivalent (PME), a measure of the performance difference between private equity returns and public market returns for similar classes of enterprises. The data applied in this study are derived from two such industry associations, Cambridge
Associates, LLC (15,16) and the Angel Investor Performance Project (AIPP) data, available from the Kauffman Foundation (17).

The data tracked by Cambridge Associates is widely consulted by practitioners in the private equity market. The Cambridge Associates data is illustrated in Figures 1 and 2, showing historical IRR and standard deviation performance of private equity buy-out (EBO) funds and venture capital (VC) funds by fund vintage year. The data shown are based on the aggregated cash flows of all funds established in each vintage year. These funds typically are active for periods of 10 years, implying that older funds are more likely to have exited all investments in the fund portfolio, while newer funds have active investments whose value is captured as the net asset value (NAV) of the investment at the end of each vintage year. The IRR by vintage year data is calculated using equation [1] by applying the net aggregated cash flows of to limited partners (i.e., after deduction of all expenses and carry percentages) for all funds established in each vintage year. The standard deviation for each vintage year is the standard deviation of the IRR for all funds established in the vintage year.

Notationally, the IRR for each fund, \(j\), established in a vintage year, \(y\), is calculated by solving for \(IRR_j\) in the following equation:

\[
NPV_j = \sum_{i=1}^{N} \frac{C_{ij}}{(1 + IRR_j)^{i/4}} = 0
\]

Where:

\(j = 1,2,3\ldots M; M = \) total number of funds established in vintage year \(y;\)

\(i = 1, 2, 3\ldots N; N = \) the number of quarters that fund \(j\) exists;

\(C_{ij}\) = the net aggregate cash flows to or from limited partners in quarter \(i\) for fund \(j;\)

\(C_{Nj}\) is the Net Asset Value (NAV) of the fund at the end of 2012;

\(NPV_j\) = Net Present Value of fund \(j\), which is set to 0 to calculate \(IRR_j\)

The IRR for vintage year \(y\), \(IRR_y\), is then calculated as follows:

\[
IRR_y = \frac{1}{M} \sum_{j=1}^{M} IRR_j
\]

Similarly the standard deviation for each vintage year is calculated as follows:

\[
\sigma_y = \sqrt{\frac{1}{M - 1} \sum_{j=1}^{M} (IRR_j - IRR_y)^2
\]
The resultant data for all three private equity markets is summarized in table 1. In this study we apply the arithmetic means of the vintage year IRR and standard deviations to determine the sector risk and return. The arithmetic mean is used for the following reasons:

1) Weighting by number of portfolios/funds in a vintage year would distort the data in favor of years that had larger portfolios, especially for the angel market.
2) Standard deviation would not be representative of the actual market standard deviation if it were weighted by portfolio/fund size.

5.2. Private Equity Buy-Out:

Private equity buy-out funds typically invest in opportunities where established enterprises are looking to spin off sections of their companies as a result of changing corporate strategy, or where an entire enterprise is seeking financing to implement a new strategy. These funds tend to be large, of the order of several billion dollars, and their focus on established enterprises with revenue history, results in their investments typically being of lower risk than the earlier stage investments made by venture capital funds, with commensurate lower returns. It is very unlikely that ECF investors would participate in the investments made by equity buy-out funds as the scale of these investments is such that the $1M maximum annual investment permitted by the JOBS Act for ECF investors would not be material enough to justify raising ECF investment.

Nevertheless, equity buy-out funds constitute a key segment of the private equity investment market and as such provide a necessary data point on the capital market line of the private equity market. Figures 1 and 2 show that the EBO market is less volatile than the Venture Capital market. Linear regression shows IRR declining from 20% at the start of the period to 10% at the end. The mean IRR is 14.7% and the standard deviation is 16.4%. In this paper we round to the nearest 0.5% yielding an IRR of 14.5% and a standard deviation of 16.5% for the equity buy-out market.

5.2. Venture Capital:

Venture capital funds typically invest in privately held late, early and seed stage companies that have significant growth potential. ECF investors will also be seeking such early stage high growth opportunities, although the scale of ECF investments vs. VC investments would differ given the restrictions on capital amounts required by the JOBS Act. Nevertheless, as shown in subsequent sections of this paper, ECF investors can successfully provide seed capital for companies that require VC levels of investment in partnership with VC investors, provided revenue growth and capital structure achieves required thresholds.

Under the conditions that we assume in this paper regarding VC investment, the seminal paper (18) based on 577 VC funds, finds that value-weighted net VC fund IRR is 17% with a standard deviation of 31%. The more diverse assumptions described in the literature (such as writing off all mature investments) results in the IRR ranging from as low as public equity market returns (or slightly less – (14)) to 21% (18, using the Public
Market Equivalent (PME) metric). We discount the assessments of VC performance in (14), as the assumption that NAV of mature investments is grossly inaccurate is debatable.

Figures 1 and 2 clearly illustrate the large volatility in Venture Capital returns performance. Linear regression of the data shows IRR declining from 20% at the start of the period, to 12% at the end. The mean IRR is 16.3%, with a standard deviation of 25.2% over the period 1981 to 2012. This Cambridge Associates data contains more data points than that contained in (18) and also contains more recent data. Therefore in this paper we use 16.5% IRR with a standard deviation of 25% for the VC market. This is equivalent to a 3x return multiple over 7 years, which is consistent with return expectations for venture funds in practice.

![IRR Performance of Equity Buy-Out and Venture Capital Funds](image)

**Figure 1**: IRR performance of 1,112 US Equity Buy-Out funds and 1,474 US Venture Capital Funds by year in which the funds were established (vintage year) over the period 1981 to 2012. Data shows dollar-weighted, pooled IRR, net to limited partners, of all funds established in the vintage year. Also shown are linear regressions of the IRR performance of both types of fund.
Figure 2: Standard deviation of 1,112 US Equity Buy-Out funds and 1,474 US Venture Capital Funds by year in which the funds were established (vintage year) over the period 1981 to 2012. Also shown are linear regressions of the standard deviation performance of both types of fund.

5.3 Angel Investors:

A closer proxy for the performance of private equity investments in early stage companies is that of angel investors. Angel investors are typically wealthy individuals, with substantial business operating experience, who invest in early stage companies in their fields of expertise. The risk profile for angel investors closely resembles the likely profile for ECF investors in that their transactions are conducted directly with the issuing company and usually at very early stages such as the seed round (19).

The angel market is informal and no formal reporting requirements exist. Various studies of this market have been performed (20), but the available data is much sparser and less structured than that available for the EBO and VC markets.

The Marion Ewing Kauffman Foundation has conducted the Angel Investor Performance Project (AIPP) (17). The database is publicly available and contains 582 exited US angel investments sourced from associations created by angel investors to provide better insight into the industry’s performance and also to lobby on behalf of the industry. Data reported through such associations is subject to the same issues as the VC fund data and should therefore receive the same degree of caution. The study nevertheless provides the most comprehensive set of data on this asset class to date.
We have applied this data to derive the same set of metrics as provided by the Cambridge Associates data for venture capital and private equity buy-out firms. This required that:

1) We extracted only exited investments (as non-exited investments may or may not have remaining value and NAV for non-exited investments was not recorded in the AIPP data).

2) We then calculated the mean IRR and IRR standard deviation for individual investors that have portfolios of two or more investments, to ensure the data is comparable to VC and EBO funds, which are portfolios. This yields $\text{IRR}_j$ for each portfolio. The AIPP data provided a total of 88 such portfolios.

3) We then extracted the vintage year for each angel portfolio, using the earliest initial investment year in the portfolio, and calculated $\text{IRR}_y$ and $\sigma_y$ for each vintage year that had 3 or more portfolios, again to enable direct comparison with the VC and EBO data.

4) As for the EBO and VC markets, we then calculated the arithmetic mean of $\text{IRR}_y$ and $\sigma_y$ over all vintage years that had three or more portfolios. This then yielded the necessary datapoints to enable calculation of the capital market line using consistent data from all three markets.

The resultant mean IRR for the angel market is 30.6% and the IRR standard deviation is 65%. The resultant data for each relevant vintage year for all three private equity markets is summarized in table 1.
Table 1: Summary data for the three private equity markets. Mean IRR is the arithmetic mean of the vintage year IRR and IRR standard deviation is the arithmetic mean of the vintage year standard deviations.

<table>
<thead>
<tr>
<th>Vintage Year</th>
<th>Equity Buy-Out</th>
<th>Venture Capital</th>
<th>Angel Investors</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Vintage Year Mean IRR</td>
<td>Vintage Year Std Deviation</td>
<td>N</td>
</tr>
<tr>
<td>1981</td>
<td>9</td>
<td>9.01</td>
<td>5.59</td>
</tr>
<tr>
<td>1982</td>
<td>11</td>
<td>7.2</td>
<td>3.29</td>
</tr>
<tr>
<td>1983</td>
<td>28</td>
<td>9.55</td>
<td>5.733</td>
</tr>
<tr>
<td>1984</td>
<td>32</td>
<td>7.76</td>
<td>8.82</td>
</tr>
<tr>
<td>1985</td>
<td>26</td>
<td>11.7</td>
<td>8.21</td>
</tr>
<tr>
<td>1986</td>
<td>11 12.82</td>
<td>7.44</td>
<td>30</td>
</tr>
<tr>
<td>1987</td>
<td>12 13.15</td>
<td>7.64</td>
<td>34</td>
</tr>
<tr>
<td>1988</td>
<td>17 14.02</td>
<td>7.37</td>
<td>26</td>
</tr>
<tr>
<td>1989</td>
<td>18 20.31</td>
<td>24.48</td>
<td>37</td>
</tr>
<tr>
<td>1990</td>
<td>8 14.99</td>
<td>4.87</td>
<td>17</td>
</tr>
<tr>
<td>1991</td>
<td>11 32.21</td>
<td>20.27</td>
<td>17</td>
</tr>
<tr>
<td>1993</td>
<td>25 18.3</td>
<td>29.36</td>
<td>36</td>
</tr>
<tr>
<td>1994</td>
<td>21 13.55</td>
<td>15.17</td>
<td>42</td>
</tr>
<tr>
<td>1995</td>
<td>33 16.2</td>
<td>23.51</td>
<td>35</td>
</tr>
<tr>
<td>1996</td>
<td>37 9.63</td>
<td>18.2</td>
<td>42</td>
</tr>
<tr>
<td>1997</td>
<td>51 5.54</td>
<td>18.2</td>
<td>71</td>
</tr>
<tr>
<td>1998</td>
<td>54 11.02</td>
<td>11.25</td>
<td>80</td>
</tr>
<tr>
<td>1999</td>
<td>54 12.48</td>
<td>13.76</td>
<td>113</td>
</tr>
<tr>
<td>2000</td>
<td>78 13.48</td>
<td>11.45</td>
<td>156</td>
</tr>
<tr>
<td>2001</td>
<td>27 23.26</td>
<td>19.09</td>
<td>54</td>
</tr>
<tr>
<td>2002</td>
<td>35 15.89</td>
<td>25.22</td>
<td>33</td>
</tr>
<tr>
<td>2003</td>
<td>35 14.75</td>
<td>13.42</td>
<td>38</td>
</tr>
<tr>
<td>2005</td>
<td>91 8.98</td>
<td>10.24</td>
<td>63</td>
</tr>
<tr>
<td>2006</td>
<td>78 11.59</td>
<td>12.47</td>
<td>84</td>
</tr>
<tr>
<td>2007</td>
<td>96 13.14</td>
<td>12.08</td>
<td>63</td>
</tr>
<tr>
<td>2008</td>
<td>74 19.1</td>
<td>20.41</td>
<td>61</td>
</tr>
<tr>
<td>2009</td>
<td>35 19.03</td>
<td>18.91</td>
<td>21</td>
</tr>
<tr>
<td>2010</td>
<td>31 19.05</td>
<td>23.06</td>
<td>40</td>
</tr>
<tr>
<td>2011</td>
<td>56 13.75</td>
<td>17.34</td>
<td>41</td>
</tr>
<tr>
<td>2012</td>
<td>42 -7.7</td>
<td>28.21</td>
<td>44</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>N Total</th>
<th>Mean IRR</th>
<th>IRR Std Dev</th>
</tr>
</thead>
<tbody>
<tr>
<td>1112</td>
<td>14.7</td>
<td>16.4</td>
</tr>
<tr>
<td>1474</td>
<td>16.3</td>
<td>25.2</td>
</tr>
<tr>
<td>88</td>
<td>30.6</td>
<td>65.0</td>
</tr>
</tbody>
</table>

5.4. Analysis:

5.3.1 ECF Systematic Risk:

ECF investments will have inherently higher systematic risk than that of the other private equity markets. This increased risk is due to the following factors:

1) **Limited Liquidity**: Private equity investments are not liquid and therefore proceeds cannot be extracted whenever desired, as is the case for public equities. It is unclear at this time whether a secondary market will develop for ECF investments. The JOBS Act only requires that ECF investments are not
transferable for a period of 1 year after investment and is silent as to whether these assets may then be publicly sold. Nevertheless, such secondary sales will still be subject to the constraints of the JOBS Act (such as the dollar amount that may be invested in securities in the secondary market per year). Also, most venture capital deals include buy back options for the company whereby the company has first option to purchase any shares that a venture capital investor wishes to sell, at the face value of the shares. If, as is likely, ECF investment terms include such a buy back option, then the secondary market will mostly only apply to investments that are being sold at below their face value. We therefore conclude that the ECF market will have the same liquidity risk as venture and angel investments.

2) **Reduced Control:** VC investors, and to a lesser extent, angel investors, tend to have well-structured terms and conditions to establish control over their investments, including Board seats, controlling voting rights, information rights, anti-dilution preferences and liquidation preferences. While such protective provisions can be included in the terms of ECF investments, a large group of small investors will most likely result in each investor holding a minority share. Voting will therefore be based on the aggregate views of all investors, resulting in reduced control for individual ECF investors relative to VC and angel investors.

3) **Information Asymmetry:** Issuers of private equity securities are not required to publicly disclose material developments, as is legally mandated for public companies. This reduced disclosure can result in rapid changes in the NAV of private equities when material information does become available to investors. Given the less active role and reduced visibility that ECF investors would have relative to VC investors and angel investors, this risk is higher in ECF investments.

4) **Legal Constraints:** The JOBS Act constrains the amount ECF issuers can raise to a maximum of $1M per year, limiting the ability of ECF investors to participate in later stage financing rounds both for reasons of scale and timing. This can constrain growth for ECF funded companies, reducing their ability to succeed, and raising the risk to ECF investors.

5) **Moral Hazard:** Risk of moral hazard increases with reduced oversight and limited due diligence. This risk is greater for ECF investments relative to venture and angel investors given the reduced visibility and control of individual ECF investors.

We conclude therefore that ECF investors will demand a risk premium over the systematic risk faced by buy-out, venture capital and angel investor private equity classes.

**5.3.2 Capital Market Line for private equity investments:**

We now can apply the mean-variance theory described in section 5.1 to estimate the expected returns required of ECF investments. Firstly we recognize that the EBO, VC and angel markets are portfolios comprised of four primary enterprise stages (which each can be considered as a portfolio of individual investments of enterprises at that stage), as shown in table 2. ECF investors will be making investments in this same set of
enterprises, but with different weights for each stage compared to other private equity investment classes, due to the higher risk associated with ECF investments as described in section 5.3.1. We use these four enterprise stages as the constituent securities of the private equities market and regard the EBO, VC and angel markets as portfolios of these constituent securities.

<table>
<thead>
<tr>
<th>STAGE</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Seed</td>
<td>Newly formed enterprises with no revenue and no product, but a viable business idea that requires product and market validation, usually by building a prototype with which market demand can be assessed</td>
</tr>
<tr>
<td>Early</td>
<td>Enterprises that have verified their product value proposition by confirming appropriate functionality of prototypes and have validated revenue potential with confirmed customer traction, but need to convert the prototype to a commercial product</td>
</tr>
<tr>
<td>Late</td>
<td>Enterprises that are in production and shipping to customers, but not yet profitable and need working capital to grow revenue to achieve positive cash flow.</td>
</tr>
<tr>
<td>Buy-out</td>
<td>Established privately held enterprises or sub-sets of publicly held enterprises whose management is seeking acquisition due to changing business strategy.</td>
</tr>
</tbody>
</table>

Table 2: Private equity enterprise stages.

We have concluded that the EBO, VC and angel markets are efficient and therefore the mean IRR and IRR standard deviation data points we have identified for these markets lie on the capital market line. To determine the exact efficient frontier of the private equities market requires the covariance matrix, $V$, (or equivalently, the correlation matrix, $\rho$, from which $V$ can be calculated if standard deviations of each security are known, as is the case with the data available). This enables explicit determination of $\text{var}(R^p)$ as a function of $\mu$ using equation [2]. These covariances or correlations are difficult to extract from the available data. We therefore created two boundary conditions for the capital market line by applying correlation of 100% and correlation of 0% between each constituent security, in each case requiring that the VC and angel markets lie on the resultant efficient frontier.

Notationally, for the four constituent securities of the equities market, this means that:

$$\rho \ (0\%) =
    \begin{pmatrix}
    1 & 0 & 0 & 0 \\
    0 & 1 & 0 & 0 \\
    0 & 0 & 1 & 0 \\
    0 & 0 & 0 & 1 \\
    \end{pmatrix}
$$

and

$$\rho \ (100\%) =
    \begin{pmatrix}
    1 & 1 & 1 & 1 \\
    1 & 1 & 1 & 1 \\
    \end{pmatrix}$$
We would expect then that the IRR for the ECF market will lie between these two boundary cases since it is unlikely that ECF investments would be negatively correlated with angel and VC investments. We can construct the capital market line for each of these two boundary cases by adding a risk free security to the mix of private equity constituent securities. We use the current interest rate on 10 year Treasury Bonds for this risk free security (current rate is 2.8%). We also assume that borrowing is not applied in the private equity markets (i.e. no negative weights are allowed for equation [3]).

Figure 3 illustrates the capital market lines for the 100% correlation case (Rho=100%) and the 0% correlation case (Rho = 0%). It turns out that the capital market lines (CML) of these two boundary conditions are virtually identical, implying that the capital market line is robust to correlations between the various constituent investments. The returns and standard deviations of the four constituent securities have been adjusted such that the EBO, VC and angel markets lie on the resultant efficient frontier for both correlation boundaries. We can now estimate the risk premium for the ECF market and apply the resultant standard deviation to determine the resultant ECF expected IRR, as also shown in Fig.3. We estimate a 10% risk premium for ECF investments over angel investments, based on the higher systematic risk of ECF investment as described in section 5.3.1.

![Capital Market Line for Private Equity](image)

**Figure 3: The private equity capital market line**

Based on this analysis, we conclude that the target ECF expected IRR is 35%. In the remainder of this paper we apply a range of expected IRR for the ECF market of 30% - 35%. This is driven by three primary reasons:
1) The mean-variance model is a fairly simplistic representation of actual market behavior. Comparisons of public equities data to the CAPM model, which is derived from mean-variance theory, shows that empirical data tends to be flatter than that predicted by the CAPM (21). Hence the actual range of expected IRR is likely be lower than predicted by Figure 3.

2) The ECF risk premium is not explicitly known. We have estimated a 10% premium over the angel investor risk, but the risk factors are difficult to quantify. Therefore a range that starts at the same level as angel investor returns is reasonable given the similarities between angel and ECF investment.

3) As mentioned in section 5.3.4, the angel investor data is sparse. This implies a degree of uncertainty for the derived angel investor IRR and standard deviation.

6. Implications of the Target Risk-Adjusted Returns:

In section 5 we showed that a target range for risk adjusted return of ECF investment portfolios lies between 30% and 35%. This conclusion implicitly assumes that non-accredited ECF investors in early stage enterprises will have the same risk-return expectations as other traditional, sophisticated private equity investors in early stage enterprises. Some degree of patronage may exist for crowd fund investors that regard investing in small local firms as a contribution to the local community and therefore would settle for lower returns than discussed above. But in general, CFPs will likely host issuers from a wide spectrum of industries and geographies, and therefore the investor would consider an equity investment made through such a CFP as primarily driven by the returns that the investment could yield. Furthermore, it is assumed here that crowd funding investors would be as equally inclined as other, established, private equity investors to spread their risk over a portfolio of such investments.

The expected IRR identified for ECF in section 5 is the return for the entire ECF market. We therefore need to translate this market return into an expected return for individual ECF investments since the expected return for individual investments is the constraint for our analysis of required revenue growth and return on invested capital for ECF companies. Empirical data shows that VC and angel investments are distributed over a range of returns with the distribution heavily skewed to the low end of the returns spectrum. The distribution for the 587 exited angel investments in the AIPP data is shown in Fig. 4, illustrating that 46.7% of the exited investments were written off (IRR=-100%) and 61.8% of angel investments had less than 0% IRR.

Angel investors are the closest established proxy for ECF investors given their similar investment process, limited post investment control and poor post investment visibility (although in all of these three factors angel investors are better positioned than ECF investors). The distribution for ECF investors is therefore likely to be more skewed to the low end. Further data from the Bureau of Labor Statistics (22,23) shows that 65% to 75% of early stage investments are likely to fail. The expected IRR for a private equity portfolio therefore has to be produced by the remaining 35% to 25% of the portfolio.
In the absence of historical ECF investor data but based on the empirical data discussed above, we will apply a bimodal exit distribution in which 50% to 60% of ECF investments produce -100% IRR (i.e., all funds invested are written off) as a proxy for the required performance of an ECF portfolio. This requires the remaining 25% to 30% of the portfolio to yield the expected portfolio IRR.

![Distribution of returns for angel investments based on AIPP data](image)

**Figure 4: Distribution of returns for angel investments based on AIPP data**

The return multiple required of the producing portion of a portfolio is given by:

\[ M_i = \frac{(1 + r)^i}{p} \]

Where:
- \( M_i \) = return multiple required in year \( i \)
- \( i \) = number of years from investment
- \( r \) = portfolio internal rate of return in decimal form
- \( p \) = the productive portion of the portfolio in decimal form

Figures 5 and 6 illustrate the returns multiples for the producing portion of the portfolio required for the overall portfolio IRR to reach the target of 30% (Fig. 5) and 35% (Fig. 6). From these charts it can be seen that a portfolio of which 45% of investments are productive (with the other 55% of investments written off, yielding -100% IRR), but which yields a portfolio IRR of 30%, requires the remaining 45% of the portfolio to yield multiples of approximately 10X the initial investment amount over a period of 6 years or 5X over a period of 3 years.
Figure 5: Required returns multiples if only a portion of the portfolio is productive and portfolio IRR is 30%.

Figure 6: Required returns multiples if only a portion of the portfolio is productive and portfolio IRR is 35%.

As a consequence, a portfolio of ECF investments whose initial value (or basis) is $10,000, and of which $5,500 is written off because 55% of the enterprises fail, would require the remaining $4,500 to yield $45,000 (10X) in 6 years, or $22,500 (5X) in 3
years for the overall portfolio IRR to reach 30%. A 10X multiple in 6 years translates to a required IRR from the productive portion of the portfolio of 46.8%.

In the following sections we assume that returns for investors in a private equity enterprise are based on the value upon acquisition or IPO of the enterprise. While dividend payments, or other forms of profit sharing, are also options for realizing returns from ECF investments, it is unusual for a start-up company to pay dividends during its early stage growth phase. In this analysis we therefore only apply discounted future cash flow valuation of the company to determine ECF investor returns. This means that successful ECF investments (i.e., investments that can yield the expected returns) must have credible potential to generate growth in enterprise value that can achieve the multiples shown in Figures 5 and 6.

### 7. The Three Primary Enterprise Classes for Equity Crowd Funding

Having established the value of the primary performance metric for successful equity crowd funded enterprises, this section identifies three classes of enterprises that are well suited to equity crowd funding due to their capability to achieve the growth rates shown in Figs. 5 and 6. The three classes are then modeled and the required IRR imposed on the models to enable determination of the two key decision parameters to achieve the required IRR: revenue growth and capitalization structure. The three classes are constrained and classified by the requirement of the JOBS Act that equity crowd funded enterprises may not issue more than $1M in securities in a given 12 month period to non-accredited investors.

The 3 classes of enterprise are summarized in Table 3 and are defined as follows:

1) **Low Capitalization Start-up companies**: These are companies that require investment of less than $1M per year to achieve positive cash flow. These companies are characterized by requiring relatively small amounts of capital to develop and start shipping their products, generating revenue within a period of one to two years from initial investment. Examples of this class of company are: mobile phone/tablet game developers, mobile phone/tablet app developers, certain types of software developers (for example Software as a Service (SaaS) companies) and electronic gadget developers (mobile phone headsets, for example). This class of company is currently underserved in terms of equity financing – they are typically too small for venture capital and other forms of private equity investment.

2) **High Capitalization Start-up companies**: These are companies that require investment of more than $1M per year to achieve positive cash flow. Examples of this class of company are: integrated circuit (chip) companies, complex software applications companies (e.g., computer aided design software), electric automobile companies, companies developing new drugs that require FDA approval and companies developing industrial robotics. These companies are
characterized by requiring more than $1M per year to develop their products and may require several years before they are able to ship their first product, but if the product is successful they have the potential for explosive growth. This is the preferred class of company for venture capital investment. This class is included as a potential equity crowd funding target on the assumption that ECF investors provide the seed round of funding prior to traditional venture capital funds stepping in to provide the larger amounts required.

3) **Single Event Projects**: These are projects that require funding for a specific product or event. Examples of this class of enterprise include an author requiring funding to write a book, a movie producer planning a new movie, a rock band that requires funding for a tour or a recording and a sports event organizer that requires funding for an event. Each such project could be organized into a business entity that provides equity to ECF investors. Returns could be generated by dividend payments or pro rata direct distribution of net income from the event or product. This class of enterprise already has had some success in raising funding through patronage crowd funding (24), but is generally also underserved in terms of private equity funding.

<table>
<thead>
<tr>
<th>Enterprise Type</th>
<th>Time to Revenue</th>
<th>Typ. Funding Needs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low Cap Start-Up</td>
<td>1-2 years</td>
<td>&lt;$1M per year</td>
</tr>
<tr>
<td>High Cap start-Up</td>
<td>2-5 years</td>
<td>$2M - $5M per year</td>
</tr>
<tr>
<td>One Time Project</td>
<td>6 months</td>
<td>&lt;$1M per project</td>
</tr>
</tbody>
</table>

Table 3: Summary of enterprise classes that are primary targets for equity crowd funding

8. **Feasible Regions based on Financial Models for each class of Enterprise:**

In this section each of the 3 classes of enterprise are modeled and illustrated by a typical instance of each class, and IRR performance is calculated. Model parameters are then defined with two parameters allowed to vary: revenue growth and capitalization structure (as represented by equity ownership percentages). All other parameters are fixed. The target IRR is then applied to the models to determine the feasible region for the two variable parameters.

8.1 Model Parameters:

i) **Variable Parameters:**

Revenue Growth and Capital Structure: The two parameters that we permit to vary in this analysis and which therefore define the feasible region boundaries, are Revenue Growth and Capital Structure (as defined by the percentage of the issuing company’s equity owned by ECF investors). The pro forma distribution to investors is calculated for each quarter by applying the ownership percentage to the company value. This distribution illustrates the amount investors would receive if the company had been
acquired in that quarter and, together with the investment installments, constitute the cash flow data for IRR calculation.

ii) Fixed Parameters:

1) Productive Portion of Portfolio: From figure 6 it can be seen that to achieve 35% IRR on 40% of a portfolio, for example, requires the productive portion of the portfolio to deliver an IRR of 57% in 6 years (this can be seen from fig. 6 by the fact that in 6 years the productive 40% of a portfolio needs to yield 15x, which requires an IRR from the productive portion of the portfolio of 57%). The percentage of the portfolio that is productive is therefore a fixed parameter.

2) Price/Earnings Ratio: The price/earnings ratio is the determinant of company valuation. The ratio is derived from public company comparables for peer industries.

3) Future Cash Flow Period: The market value of an enterprise for each quarter is determined by applying the price/earnings ratio to the moving average of future forecast earnings. In this analysis we apply a twelve-month period for future earnings, and then determine company valuation by multiplying this 12 month future revenue by the price/earnings ratio. Longer-term revenue forecasts (more than one year) would typically be heavily discounted by a prospective acquirer, given the uncertainty of forecasting long-term revenues for a start up. Discounted future cash flow is widely used in practice to determine company valuation for high growth, early stage companies (9).

4) Time to revenue: This is the time period from first investment installment to first quarter of revenue shipments.

5) Net earnings to revenue ratio: This ratio is applied to the revenue forecast to calculate earnings, which constitute the positive cash flows from which IRR is calculated.

6) Investment amount: This parameter defines the negative cash flows in the IRR calculation.

7) Investment timing: This parameter determines when investments are made, providing the time basis for negative cash flows in the IRR calculation.

8) Liquidation preference: (Only applies to Large Capitalization start-ups). This parameter sets the amount that is first distributed to VC investors.

The fixed parameters enable creation of a hyper-cubic feasible region for the 9 or 10 dimensional vector of model parameters whose boundary is a function of the two variable parameters. Such a decision hyper-cube can be generated for each prospective enterprise seeking listing on a CFP to enable evaluation of the enterprise’s ability to yield the required IRR. Also, the feasible region can be perturbed to enable sensitivity analysis,
and optimization techniques can be applied to determine the optimal values of the decision parameters.

8.2 Low Capitalization Start-Up:

The low capitalization start-up model assumes that an entrepreneur (or group of entrepreneurs) that has a compelling business idea, requires less than $1M per year for up to two years to create a product or service, launch it and begin to build revenue from it. The model also assumes that the market for the product or service is large enough and the value proposition of the product or service is compelling enough, to sustain rapid and significant revenue growth required to achieve the expected IRR. Fig 7 illustrates the minimum required revenue profile for such a company to meet an expected IRR of 57% as illustrated in Fig 8.

Figure 7: Revenue, Cumulative Investment and Cash Flow profiles for a low capitalization start up with 60% ECF investor ownership that can deliver 25% IRR for a portfolio of which 30% is productive.

The model parameter assumptions are as follows:

1) Time to revenue: Revenue begins in quarter 9.
2) Investment amount and timing: $2M of investment, spread as follows: Q1: $0.5M, Q4: $0.5M, Q6: $0.5M and Q8: $0.5M
3) Expected IRR and productive portion of portfolio: 40% of the portfolio is productive and desired portfolio IRR is 35%.
4) Market value to earnings ratio: Market value = 15x net earnings.
5) Earnings to revenue ratio: 15%.
A model for this class of company is provided in Appendix A1 using the parameter assumptions described in this section 8.2. The market value of the company for each quarter is determined by applying the 15x market value/earnings ratio to the moving average of the next 12-month forecast earnings (FTM).

The resultant IRR for each quarter is shown in Fig. 8 with ownership percentage shown as a variable parameter. Fig 8 illustrates the importance of equity ownership as a decision metric. The figure shows that the period for which the company can achieve the target IRR. The figure also illustrates the importance of timing an acquisition transaction such that the company is ideally acquired at or close to the point at which IRR is maximized. For the enterprise profile of Fig. 7, that point is achieved at quarter 16 for the 40% ownership case, or 4 years after the first investment installment was made.

Based on this analysis, an investor that invested $1,000 in each of the four investment installments shown in Figure 7, for example, and who is a member of a crowd funding investor group owning 50% of the company, would receive an IRR of 66% if the company was sold at market value in quarter 18. The investor would receive $22,785 for the $4,000 invested.

Figure 9 illustrates the importance of revenue growth as a decision metric for a company to achieve expected IRR. The figure shows that if linear equivalent revenue growth (LEGR) drops below $125K per quarter, then the target 57% IRR is not achievable, even with 70% equity ownership of the company (LEGR is a linear regression of the first 12 quarters of revenue; we use this metric rather than CAGR (compound annual growth rate) as CAGR is very sensitive to the size of the initial revenue and the initial revenue is typically small relative to the revenue achieved after 3 years and consequently yields arbitrarily large CAGR).

Conclusion: A low capitalization start up can provide internal rates of return that would justify ECF investment provided revenue growth and equity ownership are above the thresholds required by the target IRR. By way of illustration, with the investment profile shown in Fig 7 (i.e. parameter a = $175K/Quarter) a low capitalization start up will require investor equity ownership of at least 50% to achieve an ECF portfolio IRR of 35% with 40% of the portfolio productive, which requires an individual investment IRR of 57% in year 6.
Figure 8: IRR by quarter, for the company with profile illustrated in Fig. 7 using three different levels of the investors’ percentage ownership to calculate IRR. Also shown is the 57% IRR line, which is required to achieve 35% portfolio IRR with 40% of the portfolio productive in year 6 (Quarters 20-24).

Figure 9: IRR by quarter, for the company with profile illustrated in Fig. 7, using three different levels of revenue growth to calculate IRR and assuming 50% investor ownership. Also shown is the 57% IRR line, which is required to achieve 35% portfolio IRR in year 6 with 40% of the portfolio productive. The parameter “a” is the revenue LEGR (linear equivalent growth rate) which is the slope of the linear regression trend line of the first 3 years of revenue, in $M/quarter.

8.2 High Capitalization Start-Up:
This class of enterprise requires larger investment than the amount allowed by Title III of the JOBS Act ($1 Million per year) to fund product or service development. It also requires more time for product development, resulting in a longer time to revenue than the low capitalization start up. As a result of the larger investment requirements, revenue growth for this class of company has to be substantially larger than that of a low capitalization start-up to achieve the expected IRR. Nevertheless, this class of enterprise can deliver the target IRR for equity crowd funding investors, provided again that revenue growth and initial ownership exceed definable thresholds.

This class of enterprise is the primary domain of the venture capital industry. The most likely way that a crowd funding investor could invest in this class of enterprise is in the form of a seed investment. Seed investments are the first round of funding secured by a new start up and is aimed at proving out the product or service concept sufficiently that the company can raise a venture backed follow up financing round. Seed investments are small in comparison to the amount the company will ultimately need to develop its product or service, typically well below $1M, and therefore fall within the constraints of the JOBS Act.

A typical funding profile for this class of company has three funding rounds with acquisition as the most likely liquidation event. It is possible that the company could elect to do an IPO, but the number of venture backed companies exiting in an IPO each year is only about 3% - 5% of all new venture backed investments made in the same year (25). In the scenario considered here, crowd funding investors would only participate in the seed funding round which is followed by two large (> $1M) venture capital rounds in which the seed investors do not participate and therefore will very likely be diluted as the venture capital investment rounds occur. A benefit of this model is that the VC investment results in the start-up becoming subject to the rigorous management expectations of its venture capital investors in rounds B and C and therefore enables ECF investors to benefit from professional venture capital investment practices.

Figure 10 illustrates a revenue, cash flow and cumulative investment profile that can achieve the minimum expected IRR for equity crowd funding investors, assuming these investors only participate in the seed round. The assumptions and parameters in the model are as follows:

1) Time to revenue: Revenue begins in quarter 9.
2) Investment amount and timing: $20.75M in investment is required, spread as follows: Q1: $0.75M, Q4: $8M and Q10: $12M
3) Capital Structure: Seed round capital structure results in equity crowd funding investors receiving 45%, founders also receiving 45% and a stock option pool of 10%.
4) Liquidation Preference: The venture capital rounds have liquidation preference terms of 1X.
5) Expected IRR and productive portfolio: 30% of the portfolio is productive and desired portfolio IRR is 25%.
6) Market value/earnings: Market value = 12x earnings.
7) Earnings/revenue: 15%.

Figure 10: Revenue, cash flow and cumulative investment profile for a large
capitalization start up. ECF investors only participate in the seed round.

The resultant IRR for the ECF seed investors in such an enterprise is shown in Fig. 11.
Despite dilution, the ECF seed investors can still receive returns that achieve the expected
57% IRR provided linear equivalent growth rate (LEGR) is at least $1.05M/quarter. In
this case, the IRR peak is less pronounced which provides more flexibility to investors
for timing of an acquisition.
Figure 11: Returns to seed investors with 45% seed round ownership for the company with investment, revenue and cash flow profile shown in Fig. 10. Minimum revenue LEGR of $1.05M per quarter (parameter a in the chart) is required for this company to achieve the target 57% IRR in year 6 with 40% of the portfolio productive and portfolio IRR of 35%. An increase in LEGR to $1.37M/quarter results in a 10% increase in IRR for seed investors.

Conclusion: Crowd funding in the form of a seed funding round for start-ups that require larger investment than Title III of the Act permits, can yield the expected returns to the seed investors. As before an individual investment in the productive 40% of an ECF portfolio that yields 35% would require that investment to yield 57% IRR in year 6. This constraint would require that a well-managed company as represented by Figure 10 delivers an LEGR of at least $1.05M per quarter if ECF investors own 45% of the company after the seed round. Also, if LEGR is $1.05M per quarter, the company could only yield the target IRR for quarters 19 - 23.

8.3 Single Event Projects:

Single Event Projects are events (rock concerts, plays, sporting events) or single product enterprises (novel, movie, music recording) where a business is registered to fund the enterprise and issues equity based securities in return for cash investment to investors. Returns are generated by direct sharing of net proceeds or by dividend payments from proceeds of the event or from sales of the product. The model assumes that returns would occur in a relatively short period of time compared to the other models discussed above, with investment durations between 6 to 24 months. An example of an event, such as a rock concert, that requires $750K in funding in return for 80% ownership by investors is summarized in figure 8.3.1.

<table>
<thead>
<tr>
<th>Investment Amount ($'000)</th>
<th>750</th>
</tr>
</thead>
<tbody>
<tr>
<td>Investor Equity %</td>
<td>80%</td>
</tr>
<tr>
<td>No. of Concert Goers</td>
<td>25000</td>
</tr>
<tr>
<td>Avg. Price per ticket ($)</td>
<td>75</td>
</tr>
<tr>
<td>Total Revenue ($'000)</td>
<td>1875</td>
</tr>
<tr>
<td>% of Investment used in Expenses</td>
<td>100%</td>
</tr>
<tr>
<td>Expenses ($'000)</td>
<td>750</td>
</tr>
<tr>
<td>Net Gain ($'000)</td>
<td>1125</td>
</tr>
<tr>
<td>Net Gain Accruing to Investors ($'000)</td>
<td>900</td>
</tr>
<tr>
<td>Investment Duration (months)</td>
<td>6</td>
</tr>
<tr>
<td>Annualized IRR (%)</td>
<td>44%</td>
</tr>
</tbody>
</table>

Table 4: Parameter summary of a Single Event project (e.g., Rock Concert) which requires $750K to execute and in which investors own 80% of enterprise equity. Distribution of proceeds occurs 6 months after the investment is made.

Single Event projects are very sensitive to two key parameters: 1) the duration of the investment and 2) the equity ownership percentage held by investors. Fig. 12 illustrates this sensitivity to duration of investment for various ownership levels of the model described in Table 4.
Fig. 12. Sensitivity of returns to duration of investment in the Single Event Project model.

It is clear from Fig. 12 that for a project with the characteristics shown in table 4, ownership by investors needs to be high (>80%) and the duration of the investment needs to be short (<15 months) to generate returns that can achieve the expected IRR. Note that even at 70% ownership, the project cannot yield the expected returns.

The model can be refined to enable distributions to be made as revenue accrues from concert goers buying tickets in advance, thereby spreading returns over a period of time rather than making a one time distribution as assumed in the illustrated model. This would lengthen the time period in which distributions can be made, while still maintaining the expected returns. Adding the assumption of installment investments, rather than the one-time lump sum investment as assumed in Fig. 12 could further refine the model, although administering such payments would add cost and complexity to the transaction. Such installment payments would be more likely for longer term one time projects, such as an author writing a book, who only needs sufficient advance payments to support living and research expenses up to the point where the book is ready for publication.

Figure 13 illustrates the effect of spreading the investment over a period of 6 months with three equal installments of $250K each made at months 0, 3 and 6 for the 80% equity ownership case. As expected this yields considerably better IRR in the short term. The implication of this for ECF investors is that spreading a short duration one time investment over a period of time results in better returns than single lump sum investments and should be a key consideration in negotiating the terms and conditions of such transactions.
Figure 13: Effect of spreading investment over 6 months in three installments made at month 0, 3 and 6 for 80% equity ownership model with lump sum distribution.

Conclusion: Single Event projects can achieve the expected IRR for a private equity portfolio investment, provided that investors secure a sufficiently high percentage ownership and the returns are realized in a sufficiently short time period, with the investment spread over a mutually workable period in installment payments.

9. Conclusions:

9.1 General Conclusions:

The empirical historical IRR and standard deviation achieved in three private equity market segments has been identified and applied to the Markowitz portfolio model to determine the capital market line of the US private equity market. We show that the systematic risk of ECF investments is higher than that of any of these three market segments, which enables us to estimate an expected IRR range required from the ECF market segment to justify the risk that these investments represent. This process yields an expected IRR range for the ECF market segment of 30% to 35%.

We further recognize that this expected IRR is a portfolio IRR, and apply a bimodal distribution to estimate the IRR that an individual investment would have to deliver such that the portfolio IRR is achieved. The bimodal distribution is determined from the historical distribution of returns in the angel investor market, which is the closest proxy to the ECF market segment of the three market segments analyzed. We then applied the resultant individual company expected IRR as a constraint to three parameterized company models that are representative of the three classes of companies that we identified as potentially suited to ECF funding, namely, small capitalization, large capitalization and single event classes. By varying two of the 11 parameters applied in these models, with the others remaining fixed, we determined the boundary of the
feasible regions for these two parameters when constrained by the expected IRR for the ECF market segment.

A number of data points around the boundary of the feasible region were illustrated. The results showing required performance at selected ownership and revenue growth rates are summarized in Table 5.

<table>
<thead>
<tr>
<th>Ownership %</th>
<th>Low Capitalization</th>
<th>Large Capitalization</th>
<th>Single Event</th>
</tr>
</thead>
<tbody>
<tr>
<td>50%</td>
<td>175</td>
<td>1,050</td>
<td>80%</td>
</tr>
<tr>
<td>45%</td>
<td>13-21</td>
<td>20-22</td>
<td>n/a</td>
</tr>
</tbody>
</table>

Table 5: Performance requirements for the three classes of companies at selected ownership and revenue growth rates. Other model parameters are fixed at values described in section 8.

The results show that enterprises that can yield the expected IRR would have to be capable of high growth while conceding significant ownership to investors: for the Low Capitalization start up with ECF investor ownership of 50%, quarter on quarter revenue growth has to average $175K/quarter for the first 12 quarters of revenue shipments, assuming these revenue shipments start after 8 quarters from the first ECF investment. For the Large Capitalization start-up case, with 45% ECF investor ownership after the seed round, revenue growth would have to average $1.05M per quarter for the first 12 quarters, also assuming that revenue shipments start after 8 quarters from the seed round. Lower ownership percentages would require commensurately higher revenue growth, and vice versa. These constraints therefore severely limit the set of enterprises that can succeed through ECF investment.

9.2 Future work:

This paper outlines how two key parameters (revenue growth and equity ownership) necessarily have to achieve required thresholds to meet target IRR performance. This process can be generalized to any number of decision parameters and target performance metrics, resulting in decision threshold hyper-cubes for the model parameters, driven by the selected target performance metric or metrics. Such a generalized decision support system (DSS) would provide investors, issuers and CFPs with an efficient, structured process for rapid evaluation of prospective investments in enterprises offering securities under Title III of the JOBS Act. Developing such a generalized DSS is the subject of future work.
A DSS based on the parameterized models and decision parameters outlined in this paper could be expanded to include heuristics-based parameters derived, for example, from observing the criteria used in current private equity due diligence. Applying a DSS that includes an appropriate mix of objective parameters and heuristics-based parameters would result in deeper and wider evaluation of prospective ECF issuers than that required by the SEC regulations. The proposed SEC regulations, for example, do not include many of the critical due diligence items applied in current private equity due diligence practice, such as analysis of the product or service value proposition, serviceable available market (SAM) size and growth, competitor landscape, strategy, market share and growth, product development plans, adequacy and skill mix of the product development team and management team, all of which can be included as decision parameters in a DSS. Such a DSS would effectively reduce the systematic risk in ECF investments allowing lower IRR thresholds and thereby expanding the set of enterprises that can yield ECF returns.

In addition to the decision support such a DSS could provide, the structured enterprise data and performance results collected by a CFP using such a DSS and stored in its database, lends itself to the application of artificial intelligence and machine learning algorithms that would result in refinement of the DSS models over time. This transforms the DSS into an intelligent DSS (IDSS) as more data becomes available over time. This addition of intelligence to the DSS could be accelerated by collecting data from existing private equity institutions and applying that data to refine the DSS while it is being developed. This is also the subject of future work.

The likelihood of private equity investments achieving the expected IRR has been shown in the literature to have strong dependency not only on the quality and depth of due diligence conducted on the prospective enterprise, but also on post-funding guidance provided by investors (26). The authors expect that the process of post-funding monitoring of enterprises will also fall on the CFP. The inputs and outputs of the DSS outlined in this paper can be applied to set monitoring thresholds for various parameters, such as the time to completion of product development, which can be automatically monitored from post funding disclosures by funded enterprises. Such disclosure can be required through the term sheet as a condition of investment. Future work therefore includes defining and automating such post funding disclosure requirements.

Additionally, the term sheet, which defines the terms and conditions of private equity investments, provides critical protections to investors, including liquidation preference, access to company information, structure of the Board of Directors, anti dilution protections and more. It is unlikely that a large, diverse group of individual investors, the “crowd” in the crowd funding process, would self organize to efficiently create a mutually acceptable term sheet for a crowd funded investment. The authors therefore expect that the task of creating term sheets will fall on the CFP as a service provided to its investors and issuers. Future work therefore includes applying the output of the DSS outlined in this paper as source data for automating construction of term sheets.

Acknowledgments:
The authors wish to acknowledge and thank Sidney Faulkner, Mark Hawkins, Professor Nirvikar Singh, George Pavlov, Dean Witter and Cambridge Associates, LLC, for valuable performance data provided on venture capital and private equity investment and for their insightful suggestions and comments for improvements in the paper.

References:

7. Securities and Exchange Commission notice:”...any offers or sales of securities purporting to rely on the crowdfunding exemption would be unlawful under the federal securities laws.” http://www.sec.gov/spotlight/jobsact/crowdfundingexemption.htm
## Small Capitalization Start Up

<table>
<thead>
<tr>
<th>Price/Earnings Ratio</th>
<th>35</th>
</tr>
</thead>
<tbody>
<tr>
<td>Net Earnings/Sales Ratio</td>
<td>13%</td>
</tr>
<tr>
<td>Percentage Ownership (Fully Diluted)</td>
<td>70%</td>
</tr>
<tr>
<td>First revenue (Qtr)</td>
<td>9</td>
</tr>
<tr>
<td>Revenue Trendline Growth (3Q/3Q)</td>
<td>0.13%</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Appendix A1: Models</th>
<th>QoQ Growth</th>
<th>100%</th>
<th>140%</th>
<th>17%</th>
<th>7%</th>
<th>20%</th>
<th>11%</th>
<th>10%</th>
<th>-9%</th>
<th>5%</th>
<th>14%</th>
<th>8%</th>
<th>-4%</th>
<th>12%</th>
<th>14%</th>
<th>6%</th>
</tr>
</thead>
<tbody>
<tr>
<td>V1</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>6</td>
<td>7</td>
<td>8</td>
<td>9</td>
<td>10</td>
<td>11</td>
<td>12</td>
<td>13</td>
<td>14</td>
<td>15</td>
<td>16</td>
</tr>
<tr>
<td>V2</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0.25</td>
<td>0.25</td>
<td>0.25</td>
<td>0.25</td>
<td>0.25</td>
<td>0.25</td>
<td>0.25</td>
<td>0.25</td>
<td>0.25</td>
<td>0.25</td>
<td>0.25</td>
</tr>
<tr>
<td>V3</td>
<td>13</td>
<td>14</td>
<td>15</td>
<td>16</td>
<td>17</td>
<td>18</td>
<td>19</td>
<td>20</td>
<td>21</td>
<td>22</td>
<td>23</td>
<td>24</td>
<td>25</td>
<td>26</td>
<td>27</td>
<td>28</td>
</tr>
<tr>
<td>V4</td>
<td>1.5</td>
<td>1.8</td>
<td>2</td>
<td>2.2</td>
<td>2</td>
<td>2.1</td>
<td>2.4</td>
<td>2.6</td>
<td>2.5</td>
<td>2.8</td>
<td>3.2</td>
<td>3.6</td>
<td>3.9</td>
<td>4.3</td>
<td>4.7</td>
<td>5.1</td>
</tr>
<tr>
<td>V5</td>
<td>1.5</td>
<td>1.5</td>
<td>1.7</td>
<td>1.7</td>
<td>1.7</td>
<td>1.5</td>
<td>1.5</td>
<td>1.5</td>
<td>1.5</td>
<td>1.5</td>
<td>1.5</td>
<td>1.5</td>
<td>1.5</td>
<td>1.5</td>
<td>1.5</td>
<td>1.5</td>
</tr>
<tr>
<td>V6</td>
<td>2.2</td>
<td>2.4</td>
<td>2.5</td>
<td>2.6</td>
<td>2.5</td>
<td>2.4</td>
<td>2.5</td>
<td>2.6</td>
<td>2.5</td>
<td>2.8</td>
<td>3.2</td>
<td>3.6</td>
<td>3.9</td>
<td>4.3</td>
<td>4.7</td>
<td>5.1</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Quarter</th>
<th>V1</th>
<th>V2</th>
<th>V3</th>
<th>V4</th>
<th>V5</th>
<th>V6</th>
</tr>
</thead>
<tbody>
<tr>
<td>Revenue ($’000)</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Expenses ($’000)</td>
<td>0.1</td>
<td>0.1</td>
<td>0.25</td>
<td>0.25</td>
<td>0.25</td>
<td>0.25</td>
</tr>
<tr>
<td>Net Cash Generated ($’000)</td>
<td>-0.1</td>
<td>-0.1</td>
<td>-0.25</td>
<td>-0.25</td>
<td>-0.25</td>
<td>-0.25</td>
</tr>
<tr>
<td>Cum Cash Flow ($’000)</td>
<td>-0.1</td>
<td>-0.2</td>
<td>-0.45</td>
<td>-0.7</td>
<td>-0.95</td>
<td>-1.2</td>
</tr>
<tr>
<td>Investment ($’000)</td>
<td>0.5</td>
<td>0.5</td>
<td>0.5</td>
<td>0.5</td>
<td>0.5</td>
<td>0.5</td>
</tr>
</tbody>
</table>

| FTT Earnings (SM) | 0.5 |
| FTT Moving Average Earnings (SM) | 0.5 |
| Company value - FTT earnings (SM) | 0.5 |
| Distribution to Shareholders FTT (SM) | 0.5 |
| NPV - FTT | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| IRR FTT (%) | 48% | 77% |
| NPV - TTM | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| IRR - TTM (%) | 11% | 48% | 57% | 65% | 65% | 65% | 65% | 65% | 65% |