Uncertainty and investment in private sector: An analytical argument and a review of the economy of Iran

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UNCERTAINTY AND INVESTMENT IN PRIVATE SECTOR:

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Acronyms

AR	Auto Regressive
ARDL	Auto Regressive Distributed Lag
CAPM	Capital Asset Pricing Model
COW	Correlates of War
DL	Distributed Lag
EHII	Estimated Household Income Inequality Dataset
FEVD	Fixed Effects Vector Decomposition
FGLS	Feasible Generalized Least Square
ICPSR	Inter-University Consortium of Political and Social Research at the University of Michigan
LDV	Lagged Dependent Variable
LSDV	Least Square Dummy Variable
MA	Moving Average
OLS	Ordinary Least Square
OPEC	Organization of Petroleum Exporting Countries
PCSE	Panel Corrected Standard Errors
SSE	Sum of Squares of Errors
TSCS	Time Series-Cross Section
UNIDO	United Nations Industrial Development Organization
UTIP	University of Texas Inequality Project
VIF	Variance Inflation Factor

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Chapter I

Introduction

1.1- Introduction

The bearing of uncertainty and instability on private investment, an issue of concern for policy-makers, has been given considerable attention in the analytical and empirical literature. The issue is important owing to the fact that the lessening of extended poverty and unemployment on the one hand and the achievement of sustainable development on the other hand depends on the increase in private investment. The World Development Report (World Bank, 2005b) says:

Private firms—from farmers and micro-entrepreneurs to local manufacturing companies and multinational enterprises—are at the heart of the development process. Driven by the quest for profits, they invest in new ideas and new facilities that strengthen the foundation of economic growth and prosperity. They provide more than 90 percent of jobs, creating opportunities for people to apply their talents and improve their situations. They provide the goods and services needed to sustain life and improve living standards. They are also the main source of tax revenues, contributing to public funding for health, education, and other services. Firms are thus critical actors in the quest for growth and poverty reduction.

Recent studies have shown that private investment is more efficient and productive than public investment (Serven and Solimano, 1991 and Kahn and Reinhart, 1990). For the same reasons, public investment cannot adequately resolve the aforementioned problems. Due to mismanagement, public enterprises are plagued

by inefficiency. World Development Report (2005) has quoted from Pinheiro et al. (2001) that growth without an enhanced private sector is possible but unlikely to be sustained. For instance, Pinheiro et al. characterize Brazil in the 1960s and 1970s:

They experienced strong growth while closing domestic markets to international competition and pursuing ***heavy public investment*** *through state-owned enterprises. The initial results were impressive, but the growth proved unsustainable. Protected firms lacked the incentives to improve their productivity and fell further behind international best practices. Other firms had less access to new technologies and had to pay higher prices for inputs supplied by protected sectors. Public investment to sustain growth led to severe debt problems— and ultimately to a macroeconomic crisis.*

Thus, the public sector not only is incapable of providing a permanent solution to problems but also adds to other difficulties. Conversely, private sector is driven by economic incentives. The significance of profitability constrains them to use scarce resources in the best way for production and investment; this often paves the way for an increase in employment, reduction of poverty, sustainable development and growth.

But, how should the private sector be encouraged to invest more? What causes differences in country wise participation of private sector in investment? Table-1.1 indicates private investment (percentage of GDP) and GDP per capita (constant 2000 U.S. $) in 1980, 1990 and 1999 for six countries. It shows that in 1980, Argentina had the same private investment rate as Malaysia, but 4 times the per capita GDP. In this year, Iran at six times the per capita GDP of India had the same private investment rate. In 1990, Malaysia with 50% of the per capita GDP of Argentina had 2.3 times the private investment rate. Simultaneously, South Africa at ten times per capita GDP

of India had a lower rate of private investment. There is an analogous comparison between Argentina and China in 1999. In 1999, India with a lower per capita GDP than Iran, Malaysia and South Africa had a higher rate of private investment. In 1999 Argentina had a lower private investment rate than in 1980 despite a higher per capita GDP.

Table-1.2 shows nominal and real interest rates and share of private investment in China and India for 1980, 1990 and 2000. China has increased 4.6 times the private investment rate despite a 6.8 times growth in its real interest rate between 1980 and 1999. Similarly, we observe an increase in the private investment rate in India in spite of the growth in the real interest rate in this period. Furthermore, private investment does not show reasonable reaction to nominal rate fluctuations from 1980 to 1990 and from 1990 to 2000. As Modigliani and Miller (1958) mention: "*at the macroeconomic level there are ample grounds for doubting that the rate of interest has as large and as direct an influence on the rate of investment…"*

	Year					
	1980		1990		1999	
	GDP per capita	Private Investment	GDP per capita	Private Investment	GDP per capita	Private Investment
Argentina	7551	19.2	5643	9.4	8062	16.1
China	173	3.7	364	8.3	798	17
India	222	10.1	316	13.9	440	14.9
Iran	1278	11.4	1196	8.5	1460	13
Malaysia	1848	19.5	2498	20.9	3653	11.3
South Africa	3436	13.3	3058	12.9	2881	10.3

Table 1.1- Comparison of GDP per capita and private investment rates among selected countries.

Initial theories of private investment emphasized the importance of reduction of interest rate and increase in output as channels in encouraging private investment. Keynes (1936) explicitly demonstrates that investment will occur to the level at which marginal efficiency equals the current rate of interest. Hence, a decrease in the rate of

interest will increase investment. The flexible accelerator model is the departure point from a handful of investment behavior theories. Flexible accelerator mechanism shows that

$$K_t - K_{t-1} = [1-\lambda][K_t^* - K_{t-1}]$$

Denoting the level of capital in period t by K_t and the desired level of capital by K^*_t , capital is adjusted toward its desired level by a fraction of the difference between desired and actual capital in each period. If δ denotes the rate of replacement then we can have

$$I_t = [1-\lambda][K_t^* - K_{t-1}] + \delta K_{t-1} \qquad (1)$$

Accelerator theory, liquidity theory, expected profit theory differ in specification of the desired level of capital[1]. However, Jorgenson (1963) mentions that:

It is difficult to reconcile the steady advance in the acceptance of the neoclassical theory of capital with the steady march of the econometric literature in a direction which appears to be diametrically opposite…Both profits and capacity theories have tried a rate of interest here or a price of investment goods there. By and large these efforts have been unsuccessful.

In their search for an econometrically significant model, Jorgenson (1963) and Jorgenson and Siebert (1968 a, b) formulated a new neoclassical theory for investment. In this theory the desired capital stock is equal to the value of output deflated by the price of capital services where the later is denoted by C_t:

$$C_t = \frac{q_t}{(1-u_t)}[(1-u_t w_t)\delta + r_t - \frac{q_t - q_{t-1}}{q_t}] \qquad (2)$$

[1] - Jorgenson and Siebert (1968a) might be studied for more details.

where q_t is the investment good price index, δ the rate of replacement, r_t the cost of capital, u_t the rate of taxation of corporate income, and w_t the proportion of depreciation at replacement cost deductible from income for tax purposes. This equation says that the price of capital services is equal to the depreciation at current cost minus tax saving due to depreciation plus the cost per unit capital minus the accrued capital gains. Then, the neo-classical model specifies

$$K_t^* = \alpha \frac{P_t Q_t}{C_t} \qquad (3)$$

Where, P_tQ_t is the value of output and α is the elasticity of output with respect to capital. The desired level of capital is a function of value of output and the rental price of capital services calculated in equation (2). Then, with substitution of the expression for δ from (2) and the expression for K_t^* from (3) in equation (1), investment is calculated as a function of output and *rental value of capital services.* This rental value is calculated through a *shadow* or accounting price for capital services that depends on the cost of capital, the price of investment goods, the rate of change of this price, and the tax structure for business income.

Romer (1996) mentions that this model does not consider any mechanism through which expectations affect investment demand. For instance, in developing countries, policies which seek to achieve aforementioned objectives (e.g. poverty, unemployment or growth) might end up boosting demand for money for consumption and not for investment. The result can be either a financial crisis (e.g. Latin America or Africa) or an increase in the inflation rate (e.g. Iran).

Such criticisms have caused researchers to recognize uncertainty as the third factor which affects private investment.

	Year								
	1980			1990			2000		
	interest rate		private investment (%)	interest rate		private investment (%)	interest rate		private investment (%)
	real	nominal		real	nominal		real	nominal	
China	1.21	5.04	3.7	3.49	9.36	8.3	4.86	5.85	17
India	4.48	16.5	10.1	5.39	16.5	13.9	8.19	12.3	14.9

Table 1.2- Real and nominal interest rates for India and China.

As a starting point consider a conventional *NPV* model under certainty:

$$\overline{NPV} = -I_0 + \sum_{t=1}^{N} \frac{\overline{X_t}}{(1+i)^t} \quad , \text{t = 1 to N}$$

where $\overline{NPV}$ is expected net present value, $\overline{X_t}$ denotes expected cash flow in period t [2], i is the risk-free rate of interest, N is the time span of the project and I_0 denotes the initial cash outlay. Investment is a long-run plan. The investor expects to maximize his profit during a defined lifetime. Therefore, he tries to predict the future flows of profits, and compute its present value. Only, projects with positive $\overline{NPV}$ are candidates for acceptance. What happens if the investor cannot accurately forecast future flows and there is a difference between ex-ante and ex-post flows rendering the predictions unreliable? In this situation the investor adjusts his discount rate using the following formula:

$$\overline{ANPV} = -I_0 + \sum_{t=1}^{N} \frac{\overline{X_t}}{(1+k)^t} \quad , \text{t = 1 to N}$$

Where $\overline{ANPV}$ is the adjusted net present value and k denotes the risk-adjusted interest rate based on the perceived degree of project risk. Therefore, higher the

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[2] - $\overline{X} = \sum_{i=1}^{N} p_i X_i$, where $\overline{X}$ denotes the expected value of cash flow, X_i is the possible amount of cash flow i, and p_i is the probability of cash flow i occurring .

observed riskiness of a project, the greater the risk premium to be added to the risk-free interest rate. This results in a higher discount rate and, thus, a lower net present value. Because, relative to the initial situation, an investor looks for a higher expected rate of return, the number of positive $\overline{ANPV}$ projects and therefore acceptable investment opportunities will be less than positive *NPV* projects. This occurs because the future is unclear. Takii (2004) demonstrates how the ability to predict positively affects the investment through its impact on adjustment cost of capital stock. But the problem is that there is a delicate difference between *risk* and *uncertainty*. According to Pike and Neal (1996):

> ***Risk*** *refers to the set of unique consequences for a given decision which can be assigned probabilities, while* ***uncertainty*** *implies that it is not fully possibly to identify outcomes or to assign probabilities. Perhaps the worst forms of uncertainty are the* ***unknown*** *unknowns – outcomes from events that we did not even consider*.

In case of *risk* there is a probability distribution of future flows that form the basis of studies but there is no index showing the magnitude of *uncertainty*. How can we anticipate the probability of a coup, revolution or war in a country? How can we determine the effect of bad governance on our industry? We need to consider the factors, which could generate such unknown circumstances to study the effect of these factors on aggregate private investment in a country.

I define an element of uncertainty as any factor by which distorts information and predictions about the future. Often, studies concentrate on uncertainty about prices, demand or costs and deal with them by maximizing the value of the firm's expectation of all future probable receipts. But, by foregoing definition, it embraces a wide range of factors that bring about not only unpredictable fluctuations in prices but

also affect the state of confidence of entrepreneurs and their trust on information at hand. So, there must be a time horizon for each project within which entrepreneurs can rely on their information and assess their projects through the maximization of expected value of all probable future revenues. This time horizon depends on factors causing uncertainty that could result an optimistic or pessimistic atmosphere in business. Unpredictable changes in the macroeconomic environment, institutions and quality of governance could be a type of uncertainty. For instance, consider a case in which there is a potential of civil war in a country. The questions that can quickly emerge among investors are: would a civil war arise? If yes, would it be harmful to our business and investment or even our lives? Who will win the war? Would there be any change in the law, rights and bureaucracy procedures after civil war? All of these questions render investors more hesitant about undertaking investment. The role of uncertainty can be compared with environmental conditions (e.g. temperature or pressure) or catalysts in chemical reactions. These factors do not have any direct participation in a reaction, and there is no reaction without suitably high incidence of these factors. Therefore, instead of assessing the impact of unpredictable future receipts on private investment, the direct effect of each possible factor of uncertainty on the private investment rate is examined in this study.

The objectives of the study are:

Main objective:

- To ascertain the impact of uncertainty on the private investment rate.

Sub-objectives:

- To identify the different types of uncertainty.
- To determine the significance of each type on private investment.

And based on these objectives the testable hypotheses are:

- H_1: Uncertainty about macroeconomic outcomes and policy changes decreases private investment.
- H_2: Uncertainty about quality of public governance has a negative effect on private investment.
- H_3: Uncertainty about socio-political institutions and conflicts decreases private investment.

The remainder of the study is organized as follows. The second part of this chapter is dedicated to a literature review. In chapter two I elaborate in the economy of Iran. A new theory of uncertainty and investment is explained in chapter three. Methodology, estimation and outcome analysis are explained in chapter four. Chapter five concludes.

1.2- Literature Review

The classification of different theories of investment under uncertainty has been presented in chart-1.1. They diverge through their different definitions of uncertainty and different assumptions about conditions in which the investment decision is taken. The post-Keynesians and neo-classics differ essentially through their definition of uncertainty. I will explain precisely the post-Keynesian method and its difference with neo-classics later in chapter 3.

Neo-classical methods focus on uncertainty about the components of the profit function (e.g. demand and price of output, costs etc.) where profits are derived from the process of production while traditional finance has focused on streams of profits from securities (and not dividend) in stock markets. The neo-classical method takes two separate routes:

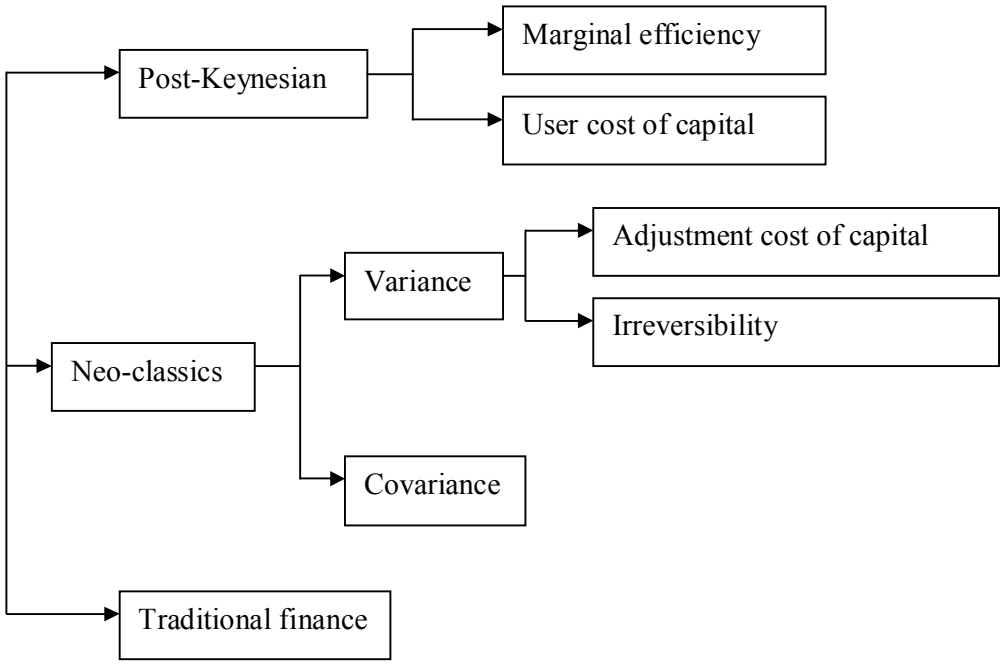

Chart 1.1- Classification of the methods in dealing with uncertainty in investment theory.

The first one, which is denoted by *Variance*, considers a firm by itself divorced from the existence of other projects and emphasizes the variation of some component of environment of a project (e.g. demand, costs, etc.) as uncertainty. The second, which is represented by *covariance,* emphasizes on the relationship between one firm and other firms in the market and relates the uncertainty to the pair wise covariance of their returns. Neo-classical methods, which emphasize on the variance as a proxy of uncertainty, diverge in two separate channels again. According to Abel and Eberly (1994):

The firm's investment decision becomes an interesting dynamic problem, in which anticipations about the future economic environment affect current investment, when frictions prevent instantaneous and costless adjustment of the

capital stock. Literatures focused on two types of frictions: adjustment costs and irreversibility.

Adjustment cost literature is based on the study of Eisner and Strotz (1963). It assumes that firms face extra costs of adjusting their capital stock and these costs are a convex function of the rate of change of the capital stock of the firm. This implies that it is costly for a firm to increase or decrease its capital stock, and that the marginal adjustment cost is increasing in the size of the adjustment. The irreversibility literature is traced back to Arrow (1968). He argues that:

There will be many situations in which the sale of capital goods cannot be accomplished at the same price as their purchase…For simplicity, we will make the extreme assumption that resale of capital good is impossible, so that gross investment is constrained to be non- negative.

Contrary to the costs-adjustment method, irreversibility predicts a concave marginal revenue product of capital. According to Leahy and Whited (1996) it makes returns to investment asymmetric:

If the future returns out to be worse than expected, the marginal revenue product of capital falls and the investor is stuck with lower returns. If prospects improve, the incentive is to invest more, thereby limiting the rise in the marginal revenue product of capital. This asymmetry implies that the marginal revenue product of capital is a concave function of wages and prices.

In the following pages these approaches are explained further.

1.2.1- Traditional Finance

Hahn (1947) argues that uncertainty represents disutility to the majority of people and will therefore only be incorporated in the price of capital. Thus, *risk premium* must be added to the market rate of interest or as *risk discount* must be

subtracted from the expected yield. Modigliani and Miller (1958) define a class k of firms that have *equivalent return* such that "*the return on the shares of any firm in any given class is proportional to (and perfectly correlated with) the return on the shares issued by any other firm in the same class*". Thus, all shares in a class have the same probability distribution of the ratio of the return to their expected return. In equilibrium in a perfect capital market the rate of price to monetary return must be same for all shares in class k. If this proportionality presents by $(1/\rho)$, we must have

$$p_j = \frac{1}{\rho_k} \bar{x}_j$$

or

$$\frac{\bar{x}_j}{p_j} = \rho_k$$

where p_j denotes the price of a share, $\bar{x}_j$ is the expected return per share of jth firm in class k. ρ_k is a constant of proportionality for all firms in class k and is interpreted as expected rate of return of any share in class k and by analogy with terminology for perpetual bonds, ρ_k can be considered as the market rate of capitalization for the expected value of uncertain streams for firms in class k. $(1/\rho_k)$ is the price which an investor has to pay for one monetary unit of expected return in the class k. With the assumption that firms cannot issue bonds and finance their activities with debts, the study shows that the expected rate of return, i, is

$$i_j = \rho_k + (\rho_k - r)\frac{D_j}{S_j}$$

where r is the rate of interest, D_j denotes the market value of the debts of the company and S_j is the market value of its common shares. This equation implies that the expected yield of a share is equal to the appropriate capitalization rate ρ_k for a pure

equity stream in the class plus a premium related to financial risk measured by the debt to equity ratio multiplied by the difference between ρ_k and the rate of interest.

This analysis has two difficulties: first as it has been mentioned earlier it does not consider dividend and so is a pure capital market analysis. Second, though the analysis is based on firm and industry level specifications the effect of uncertainty on the aggregate level of investment is unclear.

1.2.2- Adjustment – Cost Approach

Hartman (1972,1973) emphasizes a positive relationship between uncertainty and investment under convexity of marginal adjustment cost and discrete-time specification of the price of output. The following assumptions are made: The firm is a price taker in the output and labor market but prices in each period are unknown until the beginning of that period. The firm is confronted with randomly varying, increasing marginal costs of investment in each period. This model of adjustment cost is appealing because it allows for the relative fixity of capital. The firm has a finite planning horizon, T. In any period t within the horizon, the firm produces output Q_t, using capital K_t, and labor L_t, with the production function

$$Q_t = F(K_t, L_t)$$

where this function is concave in capital and labor. The labor input is completely variable within each period. The investment in each period t does not affect the capital stock until period $t+1$. Depreciation is proportional to the capital stock and capital accumulation is generated by

$$K_{t+1} = (1-\delta)K_t + I_t$$

The adjustment cost of the investment is given by $C(I_t, q_t)$ where q_t is a random variable or vector that allows the function to shift between periods. It is

assumed that this function is increasing and strictly convex in I and q. Hence, whenever I is positive, there are increasing marginal costs to acquiring capital. Whenever I is negative $C(I_t, q_t)$ is negative and its absolute value gives revenues obtained from selling capital goods. In this case the strict convexity reflects the difficulties of selling large quantities of capital rapidly. The firm's objective is to maximize the expected value of the sum of discounted cash flows:

$$E\sum_{t=0}^{T} R^t [P_t Q_t - W_t L_t - C(I_t, q_t)]$$

where R is a discount rate and the initial capital stock is fixed at K_0. Under these circumstances, the study proves that the optimal investment does not decrease with increasing wage uncertainty.

Pindyck (1982) recalculates this relationship under different situations. Unlike other studies in which demand and cost are simply unknown at the time of decision-making their current extents are known and it is only their future amount which is uncertain. It is assumed that the market demand function shifts randomly but continuously over time according to a stochastic process. A dynamic model of the firm is assumed in which some factor inputs can be adjusted freely in response to stochastic demand changes, but other factors are quasi fixed in that adjustment costs are incurred when they are changed. The analysis is one of partial equilibrium and not general equilibrium. The study concludes that when demand shifts stochastically and continuously over time the level of desired capital and output will depend upon the curvature characteristics of the marginal adjustment costs. Uncertainty will increase the desired capital stock and output of a risk averse firm if its marginal adjustment costs are rising at an increasing or constant rate. Otherwise with a concave marginal adjustment costs, the effect of uncertainty on investment will be decreasing. The study

concludes that uncertainty over costs has the same effect as demand fluctuations. These results hold irrespective of whether the firm is in a competitive or monopolistic market and whether or not the firm holds inventories.

Abel (1983) re-examines the uncertainty-investment relationship under Pindyck's continuous stochastic specification in which the current prices are known. The author demonstrates that Hartman's result continues to hold under Pindyck's assumptions. In this study it is assumed that the firm is risk neutral and operates in a competitive market and has a convex cost of adjustment function. The firm uses labor L_t and capital K_t to produce output through a Cobb-Douglas production function. The wage rate is w and I_t denotes the gross investment made by incurring an increasing convex cost of adjustment $C(I_t)$. Firm cash flow at time t is:

$$p_t L_t^{\alpha} K_t^{1-\alpha} - wL_t - \gamma I_t^{\beta}$$

where p_t is price of output. The value of the firm will be calculated through the maximization of the summation of the present values of all future cash flows. The process of the maximization will yield a marginal cost of capital q which is inversely related to the variance. A summary of the study and related formulae has been presented in appendix A. Thus, for a given level of the current price of output p_t, an increase in uncertainty, as captured by an increase in σ^2, will increase I_t . Furthermore, the study shows that in the same way an increased uncertainty of real wage will increase investment and these results are independent of time.

1.2.3- Irreversibility Approach

Pindyck (1991) analyzes the uncertainty-investment relationship under the assumption of irreversibility. He demonstrates that under this assumption that increasing uncertainty will decrease the investment. Irreversibility of expenditures

means that costs are mostly sunk costs and cannot be recovered. Another assumption is that the investment can be delayed. This gives the firm a reason to wait for new information about costs, prices and other market conditions before it commits resources. An irreversible investment opportunity is much like a financial call option. When irreversible investment expenditure is incurred, the firm exercises or "kills" its option to invest. It eliminates the possibility of waiting for new information to arrive that might affect the desirability or timing of the expenditure. The loss of this option value is an opportunity cost that must be included in the total costs of investment. The value of the project must exceed the purchase and installation cost by an amount equal to the value of keeping the investment option alive. If V denotes the value of project, V changes due to a geometric Brownian motion[3]:

$$dV = \alpha V dt + \sigma V dz \qquad (4)$$

where dz is the increment of a Wiener process such that:

$$dz = \varepsilon(t)(dt)^{\frac{1}{2}}$$

where $\varepsilon(t)$ is a serially uncorrelated and normally distributed random variable. We refer to α as the expected percentage rate of change of V with respect to time. σ^2 is variance and α and σ are constants[4]. With respect to the properties of the geometric Brownian motion model, equation (4) implies that current value of the project is known but future values are log-normally distributed with a variance that grows linearly with the time horizon. It is assumed that markets are sufficiently complete so that the individual decisions do not affect the opportunities available for other investors. Let x be the price of an asset or dynamic portfolio of assets perfectly correlated with V, and the correlation of V with the market portfolio be denoted by

[3] - For more information Ross (1999) might be studied.
[4] - For more information appendix of Pindyck (1991) might be studied.

ρV_m. Then x evolves according to $dx = \mu x dt + \sigma x dz$ and by the capital asset pricing model (CAPM) its expected return is $\mu = r + \phi \rho V_m \sigma$ where r is risk free rate of return and ϕ denotes the market price of risk. We assume that δ denotes the difference between μ and α and it is interpreted as dividend by analogy with financial markets. Let $F=F(V)$ be the value of the option to invest for a firm. The total return from holding the portfolio over a short time interval dt is $dF - F_V dV - \delta V F_V dt$. To avoid arbitrage possibilities it must be equal to $r(F - F_V V)dt$. Then using Ito's lemma we can calculate an expression for dF.

Now we want a rule that maximizes the value of our investment opportunity $F(V)$. Thus, we impose some assumptions and make some substitutions for simplicity (more details and further descriptions of the solving procedures have been presented in appendix *A*). Assuming that P is the price of output we find the value of the project $V(P)$ which determines our valuation of the firm's option to invest. This in turn determines the optimal investment rule. The optimal investment rule boils down to finding a critical P^*, such that the firm invests only if $P \geq P^*$. The study finds out that for any given price P, an increase in σ causes the opportunity cost of investing in $F(P)$ to increase more than the value of the project $V(P)$. Thus, the critical price P^* must increase with an increase in σ. Therefore, when uncertainty increases, firm will wait for a higher level of output price if $P \leq P^*$. The project is a set of call options on future production.

Thus greater the volatility of prices, the greater is the value of these options. Variability of output increases the critical price for investing, and reduces the net benefit of investment at every price. This means that greater uncertainty will increase the value of waiting (that acts as an opportunity cost for investment). Therefore, a higher price is needed to persuade the firm to invest.

In a similar way Pindyck (1992) extends his study over the effect of input cost uncertainty on investment in projects that take some time to build under irreversibility. This kind of uncertainty arises when the prices of labor, land and materials needed to build a project fluctuates unpredictably or when unpredictable changes in government regulations changes the required quantities of construction inputs. This study allows for the possibility of abandoning the project midstream, and maximizes the value of the firm in a competitive capital market. So, the decision rule is: *Invest as long as the expected cost to complete the project is below a critical number*. The investment opportunity under this condition can be considered as a put option in financial markets. The holder can sell an asset worth an uncertain amount for a fixed "*exercise price*". As its value is increased by an increase in the variance of the price of the underlying asset (like options in capital markets), therefore uncertainty will increase the value of an investment opportunity. On the other hand, input cost uncertainty reduces the critical expected cost. It means that when costs of inputs become more uncertain, it results in a value of waiting for new information before committing resources. Hence, the increasing uncertainty will lead to an increase in the value of waiting. This, leads to a reduction in investment.

Bar-Ilan and Strange (1996) study the effect of investment lags in a model of uncertain and costly reversible investment. When the construction of a project lasts for some periods then it is possible that the set off price under uncertainty may be lower than the set off price under certainty[5]. According to their argument the intuition of the model of Pindyck (1991) is that a firm postpones its project in order to avoid facing low prices immediately after it has made an irreversible decision to enter. The opportunity cost of waiting is the certain income from the project that depends on the

[5] - Set off price in defined as a level of price that encourages and persuades investors to invest.

price during the delay. Since a firm can enter immediately, a short delay facilitates the avoidance of low returns which might be less than the opportunity cost of invested capital. The contrary result of the study of Bar-Ilan and Strange arises because authors suppose that between the decision to invest and the receipt of the first revenue of the project there exist a time lag. This assumption fundamentally changes the investment decision. Now a firm that waits cannot enter the market immediately after making a decision to invest. Thus, the opportunity cost of waiting does not depend on the price during the delay. Alternatively, it depends on the price in the future. Thus, the higher uncertainty about output price in the future will increase the opportunity cost of waiting as longer time lags increase the likelihood of higher prices. Therefore, with some lags in the investment project, the firm may hurry in order to catch the possible high prices that it might not be able to take advantage of if it is not in the market.

Abel and Eberly (1995) have studied the impact of uncertainty on long-run investment. They argue that results obtained by Pindyck apply to a firm that starts with zero capital. But consequences for an ongoing firm could be different. When investment is irreversible, the optimal investment rule is to purchase capital to prevent the marginal revenue product of capital from rising above a hurdle. This hurdle, which is the user cost of capital appropriately defined to take account of irreversibility and uncertainty, is higher than Jorgenson's user cost of capital which is computed under certainty and reversibility. This causes a newly starting firm to invest less under irreversibility as compare to reversibility. This result is called the "*user-cost*" effect. The consequence is that an increase in the variance of the shocks tends to increase the user-cost under irreversibility without affecting the user-cost in the standard reversible case. This increase in the user-cost due to increased uncertainty tends to further reduce the optimal capital stock under irreversibility. On the other hand, for an

ongoing firm, it will arrive at any future date with a capital stock representing the accumulation of capital prior to that date. If demand for firm's output is unusually low at each time, the firm would like to sell some of its capital at a positive price. But under irreversibility it cannot do so and it would be constrained by its own past investment behavior which reflects the firm's optimal response to favorable conditions in the past. This phenomenon is referred to as the "*hangover*" effect to indicate the dependence of the current capital stock on past behavior. The hangover effect can lead to a higher capital stock under irreversibility. The user-cost and hangover effect might have opposing implications for the current expectation of long-run capital stock. The two effects react in opposing directions regarding the effect of increasing uncertainty on long-run investment. User-cost effect tends to reduce the capital stock under increasing uncertainty while hangover effect tends to keep the capital stock high under increasing uncertainty with irreversibility. The study points out that the effect of uncertainty on long-run investment for an ongoing firm is even more ambiguous than for a newly started firm. In the long-run there are cases in which the user-cost dominates and cases in which the hangover effect dominates. It is confirmed in this study that in the long-run increased uncertainty can increase investment under irreversibility, but it might increase investment even more under reversibility. Thus, whether the increase in the investment is higher under reversibility or irreversibility depends on the values and choice of parameters.

Abel and Eberly (1996) deduce the effect of uncertainty on investment when capital is costly reversible. It is assumed that the firm can purchase capital at a constant price $b_U>0$, and sell it at a constant price $b_L \leq b_U$. This difference could be because of firm specific nature of capital or transaction costs. On basis of these two prices and by maximization of the expected present value of cash flows two separate

user costs of capital can be calculated. User cost c_U is calculated for b_U and user cost c_L is calculated for b_L. Then authors define a rule for investment: "*keep the marginal revenue product of capital from leaving the closed interval [c_L , c_U]*". When marginal revenue of product becomes higher than c_U, firm starts to invest to bring it below the upper level of user cost. And when the marginal revenue of product falls below the c_L , firm start to disinvest to bring it above the lower level of user cost. With respect to the related calculations by authors, it is clear that increasing uncertainty widens the interval between c_L and c_U. Therefore, increasing uncertainty decreases investment.

1.2.4- Covariance Approach

Craine (1989) tries to examine the effect of risk on the allocation of capital in a simple general equilibrium model. There is a contradiction between the theories of the firm and conventional finance under uncertainty. Hartman and Abel as mentioned above argue that a mean preserving spread in the distribution of output price will increase demand for capital. But conventional financial asset pricing models suggest that an increase in the risk of an asset reduces the demand for that asset. The theory of the firm and the theory of the finance are partial equilibrium analyses that make complementary assumptions about the relationship about the asset pay-offs and discount factor.

In general equilibrium, the discount factor and pay-off to assets are independent endogenous variables. The uncertainties, which affect firm's technologies and household preference, are exogenous. A mean preserving spread in the distribution of the exogenous states of nature makes the economy riskier. Through the maximization of lifetime utility, the technology's risk is calculated as the

covariance between the riskless discount factor and the technology's return factor[6]. And the expected return to capital in technology *i* is equal to the risk free rate adjusted for capital risk. This means that riskier technologies require a higher level of expected return in order to be commercially viable.

Resources such as capital and labor, are the wealth of society. In each period aggregate capital is predetermined and aggregate labor is constant. Allocation of capital is based on the factor productivity of technology. Since capital is allocated before realization of the shocks. Output in each technology is calculated as a convex function of the productivity shock to that sector. Thus, expected output is an increasing function of the exogenous risk. But as aggregate output cannot be distributed independently of shocks to technology, the equilibrium allocation will depend on risk and expected returns as financial asset pricing models indicate.

. The article concludes that a mean preserving spread in the distribution of the state of nature that affects firm's technologies or household's preferences has no effect on aggregate investment, but it alters the allocation of capital and labor among technologies. Therefore, the share of capital devoted to less risky technologies increases.

1.2.5- Adjustment-Cost or Irreversibility?

There are some studies that try to assess and justify the contradictions between results of adjustment-cost and irreversibility approaches. Caballero (1991) argues that the difference between two methods could be because of difference in assumptions about the possibility and cost of disinvestment.

[6] - Because it shows the relative susceptibility of the technology to volatility in the discount factor which is defined as the adverse ratio of the risk free rate.

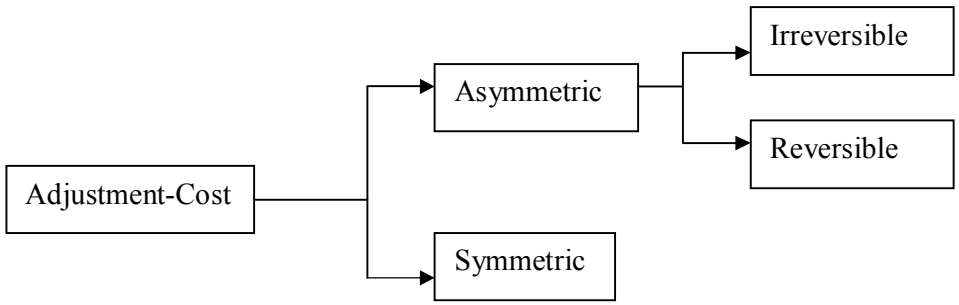

Chart 1.2- Classification of adjustment-cost theories.

But asymmetric adjustment cost is not sufficient to explain why the results are different. More important is that Hartman and Abel assume perfect competition and constant returns to scale, whereas Pindyck assumes either imperfect competition or decreasing returns to scale (or both). This paper highlights the role of the decreasing marginal returns to capital assumption (due to imperfect competition or decreasing returns to scale or both) in determining the effect of adjustment cost asymmetries on the sign of the response of investment to changes in uncertainty under the assumption of risk neutrality of investor. One of the findings is the lack of robustness of the negative relationship between investment and uncertainty under asymmetric adjustment costs to changes in the degree of competition. Asymmetric adjustment cost means that it is more expensive to adjust downward than upward. In the case of irreversible cost, adjustment costs are infinite for downward adjustment. As a matter of fact when firms are in a nearly competitive market the conclusion of Abel and Hartman holds no matter what the assumption about asymmetry is. Conclusive consequences about the sign of investment-uncertainty relationship should not be expected from the adjustment cost literature alone. The result confirms that Hartman and Abel conclusion is shown to be robust to asymmetries in the adjustment cost

function, including the irreversible investment case. Hence investment and uncertainty are positively correlated even in the extreme circumstance of irreversible investment, as long as the firm confronts a very elastic demand curve (and returns to scale are non-decreasing).

Abel and Eberly (1994) combine the two assumptions of irreversibility and existence of adjustment costs by assuming that the adjustment-cost function is strictly convex and has a value of zero at zero investment and it is infinite at any negative rate of investment. This means that they allow for cases in which the optimal rate of investment by the firm is never negative. The study introduces an augmented adjustment-cost function that considers traditional convex adjustment costs. Furthermore, it assumes the presence of fixed costs and allows for the possibility that the resale price of capital goods is below their purchase price and may even become zero. Through the maximization of the present value of the operating profits minus total investment costs, firm can calculate optimal investment. In this framework investment is a non-decreasing function of the shadow price q, which is always positive and is a non-decreasing function of variance. Thus, increase in uncertainty increases investment.

1.2.6- Empirical Studies

Relative to theoretical studies, there is a more general consensus among empirical investigations about the negative relationship between uncertainty and private investment. Leahy and Whited (1996) ascertain the uncertainty-investment relationship through a panel of U.S. companies. They utilize a measure of uncertainty from the variance of asset returns. The study performs various sample splits in order to test comparative implications of the three mainstream theories (i.e. adjustment-cost, irreversibility and covariance base models). The main result is that uncertainty exerts

a strong negative impact on investment through its effect on *q* so that this impact has little relationship to risk as conventionally measured by the capital asset pricing model (CAPM). The comparison results are in favor of theories in which uncertainty directly affects investment rather than through covariance, and it is in favor of models in which the marginal revenue product of capital is concave. This leaves irreversibility models as the most likely explanation of the relationship between investment and uncertainty. However, Bo (1999) indicates that this negative effect could exist through channels other than *q*. Koetse *et al.* (2006) argue that *q* models produce more negatively significant estimates than other models do through a Meta analysis.

Nevertheless, Fuss and Vermeulen (2004) report that there is no evidence of an effect of price uncertainty on investment. Byrne and Davis (2005) find that the negative effect of uncertainty on investment is transitory in EU countries. Furthermore, Dehn (2000) indicates that positive ex-post commodity price shocks have strong positive effects on private investment in low developing countries. Darby *et al*. (1999) find a negative relation between exchange rate volatility and investment but "*there are situations where that will happen, and situations where it will not*". The empirical studies are mostly confined to a few factors of uncertainty (e.g. Oshikoya, 1994; Serven , 1998; Rodrik, 1998; Stasavage, 2000; Feng, 2001; or Edmiston, 2004), single-country studies (e.g. Federer, 1993; Cecchetti, 1993;Zalewski, 1994; Reinikka, 1999; Darku, 2000; Gelb, 2001; Temple *et al.,* 2001; or Carlsson, 2004; Gaskari and Ganbari and Eghbali, 2004), and also include some cross-country papers which do not deduct private investment from aggregate investment (e.g. Brunetti and Weder, 1998; Jeong,2002; or Asteriou and Price,2005). Focusing on private investment rather than overall investment is preferable when considering the effect of uncertainty, because Aizenman and Marion (1996) have

shown that in cases where high uncertainty leads to a decline in private investment, public investment often increases in compensation.

Although the majority of studies do find a negative relationship between uncertainty and investment, on the whole, both approaches are not conclusive in their assessment of the impact of uncertainty on private investment. Typically, policy-makers would want to know which sources of uncertainty are more significant for private investment. The current literature does not address this question adequately. This research provides an exhaustive empirical examination of the link between uncertainty and aggregate private investment using a large set of cross-country time-series macroeconomic and institutions data for developing countries. The study makes an attempt at clearing the significance of all aspects of uncertainty as much as possible.

Chapter II

A Review of Economy of Iran

2.1- Economy of Iran

In this study I will focus on the economy of Iran. Many factors make Iran ideal for a high degree of participation of the private sector in investment: a high percentage of young population that is educated (literacy rate of people in 15-24 age group is 94 %), rich natural resources, cheap energy, income from oil resources, and suitable geographical location.

Year	1974	1980	1990	2000
Total population	32173990	39124000	54400000	63664000
Age between (15-64)%	51.19	51.75	51	61.5
Literacy (15 and above)%	40.5	49.67	63.16	76
Literacy (15-24)%	63	73	86.32	94
GDP Per capita $ (constant 2000)	1785	1278	1196	1511

Table 2.3- Comparison of socio-economical indices in Iran.

As it is indicated in table-2.1, total population of Iran has doubled from 32 to 63 million between 1974 and 2000. The age composition of population has changed with dependency ratio declining. The share of population in the 15-64 changed from 51.19% in 1974 to 61.5% in 2000. The adult literacy rate (15 and above) has increased from 40.5% in 1974 to 76% in 2000. This literacy rate for youth (15-24 age group) has changed from 63% in 1974 to 94% in 2000. As it is indicated in figure-2.1

GDP per capita has fluctuated between U.S. $ 1000 and $ 2000 over this period. This figure indicates clearly that higher GDP per capita is associated with a higher rate of private investment. For many years the real interest rate has been negative, for example, it was -9.22, -25.23 and –11.49 in 1989, 1993 and 2000. The government has tried to protect private investment by financial incentives and import barriers, but private investment has hardly gone above 15 percent of GDP in the last two decades. The low rate of investment has had disappointing consequences for sustainable development and poverty alleviation (through its negative effect on job creation for a flood of young unemployed population)[7].

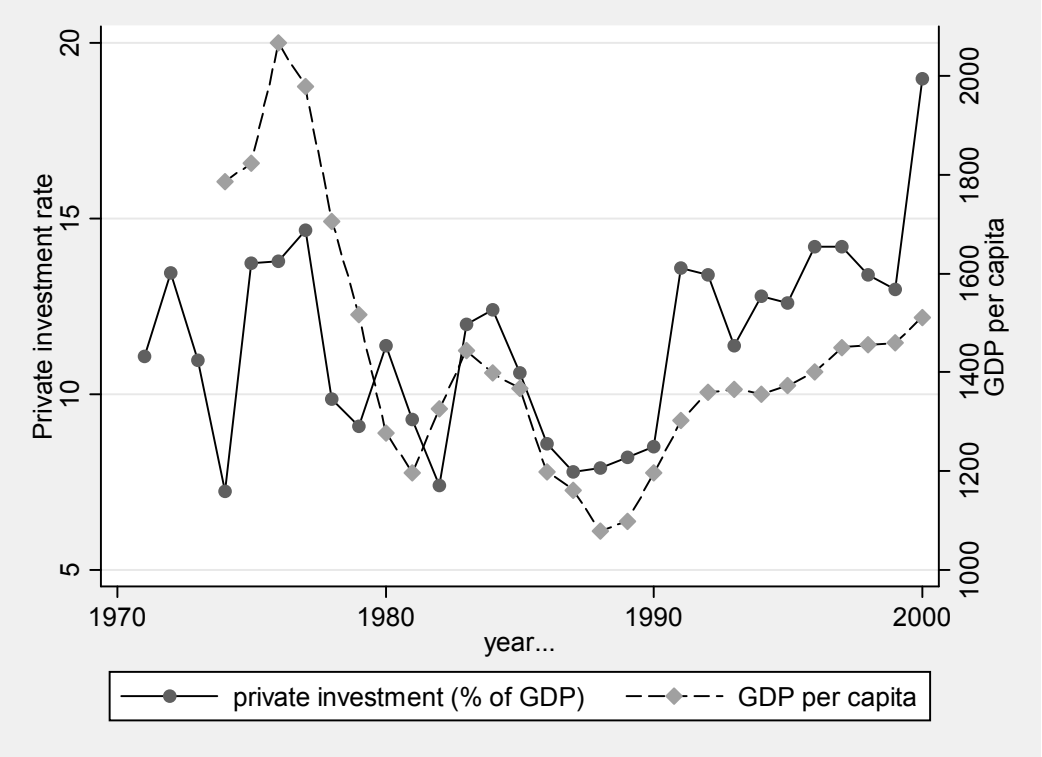

Figure 2.1-GDP per capita of Iran from 1974 to 2000(U.S. $ constant prices of year 2000).

Figure-2.2 represents the rate of private investment in Iran. It fluctuated heavily between 1973 and 1989. As I will show later these fluctuations had different causes.

[7] - Some news about capital flight has occasionally been released by media.

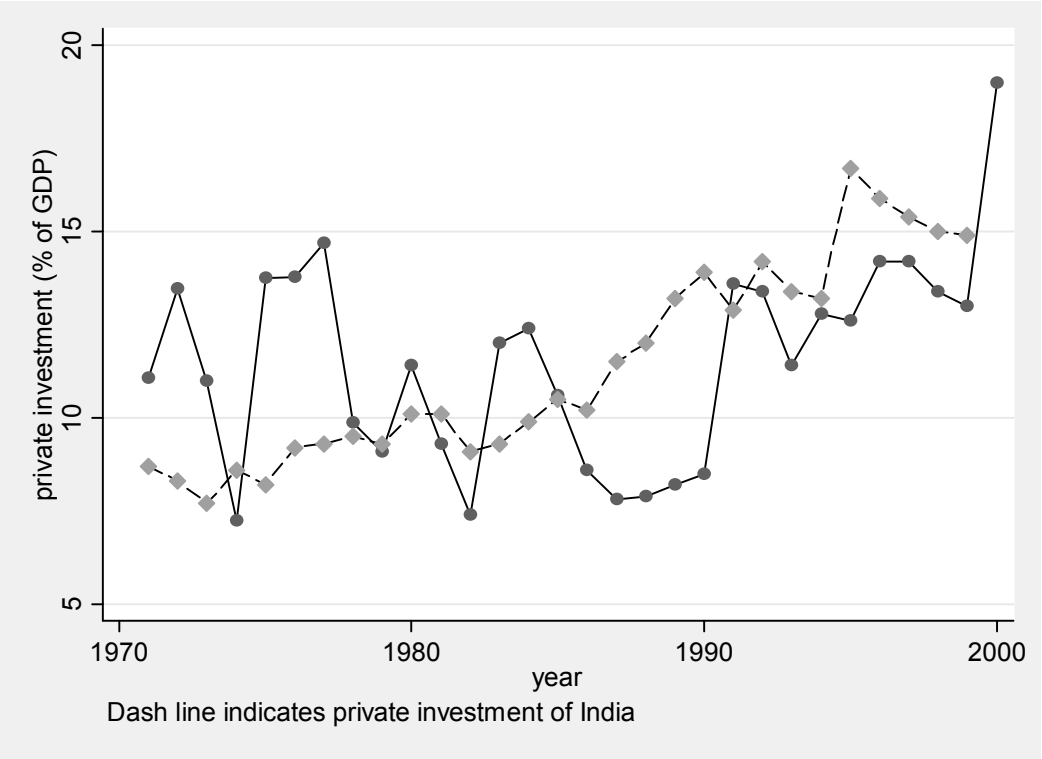

Figure 2.2- Private investment rate in Iran and India since 1971 to 2000.

It reached a minimum level of 7.23% in 1974 and a maximum of 19% in 2000 with an overall average of 11.5%. This rate has seen an upward trend since 1989 after the Iran-Iraq war. The rate of private investment in India has been shown for the sake of comparison (Figure 2.2). It varies less than that for Iran (the variance is 7.5 and 7.1 percentage point for Iran and India respectively). It has an obvious upward trend from 1973 to 1995 where it reaches the record high of almost 17%. However it shows a decline thereafter.

For a better perception of the economy of Iran, the special nature of financial and monetary markets must be regarded. After the Islamic revolution in 1979 fixed interest was prohibited because of Islamic rules. Thus, firms could not be financed by selling bonds. Furthermore, there was no advanced system of financial intermediation (e.g. venture capital). What remained were just a few big companies who could

supply their securities to the stock market, and plenty of entrepreneurs who either could enter into partnership or rush to the banks.

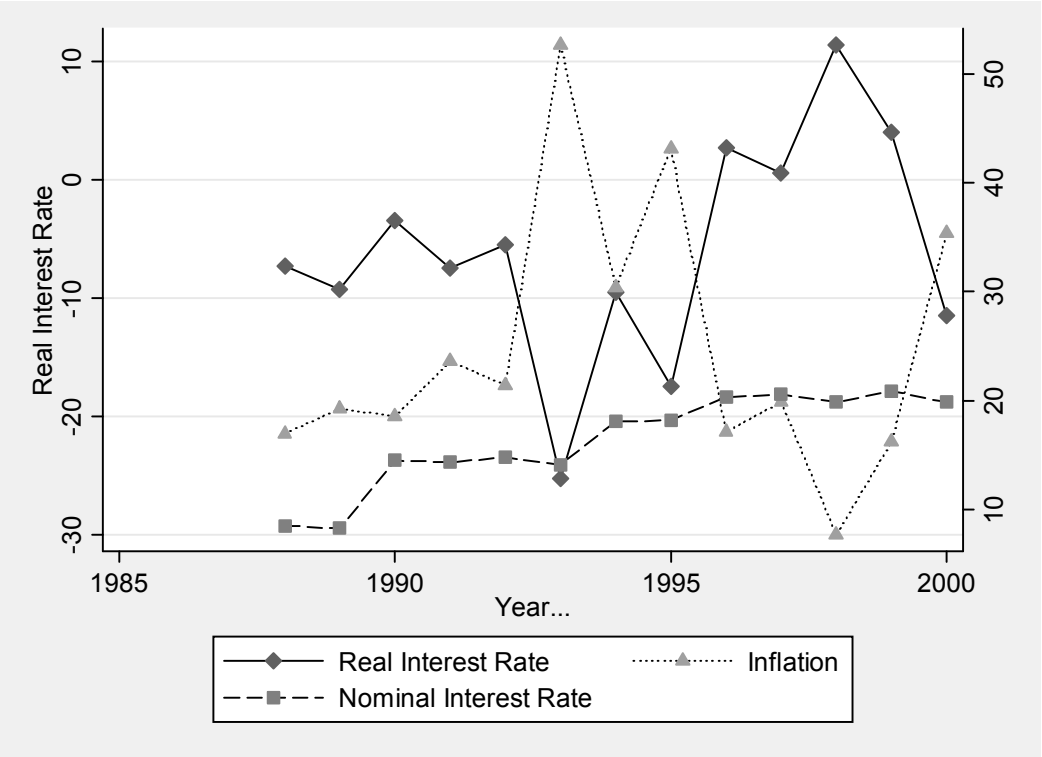

Figure 2.3- Fluctuations of inflation, nominal and real interest rates since 1988 to 2000 in Iran.

Banking institutions in Iran lend funds at a rate called "bank commission for minimum expected profit" which is compatible with Islamic rules. This rate imposed by the Central Bank of Iran differs in different industries (e.g. agriculture, services, real state etc.) according to a fixed rate schedule which is administrated by the Central Bank. What I have considered in this study, as interest rate is a weighted average of these rates. The weights are given by the participation of each sector in the economy. Thus, my intuition is that banking funds must be a greater constraining factor with regard to private investment than interest rates in Iran. As real interest is often negative in Iran (Figure 2.5) a scarcity of funds would be a constraint on investment. Figure-2.3 indicates fluctuation of nominal and real interest rates and inflation. The nominal interest rate increased from almost 10% in the late 80's to almost 20% in the

late 90's. However, inflation fluctuated severely in this period and was of a high magnitude. The rate of 52.64% in 1993 was remarkable. Therefore, the real rate of interest turned negative in many years. Between1988 and 2000, only four years yielded positive rates of real interest.

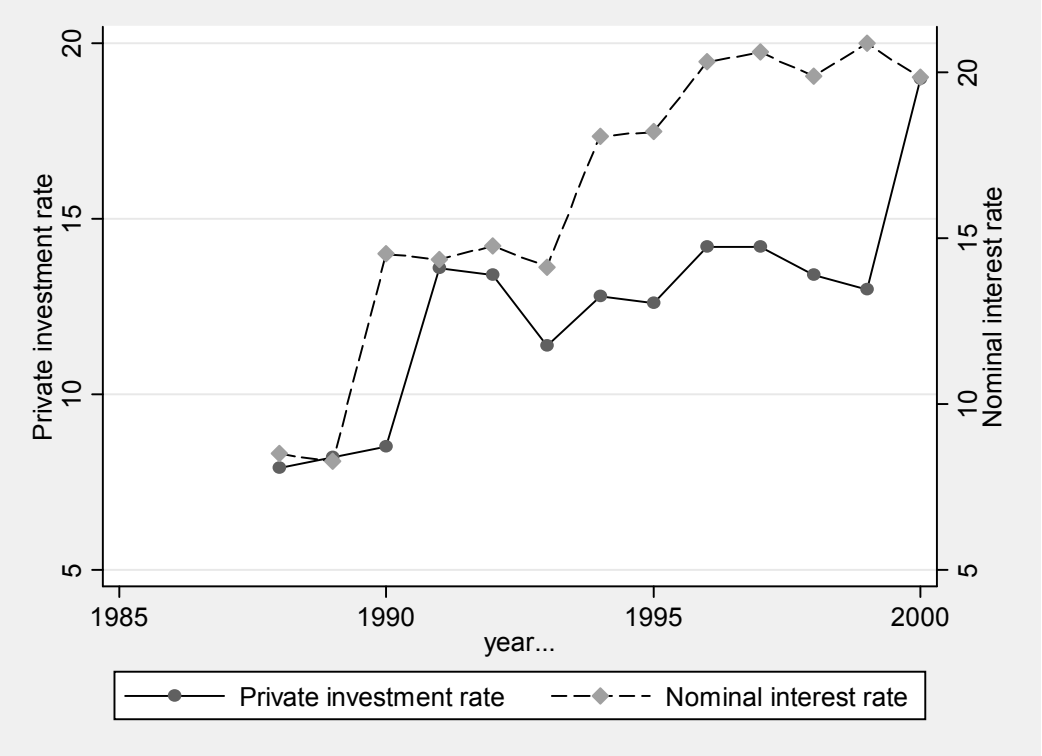

Figure 2.4- Fluctuations of nominal interest rate and rate of private investment.

Figures-2.4 to 2.6 show a comparison of the variations of inflation rate, nominal and real interest rate and the rate of private investment in Iran between 1988 and 2000. In this period the rate of private investment increased despite the fact that the nominal rate of interest rose as well. The real rate of interest and the rate of private investment vary with different patterns. From 1988 to 1997 they are positively correlated whereas there is negative correlation after 1997. Except for periods in which the rate of inflation has gone beyond 40%, increasing inflation has been associated with higher private investment.

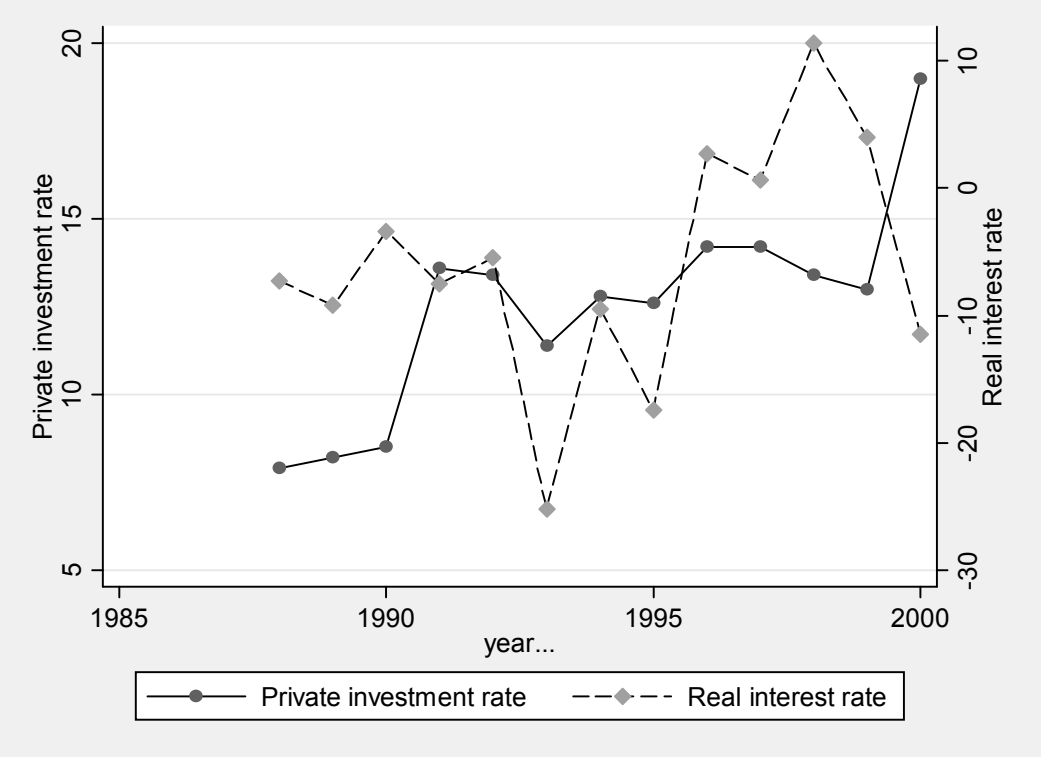

Figure 2.5- Comparison between fluctuations of real interest rate and rate of private investment in Iran.

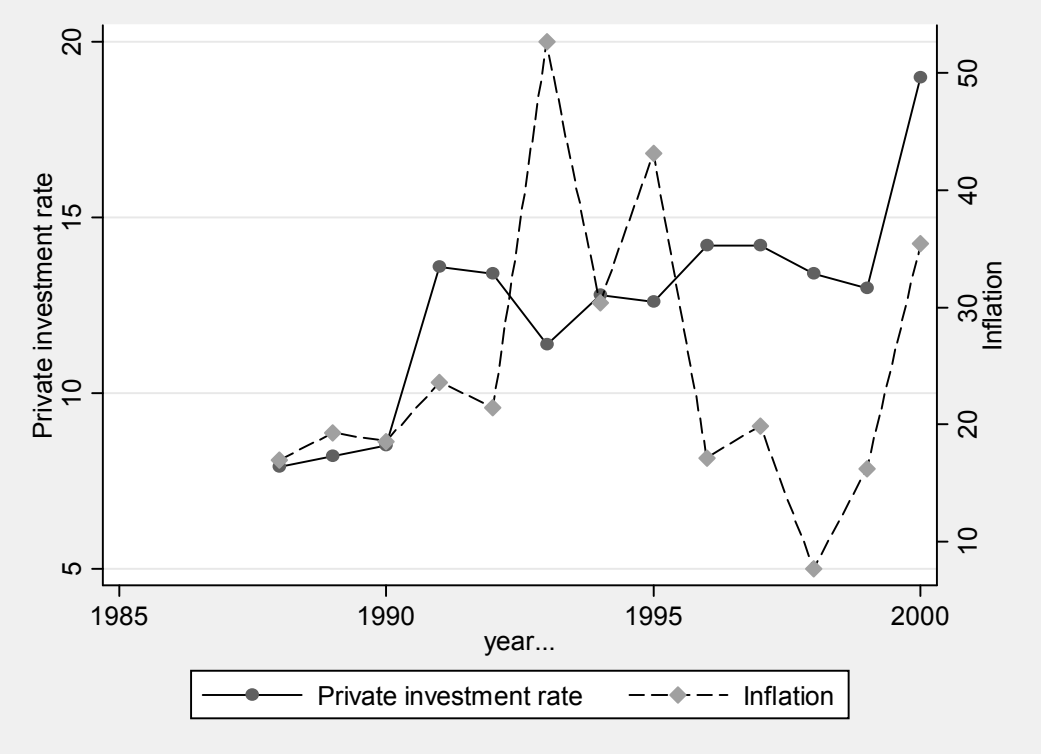

Figure 2.6- Variation of Inflation and the rate of private investment in Iran.

We cannot review the economy of Iran without a look at the oil economy. Iran is one of the main oil producers in the world. It is a member of Organization of Petroleum Exporting Countries (OPEC) with an export of about two million barrels per day.

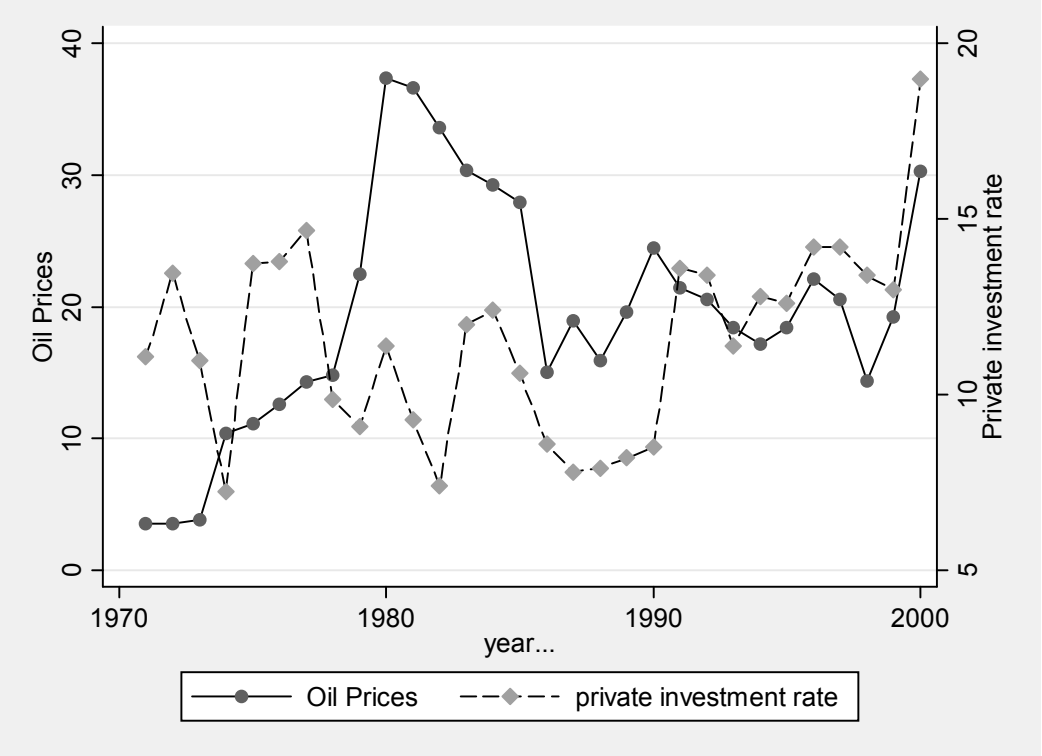

Figure 2.7- The price of crude oil ($ U.S.) and the rate of private investment (%GDP).

A major portion of the country's export revenue consists of incomes from the export of crude oil. It has hardly ever come below 80% of the total value of aggregate exports. Figure-2.7 presents the variations in the price of crude oil as well as the rate of private investment between 1971 and 2000. The prices of oil used are the spot prices of crude oil (Dollars per barrel) in West Texas Intermediate[8]. However, the real prices of oil exported out of Iran is quite below these prices though their movements are correlated with each other. Figure-2.7 shows that from 1971 to 1989 the prices of

[8] - Downloadable data is available in http://www.economagic.com .

oil and private investment rates were not correlated with each other. A decline in the private investment rate contemporaneous to the oil shock of 1974 and a small increase following a big fall in 1980 are worthy of mention. This shows that higher incomes corresponding to higher levels of oil prices not affect private investment contemporaneously. The indices have become more correlated after the war between Iran and Iraq.

2.2- Uncertainties and Economy of Iran

Diagrams pertaining to macroeconomic uncertainties are given in appendix B[9]. The uncertainty about trade in Figure-B5 and uncertainty about credit to private sector in Figure-B1 are continuously decreasing. Thus, such decreases cannot justify the fluctuations in the rate of private investment in the 70's and 80's. The uncertainty about exchange rate distortion, (Figure-B2) is also decreasing except for a structural break in 1994 and the uncertainty about inflation (in Figure-B7) cannot describe the fluctuations in the private investment rate as well. Contrary to the other uncertainties, uncertainties about real interest rate, (Figure-B4) and terms of trade, (Figure-B6), are continuously increasing. Therefore, this kind of homogeneous movement cannot justify the fluctuations of private investment in the 70's and 80's followed by an increase in the 90's. The positively correlated increment in uncertainty about real interest rate and private investment is contrary to conventional wisdom. The contemporaneous effect of other factors (e.g. postwar era) might cover the negative effect of real interest rate uncertainty. Maybe, among the macroeconomic variables, uncertainty about growth is the best justification for variation of the rate of private investment. Uncertainty about growth shows a severe fluctuation in late 70's and early 80's and starts to reduce investment after the mid 80's.

[9] - For more information about the definition and method of their calculation Chapter IV might be studied.

Diagrams of socio-political institutions have been presented in appendix B, too. Inequality (from Estimated Household Income Inequality Dataset, University of Texas) shows a U shape over time (as it is clear from Figure-B8) in Iran. If we ignore some increases in the period ranging from the early 80's to mid 90's then we can conclude that inequality and rate of private investment are positively correlated with each other in Iran. The index of democracy[10] is graphed in Figure-B9. This index is almost constant except for some changes in the early 80's in Iran. Therefore, it cannot reasonably justify fluctuations in private investment. The period of war has been graphed against the private investment rate in Figure-B10. It almost contains all time periods in the 80's. The diagram shows that the peaks of private investment achieved in wartime are a little bit lower than those in other times. Furthermore, there are two nadirs in 1982 and 1987 with the rate of private investment falling below 8%.

Figure-B11 shows a plot of the incidence of civil war against private investment rate. In the period between1978 and 1982 Iran was involved in different civil wars. In 1978-1979 there was a conflict between the Central government and the Anti Shah coalition. In 1979-1980 and also in 1982 there was a conflict between the Central government and the Kurdistan Democratic Party of Iran. In 1981-1982 there was a conflict between the Central government and Mujahedin e Khalq. Even though there were some minor and intermediate conflicts in other years those have been ignored. Other types of social unrest occurred around 1979: revolution, riots and strikes as they are indicated in Figures-B12, B15 and B16. However, there was no coup in Iran at all. There was a constitutional change (Figure-B13) in 1979. The largest number of assassinations in a year occurred in 1981. As Figure-B17 indicates, some purges occurred contemporaneously with nadirs in private investment rates in 1971, 1979 and

[10] - The definition of this index is given precisely in Chapter IV.

1986. Unfortunately, a considerable time series for the quality of indices of governance is not available with respect to Iran rendering it impossible to study its association with the private investment rate.

To sum up, among the observable variables in Iran, we can see that uncertainty about growth, war and civil war, purges, constitutional changes, and a set of social unrests (i.e. revolution, riots strikes, assassinations) might explain decline and fluctuations in the rate of private investment[11].

[11] - As the number of observations is not enough for time series especially in case of governance in which three observations are available per variable, therefore a panel data method is applied for examination.

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 expresses through the formulation of a probability distribution which is based on uncertain information and doubtful arguments, or the depiction of animal spirits (Kregel, 1987)[12].

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 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

[12] - 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.

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 cost 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)[13]. 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 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

[13] - 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.

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 risk[14] on investment in the neo-classical school as I mentioned in chapter one. However, according to the traditional finance, it must 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.

[14] - According to the neo-classical school, risk and uncertainty means equivalently.

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, $\varphi(\tau)$, $0 \le \tau < \infty$ 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 *φ(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*.

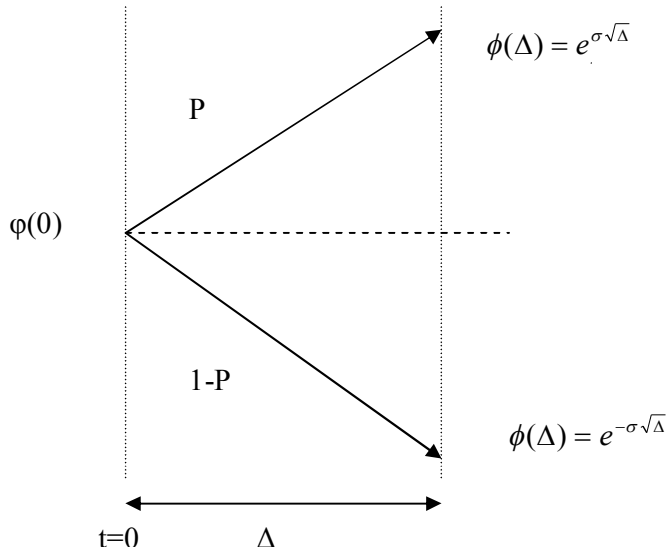

Figure 3.8

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

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

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

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.

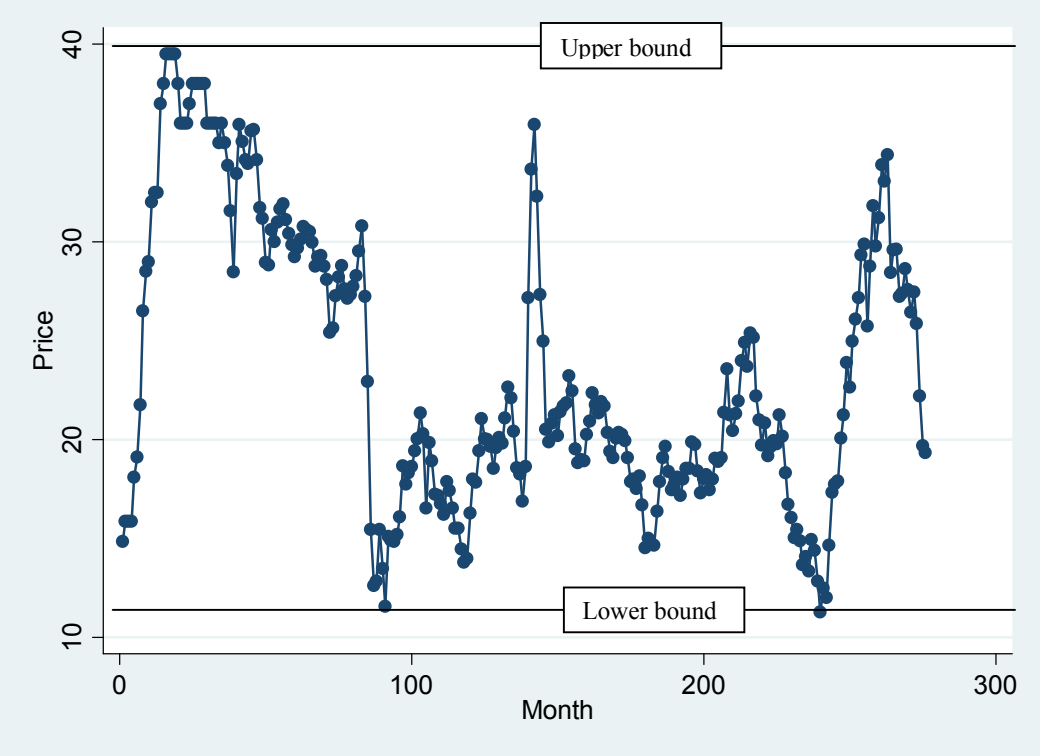

Figure 3.9

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:

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

or comes down to:

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

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.

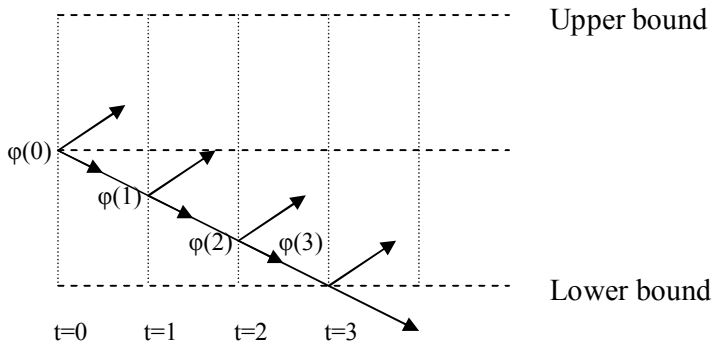

Figure 3.10

Therefore, for instance, prices will attain $\varphi(1)$, $\varphi(2)$ and $\varphi(3)$ at *t=1*, *t=2* and *t=3* respectively where $\varphi(3)$ 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:

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

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:

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

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 $\varphi(0) = 100$, $\sigma = 0.3$ $I_0 = 244$, 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:

$$\int_0^t 100e^{-(0.3+0.06)\tau} d\tau = 244$$

$$\Rightarrow \quad -\frac{100}{0.36}(e^{-0.36t} - 1) = 244$$

$$\Rightarrow \quad t=2.11$$

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.

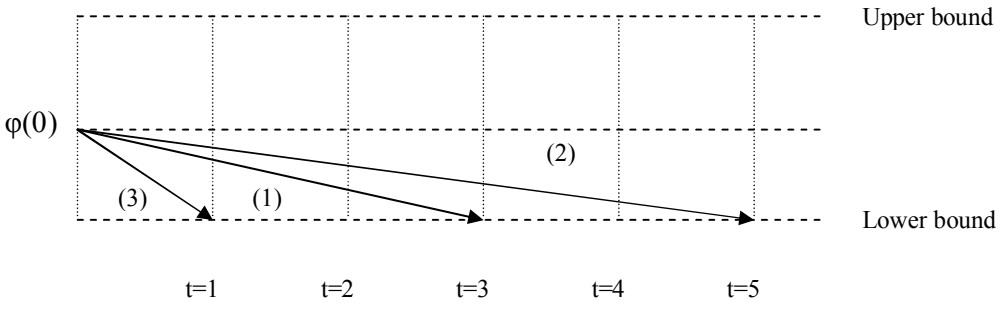

Figure 3.11

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.

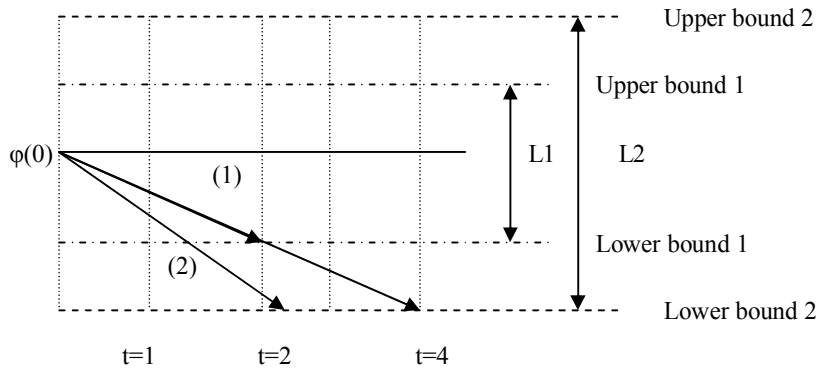

Figure 3.12

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:

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

As we assume that quantity of output is *1* 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:

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

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

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

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 $\varphi_i(t) = \varphi(t)$. Therefore, the time horizon for each individual and for the entire economy can be assumed to be a unique value t^* [15]. Thus, from equation (7) we have:

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

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

[15] - This means that $T^* = t^*$.

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

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

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

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

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

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

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

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

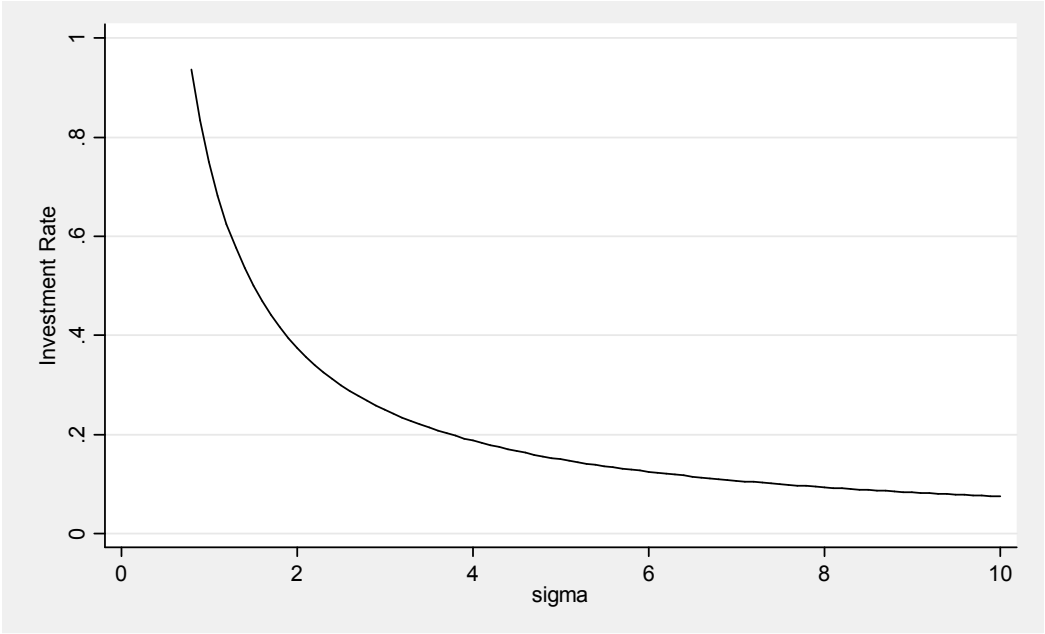

Figure 3.13

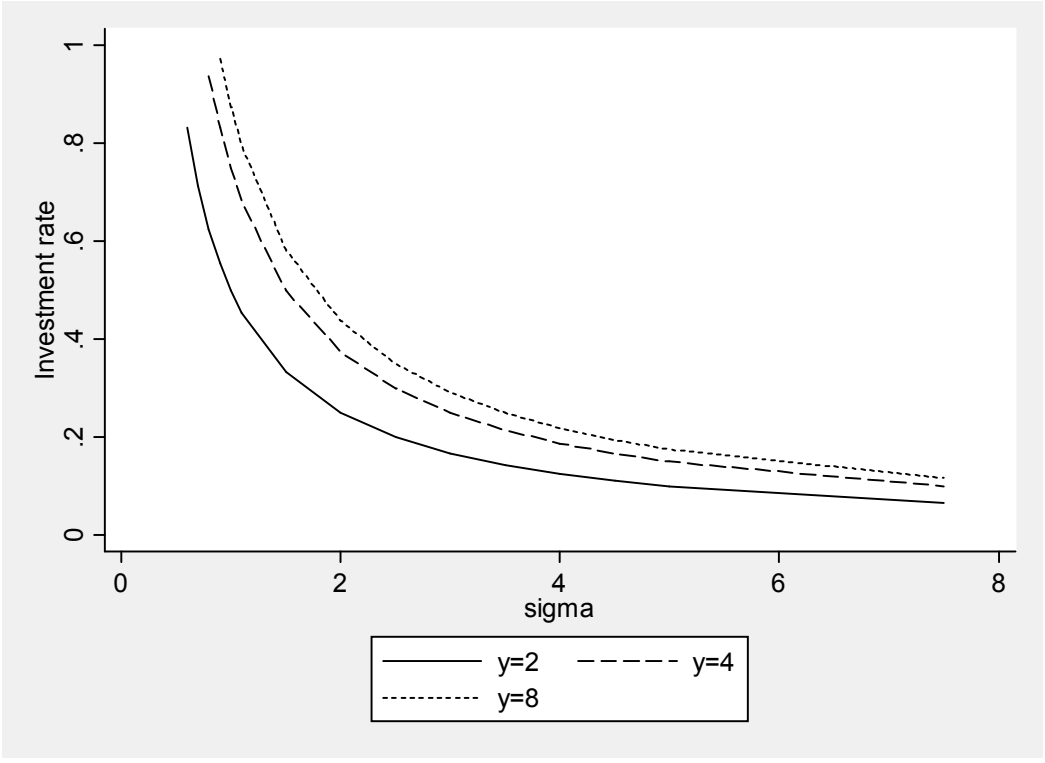

Figure 3.14

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 increases 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.

Chapter IV

Methodology, Estimation and Analysis

4.1- Data And Data Preparation Process

As datasets are prepared for different purposes therefore, they are often similar neither in spatial coverage nor in the time period covered. Also, there are some indices that are used by commercial agencies and they are not popularly available. Therefore, I have collected a set of available indices that cover a wide range of countries over a long period of time.

In this research the various types of uncertainty pertain to three different categories: *changes in policies and macroeconomic outcomes* (between 1971-2000), *the quality of public governance* (in 1996, 1998 and 2000) and *socio- political institutions and conflicts* (from 1970 to 1993).

a) Under "*Changes in policies and macroeconomic outcomes*" we deal with unpredictability in the following factors: GDP growth, trade, inflation, domestic credit to private sector, real interest rate, distortion in exchange rates and terms of trade.

b) Under "*Socio-political institutions and conflicts*" we measure uncertainty by the incidence of assassinations, strikes, purges, riots, revolutions, wars, civil wars, coups, variables that capture the extent of democracy, constitutional changes and inequality.

c) Under "*quality of public governance*" we include government participation in the economy, control of corruption, regulatory burden, property rights and rule of law. It is assumed that better quality of governance is associated with lower uncertainty.

The sources of the variables and their definitions have been explained as follows: *Private investment rate* is defined as the ratio of private investment to GDP. Data on *private investment rate* have been retrieved from Everhart & Sumlinski (2001). Private investment is defined as the difference between total gross domestic investment (from national accounts) and consolidated public investment (from different sources).

Government Participation in Economy is measured by The Heritage Foundation as an index of *government intervention*. This factor measures government's direct use of scarce resources for its own purposes and government's control over resources through ownership. The measure covers both government consumption and government production. The scale runs from 1 to 5. A score of 1 signifies an economic environment or set of policies that are most conducive to economic freedom (lowest government intervention), while a score of 5 signifies a set of policies that are least conducive to economic freedom (higher government intervention).

The index of *Property Rights* has been used by The Heritage Foundation and scored from 1 to 5 where 1 means the best condition and 5 the worst. Beach & Miles (2006) describe their methodology as the following:

> *This factor scores the degree to which a country's laws protect private property rights and the degree to which its government enforces those laws. It also assesses the likelihood that private property will be expropriated and analyzes the independence of the judiciary, the existence of corruption within the judiciary, and the ability of individuals and businesses to enforce contracts. The less certain the legal protection of property, the higher a*

country's score; similarly, the greater the chances of government expropriation of property, the higher a country's score.

The next three variables are collected from Kaufmann et al. (2005), World Bank. This data source consists of surveys of firms and individuals as well as the assessment of commercial risk rating agencies, non-governmental organizations, and a number of multilateral aid agencies. These indices are normally distributed with a mean of zero and a standard deviation of one in each period. This implies that virtually all scores lie between –2.5 and 2.5, with higher scores corresponding to better outcomes. I use the following variables from this collection:

Regulatory Burden measures the incidence of market-unfriendly policies. *Rule of Law* measures the quality of contract enforcement, the police, and the courts, as well as the likelihood of crime and violence. *Control of Corruption* measures the exercise of public power for private gain, including both petty and grand corruption and state capture.

Easterly (2001) has presented a unique collection of social, political and economic characteristics of countries: *Assassinations* is the number of politically motivated murders or attempted murders of a high central government official or politician. *Strikes* is the number of any strike of 1,000 or more by industrial or service workers (per ten million population)**.** *Purges* is the number of systematic eliminations by jailing or execution of political opposition within the ranks of the regime or the opposition (per ten million population). *Riots* is defined as the number of violent demonstration or clashes of more than 100 citizens involving the use of physical force (per ten million population). *Revolutions* is the number of any illegal or forced change in the top governmental elite, any attempt at such a change, or any successful or unsuccessful armed rebellion whose aim is independence from the central

government. *Coups* is defined as the number of extra constitutional or forced changes in the top government elite and/or its effective control of the nation's power structure in a given year. Unsuccessful coups are not counted. *Constitutional Changes* is the number of basic alterations in a state's constitutional structure, the extreme case being the adoption of a new constitution that significantly alter the prerogatives of the various branches of government. Examples of the latter might be the sub-situation of presidential for parliamentary government or the replacement of monarchical by republican rule. Constitutional amendments, which do not have significant impact on the political system, are not counted.

Index of Democracy is another variable that I use. I collect it from Polity IV project by Marshall & Jaggers (2002). The Polity IV project continues the Polity research tradition of coding the authority characteristics of states in the world system for purposes of comparative, quantitative analysis. Their methodology considers democracy (DEMOC) as consisting of three essential, interdependent elements:

> *One is the presence of institutions and procedures through which citizens can express effective preferences about alternative policies and leaders. Second is the existence of institutionalized constraints on the exercise of power by the executive. Third is the guarantee of civil liberties to all citizens in their daily lives and in acts of political participation.*

Other aspects of plural democracy (e.g. the rule of law, systems of checks and balances, freedom of the press, and so on) are means to, or specific manifestations of, these general principles. Authors also have calculated an index for autocracy (AUTOC). They at first define "Authoritarian regimes" as political systems whose common properties are a lack of regularized political competition and concern for political freedoms. Then they use the more neutral term "Autocracy" and define it

operationally in terms of the presence of a distinctive set of political characteristics. In mature form, autocracies sharply restrict or suppress competitive political participation. Their chief executives are chosen in a regularized process of selection within the political elite, and once in office they exercise power with few institutional constraints. The *POLITY* score is computed by subtracting AUTOC from DEMOC. The resulting unified polity scale ranges from +10 (strongly democratic) to –10 (strongly autocratic).

Wars and *Civil Wars* are two other indices, which I employ as the sources of uncertainty. I collect them from two sources: the first is Correlates of War (*COW)* project *1816 – 1997(V.3)* that was offered by Serkees (2000), and the second prepared by Gleditsch (2004), which is a revised version of COW covering the period 1816 - 2002. The author explains that the article displays a revised list of wars since 1816, with updates for 1997 to 2002 based on data compiled by the Department of Peace and Conflict Research at Uppsala University.

Inequality is another variable that I employ in this article. I have utilized Estimated Household Income Inequality Dataset (EHII). This dataset is offered by University of Texas – U.S. and as they state on their website, this is a global dataset, derived from the econometric relationship between UTIP-UNIDO[16], other conditioning variables, and the World Bank's Deininger & Squire data set.

The following seven macroeconomic variables are gathered from World Bank Development Indicators 2005. It consists of terms of trade, inflation, GDP growth, real interest rate, trade, exchange rate distortion and domestic credit to private sector. These variables are defined as follows:

[16] -UTIP- UNIDO is a global data set that calculates the industrial pay-inequality measures for 156 countries from 1963-1999. This is a joint project by University of Texas Inequality Project (UTIP) and United Nations Industrial Development Organization (UNIDO).

Terms of Trade are the ratio of the export price index to the corresponding import price index measured relative to the base year 2000 (year 2000 = 100). *Real Interest Rate* is the lending interest rate adjusted for inflation as measured by the GDP deflator (percent). *Inflation* is measured by the annual growth rate of the GDP implicit deflator. The GDP implicit deflator is the ratio of GDP in current local currency to GDP in constant local currency (annual percent). *Growth of GDP* is the annual percentage growth rate of GDP at market prices expressed in constant local currency. *Trade* is the sum of exports and imports of goods and services measured as a share of gross domestic product (percent of GDP). *Domestic Credit to Investment* refers to financial resources provided to the private sector, such as loans, purchases of non-equity securities, and credits that establish a claim for repayment. For some countries these claims include credit to public enterprises (percent of GDP). The last variable is *Volatility of Distortion in Exchange Rate*. Dollar (1992) constructs this index to measure outward orientation in real exchange rate policies. As he urges, outward orientation generally means a combination of two factors: first the level of protection, specially for inputs into the production process, is relatively low, and second, there is relatively little variability in the real exchange rate, so that incentives are consistent over time. Brunetti & Weder (1997) have used this index as a proxy of policy uncertainty to analyze its effect on investment. The measure of the real exchange rate is distorted by the existence of non-tradables. Therefore, Dollar tries to correct this as following:

At first, he uses the International comparisons of price levels compiled by Summers and Heston (2002). They price the same basket of consumption goods in domestic currency in different countries and then convert the measure into U.S.

dollars, using the official exchange rate. Using the U.S. as the benchmark country, the index of country i's relative price level (PRL) is

$$PRL_i = \left(\frac{P_i}{P_{u.s.}} \right) * 100$$

where P_i is the price of the consumption basket in country i in U.S. dollars. Then, Dollar regresses PRL_i on dummies for years and continents (the outliers detected by Hadi (1992, 1994) have been excluded from the estimation). This is done to correct for differences in factor endowment, which in turn serves as a proxy for differences in price of non-tradables. He uses the regression to calculate the predicted relative price level for each year and each country. The actual price level divided by this predicted price level (based on data from previous periods) is the index of real exchange rate distortion.

Unpredictability of these variables is considered as a source of uncertainty. I have calculated their unpredictability as variance of the residuals generated by the best fitted moving average (MA) process[17] conditional on information till the last period:

$$\sigma^2_{e\,x,\tau} = \frac{\sum_{t=0}^{\tau} e^2{}_{x,t-1}}{\tau - 1}$$

Where, $\sigma^2_{e\,x,\tau}$ is the conditional variance of variable x for the first τ periods and $e_{x,t-1}$ is the residual of x in a MA process in period $t-1$. I used a MA process because it gives an estimation based on information and experiences of the previous periods. Therefore, conditional variance of its residuals is a measure of unpredictability in behavior of x. The list of these MA processes is provided in table-C1, appendix C. The lists of all the variables and their properties are presented in table-C2 and table-C3 respectively.

[17] - Mostly the best fit was available by MA(3) but in some cases I had to use the other orders like one, two or four.

4.2- Methodology

I applied a panel method even though my study is about Iran. It is because of two reasons: first, shortage of data in some variables like rule of law, control of corruption and property rights, makes it impossible to utilize time series methods. Second, there are some factors, which hardly change over time - for example property rights or level of democracy. So, the analysis of these factors in a time series process is almost impossible. The methodology of panel data gives us the opportunity to take these factors into account in our analyses.

As Beck and Katz (1996) and Beck (2001) have mentioned, a panel data model yields generalizable results if the sample is collected through a random sampling scheme but yields sample specific results if a random sampling scheme is not used. I have collected data on 39 countries including Iran. The choice is dictated by availability of data and is not done through a random sampling. The list of countries is presented in table-C7 of appendix C. All inferences of the panel are valid only for the countries included in the panel. We can expand our inferences from this estimation to cover future periods for included countries but we cannot use them to generalize about other countries.

There are three incomplete panels as mentioned above: panel dealing changes in policies and macroeconomic outcomes for the period 1971 - 2000 with an average of 23 observations per country. b) Panel dealing with socio-political institutions and conflicts for the period 1970 - 1993 with an average of 18 observations per country and c) finally a panel dealing with the quality of public governance and covering three years 1996, 1998 and 2000.

The fixed effects model is used if we think that there are intrinsic differences among units. The random effects model is used if the differences among units are not

intrinsic to the units. Differences that are not accounted for by explanatory variables are random and restricted to the sample period alone. Hsiao (1986) and Beck (2004) argue that fixed effects are proper if one collected units without any sampling scheme, whereas the random effects model is suitable if one has a random sample from a larger population and wants to make inference about that larger population. Thus, the fixed effects are more suitable for my study than random effects, though, the *Hausman* specification test can be used as a diagnostic tool for distinction between fixed and random effects. I treated first and second panel as TSCS[18] data with its different cross sectional and times series issues[19], and third panel is thought as a fixed effect panel data because of the small number of observations per unit. I proceed as follow:

In the next section I will discuss the problems, challenges and results, which typically exist in TSCS data in the first panel. Then, the strategies and results about the second panel (socio- political institutions and conflicts) have been discussed. After that I will discuss the related issues in third panel, its specific problems and the results of the model.

4.3- Uncertainty About Macroeconomic Variables

4.3.1- Unit Root Test

I utilized the Maddala and Wu (1999) test to check for stationarity. The full details of test have expounded in table-C8, appendix C. There is evidence that supports rejection of the null hypothesis of nonstationarity. None of the variables in this panel has a unit root. Hence, we can proceed without any concern about spurious regression.

[18] - Time series- cross section data is a panel data with relatively more observations- say more than 10- per unit.

[19] - Therefore some tests for detection of heteroskedasticity and contemporaneous correlation is needed.

4.3.2- Poolability

The concept of poolability is concerned with the coefficients of variables for each country. It simply implies that the effect of a given explanatory variable is constant across the countries. The core question is that whether all countries have the same function for the data generation process or whether each country has its own function for the generation of data. If we assume that each variable is homogenous across countries then our model will be:

$$Y_{it} = X_{it}\beta + \varepsilon_{it} \qquad (1)$$

where Y_{it} is the value of dependent variable for country i in the period t. X_{it} is the vector of independent variables, β vector of coefficients that are common among the countries and ε_{it} is error term for country i in the period t. However, if the coefficients of exogenous variables vary from one country to the other, then we can write:

$$Y_{it} = X_{it}\beta_i + \varepsilon_{it} \qquad (2)$$

where β_i is the unit specific coefficient. We often like to pool the data to use its advantages: it increases the efficiency of the estimates (Stanig, 2005), this model allows for the analysis of variables that vary only a little over periods or over units (Franzese and Hays, 2005). The number of observations as well as degrees of freedom increases (Plumper, Troeger and Manow, 2005). On the other hand, as Stanig (2005) shows if the functional relation among variables in the data generating process is not constant across units but the data is pooled, we will have specification error in our estimation.

There is a traditional F-test for the detection of heterogeneity in the data generation process. Referring to equation 1 and 2 the null hypothesis is

$$H_0 : \beta_i = \beta$$

F test compares the difference in sum of squares residuals from the two equations mentioned above, divided by the proper number of degrees of freedom and mean square error of equation 2:

$$F = \frac{\frac{(e'e - \sum e_i' e_i)}{(n-1)K}}{\frac{\sum e_i' e_i}{n(T-K)}} \sim F\left[(n-1)K, n(T-K)\right]$$

where $e_i' e_i$ is the sum of square of errors (SSE) of the OLS regression for group i. $e'e$ is the SSE of the pooled OLS regression. N is the number of units. K denotes the number of variables including the intercept and excluding dummy variables. The number of time periods is denoted by T. But this test is not used because as Beck (2001) argues this test often tends to reject the null of pooling because of the some reasons; there might be a slight variation in all β_i, at least one country is not fit well by equation 1, or there is some parameter variation because of the large sample size common in TSCS data sets. And later he demonstrates that poolability is preferable if number of the periods covered is less than 30 so that the gain from an increase in observations generated by poolability outweighs structural differences between countries (Beck, 2006). Baltagi (2005) lists a battery of investigations through which he concludes that homogeneous estimators outperform heterogeneous one. And Beck & Katz (2004) summarize that: "... *The gains from pooling offset the costs of pooling, more than standard statistical theory asserts".* Therefore, I assume that slopes are same across the countries and over time.

4.3.3- Outliers

In this section I try to find out whether there is any country in the panel, which might act as an outlier and therefore needs to be excluded from our estimation. There are two methods for this detection (Beck, 2006). The first is a Box plot of dependent variable and the second is cross validation. The first method is simple. Its result has been shown in figure-B19, appendix B. As the figure demonstrates private investment of *Bulgaria* fluctuates in a pattern totally different from that of the other countries and must be excluded from the panel.

Cross validation needs further calculations. According to Beck (2001) the simplest form of cross validation is to leave out one country, fit an OLS regression with all other countries, and predict the left out country. Then, we can compare the mean square error of predictions. I have done it using all variables except real interest rate, because the number of observations for real interest rate is considerably lower than those for other variables. The result has been shown in table-C9, appendix C. Again, *Bulgaria* with mean square error of about 2.199 stands out as an outlier. Hence, we exclude it from our estimation and pool the other countries with each other.

4.3.4- Fixed Effects

I discussed earlier that fixed effects are proper when we collect our units without any random sampling scheme. Next in the discussion about poolability I have argued that it is better if the data are pooled. This section is dedicated to finding out whether we should have one intercept as in a completely pooled model for all countries or let each country have its own intercept. The application or elimination of fixed effects has its own risks and advantages. If we employ fixed effects, according to Beck (2001) and Baum (2006) we have to exclude time-invariant variables of the

model due to their co linearity, because, the demeaning process will eliminate them for all time periods[20]. Moreover, fixed effects will " soak up" most of the explanatory power of the variables which vary slowly over time. On the other hand, however we can fix these problems with elimination of the fixed effects and control the effects of exogenous shocks common to all countries. However, as Wilson & Butler (2004) precisely demonstrate, ignoring the fixed effects can lead us to a biased estimation due to omitted variable bias. This bias may even change the sign of coefficients. This is what they have to say about low-moving variables: "*We definitely agree that unit effects soak up the explanatory power of sluggish variables, but in our view this- to the extent that following conservative norms of inference is desirable- is a good thing, not a cost*".

We can test if the model needs fixed effects or not. The null hypothesis is

$$H_0 = \mu_1 = ... = \mu_{n-1} = 0$$

Due to Park (2005) & Greene (2003) this hypothesis is tested by a traditional F test that is based on loss of goodness of fit

$$F_{(n-1,nT-n-k)} = \frac{\frac{R^2{}_U - R^2{}_R}{n-1}}{\frac{1-R^2{}_U}{nT-n-k}}$$

Where robust (unrestricted) model is Least Square Dummy Variable (LSDV) and efficient (restricted) model is the pooled regression. Subscription *U* denotes '*Unrestricted*' to a variable and subscription *R* denotes '*Restricted*' to a variable. *n* is the number of countries, *k* is the number of the regressors excluding dummy variables, and *nT* is the number of total observations. I left *Bulgaria* out of the

[20] - Demeaning process is the subtraction of a variable from its average, which is $(x - \bar{x})$. Including a time invariant variable in a fixed effects model causes its value to be zero for all time periods.

equation. The F calculated for the panel 36.02 [37, 848] [21]rejects the null hypothesis of pooling at the 0.01 significant level.

4.3.5- Estimator Selection Strategy

If equation 1 is the model, in the process of selection of an estimator for our model then we must take into account the Gauss-Markov assumptions. If the error process meets the assumptions, Ordinary Least Square (OLS) is optimal. The Gauss-Markov assumption explains that each unit error term ε_{it} must be independent and identically distributed:

$$\begin{cases} E(\varepsilon_{it}\varepsilon_{js}) = \sigma^2 & i = j \;\&\; t = s \\ 0 & otherwise \end{cases}$$

If errors do not satisfy this assumption, OLS will be inefficient and estimated standard errors may be incorrect. This assumption may be violated because of a)Heteroskedasticity b) contemporaneous correlation and c) serial correlation. Later, these problems will be discussed in greater detail.

One strategy to deal with these problems is estimation by feasible generalized least square (FGLS) as suggested by Park (1967) and popularized later by Kmenta (1986). This method as criticized by Beck & Katz (1995, 96) as it produces standard errors that lead to extreme overconfidence. They report that calculated standard errors understate variability by about 100 percent if the number of observations is less than 30 and by almost 30 percent for more observations. Hence, we should always be wary of downward bias in standard errors and upward bias in ***t*** statistics in small samples. Furthermore, this method for contemporaneous correlated errors cannot be applied unless the number of observations becomes as big as the number of countries. Even in

[21] - The numbers in brackets are the degree of freedom.

this circumstance estimation of standard errors is problematic unless the number of observations per country is considerably larger than the number of countries.

An alternative strategy for TSCS data is OLS with Panel Corrected Standard Errors (PCSE) suggested by Beck & Katz (1995, a). They have demonstrated by Monte Carlo experiments that this strategy has better performance in the presence of either panel heteroskedasticity or contemporaneous correlation. Monte Carlo experiments have shown that PCSEs are very close to OLS standard errors when the Gauss Markov assumptions hold. Chen, Lin & Reed (2005) also reported that PCSE is superior to FGLS when one's main goal is hypothesis testing. However, one must be cautious about the number of observation per units. As Beck (2001) argues:

> *Theoretically, all asymptotics for TSCS data are in T; the number of units is fixed and even an asymptotic argument must be based on the N observed units. We can, however, contemplate what might happen as T tends to infinity, and methods can be theoretically justified based on their Large T behavior.*

So, researchers ought to be wary of TSCS methods applied for less than 10 observations per unit. Thus, we can use this method for estimating the first and second panel, but it will not be proper for the third one with just three observations per country. In the following sections the violation of Gauss-Markov assumptions will be detected.

Heteroskedasticity

One of the assumptions which lead to optimality of the OLS process is the homoskedasticity of the error terms i.e. error terms have the same variance across all

countries. This assumption might not hold for empirical data. For instance, the level of the inflation in one country might be more volatile than that in the other country.

Any assumption that error terms have the same variance across countries, must be checked by a test for the existence of this problem. I applied a modified Wald statistic for country-wise heteroskedasticity to the residuals of a fixed effect regression model, following Greene (2000). First, the fixed effect model is estimated under the assumption of homoskedasticity. The null hypothesis is that

$$H_0 = \sigma^2{}_i = \sigma \qquad , i=1,...,g$$

where g is the number of cross-sectional units. The test statistic is distributed as a Chi-squared statistic of order g. *Bulgaria* is left out of the equation again. Because, real interest rate has a lot of missing values the test is performed twice, once with real interest rate included as a variable and once without it. When real interest rate included as a variable in the test the Chi squared statistic calculated for the panel is $5.6*10^{30}$**,** which causes us to reject the null hypothesis of homoskedasticity at the 0.01 significant level. When real interest rate is excluded, the Chi squared statistic is *1858.63* and therefore we reject the null hypothesis of homoskedasticity at the 0.01 level again.

Contemporaneous correlation

Another cause for violation of the Gauss-Markov assumptions is contemporaneous correlation, which is observed if unobserved features of one country relate to unobserved features in other countries (Beck, 2001). Hence we can see contemporaneous correlation where there is a strong economic linkage between countries (e.g. European Union). Following Greene (2000), the Breusch-Pagan test, when applied to the residuals of the fixed effect regression under the null hypothesis

of cross sectional independence, can detect contemporaneous correlation. The resulting test statistic is distributed as Chi squared with *d* degrees of freedom where *d=g*(g-1)/2* and *g* is the number of countries. Unfortunately, this test fails to calculate any test statistics because its correlation matrix of residuals becomes singular. Therefore, no evidence can be gathered to test contemporaneous correlation. The solution adopted is to estimate the equation twice, once assuming contemporaneous correlation and once without. As we will see later the results are almost similar together.

Serial correlation

There are vast arguments about the methods to deal with this problem. According to Baltagi (2005), ignoring serial correlation when it exists, lead us to a consistent but inefficient estimate of the regression coefficients and biased standard errors. Wooldridge (2002) suggested a test for serial correlation in the idiosyncratic errors of a linear panel-data model. Drukker(2003) demonstrates that this test has good size and power properties in reasonable sample sizes. Under the null hypothesis of no auto-correlation the residuals from the regression of the first-differenced variables should have an autocorrelation of -0.5. This implies that the coefficient on the lagged residuals in a regression of the lagged residuals on the current residuals should be -0.5. The Wooldridge test's F-statistic that has been calculated in this case is 6.998 [1, 37] and we therefore reject the null hypothesis of no autocorrelation at the 0.05 significant level. That means we should adjust for serial correlation in the model.

Dealing With Serial Correlation

As I mentioned already, there is a vast debate about the proper methods dealing with the serial correlation in TSCS data. One strategy is the AR(1) process:

$$Y_{it} = X_{it}\beta + \varepsilon_{i,t} \quad (3)$$

$$\varepsilon_{i,t} = \rho\varepsilon_{i,t-1} + \nu_{i,t} \quad \nu_{i,t} \approx iid(0,N) \quad (4)$$

I first estimate (3) by OLS. From (3) the residuals are used to estimate ρ for the second equation. In the next step, observations are transformed by the Prais-Winsten transformation to produce serially independent errors. Kmenta (1986) suggests unit specific ρ. Beck & Katz (1995, b) argue that if it is accepted that the coefficients of parameters of interest do not vary in the pooling process, then there is no reason for serial correlation parameters to vary by units. They showed by Monte Carlo experiments that the assumption of a common serial correlation process leads to superior estimates of β even when the data are generated with unit specific ρ_i . This is because ρ_i is estimated using only a small number of observations per country and it is well known that auto regressions estimated from less than 30 observations lead to unreliable results.

They alternatively suggest a lagged dependent variable (LDV) method instead:

$$Y_{i,t} = \Phi_i Y_{i,t-1} + X_{i,t}\beta + \varepsilon_{i,t} \quad (5)$$

One problem of this method is that both the lagged dependent variable and one of the explanatory variables might be correlated. Moreover, Plumper, Troeger & Manow (2005) argued that the LDV method might absorb large parts of the trend without actually explaining whether the dependent variable exhibits a general time trend. Under this condition, estimates can be biased if at least one variable has a persistent effect. If we do not consider this persistence and do not model it, the coefficient of the lagged dependent variable is biased upwards, while the coefficient of the other independent variables are likely to be biased downwards. They then argue that the AR (1) model tends to absorb less time series dynamics and could be superior.

However, the least harmful specification of the estimation model depends on the theory of the researcher. Wilson & Butler (2004) claim that apart from AR (1) and LDV, other dynamic methods, which one can think of are the distributed lag (DL) model and the auto regressive distributed lag (ARDL) model. They emphasized that LDV will cause the fixed effects model to be biased, but the bias is relatively small for the independent variables, though a substantial bias can exist for the LDV coefficient. Beck & Katz (2004), with the acceptance of this fact, claimed that the coefficient of the dependent variable in LDV must not be interpreted casually. On the other hand, they added that ARDL is also too general and because of multicollinearity this generality is harmful.

As far as the theory of investment under uncertainty is concerned, uncertainty can arise from the "value of waiting". Investors might delay decision making to get more information and higher rates of return (Dixit & Pindyck, 1994) and (Novy-Marx, 2007). Therefore, there is uncertainty about exactly when an investor will invest. As soon as the cost of waiting exceeds the expected rate of return, the investor would abandon the investment or may even exit the industry. On the other hand, Uncertainty in period *t* is a function of uncertainty in period *t-1* because they share a common information basing ranging from period 0 to period *t-2*. Hence, I select an AR(1) model to fix the problem of serial correlation.

4.3.6- Multicollinearity

Numerous dummy variables as well as a conceptual relationship among the independent variables causes us to be suspicious about multicollinearity. For instance, a revolution could be accompanied by riots and strikes or a better rule of law which can lead to lower corruption. Even severe multicolinearity does not violate OLS

assumptions and its estimate is still unbiased. Nevertheless, the greater multicolinearity will lead to greater standard errors. Thus, confidence intervals for coefficients tend to be very wide and t-statistics tend to be very small. Then, coefficients have to be larger to be statistically significant.

There are several warning signals that indicate multicolinearity. However, there is no irrefutable test for detecting the problem. One of the better methods is detection of the variance inflationary factors (VIF). According to Montgomery, Peck and Vining (2003) a VIF above 10 is an indication of multicolinearity. The results of the VIF test after a simple OLS regression are presented in tables-C13 and C14 of appendix C. It shows that we must be concerned about multicolinearity in the panel. As multicollinearity can be severe due to multiple combinations of some correlated variables (say dummy variables in the panels), use of some dummy variables and a constant in the model may reduce the problem. Further inspection shows that elimination of dummy variables relating to China, Mexico, Nicaragua, Thailand, Uruguay and Venezuela can decrease all VIF values to a level below 10. With this strategy interpretation of intercepts will change. The intercepts of all countries, for which dummy variables have been eliminated, are considered to be identically equal to the calculated constant term, which is common to all units. The intercept calculated for other countries must be added to the constant term to show the real intercept of each country.

4.3.7- Estimation

I selected a fixed effects model with AR(1) process as follows:

$$y_{it} = c + \alpha_i + X_{it}\beta + \varepsilon_{i,t} \quad (6)$$

$$\varepsilon_{i,t} = \rho\varepsilon_{i,t-1} + \nu_{i,t} \qquad \nu_{i,t} \approx iid(0, N) \quad (7)$$

where y_{it} is the natural logarithm of private investment rate, α_i is the country specific intercepts, c is constant, X_{it} is the vector of independent variables including natural logarithm of conditional variance of residuals calculated by MA process as explained above: domestic credit to private sector, exchange rate distortion, growth, terms of trade, inflation and real interest rate. 295 observations are eliminated due to missing values if the real interest rate is included in the model. Therefore, I estimate the model twice, once without real interest rate uncertainty to use maximum information and once with real interest rate uncertainty. When interest rate uncertainty is included, the coefficients of dummy variables of Panama, Uruguay and Venezuela are assumed to be equal to zero to reduce VIF test statistic below 10 and avoid severe multicollinearity. Each of these two models is estimated twice, with and without contemporaneous correlation, as explained before (Table-C10, appendix C for more clarity). *Bulgaria* is excluded from the estimation because it will not be explained well the model. A PCSE method has been used to estimate the model. I select the *autocorrelation of residuals* as a method to compute the autocorrelation.

The results are presented in table-C10, appendix C. The results in the case of assumed contemporaneous correlation exhibit lower standard errors as compared to the case of no contemporaneous correlation. In the case of uncertainty about growth and terms of trade, their coefficients are significant when we consider contemporaneous correlation. This means that common external shocks (e.g. oil prices or financial crisis) affects terms of trade and growth of countries. Chi squared statistics of all equations lead to rejection of the null hypothesis of the Wald test that coefficients are jointly equal to zero. When real interest rate is excluded from the equation (1 and 2), uncertainty over all macroeconomic variables has a negative effect on private investment. Uncertainty in the form of exchange rate distortion and

that relating to trade, growth and terms of trade have a negative significant effect on private investment. The effect of uncertainty regarding domestic credit to private sector, inflation and real interest rate is negative but insignificant.

4.4-Uncertainty about Socio-Political Institutions and conflicts

Most of the variables are observed from 1970 to 1993. However, *coups* and *constitutional changes* are only observed till 1988. Data on index of *inequality* are available from 1970 to 1993. However, there are a lot of missing values. Hence to make a trade-off between variables and observations I will proceed as follows: I will carry out all tests and estimations in three steps. In the first step I shall include all variables except for *coups*, *constitutional changes* and *inequality* in order to use maximum information (panel *a* hereafter). In the next step I include *coups* and *constitutional changes* but not *inequality*. All other variables are included in the panel to check the effect of the first two variables between 1970 and 1988 (panel *b* hereafter). In this step *Benin, Nicaragua* and *Poland* will be excluded automatically, because, variables of these countries do not have common time period observations with other countries. And finally, in addition to the variables in panel *a* I will exclude *coups* and *constitutional changes* and include *inequality* instead (panel *c* hereafter). *Benin, Cote d'Ivoire* and *Nicaragua* will drop out according to unequally observation of variables.

Diagnostic tests are started by unit root as I have done so for macroeconomic uncertainty. Table-C8 of appendix C indicates the result of a Maddala and Wu test for panel unit root that uses augmented Dickey-Fuller transformation. The Chi squared statistics lead us to reject the null hypothesis of unit root for all variables at the 0.01 significant level.

For the diagnoses of outliers, a box plot diagram is presented in figure-B20 of appendix B. Again *Bulgaria* shows behavior which is different from the other countries. The result of cross validation test for panel *a,* is presented in table-C9, appendix C. It confirms that Bulgaria with mean squared errors of 7.819 is totally different from other countries. As, this odd behavior is caused by the fluctuations of private investment, the test is not repeated for the other panels because their results will be the same.

As I explained above, as the average number of observations does not exceed 18 per country, I pooled the coefficients of variables in equation (1) to attain greater efficiency in estimation. However, the heterogeneity of countries in intercepts must be examined. The traditional F-test statistics equals 1135.9 with [37, 635] degree of freedom for fixed effects leading us to reject the null hypothesis of pooling at the 0.01 level of significance for the panel *a*, after excluding *Bulgaria* as outlier. The F-statistic of 1083.57 [34, 448] causes us to rejects the null hypothesis of pooling in panel *b* and in the same way F-statistic 36.61 [34,523] lead us to reject the null hypothesis of pooling in panel *c.* These are all significant at 0.01 level.

Diagnosis of country-wise heteroskedasticity by a Modified Wald test yields a Chi squared statistics of 2371.89 [38] for panel *a,* $2.7*10^{28}$ [35] for panel *b* and 2579.99 [35] for panel *c.* All of them cause us to reject the null hypothesis of homoskedasticity in error terms.

The test for contemporaneous correlation fails to produce any outcome regarding singularity of correlation matrix of residuals. I apply contemporaneous correlation correction for more assurance.

The Wooldridge test for autocorrelation in panel data yields an F-statistic 6.494 [1, 37] for panel *a*, which leads us to reject the null hypothesis of no first order

autocorrelation at the 0.05 level of significance. This test for panel *b* yields an F-statistic 5.167 [1, 33], which causes us to reject the null hypothesis of no serial correlation at 0.05 level of significance. However, it is accepted at the 0.1 level. The test result is 5.817 [1, 34] for panel c, causing us to reject the null hypothesis of no serial correlation at the 0.05 level. Outcomes of diagnosis test for multicolinearity have presented in tables-C15, C16 and C17, appendix C. Results do not show severe multicollinearity in panel *a*, *b* and *c*. Like above, I use AR (1) process for estimation applying PCSE:

$$y_{it} = \alpha_i + X_{it}\beta + \varepsilon_{i,t}$$
$$\varepsilon_{i,t} = \rho\varepsilon_{i,t-1} + \nu_{i,t} \qquad \nu_{i,t} \approx iid(0, N)$$

The results are presented from 1 to 3 in table-C11 of appendix C. All equations yielded Chi squared statistics are large enough and we can reject the null hypothesis that all coefficients are jointly equal to zero. The level of democracy has direct but insignificant sign. Civil war has absolutely negative and significant effect on private investment at the 0.01 significant level. Purges also affects private investment negatively at the 0.05 significant level. Other variables, revolutions and strikes adversely and assassinations positively affects private investment but all of them are insignificant. Riots show a positive effect on private investment which is significant at 0.01 level for panel *a,* but is not significant in other panels especially in equation 4. Coups and constitutional changes affect private investment adversely and their effect is significant at the 0.01 level in panel *b*. Inequality in panel *c*, shows a positive effect but its effect is insignificant.

We may be suspicious about the coefficients and standard errors of war, because it might be correlated with fixed effects due to the fact that it is a slowly moving variable as discussed before. I have applied Fixed Effects Vector

Decomposition (FEVD) suggested by Plumper and Troeger (2004) and retested panel *a* to control for these sluggish variables. FEVD acts as following: in the first step, the unit fixed effects is estimated by running a fixed effects estimate of the baseline model. In the next step, the unit effects are split into an explained and an unexplained part by regressing the unit effects on the time-invariant and rarely changing explanatory variables of the original model. Finally, a pooled OLS estimation of the baseline model will be performed by including all explanatory time variant, time invariant and the rarely changing variables plus the unexplained part of the fixed effects vector. Plumper and Troeger show by a series of Monte Carlo experiments that FEVD is the least biased estimator when time variant and time invariant variables are correlated with unit effects. This procedure produces unbiased estimates of time varying variables regardless of whether they are correlated with unit effects or not and unbiased estimates of time invariant variables that are not correlated. Only when the estimated coefficients of the time invariant variables are correlated with the unit effects this method suffer from omitted variable bias. Desirable small sample properties and unbiasedness in estimating the coefficients of time variant variables, which are correlated with the unit effects are the advantages of this method.

The outcomes of retests have been presented in Table-C11, appendix C as *fevd*. I applied OLS again with PCSE and AR (1) estimation in the third step. The high F-statistic rejects the null hypothesis that coefficients are jointly equal to zero. A value of the Durbin-Watson statistic near 2 implies that the Prais-Winsten transformation has fixed the problem of autocorrelation in this panel. Riots have become insignificant in this panel. However, its effect has remained positive. The effect of democracy has remained insignificant. Other results are similar to that for panel *a* other than that for purges. This variable is significant at the 0.01 level.

4.5- Uncertainty about The Quality of Public Governance

This panel contains regulatory burden, control of corruption, rule of law, natural logarithm of property rights and natural logarithm of government intervention as right hand side independent variables. Each variable has been observed over 1996, 1998 and 2000.As Beck (2001) mentioned we cannot use PCSE method if the number of observations is less than 10 per unit. Hence, we must look for proper panel estimators that allow for confined observations. But before proceeding, the properties of data must be detected.

The box plot of figure-B21, appendix B indicates that *Malawi* fluctuates with a different pattern as compared to other countries. Outcomes of cross validation test confirm this result in table-C9, appendix C. The mean squared error of 2.361 for this country is very different from that for the other ones. Therefore, this country will be excluded from the next tests and estimations.

The F-statistic being 30.10 [37,56], we can reject the null hypothesis that coefficients of the unit effects are jointly equal to zero at the 0.01 significance level. Therefore, unit dummies will be included in the model to portray country heterogeneity, but the coefficients of variables are assumed to be constant across the countries through a pooling process as we discussed earlier.

The modified Wald test for country-wise heteroskedasticity yields a Chi squared statistics equal to $8.1*10^{32}$ [38] and we reject the null hypothesis of homoskedasticity between countries at the 0.01 significance level. Because contemporaneous correlation is a problem for TSCS data and not panel data, I do not test for existence of this phenomenon. The Wooldridge test for serial correlation in panel data yields a F-statistic 26.819 (1, 23), causing us to reject the null hypothesis of no first order correlation among the residuals.

The VIF test for multicollinearity in table-C18 of appendix C indicates a problem. Thus, the coefficients of dummy variables of Argentina, Chile, El Salvador, South Korea, Madagascar, Malaysia, Philippines, Poland, Thailand and Trinidad and Tobago are assumed to be zero to reduce the VIF test statistic below 10.

Regarding the outcomes of diagnostic tests we need to utilize an estimator, which allows for heteroskedasticity and serial correlation. According to Baum(2006), the cluster covariance matrix estimator allows for difference in the variance of the errors between clusters. Furthermore, it allows for correlations between errors in the same cluster. Kezdi (2003) demonstrates on the basis of a Monte Carlo study that robust clustered estimator, when utilized for the fixed effects model, is not only consistent but also behaves well in finite samples. Hence, I estimated a fixed effects model, applying a robust clustered estimator. The outcomes are presented in table-C12 of appendix C. LSDV does not report F statistic due to the clustering process. R squared is 0.879 in LSDV, which is proper. The *regulatory burden*, *rule of law* and *property rights* all have a positive effect and are significant at the 0.05 level but only the *regulatory burden* is significant at the 0.01 level. Government intervention has a negative but insignificant effect. The most surprising effect is about the control of corruption. It affects private investment negatively and is significant at the 0.1 significant level.

4.6- Outcomes Analysis

As we discussed earlier, we expect that each kind of uncertainty restrains investment. Among macroeconomic variables, uncertainty about credit to private sector adversely affects investment. Admasu (2002) concludes that difference in the level of credit to private sector is the strongest explanation for variation in private investment across countries and over time. Our finding is that however uncertainty

about the future level of the credit to private sector deters investment but its effect is not significant.

The second source of uncertainty stems from exchange rates. Articles in this field have often considered the effect of real exchange rate uncertainty on investment. As Serven (1998) explains it is related to the relative profitability of investment in domestic market v.s international market oriented activities. If the volatility of real exchange rate rises, it makes price signals less informative about the relative profitability of investment across different sectors in a way that hampers investment decisions. There are some studies which report an adverse and significant effect of real exchange rate uncertainty on investment (e.g. Serven 1997, 2002a, 2002b and Cottani et al, 1990). However Darby et al (1999) adds that this effect is not conclusive and depends upon circumstances and Byrne and Davis (2005) conclude that it is the transitory and not the permanent component, which adversely affects investment. We instead consider uncertainty about distortions of real exchange rate in the manner proposed by Dollar (1992). It is interpreted as uncertainty about the direction of government trade policy i.e. whether is outward or inward oriented. Outward oriented policies are reflected in relatively little variability of the real exchange rate so that incentives are consistent over time and encourage exports. Brunetti and Weder (1997) show that uncertainty about distortions of real exchange rate is very important for investment. My study also confirms this negative effect of uncertainty regarding exchange rate distortion on private investment rate.

Unpredictability about growth is another source of uncertainty. As Serven(1998) explains, uncertainty of output growth is a measure of the unpredictability of future demand. Fuss and Vermeulen(2004), Darku(2000) and Fedderke(2004) have reported a significant and negative impact of uncertainty

regarding growth on the investment rate. Our outcomes also confirm this result and it shows that if investors are uncertain about future demand, they hesitate to invest.

Terms of trade are related to the relative profitability of investment in the exportable merchandise sector versus import substitutive merchandise sector (Serven, 1998). According to Easterly et al (1993), depending upon the terms of trade, capital might flow from domestic saving or from abroad into the export sector or the import substituting sector. Thus, given the terms of trade, more uncertainty makes price signals less informative about the relative profitability of investment and hampers the decision to invest. Cardoso(1993) and Serven (1997)have reported significant and negative impact of uncertainty regarding the terms of trade on private investment. Our results confirm a negative significant effect of terms of trade uncertainty on the private investment rate.

It is very common in developing countries that governments abruptly ban export or import of some merchandise because of the need to protect customers or producers. An investor needs long-term policy stability in marketing, exporting or importing commodities. This kind of intervention mentioned above is a bad signal and discourages investors. Our study shows that trade policy uncertainty has adverse effect on the private investment rate.

The effect of uncertainty about inflation on investment is quite complicated and ambiguous. At first we must aware that there is a distinction between inflation uncertainty and uncertainty about prices. As Cecchetti (1993) demonstrates:

> *One can easily imagine a case where the monetary authorities target a low or zero inflation rate but allow random base drift in the price level. In this case, the inflation rate could become quite predictable whereas the price level*

could remain unpredictable in the sense that its conditional variance could rise without bound with forecast horizon.

With this point of view Able (1980) explains that inflation should not have any direct effect on private investment, except for effects on the tax structure. Therefore, its uncertainty also should not have any direct impact. However he does not reject some possible indirect effects[22]. For instance, Yigit (2002) shows that inflation uncertainty will adversely affect credit markets by reducing credit availability and raising the cost of borrowing. Thus, investment could be affected through this route. According to Oshikoya(1994) and Serven(1998) inflation is related to the aggregate level of profitability of capital. Therefore, its uncertainty and unpredictability can affect private investment adversely. Huizinga (1993) argues that inflation uncertainty affect investment through its impact on uncertainty regarding the net present value of future streams. One might argue that however the uncertainty about prices cannot be interpreted as inflation uncertainty but we cannot reject its converse, which means that inflation uncertainty cannot rise without any increase in uncertainty about prices. Thus, these two could be synonymous when we think about inflation uncertainty. The complexity of the relationship between inflation uncertainty and investment is because of the fact that uncertainty about inflation affects investment through two separate channels: uncertainty about future output prices and uncertainty about future variable factor costs (e.g. wages, input material prices, etc). Hartman (1972, 1973) and Abel (1983) demonstrate that an increase in uncertainty about ratio of output price to variable cost should increase capital investment. This is because of the fact that concavity of the production function means the benefits of

[22] -Because the effect of inflation on future streams will offset by its effect on real discount rate when we calculate the net present value. For more information financial management textbook might be studied.

investing in capital stock in those times when the price-cost ratio is high outweighs the costs of investing in capital stock in those times when the price-cost ratio is low.

Bar-Ilan and Strange (1996) show that especially in the case of investment projects (especially those which run for a long period) it is possible that an increase in uncertainty hastens the decision to invest. Including a lag between decision to invest and receipt of the first revenue of the project can change the investment decision. Under this circumstance, the investor cannot enter the market immediately. Thus, the opportunity cost of waiting does not depend on the price during the lag. Instead it will be related to the future prices. Longer intervals will increase the probability of higher prices. Thus the opportunity cost of waiting rises with uncertainty. This means that an increase in uncertainty may hasten investment in order to catch the higher prices.

These conclusions are opposite to those of Pindyck (1991) who concludes that increased uncertainty about output prices decreases investment (see the literature review in chapter 1 for more details). On the other hand, there is no doubt uncertainty about costs reduces the investment because it increases the critical expected rate of return. Pindyck (1992) starts his argument by analogy with the put option in financial markets. This is based on a rule that implies that the investor invests until the expected cost to complete the project is not higher than a critical number. Costs of construction inputs vary whether or not investment is taking place. Hence, there is a value of waiting for information (i.e. probability of lower costs) before committing resources. Therefore, uncertainty about input costs reduces critical expected cost.

Empirical results are also different. Abel (1980) finds out that an increase in uncertainty about future inflation – which he considers synonymous with high rate of inflation- reduces the investment spending. Serven (1998) also shows that inflation uncertainty has negative effect on investment. Byrne and Davis (2004) demonstrate

that inflation uncertainty can have two components (one permanent and the other temporary). Both of them affect investment adversely but the temporary component is more significant. The empirical study of Huizinga (1993) shows interestingly the complexity of the effect of inflation uncertainty on investment. He argues that inflation uncertainty leads to uncertainty about real wages, real output price, profit rate and the real price of materials inputs. Then, based on analysis of quarterly data from aggregate U.S. manufacturing from 1954-1989, he verifies that temporary increase in real wage uncertainty and permanent increase in output price uncertainty reduces investment and higher profit uncertainty leads to higher investment. And he shows that on the basis of cross sectional analysis during the 1958 - 1986, that industries with higher real wages uncertainty and with higher real price of material inputs uncertainty had lower investment and industries with higher real output price uncertainty had higher investment rate. My study shows that uncertainty with regard to inflation has a negative effect on the private investment rate. However its effect is insignificant.

It seems that unpredictable changes in the real interest rate (which is the cost of money holding) must adversely affect private investment. Zalewski (1994) finds out there is a positive relation between risk premium and interest rate volatility. Bo(1999) confirms that interest rate volatility influences investment. My study shows that uncertainty about the real interest rate does not have a significant effect on private investment, though it is negative in sign.

There is not a consensus among experts about the effect of democracy on private investment. This effect is vague and indirect. Keefer (2004) argues that more democracy means more accountability of the government. Government has to provide more security for property rights otherwise it will be punished either in the process of

elections or by free media. This argument has been confirmed by Adsera et al (2003), Fox (2000), Stasavage (2000), Goodin (2004), Li (2005), Li and Resnick (2001), Kaufman and Vicente (2005), Weingast (1995). Iyigun and Rodrik (2004) illustrate that the fiscal link between government and its citizens is also needed to increase accountability. Adsera et al (2003) demonstrates that along with accountability the degree of information also matters. An article published by OECD (2003) shows that the transparency of government is important in generating clear information and Bovens(2005) adds that media have an important role in this field. It has also been mentioned that democracy can affect investment. Ulubasoglu and Doucouliagos (2004) and Feng (2001) confirm that the accumulation of human capital and democratic behavior can facilitate the processing and aggregation of local knowledge in the best possible manner. Papaioannou and Siourounis(2004) quote from some scholars that this relation can be direct due to lower political instability and sounder structural policies.

On the other hand, Przeworski and limongi (1993) demonstrate that politics matters but regimes do not capture the relevant difference. Papaioannou and Siourounis(2004) quote (from Becker,1983) that democratic regimes can yield inefficient outcomes by enabling various interest groups to compete. Feng (2003) adds that it can spur a desire for immediate consumption that can hamper investment. Moreover, it allows the median voter to redistribute incomes toward the poor, reducing incentives to save and invest. And finally, Wu (2004) shows that in the presence of some structural factors autocrats do better than democracies. The result of my study shows however there is a positive correlation between the degree of democracy and private investment, but it is not significant. So, we cannot confirm any

relationship between the level of democracy and the rate of private investment. It is quite possible that the mentioned positive factors are neutralized by negative factors.

Barro(1999) has elaborated routes through which inequality can affect private investment: first, if the poor tend to invest more in human capital, a reduction in inequality tends to encourage investment through a higher accumulation of human capital. Second, greater inequality makes government redistribute income because of the political pressures. This results in more transfer of resources, which discourages investment. Third, inequality can lead to more crimes, riots and sociopolitical unrest, which result in higher waste of resources and lower investment. But, the author finds out little overall relation between income inequality and the rate of investment through his empirical study. He also acknowledges that inequality can have different consequences in poor and richer countries. According to Hoft (2003) societies that began with more extreme inequality are more likely to make and develop redistributive institutions. My outcomes, however, confirm the results of Barro (1999) that there is no significant relationship between inequality and the rate of private investment.

At the first glance, it seems there are sufficient reasons for war to increase uncertainty and discourage private investment. It destroys properties, increases taxes, causes more government intervention, monetary policy disturbance, dislocation of export and import trade and diversion of normally productive efforts to advance unproductive aims. But as Dulles (1942) mentioned:

> *Destruction itself creates a need for new consumer goods. The conversion of industry to wartime purposes necessitates the production of new capital goods or the reconditioning of old plant, …, the need, in the past, has been so great that although surpluses of various types of commodities exist*

side by side with shortage, the opportunity to invest has been so spectacular that funds have been forthcoming from many varied types of sources.

Thus, shortage of commodities in the wartime generates price increases, which cover the high discount rates attributable to existing uncertainties. But, there is a condition. If there is a long continued political uncertainty, it will prevent expansion even if the economic condition is ready for further investment (Dulles, 1942). Hence, from this point of view there is a big difference between war and civil war. War is more likely to tend to national unity and smoothen differences in a country and generate political stability. Civil war, on the other hand, is a consequence of extreme and long lasting divergence and conflict within a society, which coexist with political instability. Therefore, we can expect that there is a likelihood of a higher private investment rate in wartime but there is no reason for civil war to encourage private investment. My empirical outcomes confirm the aforementioned argument that wars increase the private investment rate whereas civil wars reduce it significantly.

There are some different routes through which sociopolitical unrest and instability can affect private investment. As Feng (2001) mentions, during political instability consumers reduce their saving and consumption rises since saving may become worthless. Furthermore, investors prefer to keep their properties and portfolios in liquid and portable forms like gold and foreign currencies that have better potential of retaining value. Carmignani (2001) demonstrates that political instability can lead to policy uncertainty and reduce security of property rights. Thus, a "*risk averse economic agent may hesitate to take economic initiatives or may exit the economy by investing abroad".* Sterb (2001) concludes that political instability can imply uncertainty about the rules of the game. Fielding (2003) argues that political instability can affect investment by increase in the degree of insecurity that is

felt by investors along with disruption of economic activities caused by associated extensive unrest. My findings show that not all kinds of political instability matter for private investment. Purges and coups have a negative influence on private investment while assassinations, revolutions and strikes do not affect significantly private investment. The effect of riots, however, is not stable. It shows a positive significant effect in equations *a* and *b* of table-C11 of appendix C but its effect becomes insignificant in *fevd* method. Therefore, there is some evidence which justifies rejection of the hypothesis that riots have a negative effect on private investment.

Constitutional change results in a kind of uncertainty about policies. It can signal more extensive and deeper changes in social, political and economical policies. Investors are often sensitive to such signals as these signals endanger their future rights and profits. Constitutional change can lead to higher perceived costs of capital (Rodrik, 1989 and Berg, 2001 and Jeong, 2002). Therefore, we should expect that investors adversely react to constitutional changes. Our findings also confirm this inference.

Apart from the fact that arbitrariness and unpredictability of regulation discourages investment, regulations themselves as a burden could be a source of uncertainty: Klapper et al (2004) and Alesina et al (2003) shows that entry regulation hampers entry but regulation that enhances the enforcement of intellectual property rights or those that lead to a better condition of the financial sector encourages more investment. Evenett (2003) demonstrates that competition law (e.g. laws, which deter bid rigging, monitor mergers and acquisition and regulates new entry into industry) fosters the investment climate in the country. Dollar et al (2003) adds that the monetary and time cost of regulations have negative implications for private investment. North (1993) demonstrates that countries with extensive "securities

regulation" and strong enforcement mechanisms exhibit lower cost of capital. Jamison et al (2005) shows that regulatory instruments that promote policy stability lead to higher investment. Snodgrass (1996) shows how good quality regulations can foster micro finance programs. According to Loayza et al (2004) entry regulation, labor regulation, fiscal burden, trade barriers and financial market regulations tend to reduce investment as well as growth.

Another point of view is that not only quality but also extent of regulations matter: Johnson and Kaufman (2001) conclude that regulation associated with a larger unofficial (illegal) economy implies less investment. Frye and Zhuravskaya (2000) show that unofficial firms have problem in enforcing their contracts, because they cannot use official routes for this purpose. Guadch and Hahn (1997) explain that unnecessary regulations can have adverse effect on investment through the costs imposed by them. Bolaky and Freund (2004) show that excessive regulations prevent resources from moving into the most productive sector and the most efficient firms within sectors. My empirical outcomes also confirm the negative effect of regulatory burdens on private investment.

According to Lovei and Mckechnie there are different types of corruption in a country (e.g. petty corruption, managerial and bureaucratic corruption, and grand corruption) and its patterns can vary among countries and over time (Doig and Riley). But there is no reason to think that corruption can foster private investment. It has a direct and indirect adverse effect on private investment. McMillan and Woodruff (2002) point out that official corruption makes operating difficult for business and leads to expropriation of profits. It can affect entrepreneurs by increasing costs and operating time (Miralles, 2002). Thus, investors can lose their confidence (Ferrarini, 2003). It can raise transaction costs and uncertainty in different parts of the economy

(Gray and Kaufmann, 1998) and its cost can act as an unpredictable tax (Mauro, 1997; Everhart and Sumlinski, 2001). It can lessen the competition in a country (Perotti and Volpin, 2004) because it distorts the rules of the game (Klitgaard, 1998; Khwaja and Mian, 2004; Sapienza, 2004; Hellman and Kaufmann, 2003 and Zemanovicova et al). Bribes divert productive resources, thus adversely affecting efficiency and outputs of the firms (Rodionova, 2001 and Scharfstein and Stein, 2000).

Corruption can adversely affect private investment through low quality public services and infrastructure (OECD, 2005; Tanzi and Davoodi, 1997 and Mauro, 1997). It can influence the contracts on public goods and reduce public revenues (Gray and Kaufmann, 1998 and Tanzi and Davoodi, 1997). Along with lowering of the quality of public output and services it drives up the prices of services (Lee and Ng, 2003). Furthermore, corruption can ruin the economy and private investment through other channels: bureaucrats react to the opportunities for corruption by actually increasing red tape and reducing their bribe-free performance (Keefer, 2004). Thus, it can lead to heavy and unnecessary regulation and procedural formalism to generate bribe opportunities (Djankov et al, 2002).

On the other hand, according to some scholars, it can speed up procedures like governmental permission to carry out legal activities and sometimes even illegal activities (Gray and Kaufmann, 1998). Such action leads to a large unofficial economy with hidden underground activities (Johnson and Kaufman, 2001). Corruption can also hamper the enforcement of regulation in a country (Klapper et al, 2004).

Most of the evidence is in favor of control of corruption fostering private investment, but my results indicate that control of corruption reduces the private

investment rate. There are some studies that argue that corruption can act as grease for fostering private investment (e.g. Bayley, 1966 and Lui, 1985). Thus, if the procedure for an official certification takes a month's time without corruption, then in its presence the procedure can become faster. However, bribe taking itself has a transaction cost in form of time. Therefore, the net effect on time taken would be positive (see Shahid Alam, 1989). According to Shahid Alam (1989) there are different ways in which funds allocated for investment can be diverted for corrupt activities. It is likely the funds that seemingly showed as allocated for making loans (which often is contained within government subsidies to encourage investors to invest), are often overstated through collusion between government and investors and are diverted to meet political desires or shared out between phony investors and bureaucrats. In this circumstance, since there is no real commitment to control the usage of the loans, they are more likely to be diverted to consumption. A second way in which investment funds can be diverted into corruption proceeds occurs when bribes are used to influence the gains of public contracts for investment projects. In this condition, the bribe is generally paid out of savings from cheating on the terms of the contract. Often there can be little question of a net contribution to investment from such corruption because the loss in the economic value of the project resulting from corruption will generally exceed the saving there from.

There is no doubt that in both ways mentioned above the book value of investment declared by investors is higher than real capital formation by investors. So when there is any action to control such corruption the book value of investment declines in a country. On the other hand, according to Lambsdroff (1999 a, b) along with the investment, corruption can affect the productivity of capital. And because we use the ratio of investment to GDP as the left hand side variable:

[Because] the productivity of capital declines, total output - that is GDP - drops in relation to the capital stock, meaning that the ratio of investment to GDP is likely to increase in reaction to corruption.

So it is likely that when we are trying to control corruption we observe a decline in the rate of private investment.

Those aspects of rule of law that encourage private investment include contract enforcement mechanisms, commercial norms and rules, habits and beliefs which lead to shared values and accumulation of human capital (Shirley, 2003). This is because these aspects can lessen the cost of capital (Hail and Leuz, 2004 and Pinheiro and Cabrel, 1999). The high cost of commercial dispute can discourage private investment (Broadman and Anderson, 2004) and deter firms from taking more chances (Bigsten et al, 1999). Well-functioning courts encourage entrepreneurs to test new suppliers. This is important when specific investment is needed for a relationship to develop (Johnson et al, 2002a). Many firms do not rely on written contracts. They limit their conduct to customers they know properly and incur costs when suppliers deliver goods late or that are below agreed upon quality (Hallward-Driemeier and Stewart, 2004) in the absence of contractual safeguards. Moreover, the weak legal environment is associated with a larger unofficial economy with hidden under ground activities (Johnson and Kaufman, 2001).

Furthermore, the enforcement of rules maybe equal or even more important than legal rules. Thus, the existence of a strong legal enforcement is as important as strong laws (La Porta and Lopez-de-Silanes, 1998). The market is unlikely to function in the absence of contract enforcement that encourages exchange and investment (Davis, 2004).

The other determinant of private investment is crime. It diverts resources to protection efforts, leads to health costs because of increased stress and creates an environment unfriendly to productive activity (Demombynes and Ozler, 2002). For instance, in the case of Ugandan firms, 54 percent of firms had been victims of robbery and 37 percent have been victims of fraud (Reinikka and Sevensson, 1999). In severe circumstances it can affect investment through brain drain (Demombynes and Ozler, 2002). My study results confirm this analysis (see Brunetti and Weder 1997 , Lamech and Saeed 2003, and Sharifazadeh and Bahreini 2003 for corroborative results).

Property rights constitute one of the most important factors that determine private investment. Investors will not invest if they expect to be unable to reap the fruits of their investment (Johnson et al, 2002b). This can happen through the confiscation and expropriation of their properties by government (Besley, 1995 and Fafchamps and Minten, 2001 and Keefer, 2004), inadequate enforcement of intellectual property rights (Fink and Maskus, 2005), restriction in transfer of properties (Besley, 1995), theft and embezzlement (Fafchamps and Minten, 2001). Property rights can encourage investment through improvement in the allocation of resources (Claessens and Leaven, 2003). Otherwise, investors might not have ownership rights for turning their wealth into more productive uses (The Heritage Fund, 2005). For example, according to Heinsz (2000), institutional environments in which entrepreneurs can keep their profits through political channels leads investors to reallocate resources from economic to political activity. My empirical output confirms the direct and significant effect of property rights on the private investment rate. This relationship has been confirmed by other studies (e.g. Serven, 1997 and Do and Lyer, 2003).

Government participation in the economy through consumption and production may wipe out the private sector and lead to lower level of private investment. This can occur through two routes: higher the consumption of government as a percentage of GDP, the more are the resources the government is pulling from the private or free market and second, business activities of the government might crowd out private initiative and investment due to construction of government-owned monopolies in the country. However our findings do not show a significant relationship between government contribution in the economy and the private investment rate.

Chapter V

Conclusion

5.1- Summary

The importance of private investment stems from the fact that the lessening of extended poverty and unemployment on the one hand and achievement of sustainable development on the other depends on investment by the private sector. Recent studies have shown that private investment is more efficient and more productive than public investment. Existing mismanagement in public enterprises leads to inefficiency. On the contrary, the importance of profitability in the private sector constrains them to use scarce resources in the best way through maximization or optimization of production and investment; this would lead to increase in employment, reduction of poverty, sustainable development and growth. Thus the core question is that what factors determine the rate of private investment?

The initial theories have emphasized the role of reduction of interest rate and increase in output for encouraging private investment. But there are *ample grounds for doubting* these theories. As a result, researchers have realized the importance of uncertainty in determining the private rate of investment. Many follow up questions arise: what is the mechanism through which uncertainties affect the rate of private investment? Can we really expect that uncertainties affect investment negatively? What factors can be considered to be a proxy of uncertainty?

The remainder of chapter one explains that there are three schools dealing with the effect of uncertainty on economy and investment: traditional finance, neo-classics and post-Keynesians. They diverge through their different definitions of uncertainty and different assumptions about conditions in which investment decision is taken.

Traditional finance emphasizes on the calculation of risk premium, while the risk premium determines the difference between the returns of a project and portfolio of the entire market. Neo-classical school researches consider uncertainty of a phenomenon as the variance of its outcomes. The common approach to determine the effect of uncertainty on investment is to maximize the value of the firm under existing uncertainty and under different assumptions. Different assumptions yield various outcomes. It inherently depends on the curvature of the investment function. Investment functions with convex marginal adjustment costs yield a positive relationship with uncertainty. Irreversibility is another characteristic of a project that is emphasized by some researches. This assumption implies that ones that an investor incurs sunk costs it is almost impossible to disinvest later. This fact makes investor more prudent. Then the theory concludes that more uncertainty leads to lower investment. Another approach in neo-classical school defines uncertainty as a covariance between technology's return and the discount rate. This study distinguishes between risks of a stock in financial markets and uncertainty in the value of outputs of a technology. The study follows to ascertain the effect of uncertainty on investment in a general equilibrium model. The article concludes that a mean preserving spread in distribution in the state of nature that affects firm's technologies or household's preferences has no effect on aggregate investment, but it alters the allocation of capital and labor among technologies.

In chapter 2, I demonstrated that Iran has potential for high rates of investment. Various indices of population and literacy rates, rich natural resources and energy, unique geopolitical location were favorable for attaining a high rate of investment in the country. But it has hardly gone beyond 15 percent in the last four

decades. This is possibly due to the negative role played by some aspects of uncertainty.

Chapter 3 indicates that post-Keynesians are intrinsically different from neo-classics. Post-Keynesians argue that economical phenomena are the manifestation of individuals' reactions to their expectations. As these expectations take shape in a unique situation (e.g. social, political and international circumstances) therefore these cannot be replicated again. Thus, it is impossible to predict the future on the basis of past events. The usage of expected values and variances of variables for making predictions is inaccurate consequently. Hence we cannot define uncertainty as a variance of a variable. Uncertainty is defined as something that we do not know anything about.

I accept the post-Keynesian definition of uncertainty but I argue that if the world is identically uncertain then there must be no difference between various countries. It seems that the existing institutions and cultures in each country determine the predictability of individuals' reactions to their expectations. Thus, the future is predictable to different extents in different countries. The level of predictability in each country can also vary over the time depending upon the changes in institutions. The level of unpredictability about the future can lead to a reduction in the private investment rate. I define an element of uncertainty as any factor, which distorts information and predictions about the future. Often, studies concentrate on uncertainty about prices, demand or costs and deal with them by maximizing the value of the firm through the expectation of all future probable receipts. But, by foregoing definition, it embraces a wide range of factors that bring about not only unpredictable fluctuations in prices but also affect the state of confidence of entrepreneurs and their trust on information at hand. There must be a time horizon within which entrepreneurs can

rely on information and assess their projects through the comparison of the adjusted pay back period of their projects with that horizon.

The length of the time horizon is calculable. If price fluctuates with geometric Brownian motion then each movement of price in the next period can be predicted on the basis of current price and the variance of past fluctuations. My intuition is that investors use the best worst strategy instead of maximization of expected returns in an uncertain environment. This is because the strategy which emerges for such maximization is totally useless if the worst scenario actually results happens. This means that the investor supposes that price decreases continuously with a geometric Brownian motion (worst condition). If this is the case, then the time horizon is defined as the time that it takes for the current price to reach the lower price (lower bound) that occurs in the past. This time horizon is compared with adjusted payback period of projects. Projects with longer adjusted payback period will be rejected. Among the viable projects, a project with shorter adjusted payback period is preferable. The more is the uncertainty about the future, the shorter the horizon within which information can be trusted. This time horizon depends on types of uncertainty that result in an optimistic or pessimistic atmosphere about business. The effect of uncertainty on investment can be compared with catalysts in chemical reactions. These factors might not have any direct participation in a reaction but they affect it. Therefore, instead of assessing the impact of unpredictable future receipts on private investment, the effect of each possible factor resulting in uncertainty is examined for its impact on the private investment rate.

In chapter 4 twenty three factors relating to uncertainty are classified into three different categories: changes in policies and macroeconomic outcomes, the quality of public governance and socio- political institutions and conflicts. A panel data method

is applied even though my study is about Iran. It is because of two reasons: first, shortage of data in some variables like rule of law, control of corruption and property rights, make it impossible to utilize time series methods. Second, there are some factors, which hardly change over time for example, democracy or property rights. So, the analysis of these factors in a time series process is almost impossible. The methodology of panel data gives us the opportunity to take these factors into account in our analyses. The data have been collected about 39 countries including Iran. The data have been examined for diagnosis of unit root, serial correlation, contemporaneous correlation, outliers, heteroskedasticity and multicollinearity. In macroeconomic panel a fixed effects model with AR (1) is applied to allow for serial correlations. The coefficient of some dummy variables of some countries were eliminated and a constant term is put in the model to reduce the effect of existing multicollinearity. A PCSE estimator is utilized to allow for heteroskedasticity and contemporaneous correlation. The panel is estimated twice once with inflation uncertainty and once with real interest rate uncertainty. These two variables are not used simultaneously to avoid severe multicollinearity. The panel of socio-political institutions and conflicts does not exhibit multicollinearity. Yet there is a suspicion about multicollinearity between slow moving variables like war and dummy variables. Therefore, a Fixed Effects Vector Decomposition (FEVD) model is used in addition to PCSE to control for this kind of variables. The effect of inequality, coups and constitutional changes is estimated in different panels so as to facilitate maximum use of data. In the panel for the quality of governance, there were at most three observations per country. Again the coefficients of some dummy variables are equated to zero and a constant term is added to model to avoid severe multicollinearity. Therefore, a LSDV with cluster covariance matrix is applied to

allow for a small number of observations per country, heteroskedasticity and serial correlation existing in the data. Depending on different properties of panels, proper estimators (e.g. PCSE, FEVD or LSDV) have been employed.

5.2- Empirical Findings

The main finding is that not all suggested measures of uncertainty are significant in determining the private investment rate. Among the macroeconomic factors I cannot find enough evidence to reject the hypothesis of negative effect of uncertainty relating to exchange rate distortion, terms of trade, growth and trade on private investment rate. Other factors (i.e. uncertainty about credit to private sector, inflation and real interest rate) have an insignificant effect on the rate of private investment.

The elasticity of the private investment rate to exchange rate distortion uncertainty is - 0.0343. The elasticity of the private investment rate to uncertainty about growth, trade and terms of trade are –0.018 , -0.124 and –0.0352 respectively.

Among the socio-political institutions and conflict factors the negative effect of civil war, purges, coups and constitutional changes cannot be rejected. There is not enough evidence that other measures of socio-political uncertainty (i.e. democracy, revolutions, inequality, assassinations, strikes and riots) have a significant impact on the private investment rate. However I cannot reject the positive effect of war on the private investment rate.

The growth rate of the private investment rate for every unit change in civil wars, purges, coups and constitutional changes are –0.341 , -0.0431 , -0.139 and –0.108 , respectively. However, The growth rate of the private investment rate for every unit change in war is 0.173.

Among the indices of the quality of public governance, there is not enough evidence to reject the hypothesis that worsening condition of regulatory burden, rule of law and property rights will reduce the private investment rate. However, the hypothesis of negative effect of government contribution in economy on the private investment rate can be rejected. The effect of corruption on the private investment rate is quite surprising. While intuition says that corruption has a negative effect on the private investment rate, our evidence rejects this hypothesis. This could be because of the effect of corruption proceeds disguised as investment as well as the negative effect of corruption on GDP operating through its effect on capital productivity.

The growth rate in the private investment for every unit change in regulatory burdens and rule of law are 0.408 , 0.46 respectively. The elasticity of the private investment rate to property right is 0.625. However, the growth rate in the private investment for every unit change in control for corruption is –0.215.

As some coefficients have come in form of elasticity and the others have come in form of growth rate we cannot compare them except we multiply the growth rate by its related variable, which means that the elasticity of the second form is not fix.[23] As data are not available for a common year among these three panels, this comparison is not carried out. But if we want to compare elasticities with each other, property rights occupies first place following by trade uncertainty, terms of trade uncertainty, exchange rate distortion uncertainty and growth uncertainty. And among variables that their coefficients have come in form of growth, rule of law occupies the first place, following by regulatory burdens, civil war, coups, constitutional changes and purges. In both groups governance quality variables show higher rank in

[23] - The equations have come in appendix A for better clarification.

comparing to macroeconomic uncertainty and socio-political institutions and conflicts.

5.3- Policy implications

To sum up, the lack of investment is not a hard problem but a soft problem. This means that we cannot solve this problem mechanically simply by a fiscal or monetary policy. Instead it must be considered as a net outcome of socio-politico-economical problems. Investors need a stable and predictable policy and political environment along with rigorously enforced, market friendly regulations to be confident about investing their resources. This sadly has not been the case in Iran where political stability has been endangered by violent disturbances, and the free functioning of the market mechanism has been hindered by anti market phenomena such as unnecessary regulations, not properly protected property rights or lawlessness.

In case of terms of trade uncertainty maybe we cannot do much uncertainties are external and out of control. But in Iran extraordinary dependence to oil export income could jeopardizes private investment. Thus, a policy toward diversification of exports can encourage investors by reducing the ill effect of terms of trade uncertainty.

Investors must be assured about the exchange rates policies of the government. They must be clear as to whether the policy is inward or outward-oriented and also feel assured about the certainty of the policy. Every change in strategy must be accompanied by faster awareness and preparedness of investors. The same is true about trade policy. It is very common in foreign trade policy for government to abruptly ban the exports of agricultural products, cement or steel to control domestic prices or the imports of some other goods on the pretext of protecting the domestic industries. Apart from the advantages and disadvantages of this policy, this kind of

sharp U-turns will hamper private investment. Therefore, in the case of inevitable situations it is better that the government gives due notice before enforcing a policy so as to allow the entrepreneurs time to adjust their strategies with the new law. Dramatic changes often occur after presidential elections in Iran. This is because new presidents change executive authorities across the board. It leads to dramatic changes in policies and strategies. Thus, a restriction of presidential power to change executive authorities and officers can lead to more stable outcomes.

The government must follow policies that lead to a predictable rate of growth. In case of Iran unpredictable changes in crude oil prices is one of the causes of the growth unpredictability. Reinvesting the oil export incomes in a portfolio in international financial markets with more predictable returns could be a good strategy for elimination of the effect of unpredictability of the oil export proceeds on the growth. As governments in Iran try to neutralize the budget deficit by money supply, an unpredictable budget deficit can lead to an unpredictable growth rate through unpredictable monetary policies. Every year the government tries to anticipate next year's income on basis of next year's expected expenditure. Given that the budget for each year is planned in advance of the actual accrual of oil revenues that finance such expenditures, the uncertainty in revenues can lead to unforeseen budget deficits. Therefore, writing of budget on basis of the more certain and reliable incomes can help to fix this problem.

Politically, it is very important that policies can preserve human capital as well as prevent severe social unrests and arm conflicts like civil wars. As social unrests and conflicts can lead to uncertainty for investors and lead to a reduction in investments, a well-tailored policy is needed to solve the socio-political problems without giving rise to uncertainties. Iran has experienced some cases of ethnic

conflicts especially in frontier areas, and also social unrests in the last four decade. It also has experienced some purges. As these problems are always mixed with security aspects the security authorities should contemplate on the economic consequences of their strategies and policies.

Policies for a better quality of governance might have the largest effect on the private investment rate because they function as fundamental infrastructure for production and business activities. Changing regulations, for bringing about proper market friendly reforms by reducing the red tape, is a must. In Iran a reform in labor market and trade regulation is a necessity. One of the most effective strategies is a continuous education of policy makers, particularly of the legislature. As these members change over the time and sometimes inexperienced individuals enter the legislature, a continuous process of education of members can enhance their effectivity. Another strategy could be promoting think tanks in the country. Professionals and highly skilled specialists in different fields can help the policy makers in their activities.

Enhancing the rule of law and property rights, especially intellectual property, needs reforms in cultural as well as judicial infrastructures. A powerful judicial system must rigorously enforce rights and contracts and prevent fraud in a time and cost effective way. Time and cost effective procedures have been recently emphasized by the World Bank in a project, which is named as Doing Business. Separation of commercial claims courts from other kinds of courts and development of specialization in settlement of commercial claims can lead to a more time and cost effective judicial system and thereby a better rule of law.

APPENDIX A

A Brief Review of Abel (1983):

Suppose the firm is risk natural and maximizes the expected present value of its cash flow subject to the capital accumulation:

$$V(K_t, p_t) = \max_{I_s, L_s} E_t \int_t^{\infty} [p_s L_s^{\alpha} K_s^{1-\alpha} - wL_s - \gamma I_s^{\beta}] \exp(-r(s-t)) ds$$

From maximizing we get:

$$I_t = \left(\frac{q_t}{\beta\gamma}\right)^{\frac{1}{\beta-1}}$$

Where

$$q_t = \frac{h p_t^{\frac{1}{1-\alpha}}}{r + \delta - \frac{\alpha\sigma^2}{2(1-\alpha)^2}} \qquad (1)$$

and

$$h = (1-\alpha)(\alpha/w)^{(\alpha/(1-\alpha))}$$

where r is the discount rate, δ is the rate of depreciation and σ^2 denotes the variance. This equation shows that the optimal rate of investment is an increasing function of q_t[24] and I_t depends on q_t and is independent of K_t. Since, I_t is increasing function of q_t and depends on it, we can determine the qualitative effect of uncertainty on investment simply by analyzing the effect of uncertainty on q_t. From (1) it is clear that for a given level of the current price of output p_t, an increase in uncertainty, as captured by an increase in σ^2, will increase I_t, and it is independent of the convexity of marginal adjustment function.

[24] - It is known as "marginal ***q***".

A Summary of Solving the Maximization Problem by Pindyck (1991):

We want a rule that maximizes the value of our investment opportunity *F(V)*:

$$F(V) = \max E_t[(V_t - I)e^{-\mu t}]$$

Hence, after some substitutions and simplicity we will have

$$\frac{1}{2}\sigma^2 V^2 F_{VV} + (\mu - \delta)VF_V - \mu F = 0 \qquad (2)$$

Now suppose the price of output *P* follows the stochastic process:

$$dP = \alpha P dt + \sigma P dz$$

And assume that $\alpha<\mu$. If the output is a storable commodity, δ will represent the net marginal convenience yield from storage, that is, the flow of benefits (less storage costs) that the marginal stored unit provides. For simplicity we assume that δ is constant and marginal and average production cost is equal to a constant, *C* and that the project can be cheaply shut down if *P* becomes less than *C* and then can be restarted if prices goes above the *C*. Another assumption is that the project produce one unit per period, it is infinitely lived and invests sunk cost of *I*. With these assumptions two problems are to be solved. First, finding the value of the project *V(P)*. Second, with the value of the project in hand, we must value the firm's option to invest in it, and determine the optimal exercise (investment) rule. This will reduce to finding a critical P^*, where the firm invest only if $P \geq P^*$. In a same way that we reached to equation (2) we will have:

$$\frac{1}{2}\sigma^2 P^2 V_{PP} + (r - \delta)PV_P - rV + j(P - C) = 0 \qquad (3)$$

That *j=1* if $P \geq C$ and *j=0* otherwise. This equation must be solved subject to the following boundary conditions:

I) V(0)=0

II) $V(C^-)=V(C^+)$

III) $V_P(C^-)=V_P(C^+)$

IV) $\lim_{P\to\infty} V = \frac{P}{\delta} - \frac{C}{r}$

The condition (IV) says that as *P* becomes very large the probability that over any finite time period it will fall bellow cost and production will cease become very small. The conditions (II) and (III) show that the value of the project, is a continuous and smooth function of *P*. The solution for equation (3) will yield:

$$V(P) = \begin{cases} A_1 P^{\beta_1} & P < C \\ A_2 P^{\beta_2} + \frac{P}{\delta} - \frac{C}{r} & P \geq C \end{cases}$$

and $$\beta_{1,2} = \frac{1}{2} - \frac{r-\delta}{\sigma^2} \pm [(\frac{r-\delta}{\sigma^2} - \frac{1}{2})^2 + \frac{2r}{\sigma^2}]^{\frac{1}{2}}$$

That β_1, β_2 , A_1, A_2 are functions of *r*, δ , σ and *C*. When $P<C$ then project is not producing, then, $A_1 P^{\beta_1}$ is the value of the option of the firm to produce in the future, when price increase. When $P\geq C$ the project is producing. If firm continuous to produce in future, the present value of the future flow of profits would be given by $\frac{P}{\delta} - \frac{C}{r}$. Whenever *P* fall, the firm can stop producing and avoid losses the value of its options to stop producing is $A_2 P^{\beta_2}$. To solve the second problem, similarly the value of the firm's option to invest, *F(P)* must satisfy the:

$$\frac{1}{2}\sigma^2 P^2 F_{PP} + (r-\delta)PF_P - rF = 0$$

Subject to

I) $F(0)=0$

II) $F(P^*)=V(P^*)-I$

III) $F_P(P^*)=V_P(P^*)$

The solution is

$$F(P)=\begin{cases}\alpha P^{\beta_1} & P\le P^*\\ V(P)-I & P>P^*\end{cases}$$

That α , β_1 and β_2 are the functions of r, δ , σ , and P^* that P^* is the solution to

$$\frac{A_2(\beta_1-\beta_2)}{\beta_1}(P^*)^{\beta_2}+\frac{\beta_1-1}{\delta\beta_1}P^*-\frac{C}{r}-I=0$$

That can be simply solved numerically. The study indicates in a diagram that an increase in σ can lead to an increase in *V(P)* for any *P*. The project is a set of call options on future production, so, the greater the volatility of prices, the greater the value of these options. Increase in σ also increases the critical price P^* because $\frac{\partial P^*}{\partial\sigma}>0$. The reason is that for any *P*, the opportunity cost of investing *F(P)* increases even more the *V(P)*. So, increases uncertainty, reduces investment.

Unit Root Test

The first challenge that must be dealt with is detection of unit root in the data to avoid spurious regression. There are some types of unit root tests in panel level, Maddala and Wu (1999), Levin, Lin and Chu (2002), Im, Pesaran and Shin (2003) (Unlike the two later, Fisher test of Maddala and Wu does not need to complete panel so I utilize this test for detection of unit root in data). This test combines the p-values from N independent unit root tests. Based on the p-values of individual unit root tests, Fisher's test assumes that all series are non-stationary under the null hypothesis against the alternative that at least one series in the panel is stationary. Table-5 shows the results of the test on variables. There is evidence that shows we cannot accept the null hypothesis of non-stationarity in all variables. So, no one of the variables in this panel has unit root. Hence, we can proceed without any concern about spurious regression.

Equations Applied in the Study

Equations used in different panels are presented here. Subscriptions i and t, which are applied to indicate unites and time respectively, are eliminated except where that their elimination are misleading.

1- Changes in policies and macroeconomics outcomes:

$$\ln pri = c + c_i + \beta_1(\ln dcps) + \beta_2(\ln exrdis) + \beta_3(\ln growth) + \beta_4(\ln tot) + \beta_5(\ln t) + \beta_6(\ln \inf l) + \varepsilon$$

$$\ln pri = c + c_i + \beta_1(\ln dcps) + \beta_2(\ln exrdis) + \beta_3(\ln growth) + \beta_4(\ln tot) + \beta_5(\ln t) + \beta_6(\ln int) + \varepsilon$$

2- Socio-political institutions and conflicts:

$$\ln pri = c_i + \beta_1(dem) + \beta_2(war) + \beta_3(cwr) + \beta_4(ass) + \beta_5(stkptm) + \beta_6(prgptm) + \beta_7(ritptm) + \beta_8(rev) + \varepsilon$$

$$\ln pri = c_i + \beta_1(dem) + \beta_2(war) + \beta_3(cwr) + \beta_4(ass) + \beta_5(stkptm) + \beta_6(prgptm) + \beta_7(ritptm) + \beta_8(rev) + \beta_9(cop) + \beta_{10}(con) + \varepsilon$$

$$\ln pri = c_i + \beta_1(dem) + \beta_2(war) + \beta_3(cwr) + \beta_4(ass) + \beta_5(stkptm) + \beta_6(prgptm) + \beta_7(ritptm) + \beta_8(rev) + \beta_9(inq) + \varepsilon$$

3- Quality of public governance:

$$\ln pri = c + c_i + \beta_1(rgq) + \beta_2(cor) + \beta_3(rol) + \beta_4(\ln prt) + \beta_5(\ln gin) + \varepsilon$$

APPENDIX B

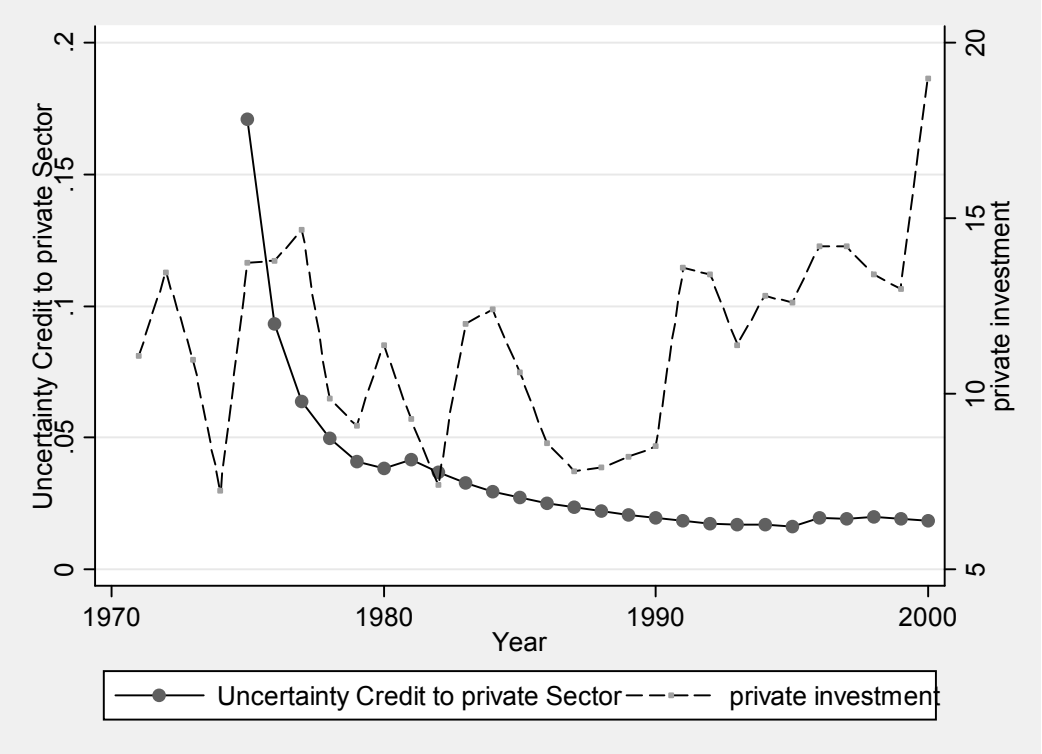

Figure B1- Uncertainty about credit to private sector vs private investment rate.

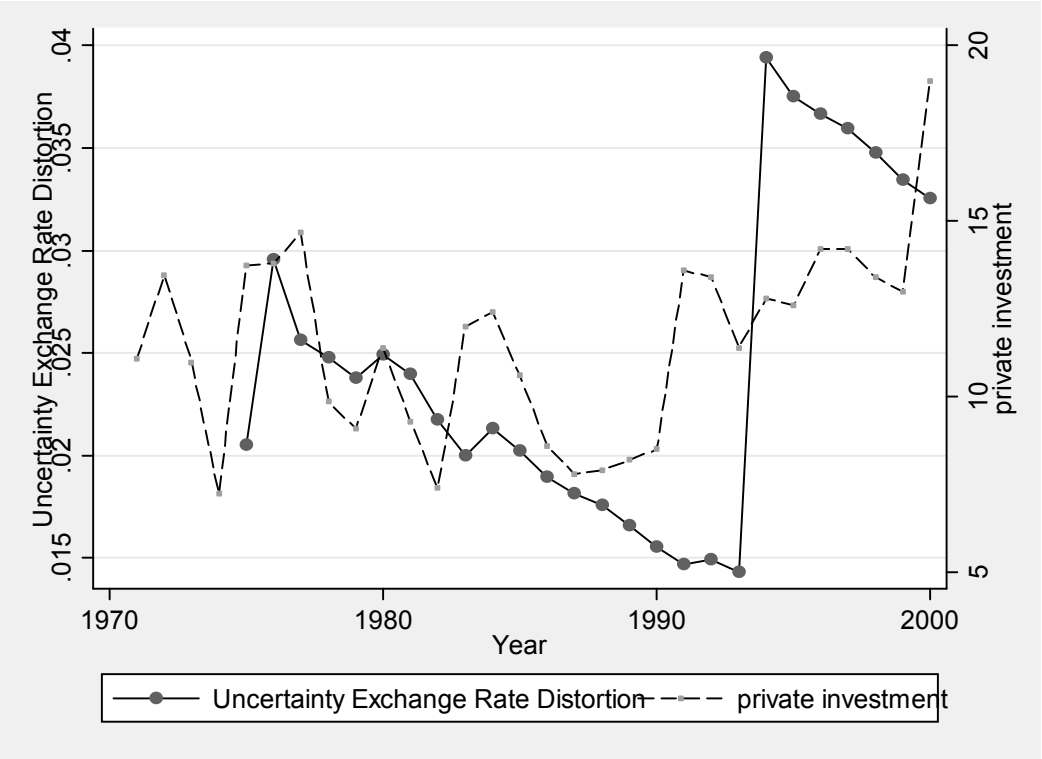

Figure B2- Uncertainty about exchange rate distortion vs private investment rate.

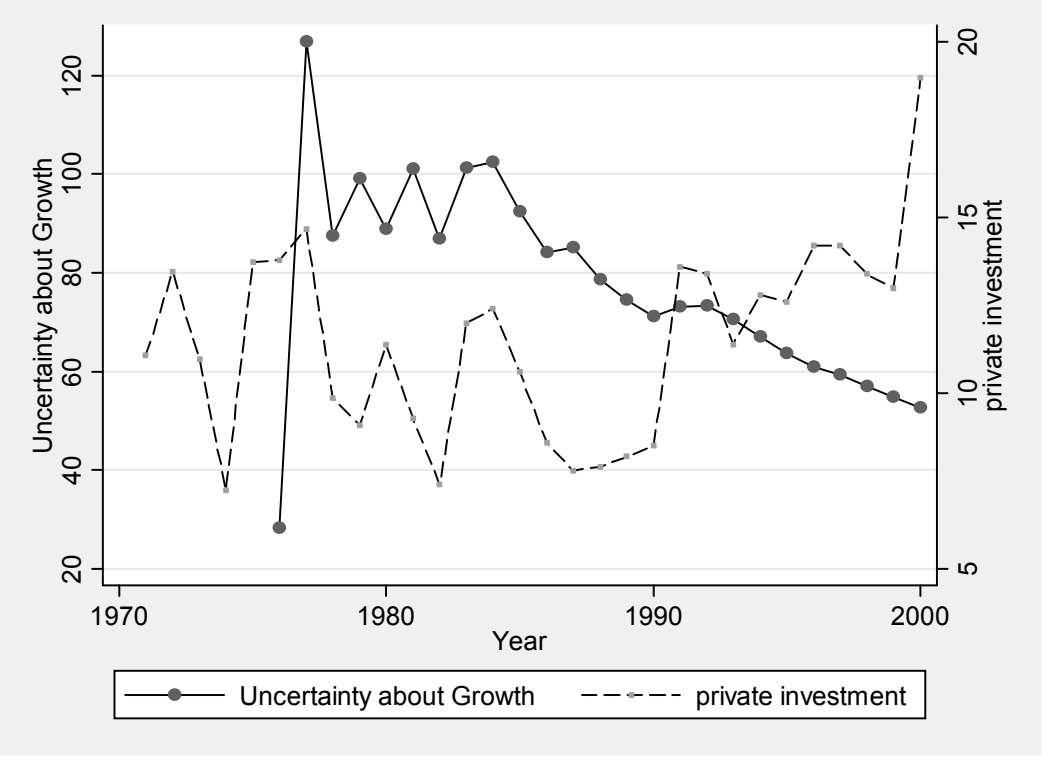

Figure B3- Uncertainty about growth vs private investment rate.

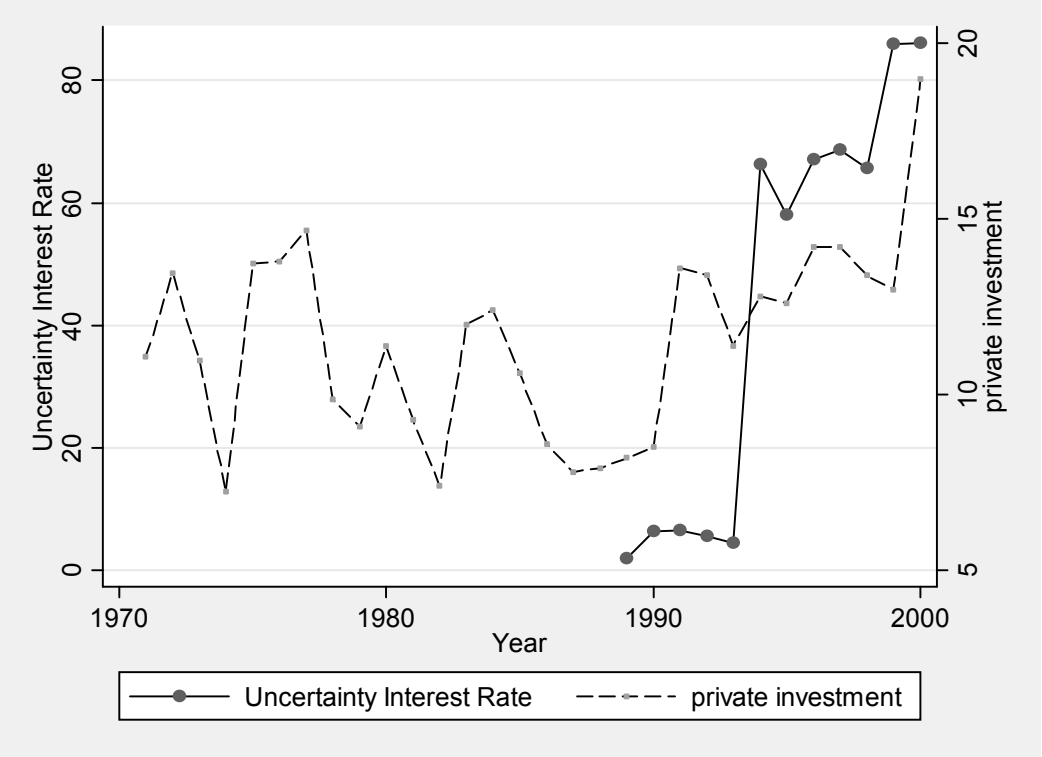

Figure B4- Uncertainty about real interest rate vs private investment rate.

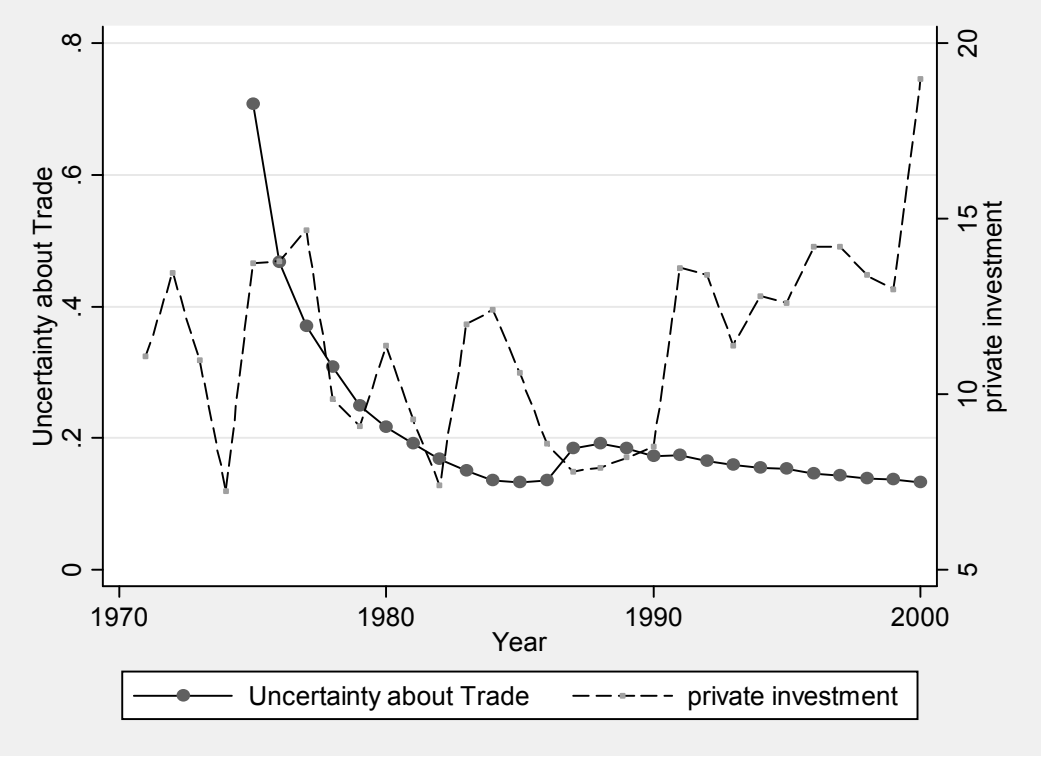

Figure B5- Uncertainty about trade vs private investment rate.

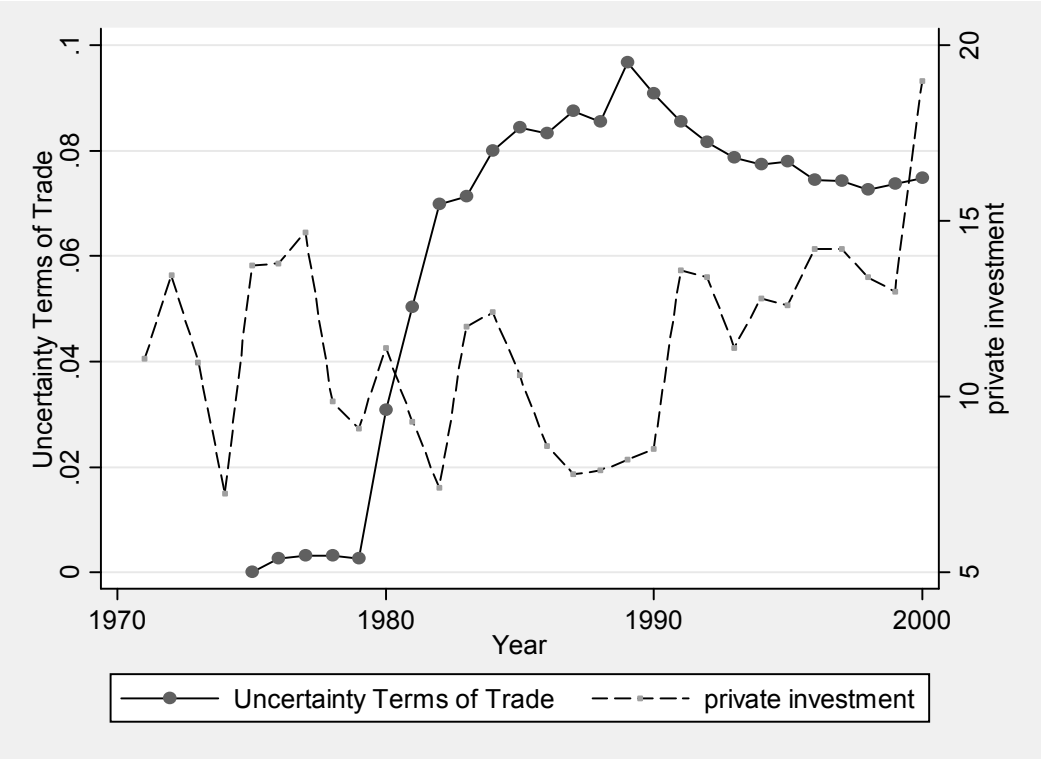

Figure B6- Uncertainty about terms of trade vs private investment rate.

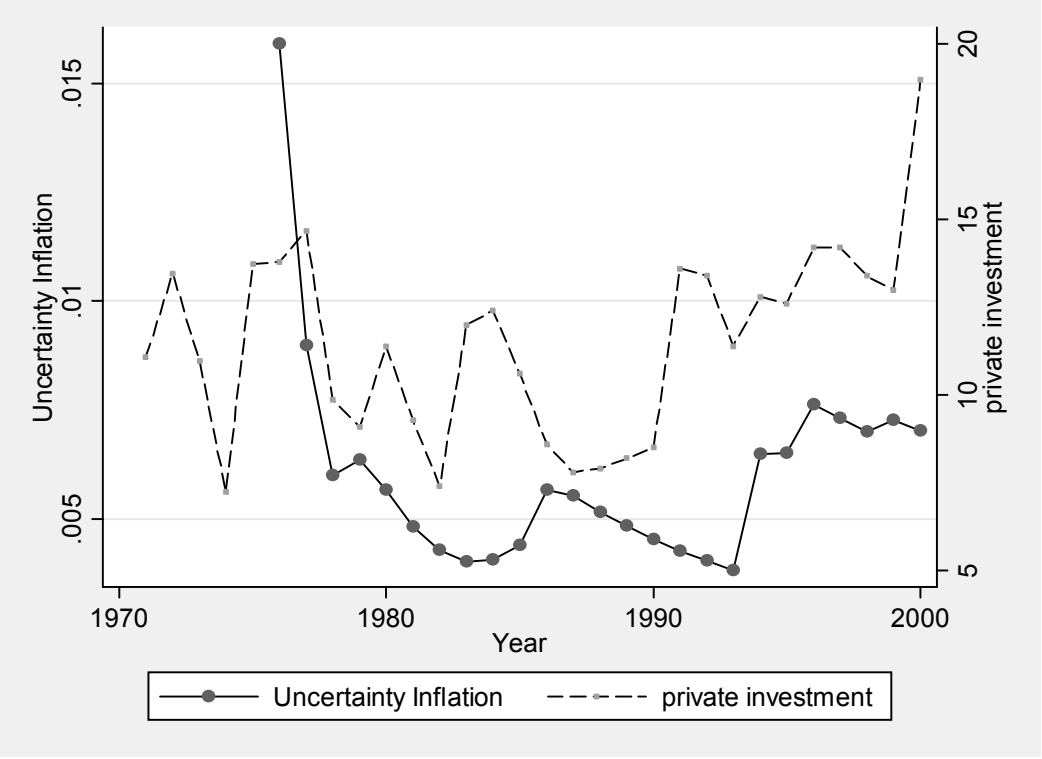

Figure B7- Uncertainty about inflation vs private investment rate.

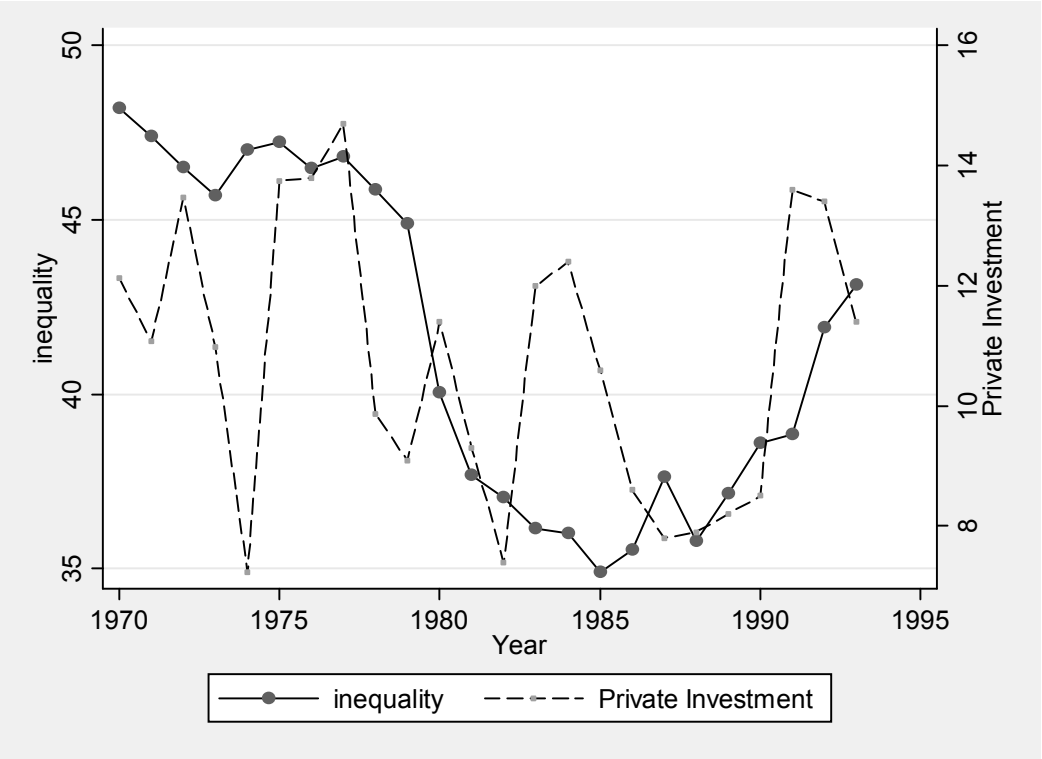

Figure B8- Inequality vs private investment rate.

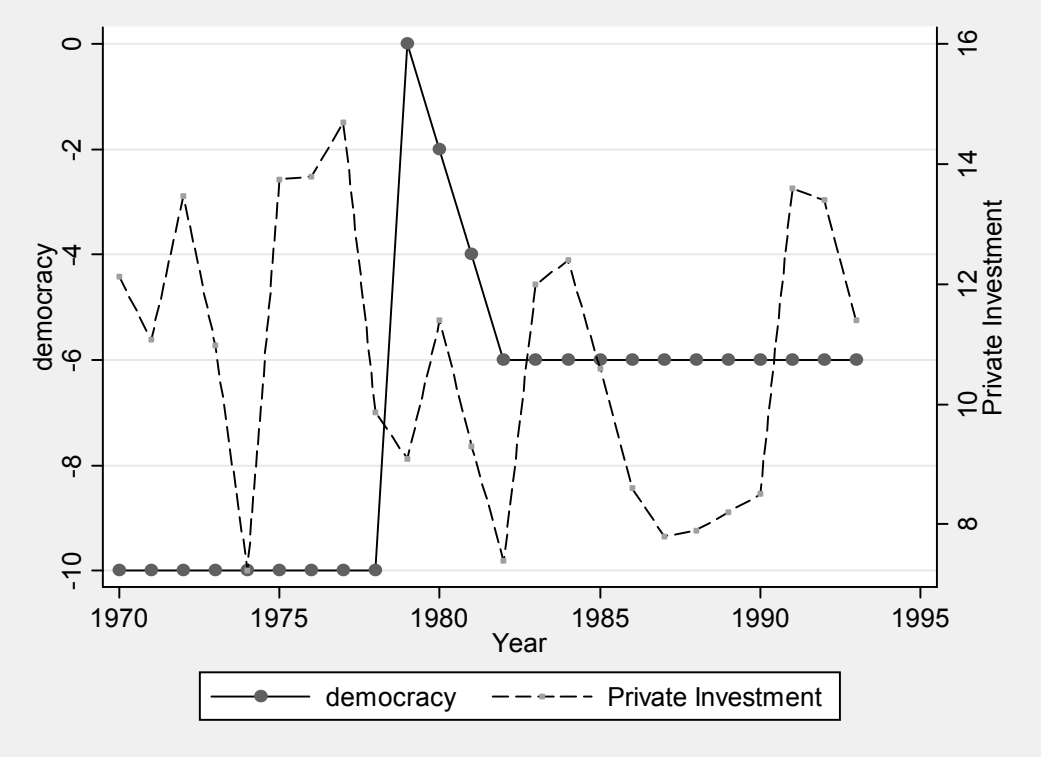

Figure B9- Democracy vs private investment rate.

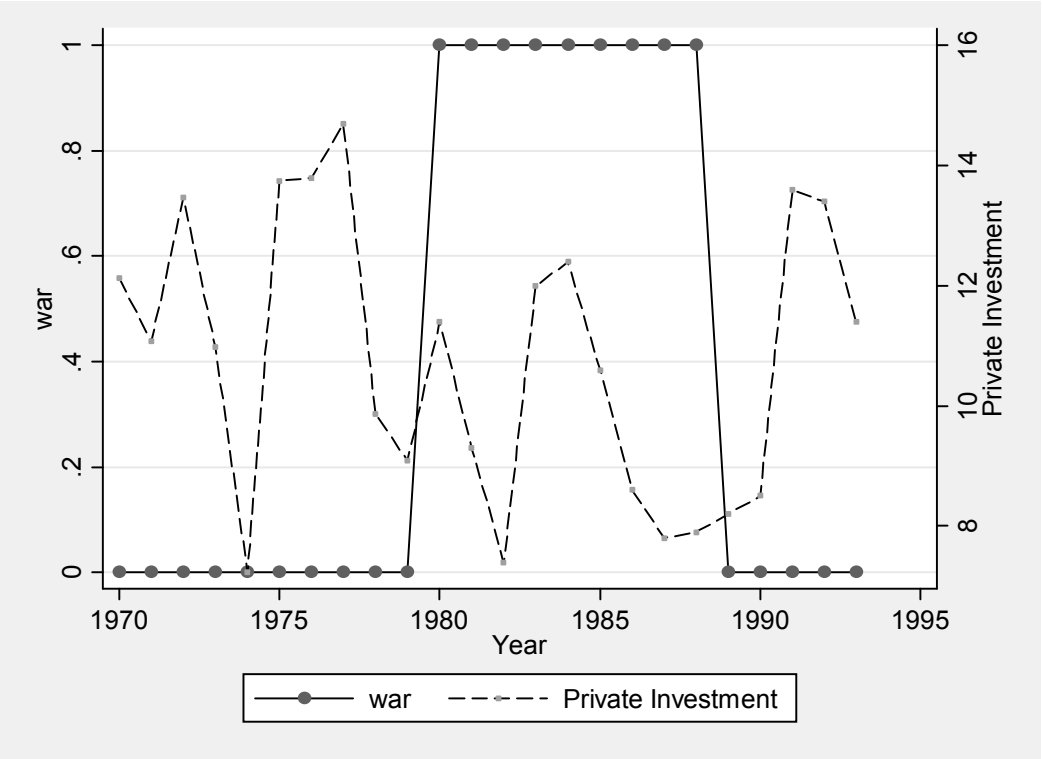

Figure B10- War vs private investment rate

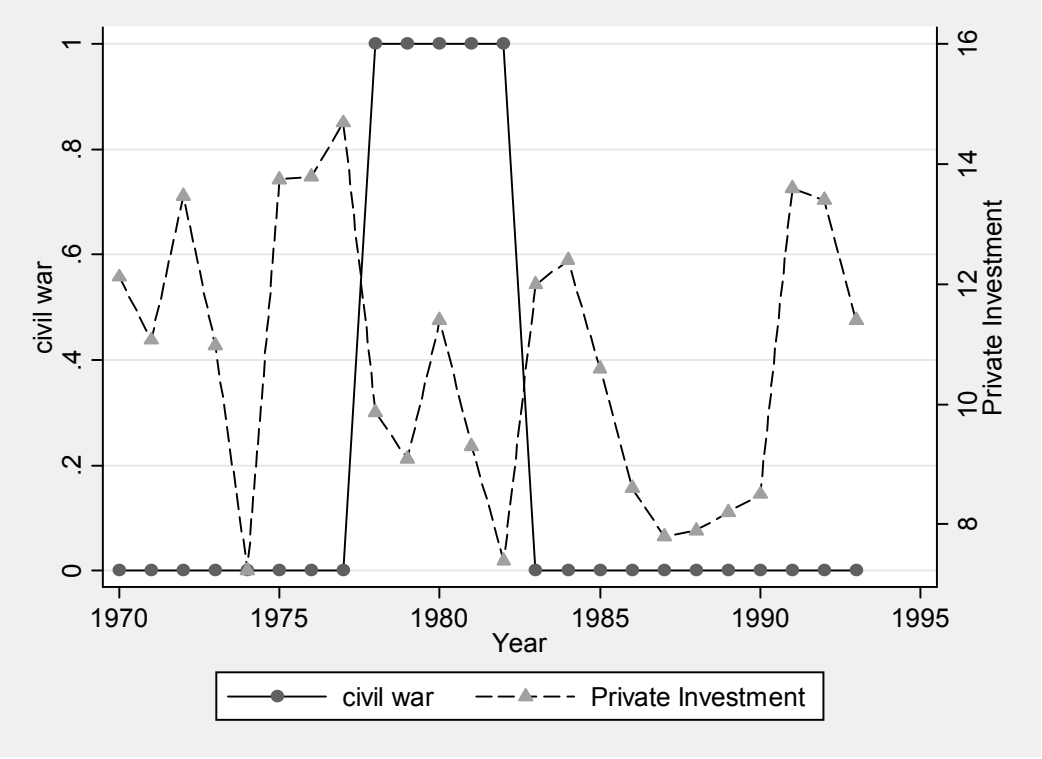

Figure B11- civil war vs private investment rate.

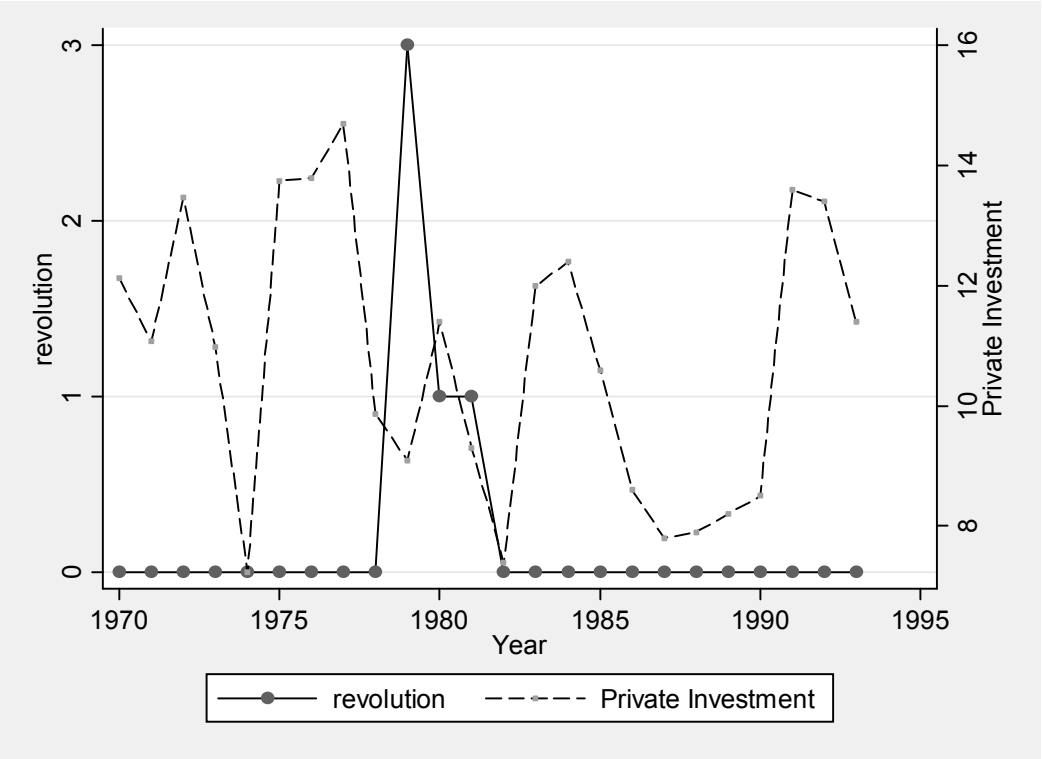

Figure B12- Revolution vs private investment rate.

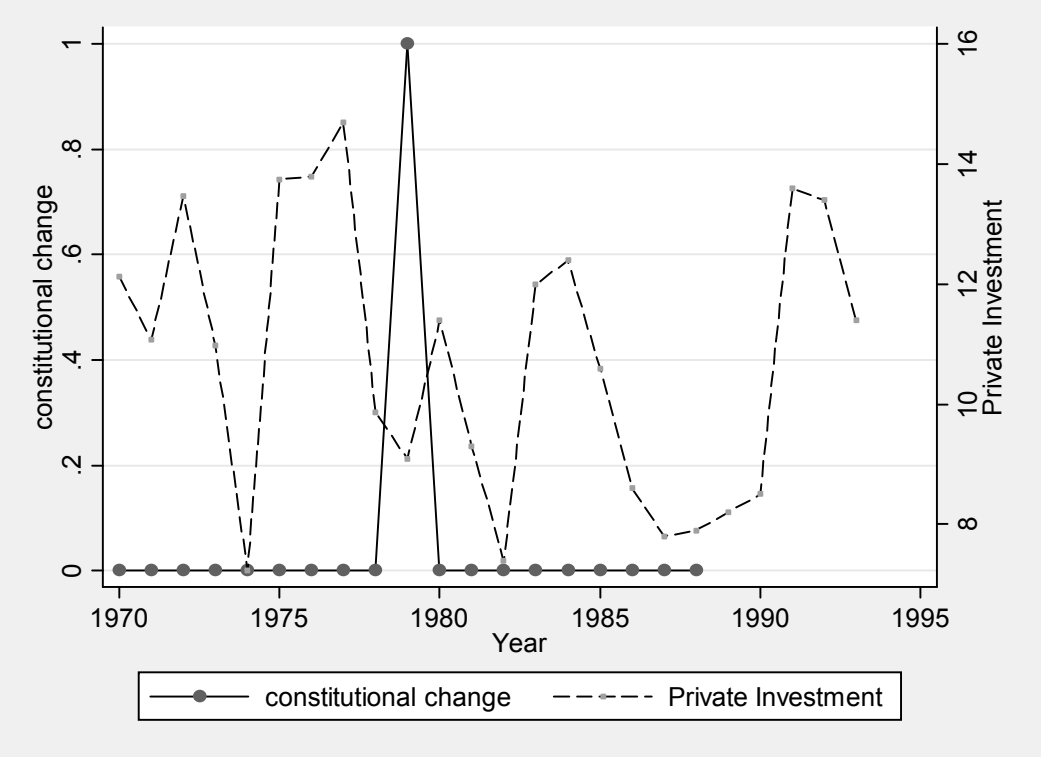

Figure B13- Constitutional change vs private investment rate.

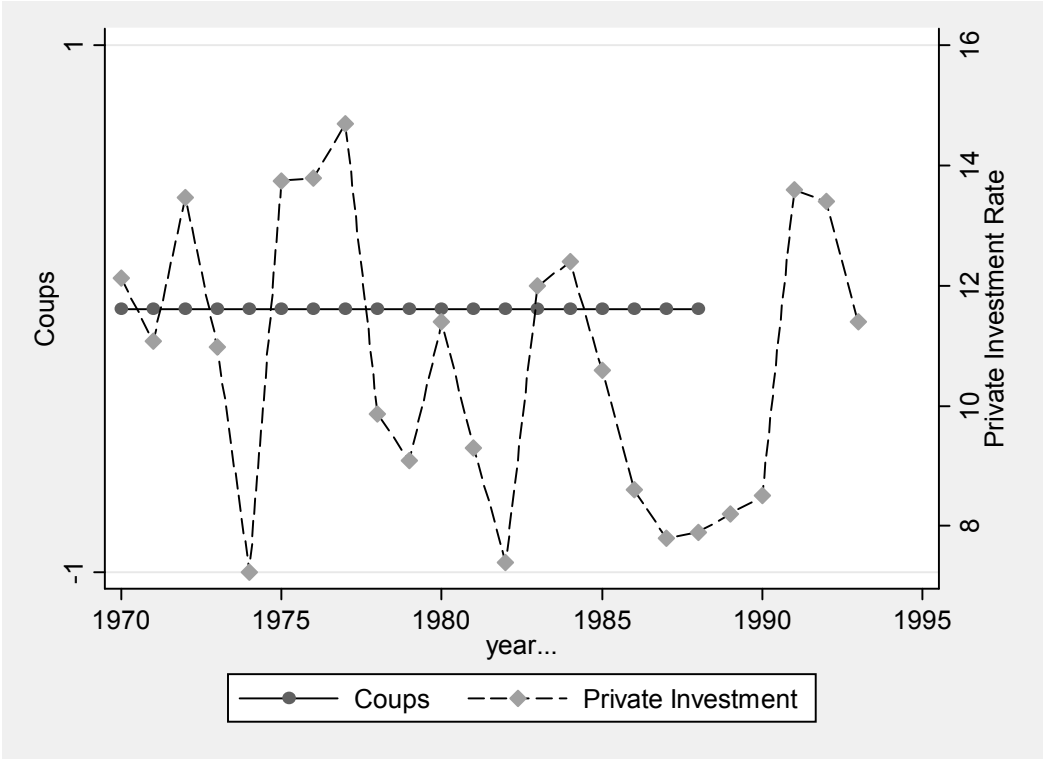

Figure B14- Coups va private investment rate.

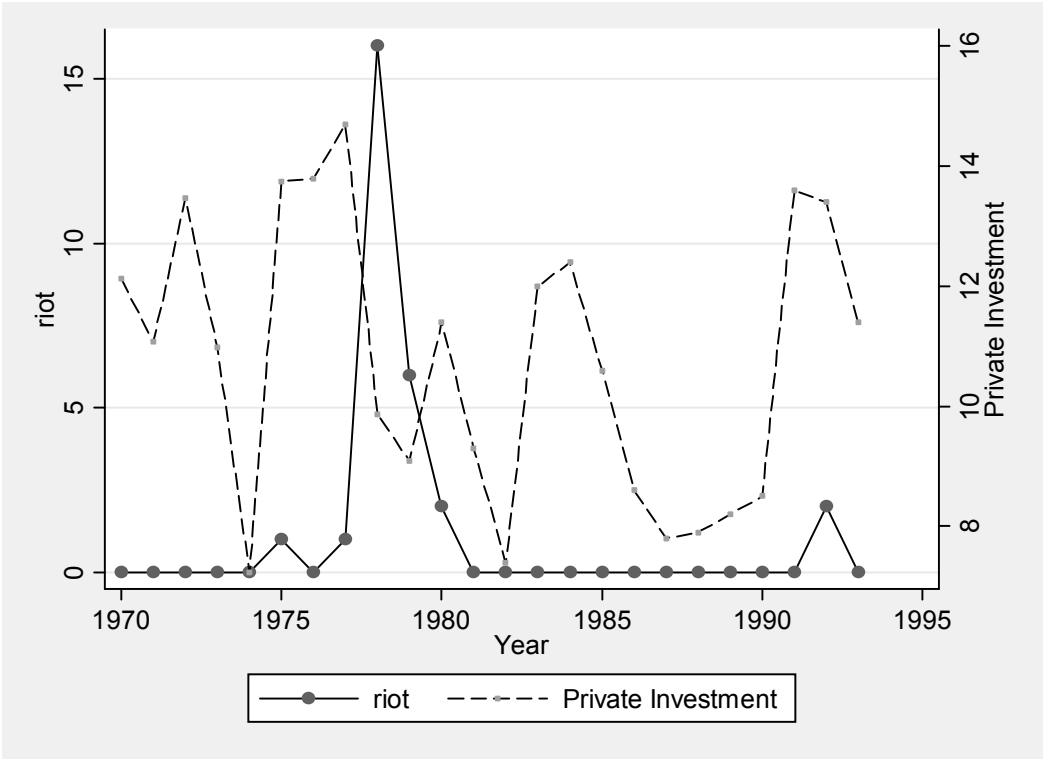

Figure B15- Riots vs private investment rate.

Figure B16- Strikes vs private investment rate.

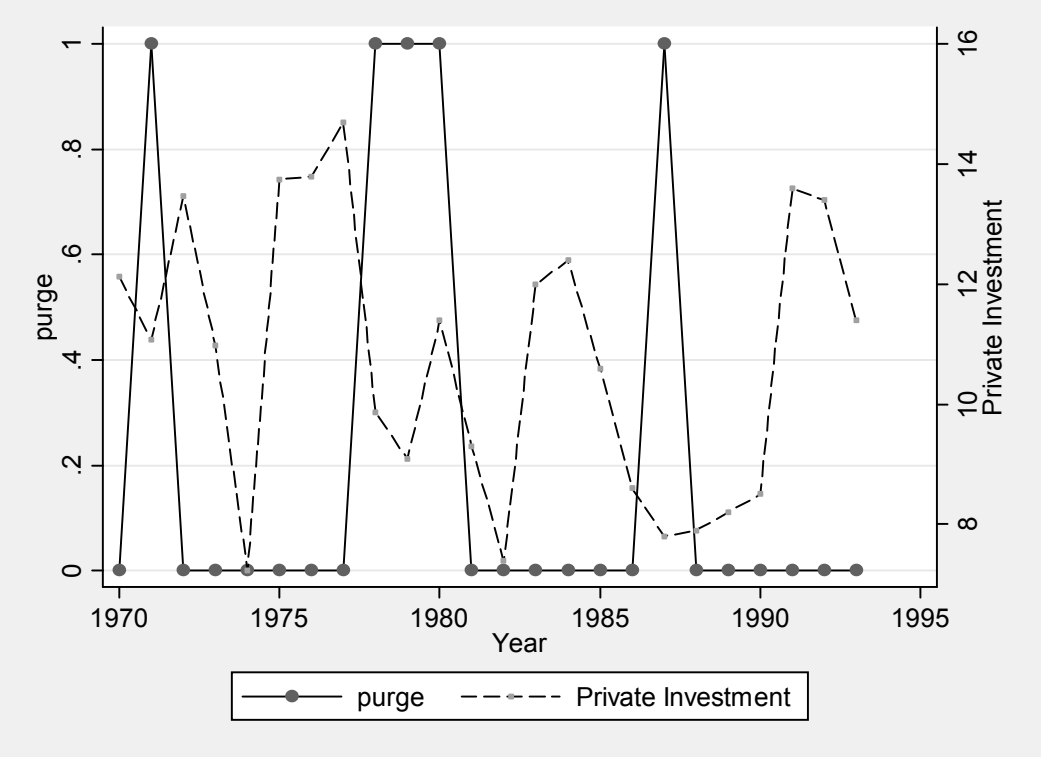

Figure B17- Purges vs private investment rate.

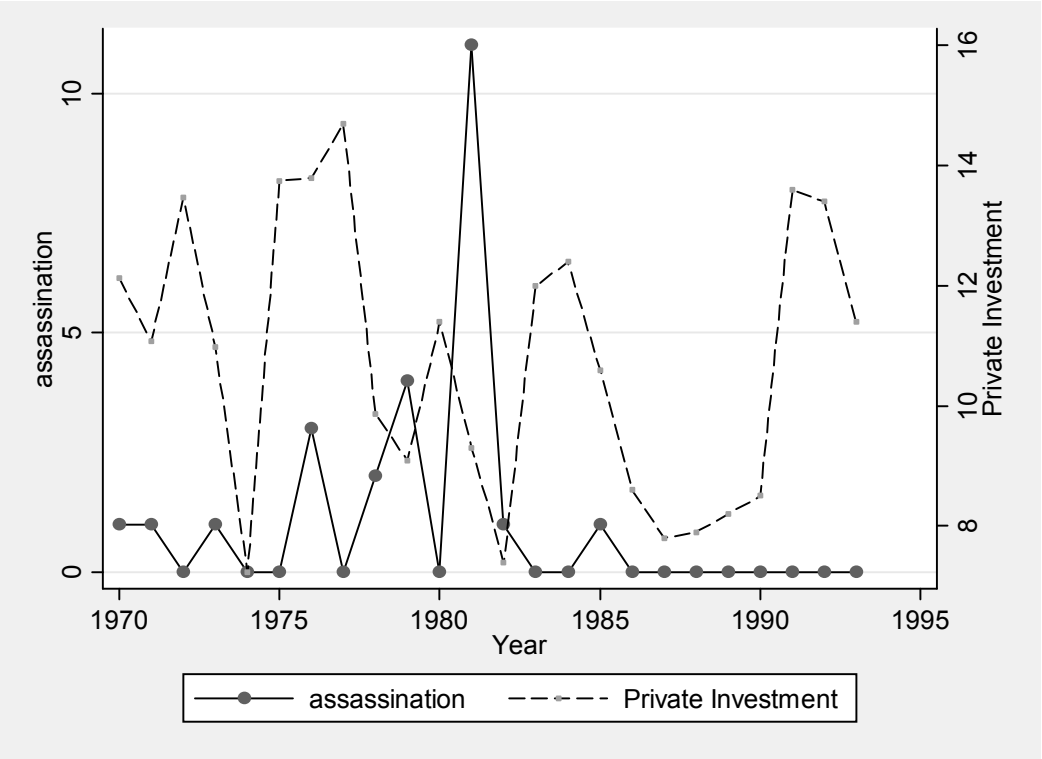

Figure B18- Assassination vs private investment rate.

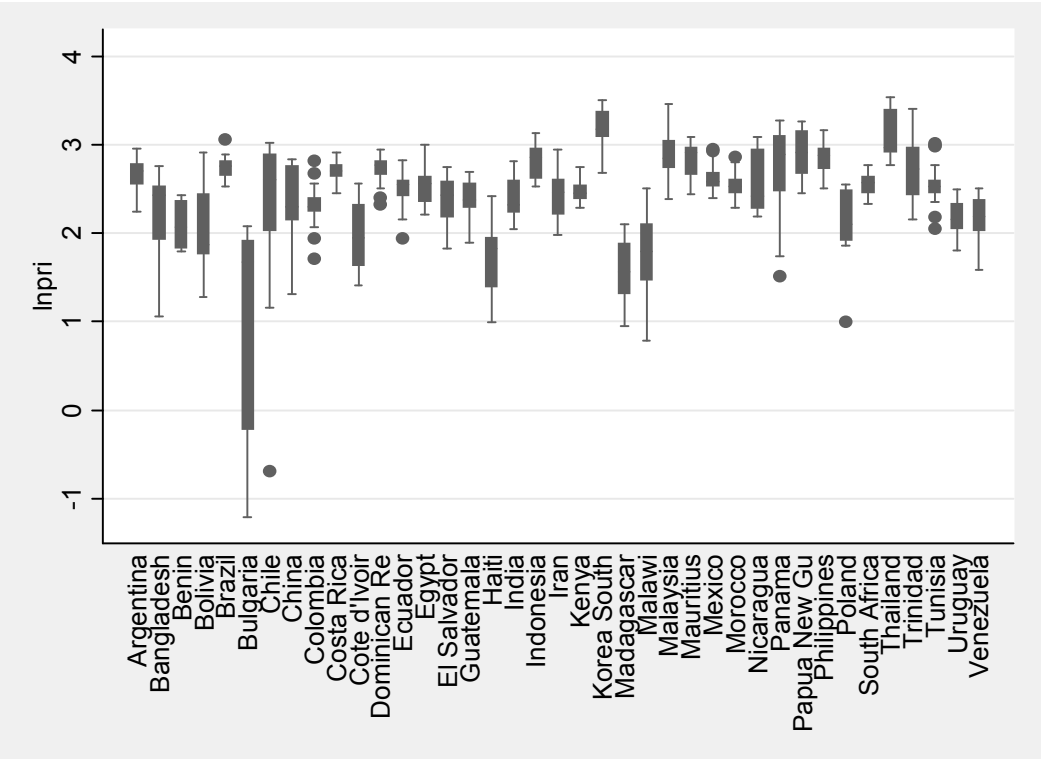

Figure B19- Box plot of macroeconomic uncertainty panel.

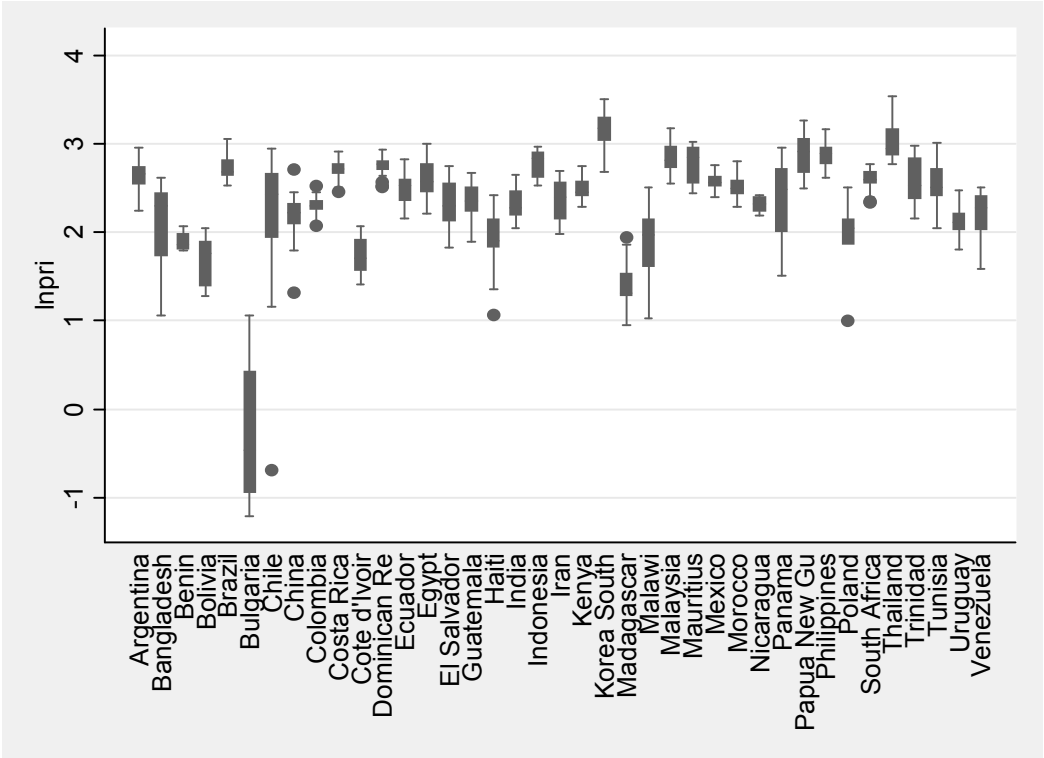

Figure B20- Box plot of socio-political institutions and conflicts panel.

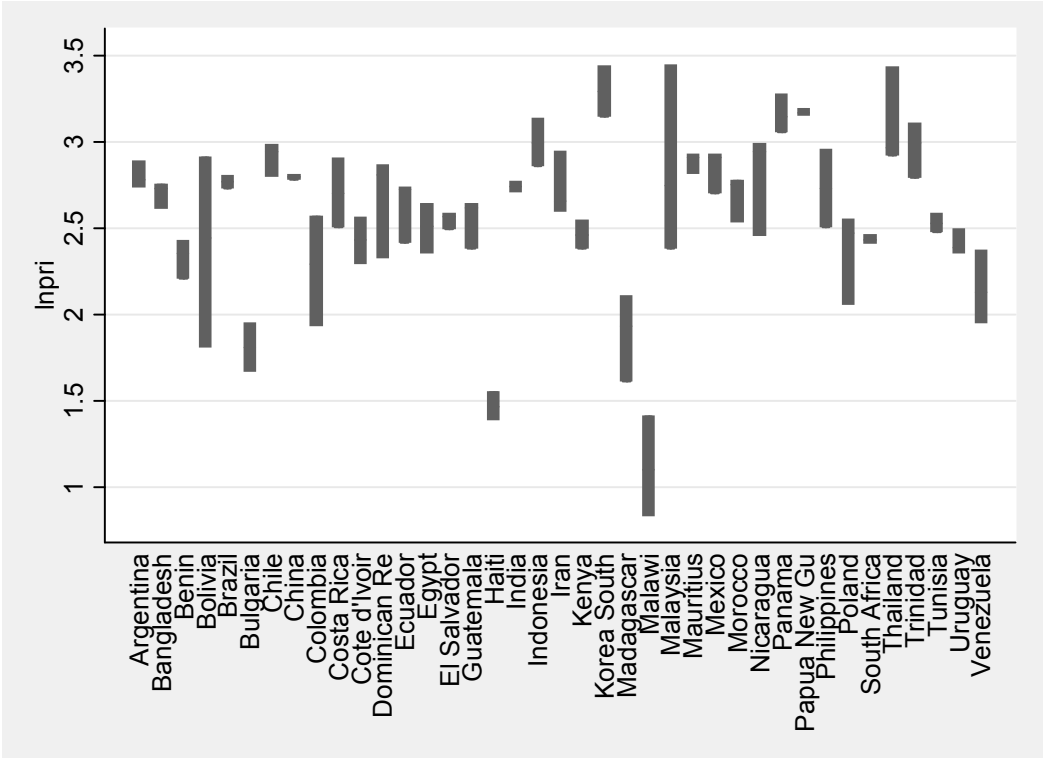

Figure B21- Box plot of the panel of the quality of governance.

APPENDIX C

Table C4- List of MA processes.

Country	Credit to private sector	Exchange rate distortion	Growth	Inflation	Interest rate	Terms of trade	Trade
Argentina	3	3	2	3	2	3	3
Bangladesh	3	2	3	2	2	3	3
Benin	3	2	1	3	3	3	1
Bolivia	3	3	3	-3	-3	1	-3
Brazil	3	1	3	3	-3	3	-3
Bulgaria	2	2	-3	3	2	2	2
Chile	2	3	3	2	1	2	2
China	1	3	3	2	-3	3	3
Colombia	2	4	4	3	1*	3	3
Costa Rica	1	3	3	2	3	2	2
Cote d'Ivoire	3	3	3	2	2	2	2
Dominican Republic	2	3	3	3	3	3	2
Ecuador	3	3	3	-1	3	4	1
Egypt	2	3	3	3	-3	1	1
El Salvador	2	3	-1	3	4	2	3
Guatemala	3	1	4	3	3	1	2
Haiti	3	1	-2	-2	2	1	3
India	2	2	3	3	3	2	1
Indonesia	3	3	3	3	-3	3	2
Iran	2	3	-3	2	2	2	3
Kenya	1	3	3	2	3	3	3
Korea	3	3	-3	1	-3	2	3
Madagascar	3	3	-2	4	3	3	2
Malawi	3	3	1	1	1	1	3
Malaysia	2	3	2	2	1	3	3
Mauritius	2	4	3	2	3	1	3
Mexico	3	3	3	2	2	2	1
Morocco	2	3	3	2	-3	3	3
Nicaragua	3	3	-2	3	-2	2	3*
Panama	3	2	3	3	1	3	3
Papua New Guinea	3	2	3	3	1	1	3
Philippines	3	2	1	2	-3	2	3
Poland	3	3	2	3	3	3	3
South Africa	3	1	3	2	3	2	3
Thailand	3	3	3	3	3	3	3
Trinidad and Tobago	1	3	3	3	3	3	3
Tunisia	3	4	3	3	3	3	3
Uruguay	3	1	3	3	3	3	3
Venezuela	3	2	-2	2	-3	2	3

1- Numbers indicates the order of MA process
2- Minus(-) shows intercept excluded of equation.
* Dummy included for outliers

Table C5 - List of variables.

lnpri	Natural logarithm of private investment rates
lndcps	Natural logarithm of uncertainty about domestic credit to private sector
lnexrdis	Natural logarithm of uncertainty about exchange rate distortion
lngrowth	Natural logarithm of uncertainty about growth
lntot	Natural logarithm of uncertainty about terms of trade
lnt	Natural logarithm of uncertainty about trade
lninfl	Natural logarithm of uncertainty about inflation
lnint	Natural logarithm of uncertainty about real interest rate
dem	Index of democracy
war	Dummy variable for war
cwr	Dummy variable for civil war
ass	Assassinations
stkptm	Strikes(per ten million)
prgptm	Purges(per ten million)
ritptm	Riots(per ten million)
rev	Revolutions
inq	Inequality
cop	Coups
con	Constitutional changes
rgq	Regulatory burden
cor	Control of corruption
rol	Rule of law
prt	Property rights
lnprt	Natural logarithm of property rights
gin	Government participation in the economy
lngin	Natural logarithm of government participation in the economy

Table F3- Summary statistics of data.

Variable	Obs	Mean	Std. Dev.	Min	Max
lnpri	927	2.481	.489	-1.203	3.538
lndcps	1095	-2.742	1.348	-5.511	.938
lnexrdis	1105	-3.83	1.419	-12.515	1.487
lngrowth	1122	2.671	.964	-4.923	5.491
lntot	1122	-3.769	1.474	-12.206	2.203
lnt	1119	-3.347	1.644	-9.604	2.717
lninfl	1122	-4.698	1.756	-10.149	.118
lnint	659	3.897	1.875	-1.002	13.343
dem	929	-.800	7.141	-10	10
war	936	.058	.235	0	1
cwr	936	.101	.302	0	1
ass	920	.469	1.799	0	25
stkptm	920	.356	1.358	0	19.31
prgptm	920	.102	.626	0	13.9
ritptm	920	.464	1.447	0	10.597
rev	920	.213	.523	0	3
inq	786	44.140	5.518	26.747	58.975
cop	729	.034	.189	0	2
con	729	.089	.289	0	2
rgq	117	.237	.591	-1.624	1.523
cor	116	-.195	.563	-1.052	1.556
rol	117	-.112	.596	-1.495	1.313
gef	117	-.043	.578	-1.468	1.413
prt	115	2.878	.919	1	5
lnprt	115	.994	.384	0	1.609
gin	115	2.843	.904	1.5	5
lngin	115	.993	.327	.405	1.609

Table C4- Pairwise correlation of independent variables in macroeconomic panel.

	lndcps	lnexrdis	lngrowth	lntot	lnt	lninfl	lnint
lndcps	1						
lnexrdis	0.0272	1					
lngrowth	0.0598	-0.1268	1				
lntot	0.2174	-0.0045	0.0949	1			
lnt	0.2937	0.2812	0.0167	-0.0144	1		
lninfl	0.2709	0.0266	0.3253	0.1946	0.3399	1	
lnint	0.2279	-0.075	0.2832	0.4869	0.1371	0.7137	1

Table C5- Pairwise correlation among socio-political institutions and conflicts panel.

	dem	war	cwr	ass	stkptm	prgptm	ritptm	rev	inq	cop	con
dem	1.000										
war	-0.086	1.000									
cwr	0.0755	0.258	1.000								
ass	0.0544	-0.001	0.278	1.000							
stkptm	0.1074	-0.050	0.006	0.045	1.000						
prgptm	-0.105	-0.009	0.010	0.102	0.034	1.000					
ritptm	-0.005	0.049	0.094	0.108	0.283	0.083	1.000				
rev	0.0105	-0.031	0.320	0.213	0.057	0.245	0.139	1.000			
inq	0.1289	0.001	0.063	0.072	0.015	-0.025	-0.029	0.113	1.000		
cop	-0.106	0.006	0.090	0.077	0.096	0.237	0.061	0.433	0.031	1.000	
con	-0.03	0.044	0.175	0.043	0.061	0.023	0.034	0.265	0.018	0.369	1.000

Table C6- Pairwise orrelation of governance quality variables.

	rgq	cor	rol	lnprt	lngin
rgq	1				
cor	0.5451	1			
rol	0.594	0.8421	1		
lnprt	-0.5887	-0.5519	-0.678	1	
lngin	-0.4446	-0.1083	-0.1301	0.3252	1

Table C7- List of the countries.

Argentina
Bangladesh
Benin
Bolivia
Brazil
Bulgaria
Chile
China
Colombia
Costa Rica
Cote d'Ivoire
Dominican Republic
Ecuador
Egypt, Arab Rep.
El Salvador
Guatemala
Haiti
India
Indonesia
Iran, Islamic Rep.
Kenya
Korea, Rep.
Madagascar
Malawi
Malaysia
Mauritius
Mexico
Morocco
Nicaragua
Panama
Papua New Guinea
Philippines
Poland
South Africa
Thailand
Trinidad and Tobago
Tunisia
Uruguay
Venezuela, RB

Table C8- Maddala and Wu unit root test.

Variable	Lags	Drift	Stat	Conclusion
Lnpri	1		132.1***	I(0)
Lndcps	1		502.89***	I(0)
Lnexrdis	1		461.16***	I(0)
Lngrowth	1		365.62***	I(0)
Lntot	1		606.88***	I(0)
Lnt	1		598.6***	I(0)
Lninfl	1		251.9***	I(0)
Lnint	1		752.8***	I(0)
dem	1	y	150.15***	I(0)
war	1	y	97.05***	I(0)
cwr	1	y	86.42***	I(0)
ass	1		211.6***	I(0)
stkptm	1		241.3***	I(0)
prgptm	1		437.9***	I(0)
ritptm	1		283.4***	I(0)
rev	1		225.48***	I(0)
inq	1	y	163.24***	I(0)
cop	1	y	104.62***	I(0)
con	1		193.64***	I(0)

*** significant at 0.01 level

Table C9- Results for cross validation.

Country	Macroeconomic Panel	Institutions Panel	Governance Panel
Argentina	0.044	0.073	0.014
Bangladesh	0.11	0.376	0.179
Benin	0.199	0.336	0.015
Bolivia	0.387	0.637	0.235
Brazil	0.138	0.092	0.085
Bulgaria	2.199	7.819	0.757
Chile	0.535	0.641	0.030
China	0.3	0.199	0.233
Colombia	0.205	0.045	0.079
Costa Rica	0.046	0.083	0.022
Cote d'Ivoire	0.286	0.608	0.075
Dominican Republic	0.097	0.130	0.038
Ecuador	0.049	0.034	0.048
Egypt	0.053	0.078	0.030
El Salvador	0.092	0.11	0.016
Guatemala	0.068	0.072	0.020
Haiti	0.457	0.47	0.572
India	0.099	0.057	0.023
Indonesia	0.428	0.123	0.291
Iran	0.0656	0.093	0.550
Kenya	0.05	0.02	0.016
Korea	0.383	0.611	0.241
Madagascar	1.074	1.26	0.424
Malawi	0.735	0.512	2.361
Malaysia	0.206	0.185	0.162
Mauritius	0.14	0.176	0.008
Mexico	0.159	0.019	0.116
Morocco	0.043	0.016	0.018
Nicaragua	0.242	0.043	0.294
Panama	0.267	0.69	0.329
Papua New Guinea	0.302	0.226	0.613
Philippines	0.124	0.247	0.021
Poland	0.169	0.536	0.209
South Africa	0.037	0.041	0.016
Thailand	0.529	0.393	0.109
Trinidad and Tobago	0.309	0.117	0.095
Tunisia	0.096	0.069	0.013
Uruguay	0.115	0.122	0.197
Venezuela	0.1	0.147	0.096

Table C10- Results for macroeconomic uncertainty panel estimation.

	(1) model1	(2) model2	(3) model3	(4) model4
lndcps	-0.0102	-0.0102	-0.0344	-0.0344
	[0.0284]	[0.0208]	[0.0400]	[0.0401]
lnexrdis	-0.0343	-0.0343	0.0358	0.0358
	[0.0169]**	[0.0172]**	[0.0291]	[0.0318]
lngrowth	-0.018	-0.018	-0.205	-0.205
	[0.0136]	[0.0105]*	[0.0377]***	[0.0420]***
lntot	-0.0352	-0.0352	-0.0873	-0.0873
	[0.0165]**	[0.0125]***	[0.0466]*	[0.0442]**
lnt	-0.124	-0.124	-0.234	-0.234
	[0.0262]***	[0.0229]***	[0.0458]***	[0.0415]***
lninfl	-0.0147	-0.0147		
	[0.0233]	[0.0196]		
lnint			-0.001	-0.001
			[0.0157]	[0.0148]
_cons	1.886	1.886	1.763	1.763
	[0.164]***	[0.132]***	[0.231]***	[0.224]***
N	892	892	597	597
R-sq	0.499	0.499	0.702	0.702
chi2	545.8	22488.9	1275.8	3886.3
rho	0.5871	0.5871	0.5296	0.5296
contemporaneous correlation	NO	YES	NO	YES

Standard errors in brackets
* p<0.1,** p<0.05,*** p<0.01

Table C11- Results for socio-political institutions and conflicts.

	(1) a	(2) b	(3) c	(4) fevd
dem	0.00333	-0.00643	0.00427	0.00482
	[0.00349]	[0.00326]**	[0.00520]	[0.00398]
war	-0.0116	-0.00372	-0.0254	0.173
	[0.0515]	[0.0616]	[0.0455]	[0.0537]***
cwr	-0.253	-0.225	-0.258	-0.341
	[0.0493]***	[0.0655]***	[0.0626]***	[0.00596]***
ass	0.00237	0.00123	0.0048	0.00208
	[0.00427]	[0.00493]	[0.00568]	[0.00810]
stkptm	-0.00306	-0.0193	-0.00579	-0.00294
	[0.00549]	[0.00839]**	[0.00721]	[0.0381]
prgptm	-0.053	-0.0571	-0.0648	-0.0431
	[0.0209]**	[0.0246]**	[0.0376]*	[0.00938]***
ritptm	0.0188	0.0221	0.0201	0.0225
	[0.00643]***	[0.00390]***	[0.0105]*	[0.0227]
rev	-0.015	-0.0000271	-0.0288	-0.00893
	[0.0157]	[0.0155]	[0.0185]	[0.0389]
cop		-0.139		
		[0.0416]***		
con		-0.108		
		[0.0271]***		
inq			0.00643	
			[0.00713]	
_cons				2.505
				[0.0217]***
N	681	493	567	642
R-sq	0.975	0.985	0.975	0.638
chi2	419762.9	1010487.3	399931.4	
F				1077.5
rho	0.493	0.3627	0.4884	0.612

Standard errors in brackets
* p<0.1, ** p<0.05, *** p<0.01

Table C12- Outcome for quality of governance uncertainty.

	(1) lnpri
rgq	0.408 [0.135]***
cor	-0.215 [0.125]*
rol	0.46 [0.204]**
lnprt	-0.625 [0.263]**
lngin	-0.0967 [0.153]
_cons	4.607 [0.592]***
N	99
R-sq	0.879

Standard errors in brackets
* p<0.1, ** p<0.05, **** p<0.01

Table C13- Outcomes of VIF test for macroeconomics uncertainty panel (without uncertainty of real interest rate).

Variable	VIF	1/VIF
lninfl	19	0.052626
lnt	13.86	0.072169
lndcps	10.16	0.098379
new_5	8.49	0.117811
lnexrdis	5.83	0.171522
new_26	5.73	0.174506
new_8	5.43	0.184139
lntot	5.27	0.189822
new_28	5.11	0.195672
new_25	5.07	0.197363
new_1	5.01	0.199746
new_37	4.99	0.200226
new_22	4.97	0.201096
new_32	4.94	0.202426
new_24	4.87	0.205497
new_7	4.78	0.209305
new_34	4.6	0.217497
new_18	4.51	0.221811
new_35	4.43	0.225537
new_20	4.32	0.231723
new_9	4.27	0.234296
new_21	4.02	0.248677
new_27	3.81	0.262652
lngrowth	3.73	0.267875
new_38	3.71	0.26944
new_19	3.52	0.283796
new_2	3.52	0.28394
new_4	3.5	0.285635
new_15	3.46	0.289095
new_16	3.35	0.298291
new_12	3.23	0.309158
new_10	3.21	0.311302
new_30	3.09	0.323413
new_14	2.96	0.338095
new_13	2.82	0.354462
new_33	2.77	0.360748
new_29	2.69	0.37229
new_17	2.61	0.383632
new_31	2.59	0.386193
new_23	2.44	0.409729
new_36	2.31	0.433482
new_3	2.2	0.454515
new_11	2.07	0.482304

Table C14-Outcomes of VIF test for macroeconomics uncertainty panel (without uncertainty of inflation).

Variable	VIF	1/VIF
lntot	38.75	0.025806
lndcps	30.62	0.032658
lnt	30.27	0.03304
lnexrdis	16.23	0.0616
new_8	15.17	0.065934
new_28	14.1	0.07091
new_30	12.85	0.077816
new_22	12.75	0.078443
new_4	11.5	0.086919
lngrowth	11.34	0.088152
new_25	11.15	0.089657
new_32	11.03	0.090693
new_35	10.7	0.093495
new_33	10	0.100037
new_26	9.27	0.107894
lnint	9.05	0.110514
new_34	8.11	0.123354
new_37	7.89	0.126696
new_24	7.81	0.127968
new_18	7.78	0.128576
new_7	7.01	0.142564
new_2	6.69	0.149477
new_38	5.92	0.168869
new_19	5.85	0.170876
new_10	4.89	0.204421
new_20	4.71	0.212421
new_9	4.57	0.218772
new_21	4.53	0.220567
new_14	4.51	0.22171
new_16	4.24	0.235651
new_1	4.15	0.240814
new_29	4.11	0.243568
new_27	3.75	0.266759
new_31	3.12	0.32059
new_36	3.03	0.330063
new_13	2.85	0.350598
new_5	2.69	0.372036
new_23	2.35	0.425916
new_15	2.27	0.441094
new_11	2.26	0.441796
new_12	2.1	0.476581
new_3	1.83	0.546459
new_17	1.46	0.684015

Table C15- outcomes of VIF test for panel *a*, socio-political uncertainty and conflicts.

Variable	VIF	1/VIF
new_34	3.98	0.251557
new_20	3.93	0.254262
new_37	3.85	0.259548
new_21	3.79	0.26402
new_16	3.7	0.270368
new_32	3.67	0.272598
new_27	3.61	0.276758
new_24	3.61	0.277114
new_38	3.53	0.282995
new_7	3.53	0.283037
new_1	3.51	0.284757
new_5	3.48	0.287125
new_15	3.48	0.287299
new_22	3.46	0.288999
new_9	3.45	0.289563
new_35	3.44	0.290351
new_18	3.4	0.294042
new_28	3.4	0.29415
new_12	3.37	0.296801
new_25	3.35	0.298466
new_13	3.35	0.298789
new_10	3.31	0.302522
new_2	3.29	0.304347
dem	3.15	0.31764
new_26	2.75	0.363356
new_8	2.68	0.372886
cwr	2.59	0.385699
new_19	2.56	0.390204
new_14	2.41	0.414431
new_17	2.33	0.428373
new_31	2.26	0.442625
new_30	2	0.499774
new_11	1.99	0.503379
new_36	1.99	0.503772
new_23	1.97	0.50743
new_4	1.7	0.589169
war	1.68	0.596609
rev	1.51	0.664451
new_33	1.5	0.668213
new_29	1.45	0.691481
ass	1.4	0.711794
new_3	1.4	0.713464
ritptm	1.33	0.752497
stkptm	1.3	0.766628
prgptm	1.19	0.841847

Table C16- outcomes of VIF test for panel *b*, socio-political uncertainty and conflicts.

Variable	VIF	1/VIF
new_20	5.75	0.173824
new_37	5.6	0.178694
new_21	5.44	0.183812
new_34	5.41	0.184976
new_16	5.36	0.186694
new_7	5.23	0.191174
new_27	5.18	0.193169
new_22	5.17	0.193587
new_1	5.16	0.193778
new_38	5.13	0.19487
new_32	5.1	0.195968
new_15	5.08	0.196943
new_5	5.06	0.197514
new_35	4.96	0.20151
new_24	4.96	0.201665
new_13	4.8	0.208238
new_12	4.79	0.20889
new_25	4.71	0.212439
new_9	4.69	0.213289
new_18	4.66	0.214394
new_10	4.62	0.216314
new_2	4.59	0.217709
new_28	4.54	0.220145
dem	4.24	0.235633
new_26	3.54	0.282744
new_8	3.17	0.315772
new_19	2.92	0.342061
cwr	2.8	0.356751
new_14	2.67	0.37511
new_17	2.62	0.381031
new_31	2.56	0.39044
new_30	2.46	0.406706
war	2.14	0.467395
new_36	1.98	0.50478
new_23	1.95	0.513383
stkptm	1.83	0.547918
rev	1.81	0.552799
new_11	1.77	0.566402
cop	1.71	0.585388
ass	1.48	0.674911
con	1.48	0.676269
ritptm	1.47	0.680291
new_4	1.45	0.687877
prgptm	1.22	0.821937

Table C17- outcomes of VIF test for panel *c*, socio-political uncertainty and conflicts.

Variable	VIF	1/VIF
new_21	4.25	0.235307
new_20	4.2	0.237984
new_24	4.15	0.241129
new_34	3.94	0.253547
inq	3.9	0.256644
dem	3.85	0.259951
new_16	3.83	0.260997
new_32	3.83	0.261239
new_27	3.76	0.26624
new_22	3.75	0.266859
new_35	3.67	0.272695
new_28	3.63	0.275553
new_7	3.62	0.276078
new_18	3.56	0.281257
new_15	3.54	0.282322
new_9	3.44	0.290325
new_25	3.41	0.293251
new_13	3.35	0.298197
new_2	3.32	0.301354
new_38	3.03	0.329959
new_19	2.8	0.35714
new_37	2.79	0.358675
new_26	2.78	0.35953
new_12	2.7	0.3697
cwr	2.69	0.371969
new_14	2.53	0.395303
new_8	2.3	0.434254
new_36	2.14	0.468007
new_30	2.06	0.484483
new_31	2.03	0.493472
new_10	2.01	0.497498
new_1	1.98	0.50537
new_17	1.87	0.534076
new_4	1.75	0.572373
new_33	1.75	0.57241
war	1.71	0.584215
rev	1.54	0.647793
new_23	1.52	0.659688
ass	1.43	0.699929
new_5	1.41	0.710773
ritptm	1.39	0.71902
stkptm	1.34	0.745375
prgptm	1.21	0.826205

Table C18- outcomes of VIF test for quality of governance.

Variable	VIF	1/VIF
rol	27.79	0.03598
lnprt	19.93	0.050179
new_7	16.68	0.059954
rgq	12.45	0.080346
cor	9.48	0.105439
new_36	9.17	0.109005
new_22	8.01	0.124848
new_25	7.41	0.134954
new_38	6.82	0.146557
new_35	6.58	0.151918
new_33	6.41	0.156022
lngin	6.18	0.161789
new_10	5.53	0.180825
new_20	5.53	0.180883
new_1	4.93	0.202642
new_28	4.66	0.214537
new_15	4.02	0.249045
new_32	3.95	0.252945
new_14	3.93	0.254663
new_30	3.92	0.255381
new_34	3.7	0.270348
new_26	3.49	0.286824
new_12	3.33	0.300131
new_37	3.18	0.314897
new_17	3.12	0.320955
new_16	2.99	0.33496
new_4	2.93	0.341244
new_23	2.87	0.347999
new_27	2.79	0.358469
new_11	2.7	0.369921
new_18	2.69	0.37107
new_8	2.47	0.404762
new_29	2.47	0.404906
new_2	2.41	0.415395
new_13	2.3	0.435171
new_5	2.25	0.444598
new_9	2.23	0.449067
new_31	2.13	0.470456
new_6	2.1	0.47715
new_19	2.08	0.481687
new_3	1.86	0.538347
new_21	1.72	0.581072

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