

Chapter III

Theory

As it has been explained earlier, there are three schools dealing with the effect of uncertainty on economy and investment: traditional finance, neo-classics and post-keynesians. Because the traditional finance and neo-classics are very close in terms of their definitions and attitudes toward uncertainty hence, I will unify them into one group (to be labeled as neo-classics now on) which will be compared with post-Keynesians. According to the neo-classical point of view, price signals provide information about objective probabilities, and expectations can be shaped through analysis of probabilities determined from past data. It treats expectations as a determinant of gambling, and explains how we can evaluate it on the basis of a population parameter estimated by a probability determined from a sample.

Estimation of the frequency distribution of the population can provide a reliable prediction about the future according to the neo-classical school, because the pattern of occurrence of events is assumed to be constant over time. We can then calculate the expected value of a random variable and use it to make rational investment decisions to maximize net wealth. In this method, probabilistic risk and uncertainty have been considered synonymous. With regard to this definition, Modigliani and Miller (1958) have calculated the market price associated with uncertain streams. Uncertainty is incorporated as a supplement to the certain interest rate in the form of a risk premium in order to determine the cost of capital. In order to maximize his wealth, a rational investor invests so that the marginal yield of his capital is equal to the risk adjusted cost of capital. In this analysis more uncertainty

will lead to a higher risk premium and therefore higher cost of capital. Hence, investment will be decreases.

Keynes and post-Keynesians separate their approach from the neo-classical approach by a different definition of uncertainty. As Kregel (1998) argues:

An obvious criticism is that the uncertainty faced in real life is unlike the uncertainty over outcomes of games of chance, because there is no possibility of random sampling with replacement. ...if the underlying population is not constant, there is no possibility of forming a sample statistic based on expectation of the frequency distribution, irrespective of whether there is sampling with replacement at a given point in time and no expectation of the likely occurrence of specific realizations can be formed on the basis of standard statistical methods.

Each event in time occurs due to a decision of an agent when he is confronted with what Kregel (1999) calls (quoting from Frank Knight) a ‘*unique situation*’. Furthermore, individuals might make a mistake either due to inadequacy of information or due to their limited computational ability to deal with a large number of possibilities. As, agents cannot optimize correctly, the scope and accuracy of their analyses is always restricted (Arestis, 1996). Arestis concludes that the past is immutable and the future is blurred and unknowable. Probability analysis is reliable when we have a statistical process in which the average calculated from the past events is not persistently different from the time average of future outcomes (Davidson, 1991). We can have this process when economic conditions are produced by natural laws. According to Kregel and Nasica (1999):

If there are ‘natural’ or ‘objective’ laws producing current economic conditions, independently of agents’ expectations, then there will be objective

probability distributions which can be estimated with increasing certainty by standard statistical procedures. But the real point of difficulty concerns the existence of the natural law, the specification of the objective process generating the results, which expectations would reflect, not with the process of predicting them.

Because economic decisions are taken on the basis of human expectations, relevant variables might not be governed entirely by a natural law. Thus, we cannot shape future expectations purely on the basis of past observations. Thus, Davidson (1991) explains that objective probabilities and rational expectations may be adequate for estimation in some area of economic decision-making but they cannot be seen as constituting a general theory. Hence we can define an uncertain situation as a condition about which we do not know anything and it is distinctly different from a risky situation, which is characterized by a probability distribution over a few events. In this condition, rationality of the agent is expressed through the formulation of a probability distribution which is based on uncertain information and doubtful arguments, or the depiction of animal spirits (Kregel, 1987)¹.

Kregel (1987) expresses rationality on the lines suggested by Keynes by saying that rational agent responds to uncertainty through use of money as a store of value where the price of money is determined by the effect of uncertainty on liquidity preference. Davidson (1991) demonstrates that liquidity preference exists because of the social institution of money and law of civil contracts: in an uncertain world where liabilities are enforceable only in terms of money, entrepreneurs have to form sensible

¹ - According to Farmer (2007) the term “animal spirits” is associated with John Maynard Keynes (1936) and captures the idea that aggregate economic activity might be driven in part by waves of optimism and pessimism.

expectations about the certainty of future cash flows. Entrepreneurs limit their contracts and liabilities to what they believe their liquidity position can survive. They do not make any significant decisions involving real resource commitments until they are sure of their liquidity position, so that they can commit their responsibilities over time. The use of overlapping money contracts helps entrepreneurs to cope with uncertainties through a manipulation of their cash flow position over time. Therefore, they do not choose to have more of their resources, than what they need, in the form of fixed capital goods. They have to maintain their assets in the form of money, even though they know well enough that the future money value of their capital would be higher than its present money value (Kregel, 1988). Thus, the need is for liquid assets instead of assets in the form of fixed physical capital. Kregel (1983) explains that:

Keynes represented the complex of expected rates of return on investment in capital assets by the marginal efficiency of capital [and] the expected returns on money by the liquidity premium. The rate of return on financial assets would, by definition, equal the liquidity premium; otherwise, agents would prefer to hold money.

The idea of marginal efficiency of capital is based on the calculation of the return on an investment project like the yield at maturity of a fixed coupon bond. The efficiency of capital calculates the rate of discount that equates the purchase price of the investment to the present value of its expected future net receipts. But, Kregel (1999) criticized this method in some aspects:

1. It assumed that reinvestment rate of interest is known and constant which means the risk of investment is constant over time.
2. It fails to deal with the fact that bonds and investment projects differ in the certainty over the size and shape of the future net receipts.

3. When there is variation in expected future flows or fluctuations in interest rates, there may be multiple internal rates of return.
4. The final and most important reason is that difficulties surrounding the calculation of the present value of future flows from a project remain because receipts from a bond coupons are perfectly known but the periodic net proceeds of an investment are not.

Then Kregel (1999) demonstrates that the method of the user costs of capital might be a better idea for evaluation an investment project. The user costs often represents the difference between the current costs of producing relative to the maintenance costs of keeping them idle. But, this definition of user cost does not express the influence of the future on the present. Keynes tried to fix this problem. It is well known that the involvement of the entrepreneur in the process of production makes him pay money for the employment of factors. And usage of money includes interest rate in our calculation as the user cost of money. Thus, the production decision is a choice among options on the basis on their profitability.

There is a profitable arbitrage trade in buying spot and selling forward where forward prices exceed spot prices by more than the carrying costs (Kregel, 1999)¹. Ultimately the forward price will finally converge to the spot price plus the carrying costs (including interest rate). Thus, the spot and forward price structure brings into equilibrium the relative benefits for holding money and other types of wealth. Hence, the maximum profit in terms of money is a guide for the entrepreneur to select among alternative opportunities with regard to the spot and forward price structure as a whole. Thus, forward prices can be considered as present value of the net sum

¹ - If merchandise is held to be sold in the future, this is involved in costs of storage, financing, insurance, transportation and so on. The carrying costs refers to this kind of costs.

received per unit of output. If the return from the current production and sales at the forward price is greater than the return gained from buying existing output at the prevailing spot price and holding it for sale at the expected price at a finite date then the agent decides to be involved in production. Decision about investment requires a precise calculation about his costs. This includes expenditures of fixed and variable factors plus the sacrifice, which he incurs by utilizing the equipment instead of leaving it idle. This sacrifice can be named as user cost. The user cost is thus the present value of the receipts that could have been earned if we delay selling the merchandise to a future date. Kregel acknowledges that there are two criticisms of this approach. The first criticism is about nonexistence of future markets and the second is the subjectiveness of expectations in this method.

Kregel argues that usage of the option-pricing model can help to remedy these deficiencies. The option pricing theory allows the value of options to be fixed without the existence of real markets to set a price. Therefore, instead of adjusting the supply prices with user cost, it could be adjusted by showing the impact of future on the present through a proper index that calculates values of the embedded options. If a commodity is purchased today in order to sell in the future, interest costs will be incurred to finance the spot purchase. If expected future prices exceed current spot prices by more than the interest rate, there is a profit in buying spot and holding for forward sale. Hence, there is profitable arbitrage trade in buying spot and selling forward. This will ultimately bring the spot and forward prices into a relationship in which the market forward price is given by the current spot price and the carrying costs which is determined by the rate of interest and convenience yield. The calculation of present values requires the specification of future prices discounted at the rate of interest. Therefore, the future prices are given by the ratio of the spot prices

plus the inclusive carry costs to unity plus the rate of interest. Thus, we do not need to formulate expectations about future prices as we have spot prices and the rate of interest. As is well known, standard deviation is needed to calculate the option values. This is the variable which is not presented in current prices and is unknown according to the post-Keynesian approach. As Kregel accepts, the usage of volatility contradicts post-Keynesian methodology.

According to Kregel and Nasica (1999) when an entrepreneur has to make a decision about an investment with long period flows, he falls back on his common sense as reflected in the actual observation of markets and business psychology rather than on the calculation of probabilities. The entrepreneur considers his past experience and may presume that status quo will continue, unless there is a reason to expect a change. There might be cases in which there is a lack of information and reliability of individual judgments. Here he relies on the judgment of the rest of the world (which he considers better informed) through what Keynes called as '*convention*'.

To sum up, there could be three environments in which the investment decision has to be made: certainty, risk and uncertainty. Under certain conditions Jorgenson's method (1963) is adequate for determination of the optimal extent of investment. Investment is made till that the marginal value of product of capital is equated to the user cost of capital. In a risky environment, the probabilities of occurrence of a particular event are known. Thus, the values of risky streams are defined in terms of expected values of probabilistic receipts. There is a puzzle about the mechanism and sign of the effect of risk¹ on investment in the neo-classical school as I mentioned in chapter one. However, according to the traditional finance, it must

¹ - According to the neo-classical school, risk and uncertainty means equivalently.

be added as *risk premium* to the discount rate. But, under uncertain circumstances that future is blurred. The post-Keynesian school tries to find an answer for investment behavior as has been discussed above.

Apart from the fact that the main problem of prediction of future receipts has remained in post-Keynesian analysis (e.g. the existence of future market for all goods or contradiction in usage of the standard deviations for calculation of option prices), there is a problem in the interpretation of uncertainty when it is generalized as a unique and absolute phenomenon across the world. If we accept that behavior of individuals is unpredictable or there is a lack of information to the same extent all around the globe, then, we must expect that we observe a unique chaotic world in which there is no difference between U.S. and Zimbabwe. It seems the real world exists somewhere between two extreme of neo-classics and post-Keynesians.

There are different sorts of beliefs, attitudes, cultures, laws and other institutions in countries, which determine the availability and reliability of information as well as its predictability. This difference in uncertainty is captured by the words of an Iranian saffron exporter interviewed by television in a trade fair in Spain: “ Here Spanish firms are giving their prices for five years. I am calling four times to Iran everyday and I hear that prices have changed each time. You will see that nobody will enter into a contract with us”.

The quality of institutions in each country provides what Keynes (1936) describes as ‘ *a considerable measure of continuity and stability in our affairs*’ to make ‘*the state of confidence*’ on the basis of which we can trust our most probable forecasts. It seems we confront a quasi-predictable world in a sense that there is a time horizon within which entrepreneurs rely on their information and predictions to make decisions. What is beyond this time horizon is the unknown world of uncertainty that

entrepreneurs do not want to step in. The length of the time horizon differs in each country depending on its institutions. The higher the uncertainty, the more unpredictable the future, and therefore, shorter the time horizon. This implies that increasing uncertainty will lead to a riskier environment. However, the entrepreneur considers predictions to be valid only within a restricted period in this risky environment.

But how can we calculate the time horizon? Suppose, $\phi(\tau)$, $0 \leq \tau < \infty$ is the output price at time τ and follows a geometric Brownian motion with drift parameter μ and volatility parameter σ . Let Δ denote a small increment of time. Assume that current price of output $\phi(0)$ is known. With the passage of Δ units of time the price of output either goes up by the factor u with probability P or goes down by the factor d with the probability $1-P$.

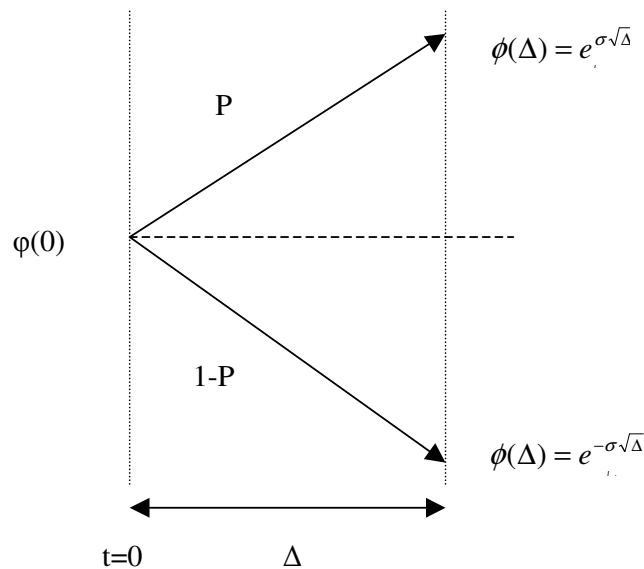


Figure 3.1

As a property of the geometric Brownian motion model u , d and P are calculable and are equal to (see Ross, 1999):

$$u = e^{\sigma\sqrt{\Delta}} \quad , \quad d = e^{-\sigma\sqrt{\Delta}}$$

$$P = \frac{1}{2} \left(1 + \frac{\mu}{\sigma} \sqrt{\Delta} \right)$$

However, I will explain later that we need not have any knowledge about probability distributions governing movements of prices in our analysis. The possible price movements are shown in figure-3.1. From the past we know how price has fluctuated over time. But given existing institutions (e.g. market forces, laws, etc.), the extent of these fluctuations has never gone beyond an upper and lower bound in a way such that $\sigma \propto L$ where L is the difference between the two bounds. This condition is indicated in figure-3.2.

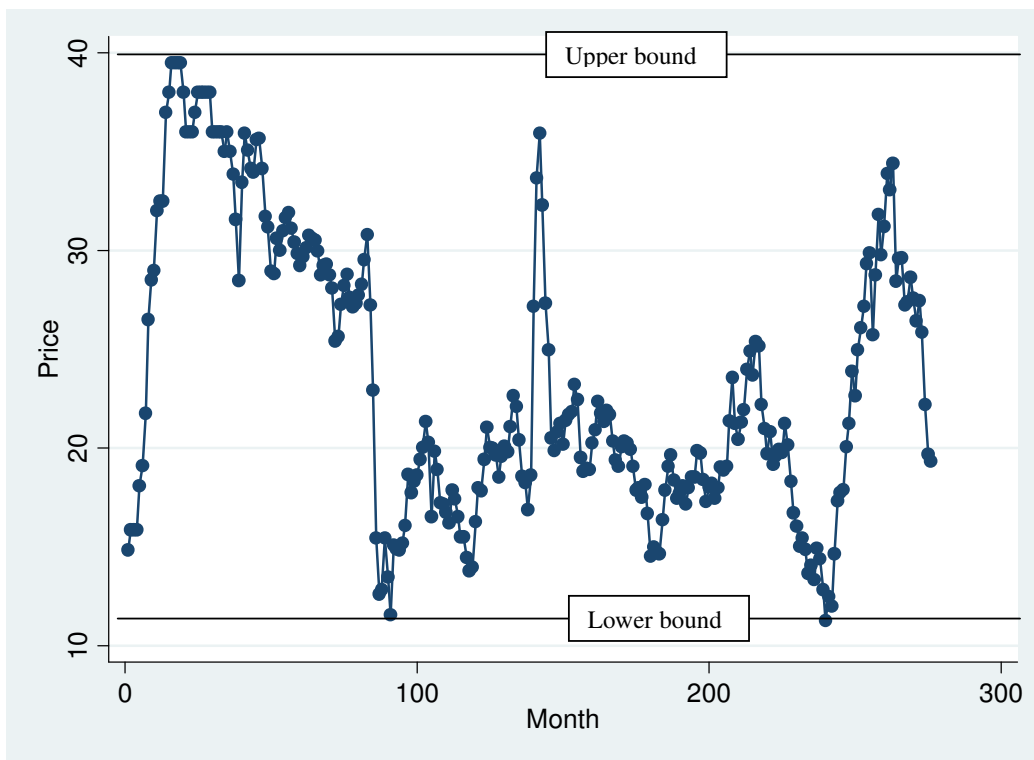


Figure 3.2

We know that with current institutions, in each increment, price can shift with a limited movement up or down. If for simplicity we suppose that $\Delta = 1$, then price goes up to:

$$\varphi(t+1) = \varphi(t) \times e^{\sigma} \quad (1)$$

or comes down to:

$$\varphi(t+1) = \varphi(t) \times e^{-\sigma} \quad (2)$$

Now suppose a carmaker wants to design and produce a car, and he does not know where it will be driven. It can range from the highways of Germany to rough mountain roads around the Himalayas. This carmaker never considers an average of these probable roads for a proper design; instead, he tries to design a car, which can survive in the worst circumstances. In the same way an entrepreneur in an uncertain environment, follows a best worst strategy (he considers the worst movement of price and calculates whether under this trend, the project can survive or not) instead of making a mathematical expectation of all probable movements. Thus, he assumes for the purpose of designing the car the future price to decrease by an amount given by equation (2). These price movements under the worst case scenario are indicated in figure-3.3.

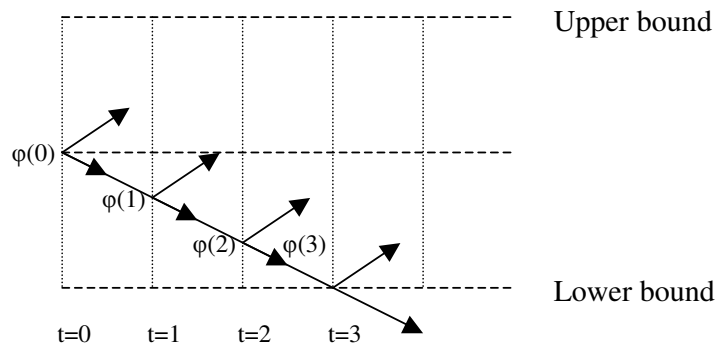


Figure 3.3

Therefore, for instance, prices will attain $\phi(1)$, $\phi(2)$ and $\phi(3)$ at $t=1$, $t=2$ and $t=3$ respectively where $\phi(3)$ equals their lower bound. What will happen thereafter? Under this assumption the price is compatible with profitability for $t \leq 3$ but not thereafter. With the existing institutions, in the past prices have never become lower than the lower bound for any given period. But there is no guarantee that for $t > 3$ the price will go up. We simply do not know what will happen next. This is the border between the world of risks and uncertainties.

Consider a firm that produces one unit of merchandise in each period and there is no variable cost. B_L denotes the lower bound to price. Critical period, t^* , is determined as follows:

$$\phi(0)(e^{-\sigma})^{t^*} = B_L$$

Therefore critical period t^* will be:

$$t^* = \frac{1}{\sigma} \ln\left(\frac{\phi(0)}{B_L}\right) \quad (3)$$

From (3) the critical period is decreasing in σ i.e. more unpredictability of the prices will lead to the reduction in the time horizon within which the entrepreneur can rely on his information and forecasts. The entrepreneur calculates the discounted payback period for his project as follows:

$$\int_{\tau=0}^{\tau=t} \phi(\tau) e^{-(\sigma+r)\tau} d\tau = I_t \quad (4)$$

where r is the discount rate and is considered constant by assumption. If the payback period t calculated by equation (4) is greater than t^* , then the project will be rejected. Projects with payback period equal to or less than t^* will be candidates for acceptance.

For instance, consider a project with $\phi(0) = 100$, $\sigma = 0.3$, $I_0 = 244$, $r = 0.06$ and lower bound of price is $B_L = 30$ and length of a period equal to a year. Assume that

there is no variable cost and one unit of output is produced each year. According to equation (3) we will have:

$$t^* = \frac{1}{0.3} \ln\left(\frac{100}{30}\right) \approx 4$$

Then, we should calculate the adjusted payback period for this project in the worst circumstance. With respect to equation (4) we can calculate t as follow:

$$\begin{aligned} \int_0^t 100e^{-(0.3+0.06)\tau} d\tau &= 244 \\ \Rightarrow -\frac{100}{0.36}(e^{-0.36t} - 1) &= 244 \\ \Rightarrow t &= 2.11 \end{aligned}$$

As $t < t^*$, the project will qualify as a candidate for acceptance.

If variance decreases with time, which means we can have more precise predictions of the future (maybe because of an improvement in institutions) then, the line of price trends turn inside from 1 to 2 in figure-3.4. Because price will decrease more slowly than before it reaches its critical level the critical time period for any given project will be higher i.e. more investment can be incurred and more projects can be accepted.

If variance increases with the time in a way that does not affect previous bounds, the line of price trends turns outside from 1 to 3 in figure-3.4, because prices decrease more rapidly than before. As the critical period occurs sooner (say $t = 1$ in figure-3.4), there will be a tendency to pick fewer projects – those with lower fixed costs and affording more liquidity (e.g. non producing businesses like those of intermediaries which sometimes need just a cell phone as fixed cost). Therefore, not only the quantity but also the quality of investment projects will change.

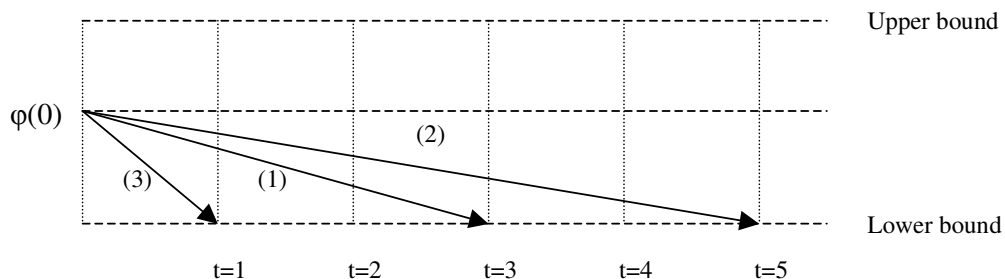


Figure 3.4

Assume that fluctuations increase in a way that widen the gap between upper and lower bound (e.g. from L_1 to L_2 in figure-3.5). At first such fluctuations do not result in a revision of the variance significantly. Therefore, the entrepreneur initially increases his investment and accepts projects with a longer payback period (e.g. it changes from $t = 2$ to $t = 4$ in figure-5) because he thinks that his projects would have more time to survive.

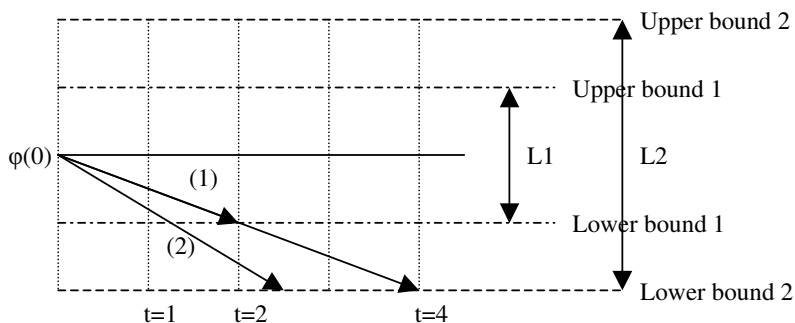


Figure 3.5

But, when these fluctuations gradually continue they can increase variance and generate a wave of pessimism among entrepreneurs, reducing their confidence in their predictions. The line of price trends turns outside (e.g. from 1 to 2 in figure-3.5), reducing the critical period as well as investments. As figure-3.5 shows the critical point with lower and upper bound 1 is reached in $t = 2$. When the range shifts to L_2

then critical period increases to $t = 4$ implying that investment will increase. But the extent to which the critical period decreases after an increase in σ will depend on the changes in L and σ . It could be greater or smaller than the initial extent of decrease.

We can combine equations (3) and (4) with the interpretation that we will accept the projects in which future discounted cash flows are at least equal to the initial investment in the critical time period. From equation (4) we will have:

$$\int_{\tau=0}^{\tau=t^*} e^{-(\sigma+r)\tau} d\tau = \frac{I_t}{\phi(t)} \quad (5)$$

As we assume that quantity of output is I in each period, therefore $\frac{I_t}{\phi(t)}$ is the rate of investment at t and is denoted by i_r hereafter. Solving the integral for τ will yield:

$$i_r = \frac{1}{\sigma + r} (1 - e^{-(\sigma+r)t^*}) \quad (6)$$

Aggregating continuously over N individuals in each period of time, from equation (4) we will have:

$$\int_{i=0}^N I_{it} di = \int_{i=0}^N \int_{\tau=0}^{t^*} \phi_i(t) e^{-(\sigma+r)\tau} d\tau di \quad (7)$$

For simplicity we eliminate r . $\frac{\phi_i(t)}{B_{Li}}$ is the value of current output deflated by the lowest level of prices in the past. I denote it by y_{it} and it can be supposed, for simplicity that y_{it} , risks and level of price at time t are equal for different individuals in different sectors so that $\sigma_i = \sigma$, $y_i = y$ and $\phi_i(t) = \phi(t)$. Therefore, the time horizon for each individual and for the entire economy can be assumed to be a unique value t^* ¹. Thus, from equation (7) we have:

¹ - This means that $T^* = t^*$.

$$\int_{i=0}^N I_{it} di = \int_{i=0}^N \int_{\tau=0}^{\tau^*} \phi(t) e^{-\sigma\tau} d\tau di \quad (8)$$

$$\Rightarrow \int_{i=0}^N I_{it} di = N\phi(t) \frac{(1 - e^{-\sigma\tau^*})}{\sigma}$$

$$\frac{\int_{i=0}^N I_{it} di}{N\phi(t)} = \frac{1 - e^{-\sigma\tau^*}}{\sigma} \quad (9)$$

The left hand side of equation (9) is the smallest ratio of aggregate investment to aggregate current product and is denoted by I_R . Thus, we have

$$I_R = \frac{1 - e^{-\sigma\tau^*}}{\sigma} \quad (10)$$

Equation (10) is very similar to equation (6) except that the cost of capital is eliminated. Substituting equation (3) in (10) will yield

$$I_R = \frac{1 - y_{it}^{-1}}{\sigma} \quad (11)$$

where y_{it} is $\frac{\phi_i(t)}{Lb_i}$ as mentioned above. The rate of investment is a function of σ and y_{it} .

It implies that higher levels of output price will increase the investment rate whereas increasing uncertainty decreases the investment rate.

It can be shown that I_R is non-increasing in σ for $\sigma > 0$. From equation (11) we have

$$\frac{\partial I_R}{\partial \sigma} = -\frac{1 - y_{it}^{-1}}{\sigma^2} \quad (12)$$

As $y_{it} \geq 1$, (12) is non-positive.

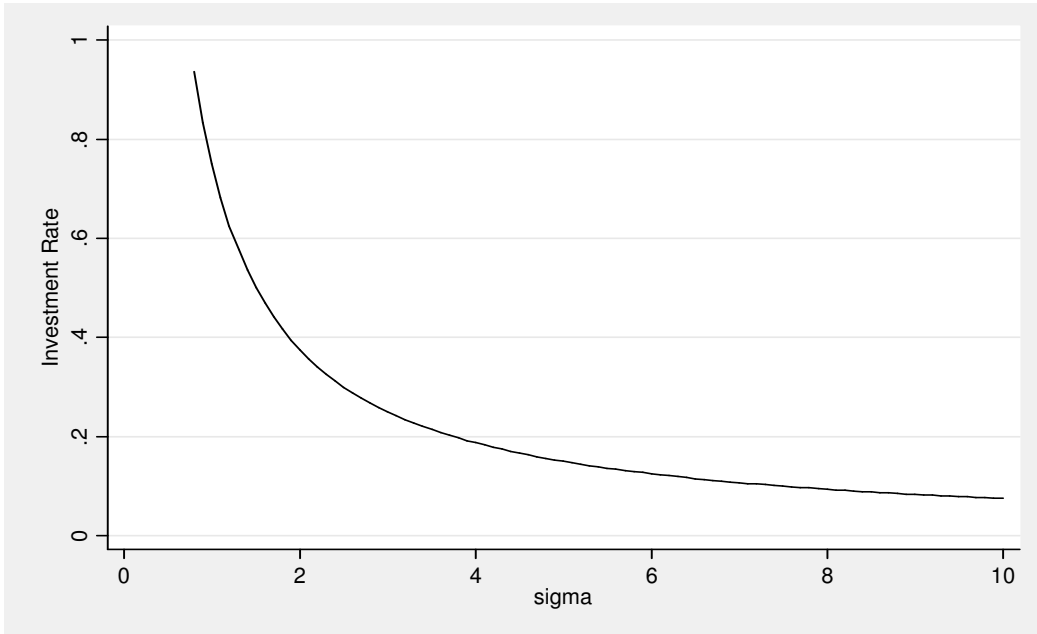


Figure 3.6

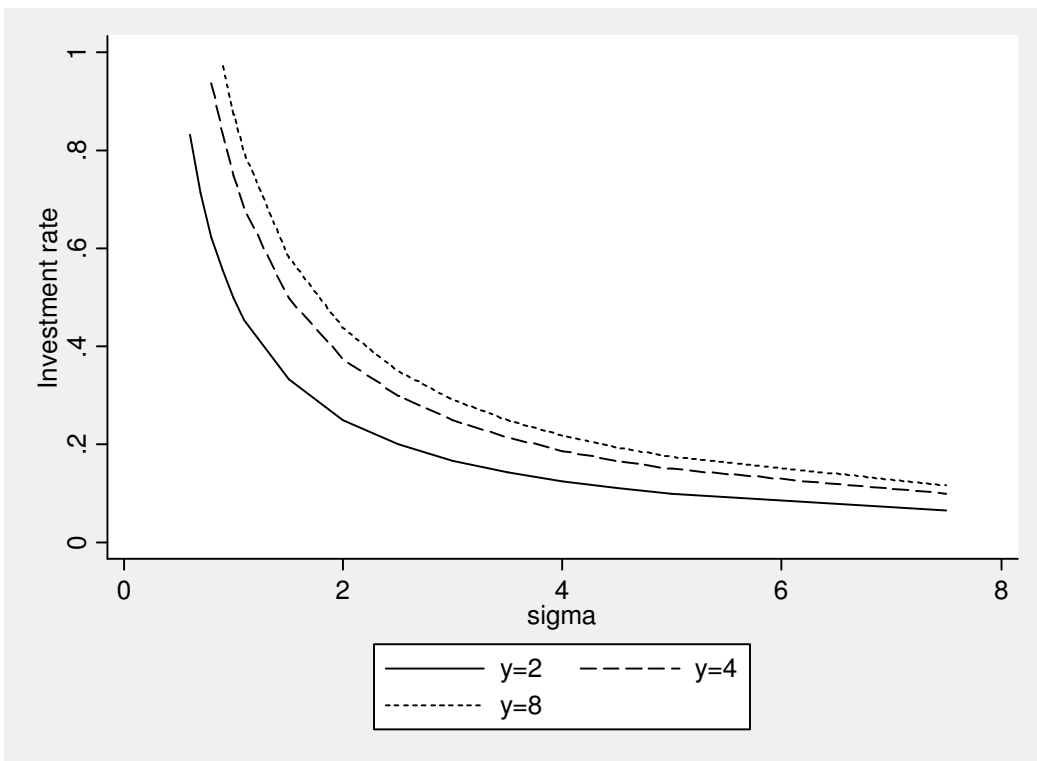


Figure 3.7

Figure-3.6 shows the changes in I_R that accompany changes in σ for $y=4$. Note that I_R cannot become greater than one because we cannot invest more than our income and it is a nonnegative amount. As is clear in figure-3.6 the investment rate is decreasing in σ . Figure-3.7 indicates that a higher y due to a higher level of current price or reduction in lower bound (B_L) will increase the rate of investment at any given level of uncertainty.

In conclusion, with the existing institutions in a country there would be a time horizon within which investors could rely on their information and predictions. This time horizon could be different from one country to another depending on institutions and institutional changes over time. Increasing uncertainty will reduce this time horizon. This means that investors will expect that current price might reach the lower bound sooner. Hence, not only will investment decrease but it will also be biased toward the more liquid projects in composition.