1. DOES VENTURE CAPITAL SPUR ECONOMIC GROWTH? EVIDENCE FROM ISRAEL[1]

Biao ZHANG[2]
Dongxiang ZHANG[3]
Juan WANG[4]
Xiashuai HUANG[5]

Abstract

Venture capital cannot only promote technological innovation and the development of high-tech industries, but also makes contribution to economic growth. Having a good reputation as the "Silicon Valley in Middle East", Israel is one of the most successful countries in developing venture capital. It is worth studying the impact of Israeli venture capital on its economic growth. We take Israel as example to establish an economic growth model with venture capital, which is taken as an endogenous variable in this paper. The results show that venture capital plays a significant role in the country's economic growth.

Keyword: venture capital, economic growth, Cobb-Douglas function, Israel
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I. Introduction

Study on venture capital has been broadly focused by scholars since the late 1980s. There are many studies that have comprehensive analysis of the contribution of venture capital to economic growth, and they are mainly concentrated on the following areas.

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[2] *Economics and Management School of Wuhan University*
[3] *Corresponding author, Associate Professor, Economics and Management School of Wuhan University, Wuhan, CHINA.*
Email: 00001858@whu.edu.cn
[4] *Economics and Management School of Wuhan University*
[5] *Economics and Management School of Wuhan University*

I.1 Influence of Venture Capital on Technology Innovation

The most significant reason why venture capital is regarded as capital is that it promotes technological innovation, which requires a lot of upfront capital investment before the emergence of new technology. Timmons and Bygrave (1986) discussed that venture capital, as a particular capital, played an important role in technological innovation. For more detailed description of the influence of venture capital on technology innovation, Keuschnigg (2004) established a simple equilibrium model of venture capital, start-ups and technological innovation. He believed venture capitalists did not only offer financial support to new enterprises, but also increased the value of the new enterprises. Growth of venture capital industry promoted technological innovation, and more venture capital investment in turn promoted the growth of this industry due to the support of tax policy. This clearly reflected the mechanism of how venture capital affected the technological innovation.

From the perspective of property transformation, Wei (2002) regarded the venture capital system as the key factor that promoted the efficiency of high-tech achievements and developed a unique property identification mechanism in the transformation process, which offered an effective medium for trading of such special commodity as intellectual property rights. Wang and Shu (2008) took the amount of patent applications as the indicator of technological innovation, conducted empirical analysis of the impact of venture capitalist on patent applications and concluded that venture capital was tied between human capital and funding and it had a strong spillover effect, which stimulated the operation of social capital, and promoted efficient allocation of resources.

I.2 Influence of Venture Capital on Employment and Output

In macroeconomics, employment is an important variable, which affects economic growth through the labor factor. Fisher (1988) analyzed venture capital funds established in some states of the US. Experience of the oldest state's venture capital funds - Massachusetts Technology Development Corporation (MTDC) has shown that successful operation of a state’s venture capital funds could get ultimate profit and had some impact on employment. Lerner (2000) also suggested that venture capital and SME business solved as many as 70% of the incremental employment problems at the time. Zhang (2007) studied the U.S. venture capital and argued from a statistical point of view that venture capital, technological innovation, and patents had a close connection; meanwhile, the connection between venture capital investment and a country's total output was also very strong. Using the data on GDP and venture capital in the U.S. from 1999 to 2003, Ma (2008) implemented the Granger causality test and a simple regression analysis to estimate the contribution rate of venture capital to GDP.

I.3 Promotion of Venture Capital to the Development of Patented Technology

Kortum and Lerner (2000) examined the impact of venture capital on the patented invention of U.S. in 20 industries for nearly 30 years.They used different methods to find out the causal relationship, taking the policy change in 1979 into account as factor stimulating the increase in venture capital, and concluded that the increase in venture capital in an industry and higher patenting rates were closely linked. Their results indicated that venture funding accounted for about 14% of U.S. innovative activity by 1998.

I.4 Venture Capital Cultivates Venture Capitalists and Promotes R&D Activities

An important element which differentiates venture capital from ordinary capital is its tremendous impact on the human factor. Hellmann and Puri (2002) collected data from Silicon Valley startups and by empirical analysis they suggested that venture capital and a variety of specialized measures, such as human resources policy, stock option plans, were relevant. On this basis, more evidence showed that the importance of venture capitalists to the new enterprises surpassed that of traditional financial intermediaries. Chorev and Anderson (2006) established a factor model of success of high-tech enterprises in Israel based on the abundant human resources and R&D activities, and described the contribution of venture capital to economic growth. Similarly, Grimpe (2006) believed that venture capital contributed to R&D activities. Venture capital promoted the development of human resources in R&D investment activities and the development of high-tech industry, thus contributing to economic growth. Wang (2008) chose data on R&D spending, venture capital, technological innovation and high-tech industry between 1994 and 2006 in China, conducted an empirical research by using canonical correlation analysis and concluded that venture capital was a more appropriate source for funding than the traditional company R&D investment, and its contribution to technological innovation was about three times of that of other capital.

I.5 Other Aspects

Jeng and Wells (2000) analyzed the determinants of venture capital in 21 countries, and argued that IPOs was the most powerful driving force to venture capital, while the private pension funds in some countries had a significant influence on the venture capital level. Avnimelecha and Teubalb (2006) made a life-cycle model based on their experience in Israeli venture capital industry.They believed that venture capital industry included a cumulative and self-reinforcing process. What’s more, venture capital and high-tech industrial clusters were interrelated and mutually reinforced. These studies reflect varying degrees of venture capital and economic growth linkages. Gu (1998) decomposed the influence of the U.S. venture capital on economic growth into productive forces, technological progress and increased employment. Cheng and Li (2001) introduced the concept of new economy and discussed the interactive relationship between venture capital and the new economy. Luo (2004) described the impact of venture capital on economic development as a chain of "Science - Technology - Production". Hu (2005) summarized the role of venture capital in promoting economic growth as capital circulation, which was a combination of various financial instruments, financial markets and financial institutions at all levels.

Thus, there is a consensus that venture capital promotes economic growth, technological progress, patent applications and the development of human capital.

This study contributes to the reseach in this field because, first, we analyze the influence of venture capital on economic growth through the comparison of different models, mainly by using different function models for the total factor productivity and, second, we take venture capital-related human capital and R&D factors as endogenous variables so as to estimate the contribution of venture capital to economic growth more effectively. This paper focuses on estimating the contribution of venture capital to the economy through the view of general empirical analysis rather than focusing on qualitative causal analysis and correlation test of venture capital, R&D, human capital and other factors.This idea for the study of contribution of venture capital to economic development provides an example of quantitative analysis, and is generally convincing on the real economy data.

The paper lacks data on Israeli venture capital, since the history of venture capital in Israel has existed for only 16 years. In other words, this paper adopts the annual Israeli economic data from 1995 to 2008. Because the sample is small, it is not conducive to eliminate multicollinearity between variables. However, the purpose of this paper is to estimate the contribution of venture capital to economic growth, which means as long as the total linear and time-series multi-lag effect has significant impact on the parameter estimation of the variables, it can be ignored.

II. Methodology

In this paper, we take venture capital in Israel as a research object. Venture capital (VC) in Israel has a short history but rapid development, which provides many advantages to the study of the contribution of venture capital to economic growth due to its high proportion of human capital, R&D input, high-tech industries and large-scale VC financing.

In addition, VC in Israel ranks second in the world, just behind the United States, and it concentrates on the introduction of venture capital and export of high-tech products. By contrast,VC in the US tends to invest in foreign funds. Thus, the study based on Israeli venture capital provides a preferable perspective of the contribution of venture capital to economic growth.

We take the factors of VC promoting economic growth as endogenous variables, and establish models based on the conventional Cobb-Douglas Function. The way how venture capital promotes economic growth can be divided into the capital factor, labor factor, human resource factor and technological progress. We extract the capital factor and labor factor of venture capital from the total capital and total labor factors, taking into account the human resource and technological progress as well. Through the comparison of results, we are able to analyze the impact of venture capital to economic growth and estimate the contribution rate of venture capital to economic growth.

III. Empirical Research[6]

The most direct contribution of venture capital to the economy of Israel is that it significantly promotes the GDP growth, that is, after its introduction, the venture capital in Israel has been expanding rapidly, meanwhile, high-tech industries have been developing rapidly, which led to the increase in the values of IPO and M&A. This certainly has enormous positive influence on economic growth, of which one is the growth of GDP in Israel.

In this paper, we use the conventional Cobb-Douglas Function based on the fundamental principles of economic growth, and separate the venture capital factor from the general factor, then make empirical research by endogenizing it into an economic growth model.

III.1 Modeling

In the economic growth model, the long-run variables of economic growth are mainly capital factor, labor factor and technological progress (total factor productivity). Venture capital can also affect economic growth through the input of capital and labor.

The basic form of the conventional Cobb-Douglas Function is $Y = A(t)K^{\alpha}L^{\beta}u$. In this paper, we endogenize the influence of venture capital to economic growth into Cobb-Douglas Function, so its basic form changes as Equation (3.1).

III.1.1.Production Function without Technological Progress

$$\mathrm{Y} = K_1^{\alpha_1} K_2^{\alpha_2} L_1^{\beta_1} L_2^{\beta_2} e^{\varepsilon} \tag{3.1}$$

Equation (3.1) is used as the reference model to determine whether there are obvious linkage between the venture capital and technological progress . If otherwise, the conclusion is the opposite.

III.1.2. Production Function with Technological Progress as Factor

$$\mathrm{Y} = A(t) K_1^{\alpha_1} K_2^{\alpha_2} L_1^{\beta_1} L_2^{\beta_2} e^{\upsilon} \tag{3.2}$$

Technological progress A(t) can be substituted by Israeli R&D activities, due to the huge amount of Israeli R&D investment, the leading position of average proportion of investment in the world, and the close relationship between the R&D and technological progress. Admittedly, technological progress comes not just from the R&D, but also from the human capital stock, the proportion of investment in imports, etc. In the following, we use human capital as an independent factor for analysis and ignore the proportion of investment in imports, because high-tech exports are the main part in Israel, and imports have non-significant influence on the technological progress.

III.1.3. Production Function with Human Capital as Factor of Production

[6] Experiments followed are all based on Eviews5.0.

$$Y = A(t)H^{\lambda} K_1^{\alpha_1} K_2^{\alpha_2} L_1^{\beta_1} L_2^{\beta_2} e^{\tau} \quad (3.3)$$

Since Lucas (1988) proposed that the input differences of human capital was one of the most important reasons for the output differences, input of human capital has become an non-negligible factor, which is just the reason why we would use human capital as an independent factor. We want to measure the contribution of human capital to economic growth, excluding the influence of technology and other factors. As education in Israel is at the forefront of the world and the human capital in Israel is preponderant; thus the introduction of human capital as a factor of production will contribute to a more accurate estimate of the contribution rate of venture capital to economic growth, and make the data more convincing. Obviously, we can also bring human capital as another factor of technological progress into the model, and this does not affect the analysis of the models (3.2) and (3.3).

Significance of parameters in the above-presented models are as follows: Y refers to gross industrial output, K_1 refers to venture capital inputs, K_2 refers to non-venture capital inputs; L1 refers to labor inputs of venture capital sector, L_2 refers to labor inputs of non-venture capital sector, H refers to human capital inputs, A(t) refers to technology level in time t, λ, α_1, α_2, β_1 and β_2 refer to the elasticity of outputs of each factor, respectively, ε,vandτare random items.

III.2 Data Selection

IIn this paper, we use the GDP of Israel as variable Y, venture capital as K1, other capital as K2, number of employers in high-tech department as L1, number of employers in other departments as L2, the percentage of R&D expenditure in total government expenditure as R&D, expenditure on education as H. In order to simplify the models, we provide linearization as follows :

$$\ln GDP_t = c + \alpha_1 \ln K_{1t} + \alpha_2 \ln K_{2t} + \beta_1 \ln L_{1t} + \beta_2 \ln L_{2t} + \varepsilon_t \quad (3.4)$$

$$\ln GDP_t = c + \xi \ln(R\&D)_t + \alpha_1 \ln K_{1t} + \alpha_2 \ln K_{2t} + \beta_1 \ln L_{1t} + \beta_2 \ln L_{2t} + \upsilon_t \quad (3.5)$$

$$\ln GDP_t = c + \xi \ln(R\&D)_t + \lambda \ln H_t + \alpha_1 \ln K_{1t} + \alpha_2 \ln K_{2t} + \beta_1 \ln L_{1t} + \beta_2 \ln L_{2t} + \tau_t \quad (3.6)$$

Where assume that: $\ln A(t) = \zeta \ln(R\&D)_t + \gamma_t$.

This paper chooses the annual data of venture capital of Israel in 1995-2008 as the sample (Appendix Table 5).

III.3 Empirical Test

III.3.1 Stationarity Testing

We should test whether the variables are stationary before making regression of each model. As time-series data is always non-stationary, which leads to the phenomenon of spurious regression, the stationarity test should be performed before the causality test. The results of the sationarity test in this paper are shown in Table 1.

Table 1

The Unit Root Test of Each Variable (ADF)

	lnGDP	lnR&D	lnH	lnK1	lnK2	lnL1	lnL2	5% significant level
t-statistics	5.657	1.903	1.880	-0.397	0.938	2.171	6.027	-1.9709
p-value	1.0000	0.9797	0.9789	0.5204	0.8964	0.9878	1.0000	

Notes: *If the value is greater than the critical value of ADF unit root test, then the sequence contains a unit root; otherwise, the sequence does not contain a unit root.*
All variables are first-order non-stationary time series.

As shown in Table 1, each variable has a unit root, which means the variables are non-stationary. But this is not equal to the fact that regression of non-stationary variables must lead to the phenomenon of spurious regression. Actually, if variables are first-difference stationary, linear combinations of variables may offset the stochastic trend of the time series. In theory, the conditions of long-term stability are taken into account in the process of the selection of each variable in the economic growth model, so we can first generally analyze the model, then the test results. Since this paper focuses on the relationship between venture capital and long-term economic growth, the short-term causal test is omitted. Stationarity test for regression residuals will be listed later.

III.3.2 Regression Analysis

Making multiple linear regression analysis of models (3.4), (3.5) and (3.6),respectively, the results are shown as follows (*,**,*** indicate that the resluts are significant at 10%, 5%, and 1% levels, respectively):

$$\ln GDP_t = 1.99 + 0.0237\ln K_{1t} + 0.0836\ln K_{2t} + 0.1101\ln L_{1t} + 1.0479\ln L_{2t}$$

(9.17)*** (4.16)*** (2.97)** (3.52)*** (15.55)***

R^2=0.9982, DW=3.3504, T=14,(1995-2008) (3.7)

$$\ln GDP_t = 2.06 - 0.0643\ln(R\&D/100)_t + 0.0273\ln K_{1t} + 0.0739\ln K_{2t} + 0.1351\ln L_{1t} + 1.0644\ln L_{2t}$$

(8.42)*** (-0.70) (3.52)*** (2.30)* (2.82)** (14.54)***

R^2=0.9983, DW=3.5084, T=14,(1995-2008) (3.8)

$$\ln GDP_t = 2.27 - 0.0509\ln(R\&D/100)_t - 0.0817\ln H_t + 0.0303\ln K_{1t} + 0.0680\ln K_{2t} + 0.1318\ln L_{1t} + 0.1191\ln L_{2t}$$

(4.18)*** (-0.55) (-0.95) (3.60)*** (2.07)* (2.73)** (11.99)***

R^2=0.9985, DW=3.4582, T=14,(1995-2009) (3.9)

The results show that goodness of fit of the three models is high, more than 99%. Meanwhile, error terms of each model may have first-order autocorrelation, since individual parameters fail in the significance test. It is worth noting that, in equation (3.9) the elasticity of human capital to GDP is negative, which apparently violates the basic principle of economics.

Since the variables are nonstationary, if these relations show no cointegrations the OLS estimators would not converge in probability, as the sample size increases and t- and F-test statistics do not have well defined asymptotic distributions. Thus, we need to test the cointegration between the dependent variables and independent variables.

As the time series in this paper are too short, we use the ARDL bound Test, proposed by Pesaran *et al*. (2001). This test is robust for small samples (Pesaran *et al*., 2001; Chang *et al*., 2005). This method is based on the following Unrestricted Error Correction Model (UECM):

$$d\ln GDP_t = a_0 + \sum_{i=0}^{n} a_{1i} d\ln K_{1t-i} + \sum_{i=0}^{n} a_{2i} d\ln K_{2t-i} + \sum_{i=0}^{n} a_{3i} d\ln L_{1t-i} + \sum_{i=0}^{n} a_{4i} d\ln L_{2t-i}$$

$$+\sum_{j=1}^{m} a_{5j} d\ln GDP_{t-j} + a_6 \ln K_{1t-1} + a_7 \ln K_{2t-1} + a_8 \ln L_{1t-1} + a_9 \ln L_{2t-1} + a_{10} \ln GDP_{t-1} + e_t \quad (3.10)$$

$$d\ln GDP_t = a_0 + a_2 \ln(RD_{t-1}/100) + a_3 \ln K_{1t-1} + a_4 \ln K_{2t-1} + a_5 \ln L_{1t-1}$$

$$+a_6 \ln L_{2t-1} + a_7 \ln GDP_{t-1} + e_t \quad (3.11)$$

$$d\ln GDP_t = a_0 + a_1 \ln(RD_{t-1}/100) + a_2 \ln H_{t-1} + a_3 \ln K_{1t-1} + a_4 \ln K_{2t-1}$$

$$+a_5 \ln L_{1t-1} + a_6 \ln L_{2t-1} + a_7 \ln GDP_{t-1} + e_t \quad (3.12)$$

Following Pesaran *et al*. (2001), the test is conducted in the following way. For equation (3.10) the null and alternative hypotheses are:

$$H_0 : a_6 = a_7 = a_8 = a_9 = a_{10} = 0$$

$$H_1 : a_6 \neq 0; a_7 \neq 0; a_8 \neq 0; a_9 \neq 0; a_{10} \neq 0;$$

For equation (3.11) and (3.12), we can write down the null and alternative hypothesis, too. If the null hypothesis of no cointegration is rejected, this indicates that the dependent variables and the independent variables are cointegrated.

Table 2

Bounds Testing for Cointegration Analysis

	Test-statistic (Chi-square)	P-value	Significant level
Equation 3.10	8.79 (n=0;m=1)	0.11	11%
Equation 3.11	12.48	0.05	5%
Equation 3.12	12.27	0.092	10%
Unrestricted intercept and no trend			

The bounds test results are reported in Table 2. Equations (3.11) and (3.12) do not contain the different items as equation (3.9) does, for the reason that the coefficient of these items are insignificant. The results show that the null hypotheses are rejected at the significance level of 11%, which indicates that the dependent variables and the independent variables in equations (3.7), (3.8) and (3.9) are cointegrated, respectively.

III.3.3 Hypothesis Testing

III.3.3.a Multicollinerity Testing

Above all, we believe that the multicollinearity problem in equations (3.7), (3.8) and (3.9) can be ignored, despite the model has high degree of goodness of fit, the standard deviation of each regression model is not large and the correlation coefficients between different variables are not higher than the goodness of fit. Even though we use the stepwise regression method for screening explanatory variables, original explanatory variables can still be retained.

Multicollinearity between different economic data is inevitable, but it does not affect this estimation. In order to verify it, we will apply ridge regression to the final modified model[7] and draw the ridge trace. The results show that there is no serious multicollinearity[8].

III.3.3.b Autocorrelation Testing

After excluding the possibility of bias of model set, we apply tests of the relevant diagram and Q-statistics to the residuals. The results[9] show that the residual sequence of equation (3.7) is an obvious AR (1) process, while the residual series of equation (3.8) and (3.9) are AR (2) processes evidently.

III.3.4 Model Revision

According to the test results above, we use AR (1) and AR (2) processes to describe residual sequences of the three models, respectively, which helps to improve the effectiveness of the regression parameters. Thus, we add auto-regression as explanatory variable, which is shown as follows:

$$\ln GDP_t = 1.87 + 0.0271\ln K_{1t} + 0.0835\ln K_{2t} + 0.0905\ln L_{1t} + 1.0796\ln L_{2t} - 0.7892AR(1)$$

(17.69)*** (7.30)*** (6.09)*** (4.81)*** (30.17)*** (-3.37)**

$$R^2 = 0.9991, F = 1676.323, AIC = -7.37, SC = -7.11 \quad (3.13)$$

$$\ln GDP_t = 2.04 - 0.1144\ln(R\&D/100)_t + 0.0327\ln K_{1t} + 0.0717\ln K_{2t} + 0.1451\ln L_{1t} + 1.1087\ln L_{2t}$$

(27.59)*** (-3.94)** (16.32)*** (11.95)*** (7.37)*** (66.18)***

$$-1.5465AR(1) - 0.7573AR(2)$$

(-5.22)*** (-2.68)*

$$R^2 = 0.9997, F = 2735.988, AIC = -8.49, SC = -8.17 \quad (3.14)$$

$$\ln GDP_t = 1.82 - 0.1063\ln(R\&D/100)_t + 0.0580\ln H_t + 0.0332\ln K_{1t} + 0.0711\ln K_{2t} + 0.1239\,\mathrm{n}\, L_{1t}$$

(10.53)*** (-4.18)** (1.34) (17.52)*** (13.57)*** (5.55)**

$$+1.0693\ln L_{2t} - 1.5651AR(1) - 0.7274AR(2)$$

(55.56)*** (-6.29)*** (-3.05)*

$$R^2 = 0.9998, F = 3129.529, AIC = -8.90, SC = -8.54 \quad (3.15)$$

Results can be obtained that goodness of fit of the model increases after the model is adjusted.The significance of the variable decreases. DW values cannot be used to test first-order autoregression, because the model has eliminated the residual serial correlation. AIC and SC values show that the selection of the order of autoregression is quite good.

In equation (3.15), although the elasticity of human capital is positive, the t-test results are still not significant. At this point, we cannot immediately conduct redundant

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[7] *Equations 3.13and 3.14.*

[8] *Details are shown in Appendix, Figure 1.*

[9] *Correlation diagrams are omitted here.*

variable test to $\ln H$, because it is easy to produce bias of the model when excluding a variable. Because it may exist the problem of extra explanatory variables to the factor of human capital in equation (3.15), we carry out a test on extra explanatory variables.The results are shown in Table 3.

Table 3

Test of $\ln H$

Ln H (Redundant Variable)			
F-statistic	2.343000	Prob. F(1,2)	0.223346
Log likelihood ratio	6.926100	Prob. Chi-Square(1)	0.008495

As the results show, the null-hypothesis cannot be rejected, which means $\ln H$ is a redundant variable, thus we exclude this variable here. The reasons of non-significance may be in the following areas:

a. Sample data is not enough;

b.Multicollinearity. Collinearity of human capital and other variables may lead to non-significance. Considering the ridge regression method, although it is able to eliminate multicollinearity, it will lead to unbiased parameter estimates;

c. Introduction of venture capital weakens the importance of human capital, which just reflects the impact of venture capital on economic growth;

d. Variable of human capital itself is not significant.Through comparison of regression equations (3.14) and (3.15), it is easy to find that the introduction of human capital has little influence on the estimates of other parameters, and the influence is negligible.

In short, the results of model modification is removing human capital as explanatory variables, and just retaining regression equations (3.13) and (3.14) as the final test results.

IV. Conclusion and Analysis

IV.1 Venture Capital and Technological Progress Experience Mutual Promotion

When considering the factor of technological progress, we find that the comparison of (3.13) and (3.14) shows that the elasticity of venture capital to GDP growth rose from 2.77% to 3.34%, while the elasticity of other capital decreases. Meanwhile, high-tech sector also increased the elasticity of labor force by nearly 5 percentage points, which was 2 percentage points more than the other labor factors. One may see that technological advances play a catalytic role in venture capital, which means a high level of science, technology and R&D will contribute to the development of Israeli venture capital, while the development of venture capital in turn promotes the technological progress by enterprise value addition and GDP growth .This constitutes a virtuous circle of venture capital and technological progress

IV.2 Outstanding Contribution of Venture Capital to GDP Growth

When considering the factor of technological progress, we compare the contribution of venture capital and labor of high-tech department to GDP with that of other capital and labor. The results are shown in Table 4.

Table 4

Contribution of Each Factor to GDP

1995 - 2007	GDP	Venture capital	Other capital	Labor in high-tech department	Labor in other department
Elasticity of GDP	100%	3.27	7.17%	14.52%	110.87%
Average annual growth rate	3.93%	39.11%	1.99%	6.30%	2.40%
Contribution rate to GDP growth	100%	1.28%	0.14%	0.91%	2.66%
Proportion in GDP or total labor	100%	1.002%	19.97%	7.96%	92.04%
Contribution rate as one unit	1	1.27	0.07	0.11	0.03
Contribution rate to GDP growth = elasticity to GDP × average annual growth rate; Contribution rate as one unit= Contribution rate to GDP growth / Proportion of GDP or total labor					

IV.2.1 The average contribution rate of Israel venture capital to GDP growth was 1.28%, far higher than that of the other capital (0.14%), while the average contribution rate of venture capital to GDP growth through the labor factor was 0.91%, lower than that of other labor sectors (2.66%). By simple addition, we can get the Israeli venture capital contribution rate to GDP growth as equal to 1.28% +0.91% = 2.19%. As for the opposite comparison results shown in labor department, they were mainly due to the number of high-tech labor sector, which had only 7.96% of labor force, also due to small elasticity of labor supply. Therefore, this paper compares not only the absolute numbers, but also the relative ones.

IV.2.2 When proportionating the contribution rate of each factor, we can conclude that the contribution rate of venture capital to GDP growth is 18.14 times that of other capital with the same proportion (1.25/0.07 = 18.14); the contribution rate of high-tech sector labor to GDP growth is 3.67 times that of other labor sector with the same proportion (0.12/0.03 =3.67). By comparing the results of this ratio, we can conclude that venture capital in Israel has a significant influence on economic growth.

Appendix

Table 5

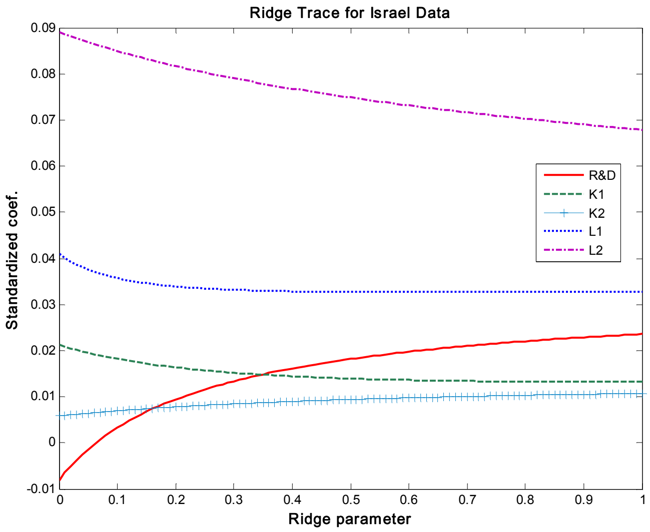
Annual Data of Venture Capital of Israel from 1995 to 2008

Year	GDP	K1	K2	L1	L2	R&D	H
1995	4234.47	5.14	1049.35	10.97	185.52	11.32%	372.63
1996	4456.28	13.07	1126.13	11.52	189.76	11.81%	405.52
1997	4584.24	20.44	1106.67	12.18	191.84	12.35%	421.75
1998	4779.18	27.16	1067.87	14.02	193.23	12.98%	430.13
1999	4933.34	41.94	1121.00	15.25	198.41	13.80%	439.07
2000	5374.42	126.07	1059.02	18.93	203.19	17.04%	456.83
2001	5354.51	83.52	1060.58	20.54	206.51	17.28%	487.26
2002	5318.76	53.92	965.98	20.75	205.74	16.89%	484.01
2003	5413.73	45.98	922.53	19.26	213.76	16.39%	476.41
2004	5685.85	65.66	932.71	19.71	220.37	16.88%	494.67
2005	5977.71	60.00	1065.35	21.72	227.64	17.35%	496.15
2006	6287.51	72.28	1125.73	23.80	233.56	17.45%	515.58
2007	6625.08	72.26	1269.92	21.99	246.21	18.19%	549.88
2008	6967.17	74.48	1303.13	25.95	251.72	18.48%	516.58

Source: *Calculation according to data published by Israel Central Bureau of Statistics. All data is calculated using constant 2005 prices; units of GDP, K1, K2, H are a billion new Sheikh; units of L1, L2 are 10 thousand people*.

Figure 1

Ridge Trace for Data in Israel



Note: As the constant coefficient is too large, Ridge trace of constant coefficients C is omitted. The coefficient standard errors of other major explanatory variables are relatively small, and Ridge track is steady. Therefore, the modified model has no significant multicollinearity.

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