**Abstract**

During financial crises, investors find difficulties in raising investment funds, especially from Venture Capital funds (VCs) which are more prone to economic changes in the private sector compared to governmental programs such as the Israeli Technological Incubator Program. This research goal is to determine whether the negative effect of economic crises on the ability of VCs to invest in startups is affecting technological incubators performance as a substitute financing tool for some startups.

By comparing the performance of incubator graduates incubated during financial crises to the performance of graduates incubated during other times this research concludes: during financial crises, Israeli entrepreneurs choose to delay new venture operations over approaching technological incubators as alternative investors

The researchers suggest an explanation: startups that fail to raise VC investments during financial crises place the blame on the economy, even though some of them would have failed to obtain those investments in a different economic environment as well, due to their high risk level. These startups prefer to postpone business launch until the economic environment stabilizes instead of approaching incubators as alternative investors.

**Keywords**

entrepreneurship, financial crisis, economic turndown, venture capital, technological incubators, innovation finance, Israel

**Introduction**

In times of financial crisis, investors find it difficult to raise money for investment in startup companies, as they are largely dependent upon the institutional market, which tends to become more conservative and often to even freeze up as a response to recession or corresponding economic changes (Block and Sandner 2009). Consequently, startups encountering difficulty raising investment must decide whether to delay the start of their entrepreneurial, as the activity or to seek alternative sources of financing. Widening the search for financing sources may involve approaching investors they would not have considered had there not been a crisis, including technological incubators; these are perceived as a financing source inferior to venture capital funds due to R&D Law limitations (which imposes restrictions in exporting know-how and on the sale of the business), the limited budget size obtainable from incubators, the bureaucratic process necessary for obtaining investments from incubators, as well as added value[[1]](#footnote-2) ('smart money') not typically obtainable from incubators.

The Israeli technological incubator program model and VC funds are substitutive since, usually, do not practice investments syndication – a fact that was established thru a sample of random companies, in which we witnessed no early stage investment from both technological incubator and VC funds, and based on Lerner (1994) claim that “first financing round syndicates tend to happen between established venture capitalists while later rounds involve less established venture organizations”.

The research question drawn from this relates to the potential seek of startups for VC alternative investments, a seek that might benefit technological incubators due to a growth in deal flow during downturn in the VC industry. The Israeli technological incubator program acts as a rational investor, aiming for maximum return on investment; the expectation, therefore, is that incubators would take advantage of VC downturn in order to invest in lower-risk startups. In other words, we question if at times of VC downturn, promising companies (those with lower risk and/or expectation of higher return at the same risk level), which would not have approached incubators were it not for the VC downturn, would push aside the less promising companies, which could have successfully raised fund from incubators in the past (that is, not in times of crisis).

The research topic will be explored by examining the success of companies graduated from the incubator program in relation to the economic environment prevailing at the time they operated. This study will examine whether technological incubators invested in lower-risk ventures during periods of VC downturn compared to other periods. It will be studied by examining the success of companies that have graduated from the incubator program in relation to the economic environment at the time they entered the technological incubator program.

The researchers assume to witness a difference in incubated startup performance (lifespan, employees, revenue, capital raising, market value, financing rounds, life cycle stage, exit progress) during VC downturn periods, given technological incubators accept companies with different risk level into their program in comparison with those accepted in other times. We assume our findings to echo with Entrepreneurs out of Necessity theory (Harding et al., 2002, Poschke 2012) that classifies new ventures motivation to necessity or opportunity – when entrepreneurs are motivated by an opportunity they are more likely to wait for the right time while entrepreneurs motivated by necessity have less choice and therefore might chose less suitable times for new venture launch.

The research hypotheses therefore assume that 'graduated companies' that had been accepted into incubators during VC downturn periods, compared with 'graduated companies' of other periods, would present different business performance expressed in average lifespan (H1), employees (H2), revenues (H3), follow-up capital raising (H4), market value (H5), financing rounds (H6), life cycle stage (H7) and number of exits (H8). The authors take into account that an economic crisis per se may increase the inherent risk in start-ups meaning that the same business may be less promising in crises times and argue that the incubator program provide a 2 year “funding shield” for startups allowing them to maintain operations when VC investments are harder to secure. A comparison with a VC-funded control group (N=90) concluded that there is no evidence for significant change in companies’ performance for startup funded by VC before, during and after the 2000 economic crisis (dot com crisis).

Differences in startup performance might indicate that crisis environment is likely to lead to a situation whereby the incubator program misses its original mark: stimulating high-risk companies -- in particular due to the fact that spurring innovation and investing in R&D are tools for coping with economic crisis. We aim to examine whether in times of VC downturn there was a change in technological incubator investment patterns, whereby they would support lower-risk ventures (on the assumption that they behave like rational investors[[2]](#footnote-3)) compared to other periods, or conversely.

We wish to foster a debate on whether mechanisms of support and/or aid to technological incubators should adapt themselves to versatile market conditions in order to achieve their objectives; the insight provided by the findings will provide a foundation for that debate. The discussion will address the need for changing operational strategies for the technological incubator program in times of VC downturn; these could then resolve market failure also during crisis periods -- and perhaps primarily so.

The objective of the study is to provide insight into potential adaptation of technological incubator program policy in accordance with changes in economic environment. The results of the study may then be used as a basis for defining operational strategies for the technological incubator program in times of VC downturn; these could then resolve market failure during crisis periods as well -- perhaps even primarily so. Policy conclusions will help determine whether the effectiveness of the incubator program as a response to market failure in financing R&D is preserved, and will also help examine whether it is necessary to increase the number of deals in the technological incubator program (and, correspondingly, the program budget), in order to maintain the same risk level that exists in non-crisis times.

**Literature Survey**

1. Market failure in innovation financing and government support as a solution

A naturally functioning economy gives rise to insufficient investment in R&D, especially its later stages, compared to the level desirable for social benefit[[3]](#footnote-4). The desired level of R&D investment -- the kind that will lead to growth and boost the economy through technological innovation -- could not be maintained without government support, because of market failure caused by various uncertainty factors[[4]](#footnote-5); first and foremost of these is the fact that knowledge is, in its very essence, a public good (Stiglitz 1999). Free market principles, too, dictate that clear evidence of the lack of proportionate investment in R&D justifies government intervention in the private market (Martin and Scott 2000).

Hausman and Johnston (2014) address the link between government and entrepreneurial processes; in particular, government activity has a substantial effect on economic opportunities and establishment of conditions ripe for growth in entrepreneurship. They indicate that technological startups as well as small and mid-size tech companies (startups that have grown) are among the central contributors to economic growth, with the Israeli high tech industry particularly so. These companies make a significant contribution to the economy and play a central role in the innovation process and the effect of its outcome.

This is visible in Israel as well, where government policy in the years 1960 through 1990 was a significant component in development and stimulation of the local high tech industry. Broad and systematic public support for innovation was a critical component in a process that essentially triggered construction of scientific-technological infrastructure and intellectual property protection (Roper 1999; Avnimelech and Teubal 2004; Frenkel et al. 2005; Kaufmann and Schwartz 2008; Kaufmann and Gura 2009; Pugatch et al. 2010).

1. The effect of economic crises on the VC industry, on government support programs and on the ability of startups to raise investment

Gompers and Lerner (1998) explain that there exists a relationship between exogenous macroeconomic variables and the VC market's ability to raise capital for investment; alternative return on investment (other market opportunities) and the degree of economic health affect investors' commitments to invest in VC funds[[5]](#footnote-6). Lerner (2011) states that risk-averse investors were hesitant to make new financial commitments in the period adjacent to the 2008 economic crisis. The effect of crises on innovation financing is marked (a record drop of 4.5% in business expenditure on R&D in OECD nations in 2009 [with the exception of Korea and France]), and in particular in VC fund activity (a 42% drop in activity of US VC funds and a 19% drop in VC funds outside the US after the 2000 and 2008 crises) in addition to the drop in syndicated investment[[6]](#footnote-7) of funds (Block and Sandner 2009; Block et al. 2010; de Vries and Block 2011).

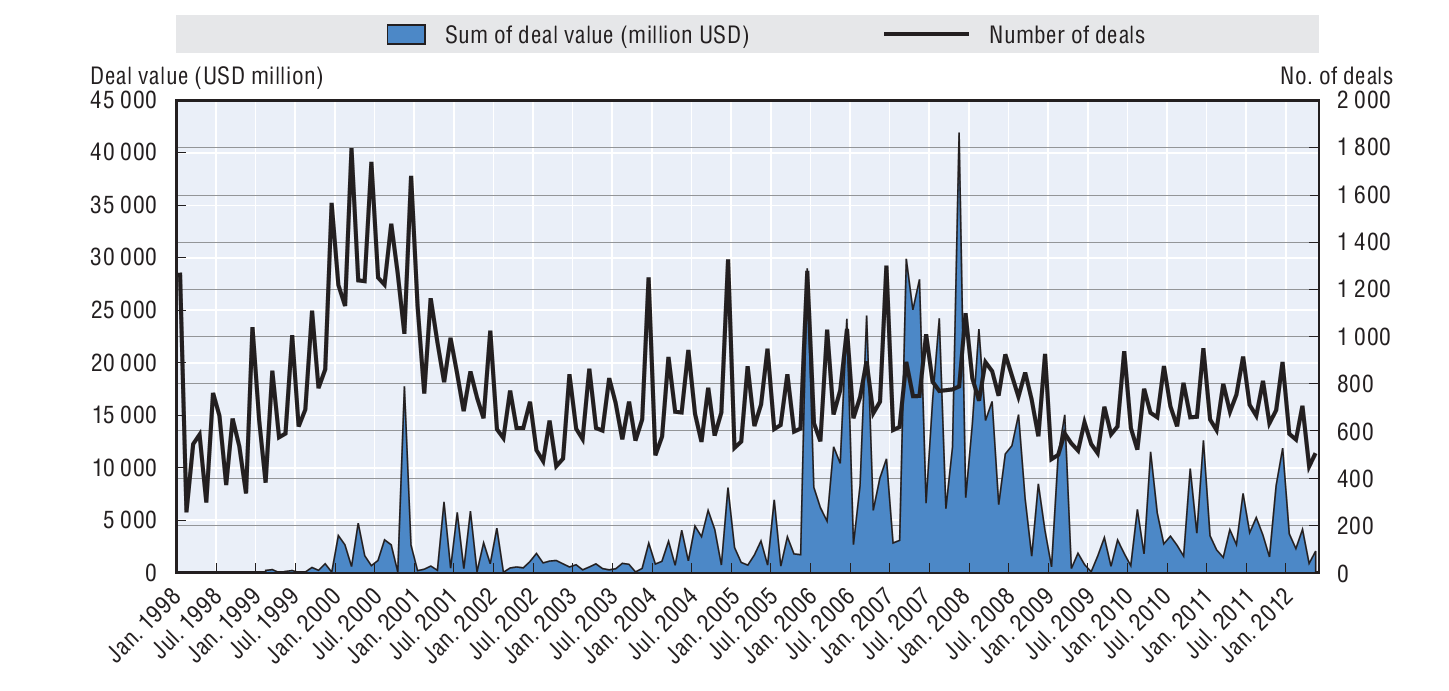
On the other hand, according to the OECD report Innovation in the Crisis and Beyond (OECD 2012), government support programs were barely affected by the 2008 crisis. The US and EU nations actually increased their budgets targeted to innovation and entrepreneurship during economic crisis periods. This was the case in Israel as well; following the economic crisis of 2000 and the decline in the sector investing in startups, a government seed fund was established in 2002, with the objective of assisting startups in raising financing for seed stage and early stage activity. This is an expression of a renewed need for continued government involvement in the area, and a justification for continuing the incubator program's public activity (Frenkel et al. 2005).

Evidence has shown that crisis has a detrimental effect on raising investment: The OECD Science, Technology and Industry Outlook (OECD 2012) claims that raising investment for new ventures (startups) was nearly impossible after the 2008 economic crisis; US internet-related startups in advanced stages of fundraising (e.g. Round B) obtained 80% of the investment they could have gotten in the period preceding the crisis, while the volume of investment in new and young companies was unaffected (Block and Sander 2009); between 2009 and 2010 there was a dramatic drop in Israel of 24% in raising follow-up investment by companies that had graduated from the incubator program, according to the meeting protocol of the Knesset Subcommittee for the Advancement of Science Intensive Industries (Knesset 2011).

1. Economic crisis and downturn in the VC industry

The slumps of the global VC industry are visible in the figure below: a downturn in 2002-2004 as a result of the economic crisis of 2000, and in 2009-2010 from the 2008 economic crisis.

Figure 1: Worldwide venture capital investments: number of deals and total value (in $M) -- a multi-year comparison

Source: Innovation in the Crisis and Beyond (OECD 2012)

2008 crisis

2000 crisis

The MoneyTree report[[7]](#footnote-8) allows a close look at the effect of the VC downturn in Israel; note that there is a decline in the number of companies in which Israeli VC invested and in total investment, in the years that follow the financial crisis. Figures 5 and 6 show that manifestations of the VC industry downturn appear immediately at the tail of the global crisis -- in 2002-2004, and in 2009-2010.

Figure 2: Annual investment by VC funds in Israel (in $M): a multi-year comparison[[8]](#footnote-9)

2008 crisis

2000 crisis

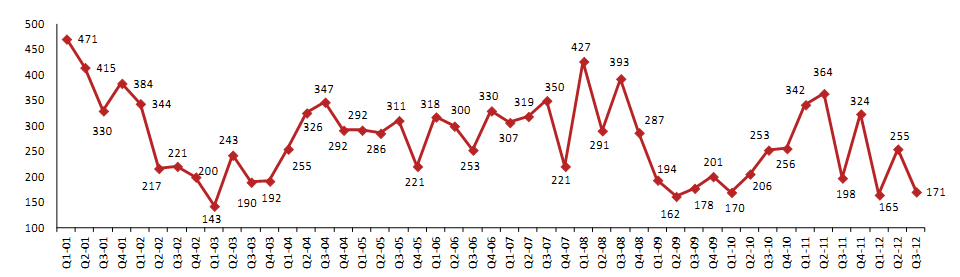
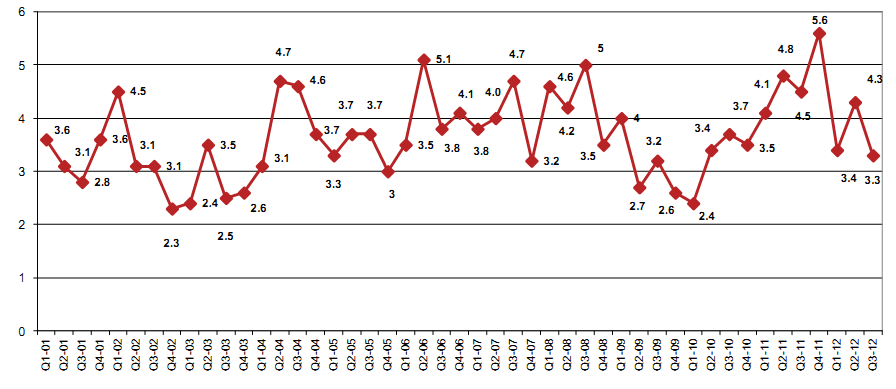
Source: MoneyTree Q3 2012 Report (PwC)

Figure 3: Average investment per company (in $M) by VC funds in Israel: a multi-year comparison[[9]](#footnote-10)

Source: MoneyTree Q3 2012 Report (PwC)

2008 crisis

2000 crisis

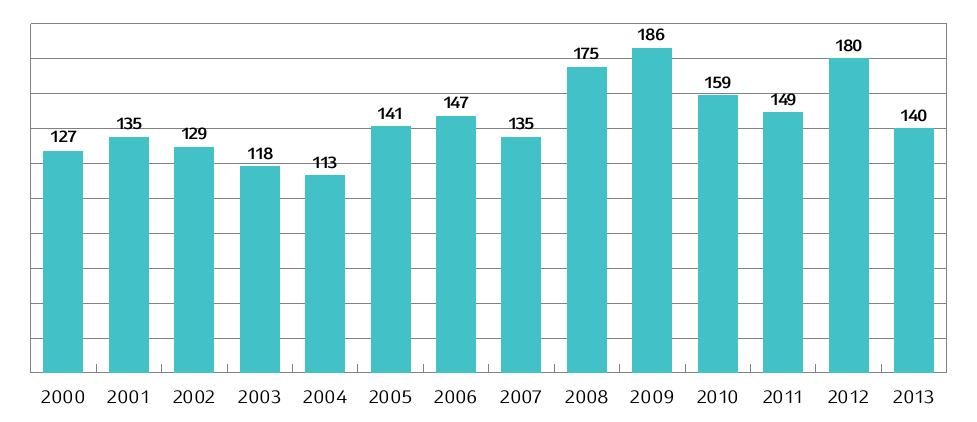
1. Fiscal expansion as a means of coping with economic crises and transforming them to growth opportunities

Governments and companies investing in innovation during times of crisis increase their competitive advantage and strengthen their position as market leaders; they are then the first to enjoy crisis recovery (Hausman and Johnston 2014). They claim that the known positive correlation between financial stability and continuity of innovation is one of the reasons that innovation is preferred by many as a means of recovery from financial crisis.

An example of this is the way Finland and South Korea successfully handled the crisis of 2000, from which they recovered due to their increase in public support of R&D and innovation. More recent examples include the activity of OECD nations in 2009, in which they explicitly and directly provided incentive and stimulation of R&D and innovation to small and mid-sized businesses, as a step in grappling with the 2008 crisis (Guellec and Wunsch-Vincent 2009); changes in research and innovation budgets in the US, Japan, China, Holland, Finland and Germany after the 2008 crisis (Pagels-Fick 2009); changes in government budget appropriations or outlays for R&D and innovation (GBAORD[[10]](#footnote-11)) in OECD nations (OECD 2012); and innovation-support readiness steps taken by OECD governments to grapple with the effects of crisis on science, technology and innovation (STI): in the years 2008 through 2011 in which effects of the crisis were greatest, most OECD nations increased their GBAORD budgets or froze them. Only five nations maintained nearly the same budget in that period, in contrast to most OECD nations who in 2009 sharply and temporarily increased that budget by an average of about 9%[[11]](#footnote-12). Only in 5 nations[[12]](#footnote-13) did budgets remain virtually constant, including in Israel, with a negligible increase of 0.9% in GBOARD budget in 2009, and no change in 2010[[13]](#footnote-14).

In budgeting the incubator program, Israel did not exercise fiscal expansion as a step to grapple with the crisis: other than a slight rise of 1.6% in 2008, program budgeting dropped significantly in real terms[[14]](#footnote-15) during the years the economy was affected by crisis (OCS 2013). The figure below presents the percent of budget change in real terms in the years the economy was affected by crisis, and it shows that fiscal expansion is not in the budgetary plan for either the 2000 or the 2008 crisis.

Figure 4: Technological incubator program budget, permission to commit (in millions of NIS): a multi-year comparison



2008 crisis

2000 crisis

**-5.5% -13% -5% +1.6% -17.2%**

Source: Office of the Chief Scientist Program Guide for 2013 (OCS 2013)

1. Technological incubators and venture capital funds in Israel as substitute investors

VC funds are active in Israel primarily in early stage financing and less so at advanced financing stages (Mayer et al. 2005). According to Frenkel et al. (2005), the technological incubator program in Israel, too, is active at the early stage, providing a solution to market failure in financing of R&D and innovation. The MoneyTree report by Kesselman & Kesselman (PwC 2007-2014) which summarizes VC activity in Israel quarterly, points to an overlap in investment policy: between 2010 and 2014 VC funds in Israel carried out an average of 7% of their total investments in seed stage financing and about 42% in early stage financing. We thus establish that funds and incubators in Israel invest in identical stages -- or at least very similar ones -- in the life of startups, and in effect represent substitute financing tools.

The Israeli technological incubator program model offers startups with nearly $500k early stage investment that 85% of it is governmental money (the rest, 15%, is the incubator investment which is a private entity using private funds) in return to 30-49% of equity shares – usually not leaving room for other investors apart from the incubator itself. The fact VC funds are not joining technological incubators investment rounds was also validated thru a sample of companies on the IVC database – none of the random companies sample we investigated raised early stage investment from both technological incubator and VC funds. In addition, Lerner (1994) claims that “first financing round syndicates tend to happen between established venture capitalists while later rounds involve less established venture organizations”. We thus establish that in Israel VC funds and technological incubator are substitute investments vehicles for the early stage.

Crisis environments boost the relationship among substitute financing tools: McCahery and Vermeulen (2010) point out that in times of financial crisis, VC funds tend to decrease new investments, and suggest to startups that they look for other sources of investment, such as Corporate Venture Capital (CVC). Block et al. (2010) also propose that ventures looking for investment during crisis explore alternative investment channels.

When VC fund investment ability diminishes and entrepreneurial ventures have difficulty finding investors, it is advisable to turn to alternative investors (Block et al. 2010; McCahery and Vermeulen 2010). In times of VC downturn, it would thus be expected that the supply of entrepreneurial ventures applying to the incubator program would rise and would naturally comprise higher quality candidates, which would not have turned to the technological incubator program if not for the crisis-causing drop in VC investments. Hence, incubator program deal flow would be expected to increase in times of VC downturn, and thus to include relatively more promising companies.

On the other hand, and based on later research by Vries and Block (2011); it is possible that the reverse may be true, whereby entrepreneurs would tend to wait for market recovery in times of crisis. This would bring about the opposite effect; a drop in the number of applications to incubators in times of VC downturn could bring to the incubation of companies of below-average quality in the technological incubator program.

1. Entrepreneurship motivation theory: Necessity versus opportunity

Harding et al. (2002) distinguishes between necessity and opportunity entrepreneurs. This approach looks at the motivations of the entrepreneurs, thus can be considered a motivational theory -- Necessity entrepreneurs are individuals who start businesses because they cannot find a decent job (or in some cases, keep one). Opportunity entrepreneurs on the other hand, are people who leave or shun gainful employment to pursue even more lucrative or attractive careers starting new businesses. While opportunity entrepreneurship is dynamic, the necessity entrepreneurship, as described by Poposka and Mihajloska (2016), is forcing ventures to operate even when an economic crisis causes the postponement of new ventures by entrepreneurs in need.

**Research Settings and Method**

1. Research Data Settings

The research topic will be explored by examining the success of companies graduated from the incubator program in relation to the economic environment prevailing at the time they operated. Like Scott et al. (2016), our primary outcome of interest is whether or not a venture successfully reaches the stage of commercialization, characterized by recurring revenue and expenses associated with sales of the products and/or services that are the business objective of the company (e.g. hiring expenses measured by number of employees), and by a reasonable expectation of repeat business and new customers. This include business models based on licensing, forging technology-licensing deal(s) and exits all considered as commercialization.

We wish to foster a debate on whether mechanisms of support and/or aid to technological incubators should adapt themselves to versatile market conditions in order to achieve their objectives; the insight provided by the findings will provide a foundation for that debate. The discussion will address the need for changing operational strategies for the technological incubator program in times of VC downturn; these could then resolve market failure also during crisis periods -- and perhaps primarily so.

The research question is if during VC downturn periods, technological incubators accept lower-risk companies into their program in comparison with those accepted in other times -- companies that exhibit higher performance (lifespan, employees, revenue, capital raising, market value, financing rounds, life cycle stage, exit progress) than in other periods, on the assumption that better performance indicates a more promising company.

The study will make use of the database of the Technological Incubator Administration, a government entity that manages and supervises technological incubator activity in Israel. We will supplement the database with up-to-date data on incubator graduates (lifespan, employees, volume of investment, financing rounds, company life cycle stage, type of exit) from the database of Israel Venture Capital Research Center (http://ivc-onlline.com), which monitors and analyzes the high-tech industry in Israel.

על-מנת לטייב את הנתונים הגולמיים הוחלו ההנחות הבאות על כלל המדגם, למעט היכן שקיימים נתונים המעידים אחרת:

1. גיוסי השקעות כוללים רק השקעות חיצוניות (השקעה משלימה לתמיכת המדען הראשי וסבבי גיוס מגורמים פרטיים) ואינם מתייחסים למענקים ממשלתיים שונים כגון BIRD, תנופה, מענקי מחקר ספציפיים וכיוצא באלו שכן אלו לא מופיעים כגיוסי השקעות במאגרי המידע. גיוסים מצומצמים/גיוסי המשך לאותו סבב גיוס (הן מבחינת ההיקף והן מבחינת מספר המשקיעים החדשים) יחשבו כסבב גיוס נוסף. גיוסי הנפקה ציבורית (IPO) והשקעה פרטית בחברה ציבורית (PIPE: Private Investment in Public Equity) יספרו כהשקעה בחברה וכסבב הגיוס המתקדם ביותר.
2. כלל החברות גייסו לפחות 100,000$ (השקעה חיצונית משלימה לתמיכת המדען הראשי), השלימו את שלב גיוס הסיד ופעלו לפחות שנתיים במסגרת תכנית החממות הטכנולוגיות.
3. היכן שלא נמצאו נתונים ובמקרים בהם הנתונים שנאספו הינם חריגים הושלמו נתוני שלב גיוס/סכום גיוס לפי חציון הקבוצה הרלוונטית (ראה טבלה 3 מטה). הנ"ל נכון גם למקרים בהם סכומי הגיוס היו חריגים ביחס לשלב הגיוס שכן לעיתים תכופות ידוע כי התקיים שלב גיוס אך לא ידוע מהו הסכום שגויס. להלן חציוני הקבוצות:

טבלה 3: חציון סכומי ההשקעות שגייסו חברות המדגם לפי שלבי גיוס

|  |  |  |
| --- | --- | --- |
| **שם שלב גיוס** | **מספור שלב גיוס** | **חציון סכום שגויס (במיליוני דולרים)** |
| סיד | 1 | 0.1 |
| סיד מורחב | 2 | 0.5 |
| סיבוב ראשון | 3 | 1.2 |
| סיבוב שני | 4 | 3.6 |
| סיבוב שלישי | 5 | 6.9 |
| סיבוב רביעי | 6 | 18.45 |
| סיבוב חמישי ומעלה | 7 | 18.7 |
| הנפקה ציבורית (IPO) או השקעה פרטית בחברה ציבורית (PIPE) | 8 | 24.22 |

בנוסף, נתוני חברת חממה שעברה מיזוג או רכישה יתייחסו לחברת החממה ולא לנתוני החברה שרכשה או התמזגה עם חברת החממה בעוד שווי חברה יקבע לפי הסכום ששולם עבורה (במידה והנתון קיים)~~.~~

1. לגבי חברות שנמצאות בשלב גיוס ("סיד") ובשלב מחזור חיים ראשוני, ואשר גייסו 500,000$ או פחות (למעשה המענק אותו הן קיבלו מהחממה), לא ביצעו אקזיט ומעסיקות פחות מ-5 עובדים (חציון המועסקים בחברה בשלב הסיד הינו 4 עובדים) והן פעילות למעלה משנתיים ממועד סיום החממה נסיק שחברות אלו אינן פעילות (גם כאשר הינן רשומות כפעילות).
2. ל-4 חברות[[15]](#footnote-16) לא אותר נתון "שלב בחיי מחזור החברה". היות ומדובר במספר זניח לא הונחו הנחות כדי להשלים את המידע.
3. Method and Variables

All companies active in the technological incubator program in Israel between 1998 and 2011 were sampled in the study (N=1096). Although we used the whole sample for the descriptive statistics analysis, most of the inferential statistics (besides one single hypothesis) used a sample of companies that were still active in 2014 (N=452) in order to remove confounder variables not examined as part of this study.

The study compares performance of companies that began activity during VC downturn, whereas VC fund investment activity was cut back in Israel ("the 2000 economic crisis" causing a VC downturn between 2002 and 2004, and the "2008 economic crisis" causing VC downturn between 2009 and 2010 -- as presented by the MoneyTree report in Figures 2 and 3), to companies accepted to the incubator program in other periods.

בוצעה השוואה של המדגם אל מול קבוצת ביקורת על מנת לשלול הסברים חלופיים כגון מגמות והזדמנויות טכנולוגיות ו/או עסקיות. הקבוצה מורכבת מ-90 חברות הזנק שקמו אך ורק באמצעות מימון קרנות הון סיכון לפני, במהלך ואחרי משבר 2000 (בשנת 2001, 2003, ו-2007 בהתאמה), סך הכל 30 חברות מכל שנה (90=N). בקבוצת הביקורת לא נמצאו הבדלים מובהקים בין ביצועי חברות שקמו במהלך משבר לביצועי חברות שקמו בתקופות אחרות. קבוצת הביקורת

לשם השוואה, להלן הצגת הסטטיסטיקה התיאורית של קבוצת הביקורת.

טבלה 6: ניתוח סטטיסטיקה תיאורית לקבוצת הביקורת

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **משתנה** | **כמות (N)** | **סכום** | **ממוצע** | **סטיית תקן** | **טווח** | **צידוד Skewness** | **גבנוניות Kurtosis** |
| משך חיים (שנים) | 90 | N/A | 7.77 | 3.205 | 1-13 | 0.036 | 0.851- |
| שלב במחזור החיים | 90 | N/A | 1.97 (סיד) | 0.710 (פחות משלב בודד) | 0-3 | 0.337- | 0.74 |
| מספר עובדים (משרות) | 90 | 3354 | 37.27 | 41.499 | 3-250 | 2.662 | 8.584 |
| כמות גיוסים ($M) | 90 | 2947.3 | 37.308 | 101.6428 | 0.1-850 | 7.001 | 54.179 |
| מספר סבבי גיוס | 90 | N/A | 4.21 (סיבוב רביעי) | 1.764 (מעל 1.5 סבבים) | 1-8 | 0.286 | 0.027- |
| הכנסות ($M) | 23 | 368.8 | 16.037 | 14.5879 | 0.5-55 | 1.408 | 1.782 |
| שווי שוק ($M) | 37 | 4996.6 | 135.044 | 370.6295 | 1.2-2250 | 5.451 | 31.552 |
| אקזיט | 28 | N/A | 1.43 (A&M) | 0.79 | 1-3 | 1.465 | 0.364 |
| גיוס IPO ($M) | 4 | 281.7 | 70.43 | 60.8050 | 16.7-128.8 | 0.03 | 5.809- |

מהשוואה זו ניתן לראות כי החברות בקבוצת הביקורת הציגו באופן עקבי ביצועים טובים יותר, או לכל הפחות זהים, מאשר כלל מדגם חברות החממה. ספציפית, החברות בקבוצת הביקורת שרדו בממוצע 3 שנים יותר והגיעו בממוצע לשלב אחד גבוה יותר במחזור החיים[[16]](#footnote-17). בממוצע, הן יצרו פי 4.5 יותר משרות, הגיעו לשווי שוק גדול יותר פי כמעט 4.5, גייסו פי 16.5 יותר השקעות במספר גדול יותר של סבבי השקעה (בממוצע השלימו סיבוב גיוס שני)[[17]](#footnote-18), ויצרו הכנסות בשיעור כפול[[18]](#footnote-19). למרות שמדובר בעשירית מכמות החברות במדגם, החברות בקבוצת הביקורת הגיעו למספר דומה של אקזיטים41. ארבעת החברות שהונפקו בהנפקה ציבורית, לעומת מספר כמעט כפול שעשו זאת במדגם חברות החממה, גייסו סכום ממוצע הגבוה פי כמעט 3 בהנפקה וסכום כולל הגבוה ב-13.5% 40.

התפלגות תחום העיסוק של קבוצת הביקורת שונה מהותית מהתפלגות מדגם חברות החממה: החלק הארי מתוכן, 60%, פעלו בתחום המחשוב, התוכנה והתקשורת בעוד השארית התפלגו דומה בשאר התחומים (ביוטק, אלקטרוניקה ומכניקה, טכנולוגיות סביבה ושונות - 12%, 9%, 5%, 5% בהתאמה).

Dependent Variable

Since the definition of success and successful performance of incubator graduated companies is subjective and since there are several indicators (e.g. economical impact, societal contribution, etc.) we chose to use proxies of success by measuring lifespan, change in number of employees, follow-up capital raising (Financing Stage), market valuation, revenues, exits and activity expansion (Lifecycle Stage). By using proxies to indicate success we aim to control the potential influence of confounding variables on a single proxy and/or indicator for success.

The research hypotheses therefore assume that 'graduated companies' that had been accepted into incubators during VC downturn periods, compared with 'graduated companies' of other periods, would present significantly different business performance expressed in average lifespan (H1), employees (H2), revenues (H3), follow-up capital raising (H4), market value (H5), financing rounds (H6), life cycle stage (H7) and number of exits (H8).

Hypothesis H1 examining graduated company survival is the only one tested on the entire sample (N=1096); the remainder of the hypotheses were tested on the sample of companies active in 2014 (N=452), as we could not determine the reason they shut down earlier and the degree to which it was related to other measures of success that we examined (hypotheses 1-5 in T-tests for independent variables; hypotheses 6-8 in Mann-Whitney tests). All variables used follow a normal distribution.

In addition, a regression model will be used to perform statistical tests and predictions of 3 different success proxies as the dependent variable: lifespan, follow-up capital raising (Financing Stage) and activity expansion (Lifecycle Stage). The other proxies participate in the regression model as independent variable to test the direction of causal relationship among the examined variables and to allow for the control of success proxies that predict success – all in order to make sure the prediction has no alternative explanation but it is independent.

We address potential variable measurement and scaling issues by measuring variables ratios (funds per round, funds per employee, funds per lifespan, employees per lifespan) and by measuring in natural logarithms (employees and funds) on all statistical tests and models. We found no difference between such ratios and log measurement and therefore used original scale variable measurements.

**Findings**

Table 1 below presents the distribution of the sample of incubator companies by year, where VC downturn years are indicated in bold. Note that 59 companies (about 5%) were disqualified from the sample because we were unable to obtaining crucial data.

Table 1: Descriptive statistics for incubated companies in the data sample

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Year** | **Number of incubated companies** |  | **Companies disqualified from sample** | |  | **Inactive companies** | |  | **Active companies** | |
|  | **Quantity** | **%** |  | **Quantity** | **%** |  | **Quantity** | **%** |
| 1998 | 84 |  | 8 | 9.5% |  | 70 | 83.3% |  | 6 | 7.1% |
| 1999 | 115 |  | 13 | 11.3% |  | 83 | 72.2% |  | 19 | 16.5% |
| 2000 | 79 |  | 9 | 11.4% |  | 55 | 69.6% |  | 15 | 19.0% |
| 2001 | 75 |  | 1 | 1.3% |  | 54 | 72.0% |  | 20 | 26.7% |
| **2002** | **92** |  | **6** | **6.5%** |  | **61** | **66.3%** |  | **25** | **27.2%** |
| **2003** | **75** |  | **1** | **1.3%** |  | **46** | **61.3%** |  | **28** | **37.3%** |
| **2004** | **87** |  | **0** | **0.0%** |  | **50** | **57.5%** |  | **37** | **42.5%** |
| 2005 | 46 |  | 3 | 6.5% |  | 27 | 58.7% |  | 16 | 34.8% |
| 2006 | 72 |  | 3 | 4.2% |  | 32 | 44.4% |  | 37 | 51.4% |
| 2007 | 69 |  | 1 | 1.4% |  | 32 | 46.4% |  | 36 | 52.2% |
| 2008 | 78 |  | 0 | 0.0% |  | 33 | 42.3% |  | 45 | 57.7% |
| **2009** | **78** |  | **3** | **3.8%** |  | **22** | **28.2%** |  | **53** | **67.9%** |
| **2010** | **86** |  | **1** | **1.2%** |  | **17** | **19.8%** |  | **68** | **79.1%** |
| 2011 | 60 |  | 5 | 8.3% |  | 8 | 13.3% |  | 47 | 78.3% |
|  |  |  |  |  |  |  |  |  |  |  |
| Total | 1096 |  | 54 | 4.9% |  | 590 | 53.8% |  | 452 | 41.2% |

Table 2: Descriptive statistical analysis for incubated companies in the data sample

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Variable** | **Quantity (N)** | **% companies that did not develop beyond the incubator[[19]](#footnote-20)** | **Total** | **Average** | **SD** | **Range** |
| Lifespan (years) | 1042 | 16% | N/A | 5.69 | 3.46 | 2-16 |
| Life cycle stage[[20]](#footnote-21) | 1038 | 25% | N/A | 0.98 (R&D) | 0.7  (as a single stage) | N/A |
| Employees (job positions) | 1006 | N/A | 7,994 | 7.95 | 13.99 | 1-300 |
| Capital raised ($M) | 1042 | 50% | 2,350 | 2.26 | 8.314 | 0-132 |
| Financing rounds[[21]](#footnote-22) | 1042 | 57% | N/A | 2.03  (extended seed) | 1.522  (1.5 rounds) | N/A |
| revenue ($M) | 41 | N/A | 304 | 7.41 | 16.607 | 0-100 |
| EBITDA profit ($M) | 1 | N/A | N/A | N/A | N/A | N/A |
| market value ($M) | 125 | N/A | 3,800 | 30.4 | 77.042 | 0-606 |
| Exits[[22]](#footnote-23) | 80 | N/A | N/A | 1.39 (M&A) | 0.755 | N/A |
| raised in IPO ($M) | 10 | N/A | 248 | 24.79 | 20.753 | 2-64 |

A descriptive analysis of the sample data in Table 2 above shows several interesting facts about the activity of the companies in the sample.

* The average lifespan of incubator companies is about 5.7 years with a relatively high standard deviation of about 3.5 years.
* The average stage in incubator company life cycle is the R&D stage. Standard deviation is about a single stage.
* Incubator companies in the period studied are responsible for 7,994 jobs in the market, where each company creates an average of nearly 8 jobs in its lifespan. The standard deviation here is large -- about 14 jobs. The largest company as far as jobs are concerned employed 300 people.
* Incubator companies in the period studied raised $2.35 million, where the average was $2.26 million with a relatively high standard deviation of about $8.3 million. The largest financing was $132 million for a single company.
* On the average, incubator companies reach the second financing stage -- the extended seed stage. This data item has a standard deviation of about 1.5 financing rounds.
* The limited data available on revenue of incubator companies in the sample -- only 41 observations -- shows that the total revenue of these companies was $304 million, while average revenue per company was $7.4 million with a large standard deviation of about $16.6 million. The highest revenue was $100 million.
* The limited data available on market value of incubator companies in the sample -- 125 observations only -- shows that their value was $3.8 billion, while the average value of a company at $30.4 million with a standard deviation of about $77 million. The highest market value was $606 million.
* The 10 observations of capital raised by IPO shows a total of $248 million raised by IPO, with the largest IPO being $64 million, and the smallest -- $2 million. The average IPO raised about $24.8 million with a large standard deviation of $20.7 million.

Additional data from the sample:

* A large majority of the 80 companies that carried out an exit did so by merger and/or acquisition (77.5%, which are 62 cases). Only 16.2% (13 companies) performed IPOs, while 6.2% (5 companies) sold their intellectual property.
* As far as geographic distribution of activity of the incubator company sample, we observe that most companies operated in northern Israel (516 companies) compared to a lower volume of activity, but almost uniform, of companies in other regions (189 in the central region, 197 in the south, and 194 in the Jerusalem region).
* In the distribution of companies by sector shown in Figure 5 below, we see the largest number of companies operating in medical devices followed closely by companies in computing, software and communications.

Figure 5: Sample company sectors

Hypothesis H1 examining graduated company survival is the only one tested on the entire sample (N=1096); the remainder of the hypotheses were tested on the sample of companies active in 2014 (N=452), as we could not determine the reason they shut down earlier and the degree to which it was related to other measures of success that we examined. All variables used follow a normal distribution. Below is the summary of statistical test results for the research hypotheses (hypotheses 1-5 in T-tests for independent variables; hypotheses 6-8 in Mann-Whitney tests):

Table 3: T-test comparing graduated incubator companies accepted during VC downturn period with those accepted during non-VC downturn period

|  |  |  |  |
| --- | --- | --- | --- |
| **Assumption** | **Test significance** | **Test value** | **Significance of the finding (for companies incubated in a downturn year, compared to other companies)** |
| H1a | p=.010\*\* | t=2.563 | on the average about one year less |
| H1b | p=.000\*\* | t=4.496 |
| H2 | p=.009\*\* | t=2.633 | employed an average of about 4.1 fewer workers |
| H3 | p=.032\* | t=26.872 | average sales revenue lower by about 8.7 million NIS |
| H4 | p=.024\*\* | t=449.708 | raised investments lower by about 2.23 million NIS on the average |
| H5 | N/A | N/A | no significant correlation found between acceptance to technological incubator during downturn years and company market value |
| H6 | p=.002\*\* | U=20,089 | reached lower investment stages |
| H7 | p=.072\* | U=22,054.5 | reached lower company life cycle stage |
| H8 | N/A | N/A | no significant correlation was found between acceptance to technological incubator during downturn years and the fact that a company carried out an exit |

\*p<0.10, \*\*p<0.05

In addition to these findings, the data indicates that compared to low-tech companies, the performance of high tech companies[[23]](#footnote-24) was more severely affected. In contrast to companies incubated during non-downturn periods, high tech companies during VC downturn periods were active for a shorter period (t=5.236\*\*, p=.000), employed fewer workers (p=.007\*\*, t=2.700), reached lower sales revenues (p=.059\*\*, t=2.011), raised less investment capital (p=.014\*\*, t=2.477), had lower market value (p=.077\*, t=1.800), participated in fewer financing rounds (p=.001\*\*, U=11,921.5) and reached lower life cycle stages (p=.015\*\*, U=13,105.5).

The findings indicate that in times of VC downturn, companies incubated are of higher risk than the average company typically accepted into the incubator program. In order to establish this assumption, we examined whether companies accepted into the incubator program immediately at the end of the VC downturn period show better performance than other companies. We explored whether companies entering the program in 2004-2005 -- the years of recovery immediately following the 2000 economic crisis -- showed performance different from those entering the incubator program in other periods.

1. A T-test of the independent variables shows a statistically significant relationship between being accepted into a technological incubator during the period of recovery from the 2000 economic crisis with company lifespan (p=.000, t=-3.588), and with investment capital raised (p=.029, t=-2.208): the **lifespan of these companies was longer by an average of 1.5 years and they raised about $2 million more in investment capital** than the others.
2. A Mann-Whitney U-test of the independent variables shows a statistically significant relationship between being accepted into a technological incubator during the recovery period from the 2000 economic crisis with life cycle stage (p=.001, U=49,132), with the investment stage the company completed (p=.007, U=51,495), and with exits (p=.013, U=55,632) -- in all of these parameters **these companies exhibited better performance** than the other companies.

Regression

For the regression model we chose a sample of companies that were not affected by the economic crises – companies that were founded after the 2000 dot-com economic crisis and its following 2002-2004 VC downturn on one hand and companies that were founded few years before the 2008 economic crisis and its following 2009-2010 VC downturn on the other hand. This selection is supported by our findings of significantly inferior performance of incubated companies graduated during a financial crisis (between 2000-2001 and 2007-2008). Therefore, our regression sample consists of companies founded between the 2 economic crises, between 2005-2006 (N=112), and we will compare these to companies founded during the 2002-2004 (N=247) and 2009-2010 (N=160) VC downturns. Table 4 presents the correlations among the collected variables –

Table 4: Results of Spearman and Pearson tests for correlation of variables in the study

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **dependent variables** | **Lifespan** | **Life cycle stage** | **Employees** | **Capital raised** | **Financing rounds** | **Profit** | **EBITDA** | **Market value** | **Exit (binary)** | **IPO** |
| Lifespan | 1 | .558\*\* | .292\*\* | .301\*\* | .495\*\* | .254\* | - | .316\*\* | .389\*\* | .452 |
| Life cycle stage | .558\*\* | 1 | .422\*\* | .466\*\* | .472\*\* | .534\*\* | - | .476\*\* | .225\*\* | -.067 |
| Employees | .292\*\* | .422\*\* | 1 | .466\*\* | .534\*\* | .542\*\* | - | .650\*\* | .452\*\* | .742\*\* |
| Capital raised | .301\*\* | .466\*\* | .466\*\* | 1 | .894\*\* | .601\*\* | - | .818\*\* | .707\*\* | .984\*\* |
| Financing rounds | .495\*\* | .472\*\* | .534\*\* | .902\*\* | 1 | .462\*\* | - | .658\*\* | .505\*\* | - |
| Profit | .254\* | .534\*\* | .542\*\* | .601\*\* | .462\*\* | 1 | - | .873\*\* | .655 | 1.0\*\* |
| EBITDA | - | - | - | - | - | - | 1 | - | - | - |
| Market value | .316\*\* | .476\*\* | .650\*\* | .818\*\* | .658\*\* | .873\*\* | - | 1 | .858 | .844\*\* |
| Exit (binary) | .389\*\* | .225\*\* | .452\*\* | .707\*\* | .505\*\* | .655 | - | .858 | 1 | - |
| IPO | .452 | -.067 | .742\*\* | .984\*\* | - | 1.0\*\* | - | .844\*\* | - | 1 |

\*p<0.10, \*\*p<0.05

Significant relationships were among between certain variables.

* **IPO** to profit, employees, volume raised and market value -- strong relationship
* **Market value** to volume of capital raised and profit -- strong relationship; to financing rounds and employees -- medium-strong relationship
* **Volume raised** to profit and exit -- medium-strong relationship

In order to avoid multicollinearity, the variables 'IPO' and 'market value' are not included in the construction of the regression model. In addition, the variable 'profit' is not included in the model because it has only 41 observations. VIF tests were performed on all regression models and no multicollinearity effect was found between the variables.

Model of models

We used a regression model consisting of 3 models to predict 3 different success proxies as the dependent variable: lifespan, follow-up capital raising (Financing Stage) and activity expansion (Lifecycle Stage) – each was tested in a separate model (each crisis was divided to sub-model and so we end up with 6 sub-models in total). We controlled for the potential cofounding effects of other proxies and tested the direction of causality by constructing the regression model with the proxies as an independent variable – for example model 1A is predicting lifespan with follow-up capital raising (Financing Stage) and activity expansion (Lifecycle Stage) as independent variables for the first crisis period, between 2002 and 2004, while model 1B is doing the same for the second crisis period, between 2009 and 2010. Model 2 and 3 will use different success proxy as the dependent variable. The lifespan variable, which indicates a company survival rate in years, is heteroscedastic and therefore was transformed into normality using Box-Cox transformation. Our regression model also includes 2 dummy variables – geographical location and technological field. In most cases the dummy variables were not found significant and therefore, besides model 1B and 2B, were not included in the regression equation. Table 5 describes the regression model and all variables examined. Note that regression equations coefficients are little bit different since we excluded variables not found significant.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Financing round** | | **Life cycle stage** | | **Normalized Lifespan**  **(Box-Cox)** | | **Dep. var.** |
| **3B** | **3A** | **2B** | **2A** | **1B** | **1A** | **Model** |
|  |  | 0.064\*\*\*  (0.02) | 0.097\*\*\*  (0.028) | 0.56\*\*\*  (0.089) | 0.475\*\*\*  (0.104) | Financing round |
| 0.439\*\*\*  (0.138) | 0.446\*\*\*  (0.129) |  |  | 2.068\*\*\*  (0.22) | 1.401\*\*\*  (0.215) | Life cycle stage |
| 0.133\*\*  (0.052) | -0.083\*\*  (0.037) | 0.044\*\*  (0.02) | 0.031\*  (0.17) | -0.46\*\*\*  (0.089) | -0.113\*  (0.006) | Time to onset of VC downturn |
| 0.182\*\*\*  (0.029) | 0.154\*\*\*  (0.034) | 0.098\*\*\*  (0.01) | 0.099\*\*\*  (0.015) |  |  | Normalized Lifespan (Box-Cox) |
| 0.042\*\*\*  (0.006) | 0.034\*\*\*  (0.006) | 0.011\*\*\*  (0.002) | 0.012\*\*\*  (0.003) | -0.006  (0.011) | -0.006  (0.012) | Employees |
| 0.275  (0.176) | 0.348\*  (0.204) | -0.094  (0.068) | -0.143  (0.095) | 0.154  (0.311) | -0.188  (0.36) | High-Tech (dummy) |
| 0.218  (0.154) | 0.94  (0.154) | -0.114\*  (0.059) | -0.48  (0.072) | 0.637\*\*  (0.269) | -0.47  (0.271) | Periphery (dummy) |
| -0.146  (0.247) | 0.061  (0.288) | 0.345\*\*\*  (0.093) | 0.469\*\*\*  (0.131) | 2.852\*\*\*  (0.406) | 2.934\*\*\*  (0.472) | Constant |
| 0.42 | 0.37 | 0.44 | 0.37 | 0.44 | 0.33 | R² |
| 359 | 272 | 359 | 272 | 359 | 272 | Observations |

Table 5: Linear regression models

Standard errors in parentheses

\*p<0.10, \*\*p<0.05, \*\*\*p<0.01

Model 1 – predicting survival rate

* Dependent variable: Y(X) - 'lifespan' (in years, normalized)
* Independent variables: R -- 'financing stage'; S -- 'life cycle stage'; T-- 'years before onset of VC downturn'; P-- peripheral geographical location of company (dummy)
* The model neutralizes the effect of raising capital by the company and its life cycle progress (proxies of company success) by controlling these as independent variables in the model.

Model 1A is comparing companies that began their activity in times that are not characteristic of VC downturn, between 2005 and 2006, to those which began their activity in the second VC downturn period, between 2009 and 2010 (N=272). The model and regression variables were found significant, and the regression equation Y(X) = 2.756 + 0.454R + 1.389S – 0.112T explains 33% of the variance. We thus find that the lifespan of incubated companies is positively explained by the financing stage and the life cycle stage of the company, and negatively explained by years before onset of VC downturn (T variable values are negative in this case because the downturn is in the future) so that companies founded before downturn are expected to survive for a longer period.

Model 1B will verify that the above does not stem from the mere fact that 2005-2006 companies’ survival rates are higher because they were founded earlier than the 2009-2010 downturn but rather from the downturn itself. We compared same companies (2005-2006) to those that began their activity during the first VC downturn, between 2002 and 2004 (N=359). The model and regression variables were found significant and the regression equation Y(X) = 2.985 + 0.547R + 2.03S – 0.458T + 0.641P explains 44% of the variance. Here, too, lifespan of incubated company is positively explained by investment stage and life cycle stage, and negatively explained by years before onset of economic crisis (T variable values are positive in this case because the crisis was in the past) so that companies founded after the crisis are expected to survive for a longer period. In this case, although the companies that were established between 2002 and 2004 were theoretically supposed to last at least a year longer as they were founded later, in practice they survived less than companies established after them, between 2005 and 2006. In this model we first witness the influence of geographical location of a company on its survival – peripheral companies survive more than 6 months longer.

Model 2- predicting life cycle progress

* Dependent variable: Y(X) -- 'life cycle stage'
* Independent variables: L -- 'lifespan (years, normalized); R -- 'financing stage'; T -- 'years before onset of VC downturn; E -- 'employees'; P-- peripheral geographical location of company (dummy)
* The model neutralizes the effect of raising capital by the company and its employee growth (proxies of company success) by controlling these as independent variables in the model.

Model 2A [Y(X) = 0.311 + 0.101L + 0.093R + 0.031T + 0.13E] was found significant when comparing among companies that began their activity in times not characterized by downturn, between 2005 and 2006, with those that began their activity during the second downturn, between 2009 and 2010 (N=272). We thus find that the lifecycle stage of incubated companies is positively explained by the lifespan, financing stage and number of employees, and negatively explained by years before onset of VC downturn (T variable values are negative in this case because the downturn is in the future) so that companies founded before downturn are expected to survive for a longer period.

This was also the case for model 2B [(Y(X) = 0.272 + 0.098L + 0.062R + 0.041T + 0.011E – 0.107P] where same companies (2005-2006) were compared with those that began their activity during the first downturn, between 2002 and 2004 (N=359). We found that the lifecycle stage is positively explained by the lifespan, financing stage and number of employees, and negatively explained by years before onset of VC downturn (T variable values are positive in this case because the downturn is in the future) so that companies founded before downturn are expected to survive for a longer period. Like in model 1B, the geographical location of a company influences on its survival – but in this model it is a light influence whereas peripheral companies survive about 1.5 months more than other companies.

Model 3- predicting capital raising/investment round stage

* Dependent variable: Y(X) -- 'financing stage'
* Independent variables: L -- 'lifespan' (years, normalized); S -- 'life cycle stage'; T -- 'years before onset of VC downturn; 'E -- 'employees'

Model 3A [(Y(X) = 0.442 + 0.429S - 0.083T + 0.154L + 0.033E] was also found significant when comparing companies that began their activity during times not characterized by downturn, between 2005 and 2006, with those that began their activity during the second downturn, between 2009 and 2010 (N=272). This was also the case when comparing same companies (2005-2006) with those that began their activity during the first downturn, between 2002 and 2004 (N=359) – model 3B [(Y(X) = 0.187 + 0.4115S + 0.149T + 0.19L + 0.041E]. Both lead to the conclusion that the investment stage of incubated companies is positively explained by the lifecycle stage, lifespan, and number of employees, and negatively by years before onset of VC downturn (T variable values are negative in model 3A/positive in model 3B since the downturn occurs is in the future/past accordingly) so companies are founded further away OR longer apart from a VC downturn are expected to survive for a longer period.

From statistically significant models 1-3 we understand that even when predicting success parameters other than lifespan, there exists a confounder variable that causes companies established during crisis period to survive for less. Our conclusion is that the confounder variable is the VC downturn, and it is powerful enough to explain the fact that companies that were established during it survive less than others -- both ones established before downturn, and ones established after it.

**Discussion**

This study sought to resolve the issue of the effect of economic crises on early stage companies in Israel. Two different hypotheses existed for the issue under examination, based on studies that focused on the effect of the 2008 economic crisis on financing entrepreneurial ventures. The first, a study by Block et. al (2010) suggests entrepreneurs in times of crisis will delay new business launch and will engage in looking for alternative sources of employment until the financial arena stabilizes. On the other hand, another study of Block's, also supported by McCahery and Vermeulen, recommended to entrepreneurs seeking investment in times of crisis to explore alternative investments channels (de Vries and Block 2011; McCahery and Vermeulen 2010). The current study questions which of the theories would be the case: that Israeli entrepreneurs in crisis times will approach technological incubators as an alternative financing channel -- which would then manifest itself with better performance of incubator companies in crisis years, or will they delay launch of new ventures.

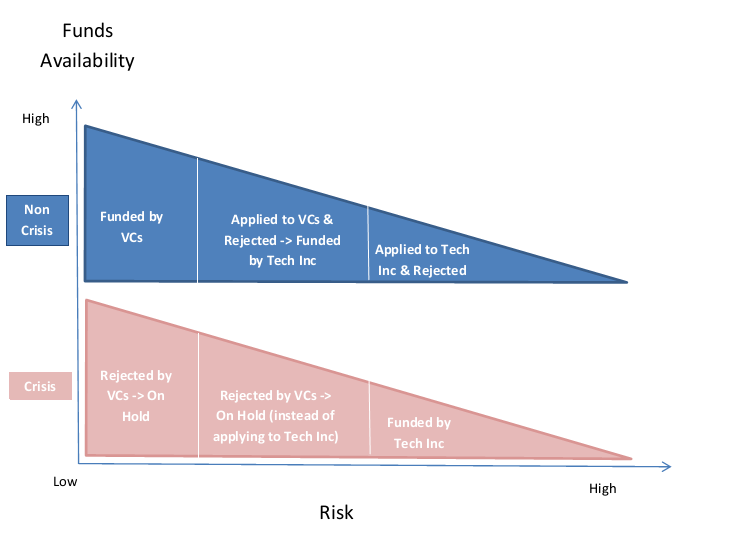
All hypotheses of this study were accepted – early stage companies incubated during VC downturn underperform in comparison to early stage companies incubated during other period. The results of this study prove that companies accepted into the technological incubator program in times characterized by economic crisis in the VC market exhibit poorer performance than companies accepted into technological incubator program in other years. This is expressed in lower lifespan, number of employees, revenue, financing, investment rounds, market value and life cycle stage. The regression model proves this as well: lifespan of companies that began activity in crisis times was shorter -- this was the case compared to companies that began activity before or after crisis. Similarly, it appears that high tech venture activity is negatively affected across the board, while more traditional business ventures are not affected by the consequences of the crisis. This is consistent with the findings of Block et al. (2010), who found that the biotech, medical devices, and internet sectors were harmed more than others in the 2008 crisis.

Conclusions and insight for policymakers

The conjecture drawn from this paper is that the hypothesis of de Vries and Block (2011) and McCahery and Vermeulen (2010); whereby entrepreneurs prefer to delay business launch in times of crisis and seek alternative sources of occupation, exists in practice in Israel. Furthermore, the great difference in performance of companies incubated during crisis times may point to something much more problematic, as Poposka and Mihajloska (2016) point out -- a situation in which an economic crisis causes postponement of new ventures and causes only those ventures which are forced or need to operate (and not out of opportunity -- 'entrepreneurs out of necessity' (Poschke 2012)) do in fact do so; as a result, only inferior ventures, with very high risk levels, make use of the incubator tool during those times. Specifically, control of the independent variables proves that even the activity of good 'entrepreneurs out of necessity' (that is, those that have succeeded in raising capital and reaching various company life cycle stages) gives rise to companies good enough to raise capital but not to achieve success in other parameters.

Consequently, and considering lower competition for government investment capital, companies that would not have been accepted into the incubator program in general have the opportunity to take part in it, in the shadow of the crisis. Although the incubator program is intended to carry higher risk than other investors, and thus in the first place attracts ventures that are not as good; the fact is, however, that the quality of 'entrepreneurs out of necessity' accepted to the program during crisis declines, together with an increase in the risk level of the companies, as reflected by performance of companies incubated during those periods. In Figure 6 below, we attempt to describe the change in behavior of startups during crisis.

Figure 6: Behavior of entrepreneurs and startups compared with investors in different periods



Tech Incubator

Tech Incubator

The figure describes two global scenarios: a non-crisis economic environment with high availability of capital for investment (in blue) and a crisis economic environment with lower availability of capital for investment (in red).

1. In the first scenario, the non-crisis environment, we assume that low-risk ventures obtain financing from private investors, while medium-risk ventures approach private investors and are rejected (because they represent too high a risk for the private investor market); they then apply to technological incubators as an alternative financing channel. High-risk companies are rejected by the incubator program due to excessive risk.
2. In the second scenario, during economic crisis, we assume that medium and high-risk ventures are rejected by private investors; these ventures attribute the fundraising difficulties to the economic crisis. Thus, after being rejected by the private investors, they prefer to wait for economic recovery rather than turn to alternative financing channels. Medium-risk ventures delay launch of their businesses because they do not know that in effect they would have been rejected without a crisis as well; this is sending them into standby mode. Based on the results of our study we assume that the incubators tend to invest in companies of excessive risk that would not have been accepted into the program had there not been a crisis, and this is because only the high-risk ventures are applying to the incubator program, and are being accepted by it because of low competition for the program resources in times of crisis.

A question arising from the research findings is whether there exists a qualitative threshold or risk threshold above which entrepreneurs and companies choose to "sit on the fence" instead of turning to alternative investment channels, and whether companies below that threshold -- those having higher risk than the average incubator company -- are the only competitors for available investment resources during times of crisis. If so, it appears that in times of crisis incubators are forced to take on poorer quality companies -- ones which would not have been accepted even by an incubator were it not for the crisis. The proposed characterization is further supported by the performance of companies entering the incubator at times of economic recovery. These companies exhibit better performance and indicate a change in entrepreneurial behavior -- from a 'wait' status during the crisis period to a situation where rejection by private investors pushes medium-risk companies to the incubator programs during non-crisis periods.

It is important to assimilate this market and entrepreneurial behavior in order to formulate dynamic policy -- the kind that adapts itself to the environment in which it is operating. Research conclusions about these behavioral changes have consequences on government policy for financing innovation as a solution to market failure; a concerted effort should be made to engage ventures "sitting on the fence" during crisis periods as an opportunity to support favorable projects for the incubator program. The findings point out that during crisis periods government budgets in this area do not achieve the kinds of results they achieve in other years. In effect, during these periods, the budget finances higher risk levels than those that policymakers had in mind -- excessive risk levels that have a significantly detrimental effect on the incubator program. It is evident that incubator budgets must be increased during those times, where the increases are to be used to attract those favorable businesses that have chosen to sit on the fence during the crisis period; at the same time, of course, it must be assured that the increased budget will not be used to finance excessive risk through high-risk companies during times of crisis. This is to be achieved by positioning the incubator program as an alternative investor in the eyes of the entrepreneurs, especially during those periods. The way to do this is by making the program more attractive through provisional changes relevant to those times, such as easing regulation and the R&D Law; entering into more classic investment sectors of VC funds; improving conditions for incubation and ownership distribution; more aggressive marketing in order to engage entrepreneurs who are sitting on the fence, positioning the incubator program as an opportunity to gain competitive advantage as an alternative to delaying venture activity, etc. The objective of the proposed actions is to engage the better companies by making the incubator program accessible to a new audience who is entrenched in the belief that they should not give up on private investment funds. It is precisely in times of crisis that there is an opportunity to draw in entrepreneurs in a different way than in other periods -- through temporary adaptation of regulation and perhaps even of the bureaucracy required for applying.

Proposals for follow-up study

As several open questions remain, we propose follow-up research to address the following:

1. Study the differences in company performance by geographic location -- Studying the variance of business performance by these subgroups will allow for delineation of the extent of crisis effect and demarcation of the risk subgroups. The findings of the follow-up study will contribute to the knowledge base and may suggest regional and sectorial policy adjustments.
2. Study entrepreneurial behavior during times of crisis -- with the goal of understanding the reason that entrepreneurs in Israel prefer to delay the launch of their activity despite the fact that the incubator program serves as a financial alternative. Identification of motives will explain this behavior, which past research has not been able to provide. Studying the motives of this behavior will also facilitate in structuring a solution and defining the opportunity inherent in crisis periods, for the incubator program.
3. Examine risk level of businesses that turn to the incubator program -- such a follow-up study could construct a profile of the average incubator business, thereby defining a risk level of the typical incubator company. Such a profile could be used as a benchmark for filtering and evaluating incubator program candidates, and thus effectively providing a key to be used for containing the risk level the incubator program is willing to carry, both in normal times and in times of crisis.

**Bibliography**

1. Avnimelech, G., Schwartz, D., & Bar-El, R. (2007). Entrepreneurial high tech cluster development: Israel's experience with venture capital and technological incubators. *European Planning Studies*, 15(9), 1181-1198.
2. Avnimelech, G., & Teubal, M. (2004). Venture capital start-up co-evolution and the emergence & development of Israel's new high tech cluster: Part 1: Macro-background and industry analysis. *Economics of Innovation and New Technology*,13(1), 33-60.
3. Block, J.H., de Vries, G., & Sandner, P. (2010). Venture capital and the financial crisis: An empirical study across industries and countries. In Cumming D. (Ed.), *The Oxford handbook of venture capital* (pp. 37-60). New York: Oxford University Press.
4. Block, J.H., & Sandner, P. (2009). What is the effect of the current financial crisis on venture capital-financing? Empirical evidence from US internet start-ups. *Venture Capital*, 11(4), 295-309. doi: http://dx.doi.org/10.1080/13691060903184803
5. de Vries, G., & Block, J. H. (2011). Venture capital syndication in times of economic crisis. *Venture Capital*, 13(3), pp. 195-213. doi: http://dx.doi.org/10.1080/13691066.2011.600278
6. Frenkel, A., Miller, M., & Shefer, D. (2005). *The technological incubators in Israel: Technological policy in an era of privatization.* Haifa: The Center for Urban and Regional Studies, Israel Institute of Technology.
7. Gompers, P., & Lerner, J., (1998). What drives venture capital fundraising?. Brookings Papers on Economic Activity. *Microeconomics* (July 1998): 149–192.
8. Gompers, P., & Lerner, J. (2001). The venture capital revolution. *Journal of Economic Perspectives* 15(2). 145-168.
9. Guellec, D., & Wunsch-Vincent, S. (2009). Policy responses to the economic crisis: Investing in innovation for long-term growth, In *OECD Digital Economy Papers*, No. 159, Paris: OECD Publishing. http://www.oecd-ilibrary.org/science-and-technology/policy-responses-to-the-economic-crisis\_222138024482
10. Hausman, A., & Johnston, W. J. (2014). The role of innovation in driving the economy: Lessons from the global financial crisis. *Journal of Business Research*, 67(1), 2720-2726.
11. Harding, R., Hart, M., Jones-Evans, D., & Levie, J. (2002). Global entrepreneurship monitor. *London: London Business School*.
12. Jeng, L. A., & Wells, P. C. (2000). The determinants of venture capital funding: evidence across countries. *Journal of Corporate Finance*, 6(3), 241-289.
13. Kahneman, D., & Tversky, A. (1979). Prospect theory: An analysis of decision under risk. *Econometrica: Journal of the econometric society*, 263-291.‏
14. Kaufmann, D., and Schwartz, D. (2008). Networking: The “missing link” in public R&D support schemes. *European Planning Studies*, 16(3), 429-440.
15. Kaufmann, D., and Gura O., (2009). Initial assessment of the Israeli technological incubator program. *Jerusalem Institute for Israel Research.*
16. Knesset (2011). The ongoing decline of follow-up financing for incubator graduates. In Knesset Subcommittee for the Advancement of Science Intensive Industries meeting protocol.
17. Lerner, J. (1994). The syndication of venture capital investments. *Financial management*, 16-27.
18. Lerner, J., Sorensen, M., & Strömberg, P. (2011). Private equity and long‐run investment: The case of innovation. *The Journal of Finance*, 66(2), 445-477.
19. Martin, S., & Scott, J. T. (2000). The nature of innovation market failure and the design of public support for private innovation. *Research Policy*, 29(4), 437-447.
20. McCahery, J. A., & Vermeulen, E. P. (2010). Venture capital beyond the financial crisis: how corporate venturing boosts new entrepreneurial clusters (and assists governments in their innovation efforts). *Capital Markets Law Journal*, 5(4), 471-500. https://doi.org/10.1093/cmlj/kmq018
21. Mayer, C., Schoors, K., & Yafeh, Y. (2005). Sources of funds and investment activities of venture capital funds: evidence from Germany, Israel, Japan and the United
22. Office of the Chief Scientist in the Ministry of Economy – Israel (2013). *Office of the Chief Scientist Program Guide for 2013*. OCS Publishing. http://www.economy.gov.il/Publications/Publications/DocLib/chief-scientist-programs-2013.pdf
23. OECD (2012). Innovation in the crisis and beyond. In *OECD Science, Technology and Industry Outlook 2012*. OECD Publishing. http://www.oecd-ilibrary.org/science-and-technology/oecd-science-technology-and-industry-outlook-2012\_sti\_outlook-2012-en
24. Pagels–Fick, G. (2009). *Fight the crisis with research and innovation? Additional public investment in research and innovation for sustainable recovery from the crisis*. Sweden: VINNOVA Analysis VA, 14. http://www2.vinnova.se/en/Publications-and-events/Publications/Products/Fight-the-Crisis-with-Research-and-Innovation/
25. Poposka, K., & Mihajloska, E., (2016). The implications and aftermath effects of the financial crisis on startups in EU. *Economic Development* (*Ekonomiski Razvoj*),18(3).
26. Poschke, M. (2012). ‘Entrepreneurs out of necessity’: a snapshot. *Applied Economics Letters*, 20(7), 658-663.
27. PricewaterhouseCoopers Israel (2012). *MoneyTree Q3 2012 Report*. Kesselman & Kesselman Publishing. https://www.pwc.com/il/en/venture-capital-israel/moneytree-home/assets/mt-q3-2012-hebrew.pdf
28. Pugatch, M., Teubal, M., & Zlotnick, O. (2010). Israel’s high tech catch up process: The role of IPR and other policies. In Odagiri, H. (Ed.), *Intellectual property rights, development, and catch up: An international comparative study*. Oxford University Press. doi:10.1093/acprof:oso/9780199574759.003.0007
29. Roper, S. (1999). Israel's technology incubators: Repeatable success or costly failure?. *Regional Studies*, 33(2), 175-184.
30. Scott, E., Shu, P., & Lubynsky, R. (2016). *Are 'Better' Ideas More Likely to Succeed? An Empirical Analysis of Startup Evaluation.*
31. Stiglitz, J. E. (1999). Knowledge as a global public good.In Kaul I., Grunberg I., Stern M. (Ed.) *Global public goods: International cooperation in the 21st century*, (pp. 308-325). New York: Oxford University Press.

1. The added value of venture capital funds -- earning them the name 'smart money' -- is composed of often non-quantifiable non-economic advantages; these include a network of contacts in the relevant industry, experience in the branch, accumulated experience in business development of young companies, etc. [↑](#footnote-ref-2)
2. According to Kahneman and Amos Tversky's prospect theory (1979), the natural tendency toward risk aversion explains the rational person's preference to choose minimizing risk over expectation for high returns. The technological incubator program, therefore, as a rational investor and in general, would prefer to invest in low-risk companies over those that offer the expectation of high returns. This explains why in those times of crisis, incubators would be expected to prefer investing in lower risk companies then those they ordinarily invest in, and to take on companies that are relatively more promising. [↑](#footnote-ref-3)
3. Social benefit may be expressed in growth, job creation, as a catalyst for broad technological change, etc. [↑](#footnote-ref-4)
4. Cost of required investment, technological and business risk, absence of precise information and flow of know-how to competitors [↑](#footnote-ref-5)
5. The researchers point out that investor willingness to invest in funds is affected by economic growth rate, changes in GNP, interest rates, variance in return on security investments and growth/decline in R&D expenditures. [↑](#footnote-ref-6)
6. Researchers offer several explanations for the fact that syndicated investment, a tool for risk distribution pertinent for coping with crisis, has been found to drop particularly during financial crises. [↑](#footnote-ref-7)
7. MoneyTree Q3 2012 Report From the website: http://www.pwc.com/il/en/venture-capital-israel/moneytree-home.jhtml [↑](#footnote-ref-8)
8. http://www.pwc.com/il/en/venture-capital-israel/moneytree-home.jhtml [↑](#footnote-ref-9)
9. http://www.pwc.com/il/en/venture-capital-israel/moneytree-home.jhtml [↑](#footnote-ref-10)
10. Government budget appropriations or outlays for research and development [↑](#footnote-ref-11)
11. According to a survey that included 26 OECD nations, with the exception of Italy and Romania [↑](#footnote-ref-12)
12. Belgium, Israel, Spain, Ireland and Great Britain [↑](#footnote-ref-13)
13. Note that the OECD's GBAORD declined by about 4% in 2010 [↑](#footnote-ref-14)
14. In the 2002 budget there was a decline in real terms of about 5.5%; about 13% in 2003, and about 5% in 2005. In effect, the 2002 budget was nearly identical to the 2000 budget in real terms, while the 2003 and 2004 budget was even lower than that of 2000 and 2001. The 2009 budget grew negligibly in real terms, by about 1.6%, while in 2010 there was a dramatic drop of about 17%. [↑](#footnote-ref-15)
15. פתיר (Patir), סטיל ביוטכנולוגיה (STiL Biotechnology), סקימאפ (SkyMap), ביוויראס (BioVirase) [↑](#footnote-ref-16)
16. עם סטיית תקן נמוכה יותר בהשוואה לסטיית התקן במדגם חברות החממה [↑](#footnote-ref-17)
17. בסטיית תקן גדולה יותר בהשוואה לסטיית התקן במדגם חברות החממה [↑](#footnote-ref-18)
18. בסטיית תקן דומה לזו סטיית התקן במדגם חברות החממה [↑](#footnote-ref-19)
19. Companies that were not active beyond the two year mark, did not get past seed stage, raised less than $100K and did not progress to a later stage financing after seed [↑](#footnote-ref-20)
20. seed, R&D, earliest revenues, growth [↑](#footnote-ref-21)
21. seed, extended seed, first, extended first, second, extended second, third, extended third, fourth, extended fourth, fifth, IPO/PIPE [↑](#footnote-ref-22)
22. merger and/or acquisition, intellectual property sale, public offering (IPO) or private investment in public equity (PIPE) [↑](#footnote-ref-23)
23. engaging in one of the areas of high technology (biotech, medical devices, computing/software/communications, in contrast to companies engaging in more traditional areas (electronics/mechanics, environmental technology or other technology categorized as "other") [↑](#footnote-ref-24)