

# The Impact of Venture Capital on the Macroeconomy

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## Abstract

The paper seeks to develop a theoretical model to explore the relationship between venture capital and the macroeconomic variables like employment, particularly in a labor surplus economy. Dynamic trade theories, such as those proposed by Vernon and Dollar, suggest that innovative goods and ideas often originate in the economically developed 'North' and subsequently move to the 'South' for production due to lower labour costs. Our model attempts to give a theoretical foundation for this observation, suggesting a positive relationship between innovation and the presence of venture capital firms.

The model demonstrates that in a two sector economy the presence of active venture capital can affect employment generation via its positive impact on a new good as well as old good sector. In a labor abundant economy as assumed in the present model, this will help increase employment opportunities.

Keywords- Financial Institutions, Venture capital, Innovation, Employment, Labour-surplus economies, Macroeconomic Model

## Introduction

The concept of venture capital has deep historical roots, tracing back centuries in Western civilization. A notable example is the financing of Christopher Columbus's explorations by Spain's Ferdinand and Isabella, often regarded as one of the earliest and most lucrative venture capital investment. The transformative industries of the 19th century emerged from the pioneering ideas of individuals, funded by small groups of small wealthy patrons- effectively the forerunners of modern venture capitalists.

Today, venture capitalists (VCs) are high net worth individuals or firms who invest in emerging, innovative firms with strong growth potential, albeit typically accompanied by substantial risks. These investors offer not only capital but also operational expertise, industry knowledge, and valuable networks. Such non-financial contributions are often as critical as the capital itself in helping young firms thrive.

Innovative ideas are inherently intangible assets presenting a unique set of challenges for financing. Traditional financial institutions, such as banks, require physical collateral for loans, making them less willing to fund abstract, high-risk projects. Moreover, these institutions generally offer limited strategic support to entrepreneurs. The presence of information asymmetries, adverse selection and moral hazard further drive up the costs of external finance. Here, venture capital bridges the funding gap by providing equity based financing, mitigating these challenges, and reducing reliance on collateral.

The investment landscape is dynamic, with a diverse market portfolio that evolves as new, unconventional ideas emerge. Venture capital plays a crucial role in identifying the most promising of these ideas. Initially, innovative concepts are intangible assets. Researchers select a subset of these ideas for further development, with entrepreneurs and firms subsequently investing in those with commercial potential. Venture capital funds then provide the necessary resources for these ventures, nurturing them until they are ready to enter the public market through IPOs. This cycle embodies Joseph Schumpeter's concept of 'creative destruction', where new innovations

replace outdated practices, thereby expanding economic growth.. Over the last three decades, venture capital has emerged as an essential component of financial innovation, particularly in the U.S., where it has contributed significantly to economic and technological progress.

A typical venture capital fund comprises institutional investors such as pension funds, insurance companies and endowments (limited partners), who allocate a small proportion out of their total assets to high risk, high reward opportunities, typically seeking annual returns of 25% - 30%. These investors are drawn to the venture capital fund not for specific projects but based on the firm's overall track record and historical success.

This paper seeks to develop a theoretical model to explore the relationship between venture capital and employment, particularly in a labor surplus economy. Dynamic trade theories, such as those proposed by Vernon and Dollar, that suggest that innovative goods and ideas often originate in the economically developed 'North' and subsequently move to the 'South' for production due to lower labour costs. Our model attempts to give a theoretical foundation for this observation, suggesting a positive relationship between innovation and employment.

## **REVIEW OF LITERATURE**

The relationship between financial markets and innovation is underexplored. However models like those proposed by Arrow (1962) and Solow (1957) delve into the origins of technical progress. Arrow posits that technical advancement results from "learning by doing", while Uzawa (1965) suggests that progress is driven by investment in human capital. Following these works scholar such as Lucas (1988) and Romer (1990) further emphasized human capital's role in technological development. In contrast, Shell (1966) linked technical progress to resources allocated to inventive activities. Focusing on finance and innovation, Landes (1969) describes the Industrial Revolution as a continuous tale of technological progress supported by financial mechanisms. Inspired by the technological progress of the twentieth century, Keynes (1936) famously anticipated a future of abundance enabled by innovations. Empirical studies, including those by Jacobs (1969,1984), Landes (1969),Murphy et al (1991), Porter (1990), Romer (1986,1994), Rosenberg and Birdzell (1986), support the assertion that innovative economies are generally more prosperous. Findings by Hall *et al* (1993), Chan *et al* (1990) and Pakes (1985) prove that increased spending on R&D by the firms is manifested in better financial performance and increased market valuation. However, when it comes to financial markets affecting innovation, Greenwood and Jovanovic (1990) report about the increase in savers' and investors' appetite for risk resulting from financial development.

Nonetheless, financing innovation presents unique challenges due to its inherent risks and uncertainties. Innovation is an extended, resource-intensive process with unpredictable outcomes, making it difficult for innovators to secure funding from banks, as intangible assets offer no collateral(O'Sullivan, 2005). The financing gap is further exacerbated by financial asymmetry, which often deters potential investors.

The bank based system in Continental Europe is less capable than the market based one in US and UK according to Boot and Thakor(1997), Rajan and Zingales(2001), Carlin and Mayer(2002), Herrera and Minetti(2007). Also public funds do not provide any strategic guidance leading to any increase in absorptive capacity according to Da Rin and Penas (2007). Information asymmetry is another feature that renders financing difficult. For example, competition prevents firms from disclosing their idea to investors (Bhattacharaya and Ritter, 1983). On the other hand, these problems of adverse selection and moral hazard are significantly reduced by capital markets and institutions, thereby reducing the firms' cost of outside finance (Rajan and Zingales, 2001).

Venture capital thus emerges as a "missing market" (Hall and Lerner, 2009) and are perceived better than banks in financing innovation by policymakers (European Commission, 2009). Venture investors are 'company builders' who influence innovation, professionalization and commercialization strategies equally, hence providing financial and non-financial assistance to young entrepreneurs (Da Rin and Penas, 2007).They provide equity investment and so share both the profits and losses .This makes them spend time and money on individual firms, assisting them, which banks cannot (Amit, Brander and Zott, 1998; Kaplan and Stromberg,2001). Earlier studies by Tybejee and

Bruno (1984), Sahlman (1988, 1990) and Gorman and Sahlman (1989) plus later studies by Admati and Pfleiderer (1994), Barry (1994), Lerner (1995) and Hellman (1998), all document significant value creation by VC's.

The literature provides several reasons for this. Venture investors are good at timing conditions (Gompers et al 2007). They invest in companies at the 'right time' and then go public 'at the right moment' thus freeing their capital to re-invest in new ventures (Michelacci and Suarez, 2004). Also the certification role of venture investors (Megginson and Weiss,1991) and their networks of relationships (Hochberg, Ljungqvist, and Lu, 2007) contributes to attract companies which already have good growth opportunities (Soreson,2006), so that venture investors would mainly turn them into 'cash cows' (Bottazzi and Da Rin,2002) with a successful exit.

Venture capital plays a positive role in accumulation of absorptive capacity of portfolio companies by influencing their innovation strategies, mainly 'make' and 'make and buy' R&D strategy and also a more regular R&D effort.(Cassiman and Veugelers,2002,2006). Kortum and Lerner (1998) also find that VC-backed firms are more likely to innovate than non VC-backed firms. A debate that closely follows is, if it is the 'innovation first' or the 'VC first'. While Hirukawa and Ueda (2008) believe it is the new technologies that increase demand for VC, Kortum and Lerner (2000) suggest the reverse order. They are supported in this by the studies conducted using firm-level data in the US (Hellman and Puri, 2000), Germany (Engel and Keilbach, 2007) and Italy (Caseli,Stefano and Perrini 2009) that show that VCs instead of fostering new innovations, invest in already innovative firms.

Regarding the strategy followed by VC's, Kaplan and Stromberg (2001b) find that VC's help overcome principal-agent contracting problem through sophisticated contracting, pre-investment screening and post- investment monitoring and advising. As against this Hellman and Puri (2000) argued that VC stimulates innovation via screening of firms than via incentives and monitoring. Engel and Keilbach (2007) also reached these conclusions. Observing German VC-backed and non VC-backed firms they found that VC's are more focused on getting existing innovations into the market and less on fostering new ones. But again Lerner et al (2008) in his study of US firms found that instead of VC just engaging in 'cherry-picking' , actually result in firms pursuing more influential innovations once the VC investment takes place.

### **The Evolution of Venture Capital in the U.S. and Europe**

The venture capital industry originated in the U.S., notably with the formation of American Research and Development in 1946. With subsequent policy changes, such as the 1979 U.S. Department of Labor's clarification of the 'prudent man' rule, institutional investors like pension funds began channeling substantial funds into venture capital. By the mid-1980s, venture capital investments surged, contributing to the high-tech revolution of the 1990s (Gilson, 2003). Studies by Kortum and Lerner, (1998) and Gompers and Lerner(1999) suggest that U.S. venture capital significantly drove technological innovation, underscoring its pivotal role in the economy.

In Europe, the growth of venture capital has lagged, hindered by factors like high entry barriers, rigid labour practices, and less-developed knowledge networks (Popov and Roosenboom,2009, 2011). Although pension funds have gradually replaced banks as primary investors, venture capital still accounts for a modest proportion of industrial innovation.

### **THE MODEL**

The model comprises a two good economy- one old good and one new, innovative good. The new innovative good follows duopolistic market structure. The total population is divided into two classes-the labor class, or workers who provide employment in the labor market and, in return, earn wages, and the capitalists, who invest their capital and thereby earn a rate of profit on their investments. We assume that the total labor force is not fixed.

There are three major players in the economy:

- The young entrepreneurs, or duopolist firms that enter the market with a new idea, either a product or a service, denoted by good  $x$ .
- A monopolist bank that partly lends to the firm to fund its finances.
- $\theta$  no. of mutual funds or venture capitalists, with each mutual fund investing in  $N$  new industries attempting to enter the new good market.

The entrepreneurs together with the banks and the mutual fund firms, invest in the new idea and reap profits according to their respective investment shares.

The total capital requirement of the duopolist entrepreneur is denoted by  $k$ , with the entrepreneur's own investment denoted by  $V$ . For the remaining funds, the entrepreneur turns to a monopolist bank which charges a high mark up  $\mu$ , and a high interest rate due to the risk and uncertainty associated with the business. Also because of a lack of collateral, there is a limit to which the banks can finance the entrepreneur's business. For additional funding, the entrepreneur turns to the private equity market, seeking help from venture capitalists, represented by mutual fund firms in the model. The venture capitalists agree to invest an amount denoted by  $u$  in the entrepreneur's project.

A venture capitalist or a venture capital firm is an early investor in a startup which shows promise of great profitability because of a possible opportunity given the nature of the product/ service that the startup potentially could produce because of innovation which could be process innovation, product innovation or organisational innovation. The venture capital provides funds in return for equity and also provides mentorship. Indeed the venture capital may even adopt a hands on approach by offering the promoters advice, organisation and participation in multiple rounds of financing as the demand for finance by the startup grows. The venture capital makes money if the startup acquired by another business because synergies are perceived or the startup sells share to the public through an initial public offering where the VC also divests its holdings for a profit. Now the sale price offered by the acquiring company or the share price that is obtained during the IPO depends on the *perceived* profitability of the product/service that the startup offers.

In this model, the VC is modelled differently. The returns of the VC from investing in a successful innovative firm is the share of the *actual* profit made by the firm which proportional to the share of investment of the VC in the capital invested by the firm not counting the loans contracted. Thus if the total investment by the firm is Rs 100, the loan taken by the firm is Rs 60, and the investment by the VC is Rs 10/-, then the share of the profit the VC will get in our model is 25% of the profit (i.e. Rs 100- Rs 60 = Rs 40; Rs 10 being 25% of Rs 40 the total share capital).

### THE HOUSEHOLD SECTOR

The household sector demands both the old good and the new good. The total number of new goods,  $n$ , and old goods,  $m$  are assumed fixed. The consumer's preferences for the two goods are assumed to follow a Cobb-Douglas utility function given by

$$U = x_1^{\beta} x_2^{\beta} x_3^{\beta} \dots \dots x_n^{\beta} (\sum_{i=1}^m y_i)^{1-\beta} \quad 1)$$

where U represents the utility function of a single consumer

$m$ = no. of old goods                       $y$ = old good industry

$n$ = no. of new goods                       $x$ = new good industry

The representative consumer spends  $\beta$  proportion of his income on the new goods and  $(1-\beta)$  on the old goods. In the utility function we assume that the new goods take multiplicative form. Hence the proportion of income that the consumer devotes to each new good  $x_j$  is  $\beta$  i.e. the consumer spends an equal proportion of his income on each

new good . As such  $n\beta^- = \beta$  where  $n$  is the total number of new goods produced by the new good industry. Also  $0 < \beta < 1$ .

The old goods are assumed to follow a Bertrand competitive market structure that produces homogeneous goods. Hence the old goods  $y_i$  are perfect substitutes and we assume that  $y_1 = y_2 = y_3 = \dots = y_m = y^-$ . This means that the quantity demanded of each old good  $y_i$  is the same. Hence the representative consumer's utility function takes the form

$$U = \prod_{j=1}^n x_j^{\beta^-} (\sum_{i=1}^m y_i)^{1-\beta^-} \quad (2)$$

The consumer's budget constraint is defined as under

$$W = \sum_{i=1}^m p_y y_i + \sum_{j=1}^n p_x x_j \quad (3)$$

Where  $W$ = the total income earned by the consumer

$p_y$  = price of good  $y$  and  $p_x$  = price of good  $x$

A constrained-optimization exercise gives the consumer's demand for the two goods:  $y^* = \frac{W(1-\beta^-)}{p_y m}$  and  $\bar{x}^* = \frac{W\beta^-}{p_x n}$

This shows that the consumer's demand for the old good  $y$  is positively related to his income,  $W$ , and  $(1-\beta^-)$  and negatively related to the price of the old good,  $p_y$ , and the total number of all the old goods available in the economy,  $m$ . Similarly, the consumer's demand for the new goods is positively related to his income,  $W$  and  $\beta^-$  and negatively related to its price,  $p_x$  and the number of total new goods in the market,  $n$ .

### THE NEW GOOD SECTOR

The new good  $x$ , following a duopolistic market structure has the following inverse demand function:

$$p_x = \frac{A}{q_1 + q_2} \quad (4)$$

where  $q_I$  is the output produced by each of the two firms and the total amount produced by one new good industry  $x$  is  $q_1 + q_2$ . With  $n$  number of industries engaged in the production of the new goods, the total number of new firms involved in the new good's production is  $2n$ .

The new good faces a downward sloping demand curve with its production function given by

$$q_I = \gamma_1 l_1^{\frac{1}{2}} \quad (5)$$

Here again  $q_I$  gives the output produced by each duopolistic firm,  $l_1$  is the labour employed in one duopolistic firm and  $\gamma_1$  is some constant. From this we get the value for  $l_1 = (\frac{q_I}{\gamma_1})^2$ . Hence the total labour requirement of the entire new good industry denoted as  $L_1$  is

$$L_1 = 2n (\frac{q_I}{\gamma_1})^2 \quad (6)$$

The revenue earned by each duopolist firm is  $R = p_x q_I$ . The price charged by both the duopolies will be the same while the quantity sold by them will differ depending upon the production capacity of each. The cost of each duopolistic firm is  $C = w_1 l_1$ . So the profit  $\Pi = R - C$

$$\Pi_I = p_x q_I - w_1 l_1 \quad (7)$$

<sup>1</sup> See Appendix- Note 1

Substituting  $p_x = \frac{A}{q_1+q_2}$  and  $l_1 = \left(\frac{q_1}{Y_1}\right)^2$ , we get

$$\Pi_1 = \frac{A}{q_1+q_2} q_1 - w_1 \left(\frac{q_1}{Y_1}\right)^2 \quad (8)$$

$$\Pi_2 = \frac{A}{q_1+q_2} q_2 - w_1 \left(\frac{q_2}{Y_1}\right)^2 \quad (9)$$

The optimization exercise leads to the following results<sup>2</sup>

$$q_1 = q_2 = \frac{Y_1}{2} \sqrt{\frac{A}{2w_1}} \quad (10)$$

$$\text{And } p_x = \frac{\sqrt{2Aw_1}}{Y_1} \quad (11)$$

So we can conclude that the quantity produced by each of the duopoly firm is equal. Hence with equal quantity sold and same prices, the revenue incurring to each of the duopolistic firm will be the same i.e.

$$R_1 = R_2 = \left\{ \frac{\sqrt{2Aw_1}}{Y_1} \right\} \left\{ \frac{Y_1}{2} \sqrt{\frac{A}{2w_1}} \right\} = \frac{A}{2} \quad (12)$$

Further substitutions give the cost function as:

$$C = w_1 \left( \frac{Y_1^2 \frac{A}{8w_1}}{Y_1^2} \right) = \frac{A}{8} \quad (13)$$

And the firm's profit function as:

$$\Pi_I = \frac{A}{2} - \frac{A}{8} = \frac{3A}{8} \quad (14)$$

Hence the profit of each duopolist =  $\frac{3A}{8}$  and the profit of each industry producing a new good =  $\frac{3A}{4}$ . Therefore the total profit earned by all the  $n$  number of industries engaged in the production of new goods can be given as:

$$n \frac{3A}{4} \quad (15)$$

Also the total labour force employed in the new good sector,  $L_1$  is as follows:

$$L_1 = 2n \left( \frac{Y_1 \sqrt{\frac{A}{2w_1}}}{Y_1} \right)^2 = \frac{An}{4w_1} \quad (16)$$

which implies that  $L_1 = f(A)$ . The value of A is the revenue generated in one new good industry and is derived later in the text. This result is an important one because it shows that when new industries come up they create new employment opportunities. As such the surplus labour existing in the economy gets employed.

### THE OLD GOOD SECTOR

The old good,  $y$ , is assumed to be produced in a Bertrand competitive market structure where each firm produces homogeneous products acting as perfect substitutes and each having the same price  $p_y$ . The wage in the old good sector is  $w_2$  and the total labour employed is  $L_2$ . The production function takes the form  $y = Y_2 l_2$  where  $y$  is the output produced by each firm and  $l_2$  is the labor employed in each firm.

With  $m$  number of firms in the old good industry, the total labor requirement of the old good industry sector  $L_2 = m_y l_2$ . Hence the total output produced is given as :

$$my = Y_2 L_2 \quad (17)$$

<sup>2</sup> See Appendix-Note 2

Since the old good follows a Bertrand oligopolistic market structure, the firms enter into price competition that reduces the profit to zero. Therefore the capitalists do not earn any profit. The revenue generated,  $p_2y$  is equal to the cost incurred in the production process which is  $w_2L_2$ . Hence profit  $\Pi = 0$ .

Now because our model has two goods, we may assume the price of good  $y$ ,  $p_y = 1$  as in Uzawa (1961)

**THE MONOPOLY BANK**

The monopolist bank lends to the entrepreneur and charges a high rate of interest. This rate is high partly due to the monopolistic nature of the bank and partly due to the uncertain nature of the business proposal, which may lack tangible collateral. The bank’s revenue is

$$R^B = \sigma\theta N(1 + r)(k - V - u)$$

And its costs are

$$C^B = (1 + i)(k - V - u)\theta N$$

- Where  $r$ = the rate of interest charged by the bank                       $k$ = capital requirement for the project
- $u$ = the investment made by the venture capitalist                       $V$ = entrepreneur’s own wealth
- $i$ = the rate of return given on bank deposits                       $\sigma$ =success parameter
- $\theta$ =number of venture capitalist firms

$N$ = number of firms that get investment from the venture capitalists.

The profit for the monopolistic bank is given by

$$\Pi^B = \theta N(k - V - u)[\sigma(1 + r) - (1 + i)] \tag{18}$$

Also we assume  $\sigma(1 + r) = \mu(1 + i)$  where  $\mu$  is the mark up that the monopolist bank charges and the success parameter  $\sigma$  lies between 0 and 100%.

**THE NEW GOOD DUOPOLISTIC FIRM’S PROFIT FUNCTION**

The duopolistic firm’s profit function, with venture capitalists and the monopolistic bank involved, is

$$\Pi^{Df} = \left[ \frac{3A}{8} - (1 + r)(k - V - u) \right] \frac{V}{V+u}$$

Here  $\frac{3A}{8}$  is the duopolist’s profit in the absence of venture capitalists and bank.

For simplification purposes let it be written as

$$\Pi^{Df} = [\epsilon A - (1 + r)(k - V - u)] \frac{V}{V+u} \tag{19}$$

where  $\epsilon = \frac{3}{8}$

Now with  $\theta$  number of venture capitalist firms, it implies that the total no. of successful new good firms in the duopolist market structure is  $\sigma\theta N$ . Hence the profit function of all the successful firms in the new good sector is

$$\Pi^{TDf} = [\epsilon A - (1 + r)(k - V - u)] \frac{V}{V+u} \sigma\theta N \tag{20}$$

**THE VENTURE CAPITALIST**

The venture capitalist’s profit function in the presence of a monopolist bank and a duopolistic entrepreneur is,

$$\Pi^{VC} = [\epsilon A - (1+r)(k-V-u)] \frac{u}{V+u} \sigma N - \alpha_1 N^2 - uN \quad (21)$$

Where the revenue is

$$R^{VC} = [\epsilon A - (1+r)(k-V-u)] \frac{u}{V+u} \sigma N.$$

And the cost is

$$C^{VC} = \alpha_1 N^2 + uN.$$

The venture capitalist's profit function depends on variable  $N$  i.e. the number of new industries, that are able to get investment from the venture capitalists. Finding the first order condition for the venture capitalist's profit function w.r.t.,  $N$ , setting it equal to zero, gives

$$\frac{\partial \Pi^{VC}}{\partial N} = [\epsilon A - (1+r)(k-V-u)] \frac{u}{V+u} \sigma - 2\alpha_1 N - u = 0$$

$$\rightarrow N = \frac{[\epsilon A - (1+r)(k-V-u)] \frac{u}{V+u} \sigma - u}{2\alpha_1}$$

Making the substitution  $\sigma(1+r) = \mu(1+i)$  in the above expression gives

$$N = \frac{[\epsilon A - \frac{\mu}{\sigma}(1+i)(k-V-u)] \frac{u}{V+u} \sigma - u}{2\alpha_1}$$

$$\rightarrow N = \frac{\epsilon A \sigma \frac{u}{V+u}}{2\alpha_1} - \frac{\mu(1+i)(k-V-u) \frac{u}{V+u}}{2\alpha_1} - \frac{u}{2\alpha_1} > 0$$

i.e. this number is assumed to be positive.

This gives the number of firms that are able to get investment from the venture capitalists. To see how this number varies as the success parameter  $\sigma$ , the mark up,  $\mu$  and the cost factor,  $\alpha_1$  changes, we perform the comparative statics exercise which gives the following results.

Proposition 1- A rise in the success parameter of the investment project has a positive impact on the number of firms that get investment from the venture capitalist.

$$\frac{\partial N}{\partial \sigma} = \frac{\epsilon A \frac{u}{V+u}}{2\alpha_1} > 0$$

Result 1- As the success parameter increases, the number of firms that get investment from the venture capitalist also increases.

Proposition 2- The cost incurred by the venture capitalist has a negative impact on the number of firms that get investment from the venture capitalist.

$$\frac{\partial N}{\partial \alpha_1} = -\frac{\epsilon A \sigma \frac{u}{V+u}}{2\alpha_1^2} + \frac{\mu(1+i)(k-V-u) \frac{u}{V+u}}{2\alpha_1^2} + \frac{u}{2\alpha_1^2} < 0$$

$$\rightarrow \frac{\partial N}{\partial \alpha_1} = \frac{u}{2\alpha_1^2} [1 + \mu(1+i)(k-V-u) \frac{u}{V+u} - \epsilon A \sigma \frac{1}{V+u}] < 0$$

Result 2- As the cost of the venture capitalist increases, the number of firms getting venture capitalist's investment decreases.

Proposition 3- The mark up charged by the monopolist bank has a negative impact on the number of firms that get investment from the venture capitalist.

$$\frac{\partial N}{\partial \mu} = -\frac{(1+i)(k-V-u)\frac{u}{V+u}}{2\alpha_1} < 0$$

Result 3- As the mark up that the bank charges increases, the number of firms getting investment from the venture capitalist decreases.

Proposition 4- The revenue earned by the duopolist in the new good sector positively influences the number of firms that get investment from the venture capitalist.

$$\frac{\partial N}{\partial A} = \frac{\epsilon\sigma u}{2\alpha_1(V+u)} > 0$$

Result 4- As the revenue earned by the duopolist in the new good sector increases, the number of firms the venture capitalist invests in also increases.

Now for simplicity, let the expression

$$N = \frac{\epsilon A \sigma \frac{u}{V+u}}{2\alpha_1} - \frac{\mu(1+i)(k-V-u)\frac{u}{V+u}}{2\alpha_1} - \frac{u}{2\alpha_1}$$

be denoted as  $N = c_1 A - c_2$  where  $c_1 = \frac{\epsilon\sigma \frac{u}{V+u}}{2\alpha_1}$  and  $c_2 = \frac{\mu(1+i)(k-V-u)\frac{u}{V+u}}{2\alpha_1} + \frac{u}{2\alpha_1}$  with  $c_1 \geq 0$  and  $c_2 < 0$ .

Earlier, equation (21) gave the profit function of one venture capitalist . In the model, with  $\theta$  number of venture capitalist firms, the total profit of all the venture capitalist firms is as follows:

$$\Pi^{TVC} = [\epsilon A - (1+r)(k-V-u)]\frac{u}{V+u}\theta\sigma N - \theta\alpha_1 N^2 - \theta u N \tag{22}$$

### THE MACROECONOMIC EQUATIONS

Our model includes two macroeconomic equations that provide the equilibrium value for the total revenue generated in the new good sector, considering the presence of venture capitalists and a monopolist bank. The first equation describes how the demand for the new good,  $x$ , is generated in the economy, while the second equation represents the savings-investment equality in the Keynesian sense.

The demand for the new good  $x$  can be expressed as follows:

$$\beta(1-s)w_1L_1 + \beta(1-s)w_2L_2 + \beta\Pi^{Tdf} + \beta\Pi^{TVC} + \beta\Pi^B = p_x n x \tag{23}$$

The left hand side represents the demand side, where the demand for the new good comes only from the consumption portion of income. Labourers engaged in both the new goods sector ( $L_1$ ) and the old goods sector ( $L_2$ ) contribute to demand. The term  $\beta(1-s)w_1L_1 + \beta(1-s)w_2L_2$  indicates that a proportion ‘ $\beta$ ’ of consumption from the wage income ( $wL$ ) is directed toward the new good, with  $w_1$  and  $w_2$  as wages in the new and old goods sectors, respectively. Here the savings rate,  $s$ , is assumed to be small, meaning a high marginal propensity to consume which derives the demand for the new good. This demand incentivizes entrepreneurs and venture capitalists to enter the market.

Additionally a ‘ $\beta$ ’ proportion of profits from new duopolist industries, venture capitalists, and the monopolist bank is invested in the new goods industry. The right hand side of the equation shows the supply side, where  $p_x$  is the price of the new good,  $n$  is the total number of new good industries,  $x$  is the output per industry.

Substituting  $n = \frac{\sigma\theta N}{2}$ , the number of new industries that succeed in the duopolistic market structure, and  $p_x = \frac{A}{x}$  the price of the new good ( where  $A$  represents total revenue and  $x$ , the quantity of new good), we obtain :

$$\beta(1-s)[w_1L_1 + \delta w_1L] + \beta\Pi^{Tdf} + \beta\Pi^{TVC} + \beta\Pi^B = \frac{\sigma\theta NA}{2} \tag{24}$$

At equilibrium the demand and supply sides are equal, hence clearing the market. This yields our first macroeconomic equation.

The second macroeconomic equation balances savings with total investment required in the new goods sector. The total capital requirement,  $K$ , for the new good sector is given by

$$K = \sigma Nk$$

where  $\theta$  is the number of venture capital firms,  $N$  is the number of new firms seeking entry, and  $k$  is the capital requirement per firm. This is equated to the savings of the labor employed in both sectors.

$$s(w_1 L_1 + w_2 L_2) = \sigma Nk \quad (25)$$

$0 < s < 1$ , we assume  $s$  is small. From this, we derive:

$$L_2 = \frac{\theta Nk - s w_1 L_1}{s w_2} \quad (26)$$

After doing some careful substituting of equations, we have:<sup>3</sup>

$$\frac{\beta(1-s)\theta c_1 A k}{s} - \frac{\beta(1-s)\theta c_2 k}{s} + \beta\sigma\theta\epsilon c_1 A^2 - \beta\sigma\theta\epsilon c_2 A - \beta\theta\alpha_1(c_1^2 A^2 + c_2^2 - 2c_1 c_2 A) - \beta\theta u c_1 A + \beta\theta u c_2 - \beta\theta c_1 A(k - V - u)(1 + i) + \beta\theta c_2(k - V - u)(1 + i) = \frac{\sigma\theta c_1 A^2}{2} - \frac{\sigma\theta c_2 A}{2} \quad (27)$$

Further solving this equation yields a quadratic equation in  $A$ , representing the revenue in the new goods industry.

$$A^2 \left\{ \beta\sigma\theta\epsilon c_1 - \beta\theta\alpha_1 c_1^2 - \frac{\sigma\theta c_1}{2} \right\} + A \left\{ \frac{\beta(1-s)\theta c_1 k}{s} + 2\beta\theta\alpha_1 c_1 c_2 - \beta\sigma\theta\epsilon c_2 - \beta\theta u c_1 - \beta\theta c_1(k - V - u)(1 + i) + \frac{\sigma\theta c_2}{2} \right\} - \frac{\beta(1-s)\theta c_2 k}{s} - \beta\theta\alpha_1 c_2^2 + \beta\theta u c_2 + \beta\theta c_2(k - V - u)(1 + i) = 0 \quad (28)$$

We get two positive solutions for  $A$  using quadratic formula solutions, resulting in multiple equilibria. Out of these two equilibrium values only one is chosen based on the stability criterion,<sup>4</sup> i.e. the stale solution is chosen.

In equation (16), we concluded that  $L_1 = \frac{An}{4w_1}$  or  $L_1 = f(A)$  where  $L_1$  is the labor employed in the new good sector,  $w_1$  is the wage of the labor employed in the new good sector,  $A$  is the revenue generated in the new good sector and  $n$  is the number of new good industries. Substituting the value of  $n = \frac{\sigma\theta N}{2}$  gives  $L_1 = \frac{\sigma\theta NA}{8w_1}$ . Hence we can conclude that the amount of labor employed in the new good sector depends positively on the revenue earned in the new good sector i.e.  $\frac{\partial L_1}{\partial A} > 0$ , on the number of firms that the venture capitalists invest in i.e.  $\frac{\partial L_1}{\partial N} > 0$ , on the success parameter of the project i.e.  $\frac{\partial L_1}{\partial \sigma} > 0$  and is negatively influenced by the wages in the new goods sector i.e.  $\frac{\partial L_1}{\partial w_1} < 0$ .

***An implicit result that can be drawn is that the amount of labor in the new good sector is positively related to the number of venture capitalists in the economy i.e.  $\frac{\partial L_1}{\partial \theta} > 0$ .*** Therefore the presence of venture capitalist increases employment in the new good sector.

Substituting the value obtained for the labor employed in the new good sector  $L_1 = \frac{\sigma\theta NA}{8w_1}$  in equation (26) gives the expression for the amount of labor employed in the old good sector i.e.

<sup>3</sup> See Appendix-Note 3

<sup>4</sup> See Appendix-Note 6

$$L_2 = \frac{\theta Nk}{sw_2} - \frac{\sigma \theta NA}{8w_2}$$

To see how the labor employed in the old good sector varies with changes in different parameters we again resort to comparative statics.

Proposition 5- The number of firms that the venture capitalist invests in positively influences the labor demand in the old good sector.

$$\frac{\partial L_2}{\partial N} = \frac{\theta}{w_2} \left[ \frac{k}{s} - \frac{\sigma A}{8} \right] > 0$$

Result 5- Increase in the number of firms that get investment from the venture capitalist increases the amount of labor employed in the old good sector.

Proposition 6- The wages given in the old good sector negatively influence the labor demand in the specific sector.

$$\frac{\partial L_2}{\partial w_2} = -\frac{\theta N}{w_2^2} \left[ \frac{k}{s} - \frac{\sigma A}{8} \right] < 0$$

Result 6- As the wages given in the old good sector increase, the demand for labor in the old sector decreases.

Proposition 7- The capital requirement in the new good sector positively influences the labor demand in the new good sector.

$$\frac{\partial L_2}{\partial k} = \frac{\theta N}{sw_2} > 0$$

Result 7- Increase in capital requirement in the new good sector increases the labor demand in the old good sector.

Proposition 8- The consumer's marginal propensity to save negatively impacts the labor demand in the old sector.

$$\frac{\partial L_2}{\partial s} = -\frac{\theta Nk}{s^2 w_2} < 0$$

Result 8- An increase in the consumer's marginal propensity to save decreases the demand for labor in the old good sector.

Proposition 9- A rise in the success parameter of the investment project decreases the labor demand in the old sector.

$$\frac{\partial L_2}{\partial \sigma} = -\frac{\theta NA}{8w_2} < 0$$

Result 9- As the success parameter of the duopolist's investment project increases, the demand for labor in the old good sector decreases.

Proposition 10- The revenue earned in the new good sector has a negative relation with the labor demand in the old good sector.

$$\frac{\partial L_2}{\partial A} = -\frac{\theta N\sigma}{8w_2} < 0$$

Result 10- An increase in revenue in the new good sector decreases demand for the labor in the old good sector.

Proposition 11- The presence of venture capital positively influences the labor demand in the old sector.

$$\frac{\partial L_2}{\partial \theta} = \frac{N}{w_2} \left[ \frac{k}{s} - \frac{\sigma A}{8} \right] > 0 \text{ because that both } s \text{ and } \sigma \text{ lie between } 0 \text{ and } 1 \text{ as mentioned earlier.}$$

Result 11- *An increase in the number of venture capital firms increases the demand for labor in the old good sector.*

SUMMARY OF RESULTS AND CONCLUSION

The model concludes that the venture capital can contribute to economic growth by financing innovation. By solving our macroeconomic equations, we derive a positive equilibrium revenue in the new goods industry when both venture capitalists and the monopolist bank support a new venture. Maximizing the profit function shows that  $L_1 = \frac{\sigma \theta NA}{8w_1}$ . *This shows that the demand for labor employed in the new good sector is positively related to the number of venture capitalist firms  $\theta$ .* Further solving for the amount of labor employed in the old good sector, we draw an important conclusion that *the number of venture capital firms also increases the demand for labor in the old good industry.*

Therefore we can easily conclude that *the presence of venture capital increases employment opportunities in the entire economy.*

The model also concludes that the profit of the venture capitalist who invests in the new sector is positively related to the success parameter of the project i.e.  $\frac{\partial \pi^{VC}}{\partial \sigma} > 0$ , the amount of investment made by the venture capitalist in the proposed project i.e.  $\frac{\partial \pi^{VC}}{\partial u} > 0$ , the revenue earned by the firm i.e.  $\frac{\partial \pi^{VC}}{\partial A} > 0$  while being negatively related to the amount of investment made by the entrepreneur himself in the project i.e.  $\frac{\partial \pi^{VC}}{\partial V} < 0$  and the cost incurred i.e.  $\frac{\partial \pi^{VC}}{\partial \alpha_1} < 0$ .

As far as the number of firms that the venture capitalists invest in,  $N$ , is concerned, the model concludes that it is positively related to the amount of revenue generated in the new sector i.e.  $\frac{\partial N}{\partial A} > 0$  and the success parameter of the project i.e.  $\frac{\partial N}{\partial \sigma} > 0$ . Also it is negatively related to the cost incurred by the venture capitalist in the investment project i.e.  $\frac{\partial N}{\partial \alpha_1} < 0$  and to the bank mark up i.e.  $\frac{\partial N}{\partial \mu} < 0$ . The model assumes a monopolistic bank but even in the case of a perfectly competitive bank, that charges a lower interest rate, the result holds true

The model therefore demonstrates that the presence of active venture capital is very crucial in employment generation via its positive impact on the new good as well as the old good industry. Therefore it becomes very important to promote them and direct the flow of the savings of the economy towards these venture capital funds. In a labor abundant economy as assumed in the present model, this will help increase employment opportunities.

APPENDIX

1. Note 1

$$Z = \prod_{j=1}^n x_j^{\beta} (\sum_{i=1}^m y_i)^{1-\beta} + \lambda [I - (\sum_{i=1}^m p_1 y_i + \sum_{j=1}^n p_2 x_j)]$$

The first order conditions are

$$\frac{\partial Z}{\partial x_k} = \beta x_k^{(\beta-1)} \prod_{j=2}^n x_j^{\beta} \sum_{i=1}^m y_i^{(1-\beta)} - \lambda p_2 = 0 \tag{a}$$

$$\frac{\partial Z}{\partial y} = (1-\beta) y_1^{-\beta} \prod_{j=1}^n x_j^{\beta} - \lambda p_1 = 0 \tag{b}$$

$$\frac{\partial Z}{\partial \lambda} = I - \sum_{i=1}^m p_1 y_i - \sum_{j=1}^n p_2 x_j = 0 \tag{c}$$

From (a) and (b),

$$\frac{p_1}{p_2} = \frac{(1-\beta) y_1^{-\beta} \prod_{j=1}^n x_j^{\beta}}{\beta x_k^{(\beta-1)} \prod_{j=2}^n x_j^{\beta} \sum_{i=1}^m y_i^{(1-\beta)}}$$

$$\frac{p_1}{p_2} = \frac{(1-\beta)x_j^{n\beta}}{\beta x_k^{(\beta-1)} x_j^{(n-1)\beta} m y_i} = \frac{n(1-\beta)x_j^{n\beta} - (n-1)\beta}{\beta x_k^{(\beta-1)} m y_i}$$

$$\rightarrow \frac{p_1}{p_2} = \frac{n(1-\beta)x_j^\beta}{\beta x_k^{(\beta-1)} m y_i}$$

Since at equilibrium  $x_i = \bar{x}$  and  $y_i = \bar{y}$  amount of each good produced is the same. Hence

$$\rightarrow \frac{p_1}{p_2} = \frac{(1-\beta)n\bar{x}}{\beta m \bar{y}}$$

Upon rearranging, we get  $\bar{x} = \left[ \frac{\beta m p_1}{(1-\beta) n p_2} \right] \bar{y}$  (i)

Substituting the value obtained in the budget constraint i.e.  $I = p_1 m \bar{y} + p_2 n \bar{x}$

we get,

$$I = p_1 m \bar{y} + p_2 n \left( \frac{\beta m p_1}{(1-\beta) n p_2} \bar{y} \right)$$

$$= (p_1 m \bar{y} + p_1 \frac{\beta}{(1-\beta)} m \bar{y}) = p_1 m \bar{y} \left( 1 + \frac{\beta}{(1-\beta)} \right) = p_1 m \bar{y} \left[ \frac{1}{(1-\beta)} \right]$$

$$\rightarrow I = p_1 m \bar{y} \left( \frac{1}{1-\beta} \right) \quad \text{or } \bar{y}^* = \frac{I(1-\beta)}{p_1 m}$$

Substituting this value in (i) gives  $\bar{x}^* = \frac{I\beta}{n p_2}$

2. Note2

$$\frac{\partial \Pi_1}{\partial q_1} = A \frac{\partial \left( \frac{q_1}{q_1 + q_2} \right)}{\partial q_1} - 2W_1 \frac{q_1}{y_1^2} = 0$$

$$\frac{\partial \Pi_1}{\partial q_1} = \frac{A q_2}{(q_1 + q_2)^2} - 2W_1 \frac{q_1}{y_1^2} = 0$$

$$\frac{\partial \Pi_2}{\partial q_2} = A \frac{\partial \left( \frac{q_2}{q_1 + q_2} \right)}{\partial q_2} - 2W_1 \frac{q_2}{y_1^2} = 0$$

$$\frac{\partial \Pi_2}{\partial q_2} = \frac{A q_1}{(q_1 + q_2)^2} - 2W_1 \frac{q_2}{y_1^2} = 0$$

At equilibrium  $q_1 = q_2$ , hence  $\frac{A q_1}{(2q_1)^2} - 2W_1 \frac{q_1}{y_1^2} = 0$

$$\rightarrow \frac{A q_1}{(2q_1)^2} = 2W_1 \frac{q_1}{y_1^2}$$

$$\rightarrow \frac{A q_1}{(2q_1)^2} = 2W_1 \frac{q_1}{y_1^2}$$

$$\rightarrow \frac{A}{4q_1^2} = 2W_1 \frac{1}{y_1^2}$$

Therefore  $q_1 = q_2 = \frac{y_1}{2} \sqrt{\frac{A}{2W_1}}$

3. Note 3

$$\beta(1-s) \left[ w_1 L_1 + w_2 \left( \frac{\theta N k - s w_1 L_1}{s w_2} \right) \right] + \beta \left\{ [\epsilon A - (1+r)(k - V - u)] \frac{V}{V+u} \sigma \theta N \right\}$$

$$+ \beta \left\{ [\epsilon A - (1+r)(k - V - u)] \frac{u}{V+u} \theta \sigma N - \theta \alpha_1 N^2 - \theta u N \right\}$$

$$+ \beta \{ \theta N (k - V - u) [\sigma(1+r) - (1+i)] \}$$

$$= 2 \frac{A}{x} \frac{\sigma \theta N}{2}$$

$$\rightarrow \beta(1-s)w_1L_1 + \beta(1-s)\left(\frac{\theta Nk}{s}\right) - \beta(1-s)w_1L_1 + \beta\sigma N\theta[\epsilon A - (1+r)(k-V-u)]\left[\frac{V}{V+u} + \frac{u}{V+u}\right] - \beta\theta\alpha_1N^2 - \beta u\theta N + \beta\theta N(k-V-u)\sigma(1+r) - \beta\theta N(k-V-u)(1+i) = \frac{\sigma N\theta A}{2}$$

$$\rightarrow \beta(1-s)\left(\frac{\theta Nk}{s}\right) + \beta\sigma N\theta[\epsilon A - (1+r)(k-V-u)] - \beta\theta\alpha_1N^2 - \beta\theta uN + \beta\theta N(k-V-u)\sigma(1+r) - \beta\theta N(k-V-u)(1+i) = \frac{\sigma N\theta A}{2}$$

$$\rightarrow \beta(1-s)\left(\frac{\theta Nk}{s}\right) + \beta\sigma N\theta\epsilon A - \beta\sigma N\theta(1+r)(k-V-u) - \beta\theta\alpha_1N^2 - \beta\theta uN + \beta\theta N(k-V-u)\sigma(1+r) - \beta\theta N(k-V-u)(1+i) = \frac{\sigma N\theta A}{2}$$

$$\rightarrow \beta(1-s)\left(\frac{\theta Nk}{s}\right) + \beta\sigma N\theta\epsilon A - \beta\theta\alpha_1N^2 - \beta\theta uN - \beta\theta N(k-V-u)(1+i) = \frac{\sigma N\theta A}{2}$$

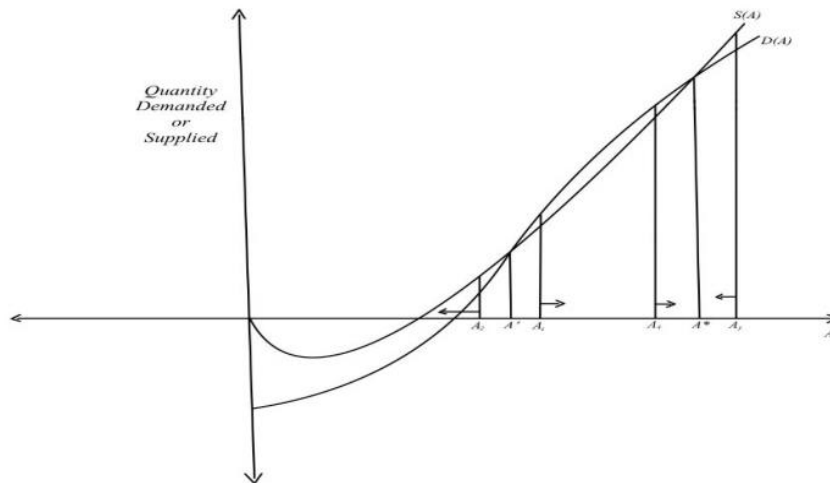
Next substituting the value of  $N=c_1A-c_2$  in the above equation gives

$$\begin{aligned} & \beta(1-s)\left(\frac{\theta(c_1A-c_2)k}{s}\right) + \beta\sigma(c_1A-c_2)\theta\epsilon A - \beta\theta\alpha_1(c_1A-c_2)^2 - \beta\theta u(c_1A-c_2) \\ & \quad - \beta\theta(c_1A-c_2)(k-V-u)(1+i) \\ & = \frac{\sigma(c_1A-c_2)\theta A}{2} \end{aligned}$$

$$\rightarrow \frac{\beta(1-s)\theta c_1 A k}{s} - \frac{\beta(1-s)\theta c_2 k}{s} + \beta\sigma\theta\epsilon c_1 A^2 - \beta\sigma\theta\epsilon c_2 A - \beta\theta\alpha_1(c_1^2 A^2 + c_2^2 - 2c_1 c_2 A) - \beta\theta u c_1 A + \beta\theta u c_2 - \beta\theta c_1 A(k-V-u)(1+i) + \beta\theta c_2(k-V-u)(1+i) = \frac{\sigma\theta c_1 A^2}{2} - \frac{\sigma\theta c_2 A}{2}$$

4. Note 4

It has been depicted below with the help of the graph.



The graph above shows the stability of the equilibrium in the multiple equilibria scenario. On the x-axis we have the revenue generated by the sale of the new good. On the y-ordinate we have the total quantity demanded or supplied of the new good. The upward sloping curve S represents the supply side of the new good. The S-shaped curve D represents the demand side of the new good. When these two curves intersect we get an equilibrium value for the total revenue generated. In our case however we get multiple equilibria since the demand curve intersects the supply curve at two places, at point A' and also at point A\*. To check which of these two is the stable equilibrium, we analyze how the equilibrium in each case behaves when it deviates a little from its position, whether it gets restored back or gets deviated further away. We can see that from point A' if we move towards point A<sub>1</sub>, the demand exceeds the supply. This leads to an increase in the supply price of the new good which increases the entrepreneurs's revenue and hence profits. Hence instead of moving back to the equilibrium value A', the market will move away from it. Similarly if we move from point A' towards point A<sub>2</sub>, the supply will exceed the demand. This in turn will cause a reduction in the price of the new good. As a result the revenue generation will decrease. Hence, again the market will move away from the equilibrium value A'. We therefore conclude that it is not a stable equilibrium.

On the other hand, if we consider the equilibrium value A\*, and from it, move towards point A<sub>3</sub>, the market will revert back to A\*. This is because at point A<sub>3</sub> the supply will exceed the demand which will cause a reduction in the prices and hence in the revenue. Consequently the market will move back to the equilibrium value A\*. Similarly if, from A\* the market deviates to point A<sub>4</sub>, the demand will exceed the supply. This will increase the price and hence generate more revenue so that the original equilibrium A\* is restored. Therefore deviation from A\* in either direction will eventually revert back to it. This establishes the stability of the equilibrium point A\*.

We therefore take A\*, the larger revenue value, to be the equilibrium value for the revenue generated in the new good industry.

$$\text{Coefficient of } A^2 = a_2 = \beta\sigma\theta\epsilon c_1 - \beta\theta\alpha_1 c_1^2 - \frac{\sigma\theta c_1}{2}$$

$$\rightarrow \theta c_1 \left[ \beta\sigma\epsilon - \beta\alpha_1 c_1 - \frac{\sigma}{2} \right]$$

Next substituting the value for  $c_1 = \frac{u}{(u+v)} \frac{\epsilon\sigma}{2\alpha_1}$  we get

$$\text{Therefore Coefficient of } A^2 = \theta c_1 \left\{ \beta\sigma\epsilon - \beta \left[ \frac{u}{u+v} \frac{\epsilon\sigma}{2} \right] - \frac{\sigma}{2} \right\}$$

$$\rightarrow \theta c_1 \left\{ \beta\sigma\epsilon \left[ 1 - \frac{u}{u+v} \frac{1}{2} \right] - \frac{\sigma}{2} \right\}$$

$$\rightarrow \theta c_1 \sigma \left\{ \beta\epsilon \left[ 1 - \frac{u}{u+v} \frac{1}{2} \right] - \frac{1}{2} \right\} < 0$$

This comes from the fact that  $\beta < 1$ ,  $\epsilon < 1$  and the expression  $\frac{u}{u+v} < 1$ .

Coefficient of  $A = a_1 =$

$$\frac{\beta(1-s)\theta c_1 k}{s} + 2\beta\theta\alpha_1 c_1 c_2 - \beta\sigma\theta\epsilon c_2 - \beta\theta u c_1 - \beta\theta c_1 (k - V - u)(1 + i) + \frac{\sigma\theta c_2}{2}$$

$$\rightarrow \theta \left\{ \frac{\beta(1-s)c_1 k}{s} + 2\beta\alpha_1 c_1 c_2 - \beta\sigma\epsilon c_2 - \beta u c_1 - \beta c_1 (k - V - u)(1 + i) + \frac{\sigma c_2}{2} \right\}$$

$$\rightarrow \theta \left\{ \beta c_1 \left[ \frac{(1-s)k}{s} + 2\alpha_1 c_2 - u - (k - V - u)(1 + i) \right] - c_2 \sigma \left[ \beta\epsilon - \frac{1}{2} \right] \right\}$$

Next substituting the value for  $c_1 = \frac{u}{(u+V)} \frac{\epsilon\sigma}{2\alpha_1}$  and

$$c_2 = \frac{\mu(1+i)(k-V-u)\frac{u}{V+u}}{2\alpha_1} + \frac{u}{2\alpha_1}, \text{ we get}$$

$$\rightarrow \theta \left\{ \beta \frac{u}{(u+V)} \frac{\epsilon\sigma}{2\alpha_1} \left[ \frac{(1-s)\sigma k}{s} + \mu(1+i)(k-V-u)\frac{u}{V+u} + u - u - (k-V-u)(1+i) \right] - \left[ \frac{\mu(1+i)(k-V-u)\frac{u}{V+u}}{2\alpha_1} + \frac{u}{2\alpha_1} \right] \sigma \left[ \beta\epsilon - \frac{1}{2} \right] \right\}$$

Therefore Coefficient of A =

$$\theta \left\{ \beta \frac{u}{(u+V)} \frac{\epsilon\sigma}{2\alpha_1} \left[ \frac{(1-s)\sigma k}{s} - (1+i)(k-V-u)\left(1 - \frac{u}{V+u}\mu\right) \right] - \left[ \frac{\mu(1+i)(k-V-u)\frac{u}{V+u}}{2\alpha_1} + \frac{u}{2\alpha_1} \right] \sigma \left[ \beta\epsilon - \frac{1}{2} \right] \right\} > 0$$

This result is based on our assumption that the marginal propensity to save  $s$  of the consumers is very small. As such the expression  $\frac{(1-s)k}{s}$  turns out to be very big in value in comparison to the other terms in the above equation and hence the overall expression turns out to be positive.

Coefficient of the Constant term =  $a_0 =$

$$-\frac{\beta(1-s)\theta c_2 k}{s} - \beta\theta\alpha_1 c_2^2 + \beta\theta u c_2 + \beta\theta c_2(k-V-u)(1+i)$$

$$\rightarrow \beta\theta c_2 \left\{ (k-V-u)(1+i) - \frac{(1-s)\sigma k}{s} - \alpha_1 c_2 + u \right\}.$$

Again substituting the values for  $c_1 = \frac{u}{(u+V)} \frac{\epsilon\sigma}{2\alpha_1}$

$$\text{and } c_2 = \frac{\mu(1+i)(k-V-u)\frac{u}{V+u}}{2\alpha_1} + \frac{u}{2\alpha_1} \text{ we get}$$

$$\beta\theta \left[ \frac{\mu(1+i)(k-V-u)\frac{u}{V+u}}{2\alpha_1} + \frac{u}{2\alpha_1} \right] \left\{ (k-V-u)(1+i) - \frac{(1-s)k}{s} - \frac{\mu(1+i)(k-V-u)\frac{u}{V+u}}{2} - \frac{u}{2} + u \right\}$$

Therefore Coefficient of the Constant term =

$$\beta\theta \left[ \frac{\mu(1+i)(k-V-u)\frac{u}{V+u}}{2\alpha_1} + \frac{u}{2\alpha_1} \right] \left\{ (k-V-u)(1+i) \left[ 1 - \left( \frac{u}{V+u} \right) \left( \frac{\mu}{2} \right) \right] + \frac{u}{2} - \left[ \frac{(1-s)k}{s} \right] \right\} < 0$$

Here again use is made of the assumption that the marginal propensity to save of the consumers is very small which makes the expression  $\frac{(1-s)k}{s}$  very huge in value. With a negative sign before it, the expression now becomes negatively huge enough as compared to the other terms in the above equation and hence the whole expression becomes negative.

Since the coefficients of  $A^2$  and the constant term are negative and the coefficient of  $A$  is positive and since the given equation is assumed to have real roots, the roots are positive and are given by

$$A = \frac{-a_1 \pm \sqrt{a_1^2 - 4a_2a_0}}{2a_2}$$

We take the larger root i.e.

$$A = \frac{-a_1 + \sqrt{a_1^2 - 4a_2a_0}}{2a_2}$$

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