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GROWTH, POLITICAL INSTABILITY, AND THE DEFENSE BURDEN

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Abstract

This paper develops a model to examine the economic effects of political instability and military expenditure. In the model, "kleptocracies" use defense as "imperfect" insurance against the probability of being overthrown. Increasing defense has a secondary effect of augmenting the human capital stock (a spin-off effect). However, defense investment comes at the expense of consuming scarce resources (a crowding out effect). The paper's central contribution is to model each of these effects and their relationship to one another. The resulting theory predicts that the equilibrium is Pareto inefficient and that increased political instability and increased defense can inhibit economic growth. Empirically, increases in political instability are found to decrease growth while increases in defense are found to decrease political instability. The paper also finds that increases in defense have a direct negative effect on growth, although the relation is weak. The weak relation implies the aforementioned crowding out effect is largely mitigated by the spin-off effect.

Growth, Political Instability, and the Defense Burden

Stephen Brock Blomberg[1]

1 Introduction

The problem of lagging productivity in many countries has led to a reexamination of traditional theories of economic growth. As Seers points out, "The major inadequacies of conventional economics . . . are that the analysis focuses on the wrong factors, and the models do not fit at all closely to the way in which nonindustrial economies operate".[2] In response to this characterization of conventional economics, this paper focuses on two factors rarely examined yet extremely important for growth–defense and political instability.

Worldwide military expenditure topped the $ 1 trillion mark for the first time in 1987. This means worldwide military spending was greater than the entire Gross National Product (GNP) of Latin America and the combined GNP of Africa and the Middle East.[3] Worldwide political instability has also been pervasive in the recent past.[4] From 1950-82, insurrecting parties attempted to overthrow their governments roughly every 8 years, with about one half of those attempts being successful.[5] Figure

[1]The author is a student intern in the Division of International Finance. This paper represents the views of the author and should not be interpreted as reflecting the views of the Board of Governors of the Federal Reserve System of other members of its staff. I have benefited greatly from discussions with Joseph Harrington, Gregory Hess, Louis Maccini, and Athanasios Orphanides. Special thanks also to P.K. Asea, Lisa Blomberg, Jon Faust, Rumana Khan, David Zervos and the participants of the Johns Hopkins and Federal Reserve Board seminars for their valuable comments. In addition, I thank William Carrington and Martin Gaynor for helpful discussions related to the empirical aspects of the paper and Holger Wolf & Phillip Swagel for providing me with the data sets used in the paper. All remaining errors are of course my responsibility.

[2]Quote attributed to Seers in Belassa (1990), p I-2.

[3]See World Military Expenditure and Arms Transfers, (1990).

[4]Political instability is defined throughout the paper as any irregular executive transfer of power. The figures are actually understated. Calculations were made by treating any year with at least one year as being one coup in that year.

[5]See Londregan & Poole (1980).

A.1 in the appendix emphasizes the importance of political instability, geographically. Countries in the sample that have experienced at least one coup from 1960-85 are highlighted. Note that 51 of 118 countries in the sample have experienced some form of political instability with the highest concentration being located in South America and Africa. Despite these facts, little attention has been given to analyzing the economic effects of political instability and defense.

The research that has analyzed the relationship between defense, political instability, and growth has not yet coalesced. There are several lines of literature which have investigated the relationship between growth & political instability or defense & growth; however, there is no unifying theory which simultaneously relates growth, political instability and defense. One of the major goals of this paper is to "bridge" the gap in the literature by incorporating aspects from each of the theories into one school of thought.

The paper presents a brief overview of the literature with a schematic diagram provided in the appendix to aide in the exposition. The first line of research has been primarily concerned with analyzing the relationship between defense and growth. Originally, Benoit (1973) provided support for the view that increased military expenditure yields greater growth.[6] The result that defense enhances productivity is explained by assuming military spending is the conduit through which human capital, infrastructure, and discipline, etc. develop in society. However, an alternative hypothesis is that a country's growing military burden (military spending as a percentage of GNP) crowds out investment and creates a large tax liability for future generations.[7] Most recently, Chowdhury (1991), in his study of 55 developing countries, showed that either hypothesis can be true depending on the particular economy being investigated. The ambiguity in the results stems from the fact that this line of research has not considered the intimate relationship between defense, growth and *political instability.*

The more recent lines of research do introduce political instability into the analy-

[6]The results were later corroborated by Benoit (1978), Kennedy (1974), and Whynes (1979) among others.

[7]For research supporting this hypothesis see Smith (1977, 1978, 1980b), Deger & Smith (1983), Deger & Sen (1983), and Leontief & Dutchin (1983) among others.

sis but focus largely on its partial relationship to defense or to growth. For example, Hess and Orphanides (1991) develop a model to analyze the relationship between defense and political instability. In their paper, they give the conditions necessary for an elected official to start an unnecessary war to increase his probability of re-election. But, their analysis concentrates largely on the political aspects involved without considering how political instability affects growth. Others, such as Alesina *et al* (1991) and Londregan & Poole (1990,1991a,b), have investigated the empirical relationship between political instability and growth but fail to link the relationship to defense. Grossman (1991) does link political events to economic activities in his positive theory of insurrections, but fails to provide a readily testable hypothesis. This paper unifies these approaches by examining how defense and political instability affect economic factors such as savings, investment, and economic growth, both theoretically and empirically.

As a preliminary exercise, to help sort out the relationship between the relevant political and economic variables and establish the importance of the form of government, the paper provides data indexed by government.[8] Table 1 illustrates some differences in military spending and political instability between democratic and non-democratic states. Notice that regardless of how it is defined (i.e. number of coups or revolutions) political instability is significantly higher in the non-democratic states.

Table 1: **Political and Economic Factors**†

Type of Government	*Growth*	*M/GDP*	*Coups*	*Revolutions*
Democracies	2.8%	2.97%	.002	.033
Non-Democratic States	1.6%	2.99%	.064	.240

†1960-85 Average Military Expenditures (M), Gross Domestic Product (GDP), Per Capita Growth (Growth), Coups (Coup) and Revolutions (Revolutions) Per Million. Source: Barro (1991) and author's calculations.

The correlation coefficients of the variables in question are reported in Table 2 and Table 3. It is important to note that the relationships between the variables differ dramatically in democracies as compared to dictatorships. Per capita growth,

[8]Countries are classified as non-democratic or democratic depending their classification in Alesina *et al* (1991) and Jodice & Taylor (1983) over the majority of years 1960-82.

Table 2: **Correlation Coefficients For Democracies**†

	Constl Changes	*Govt Crises*	*M/GDP*	*Coups*	*RevCoup*	*Growth*
Constl Changes	1.000	−0.013	−0.055	0.771	0.496	0.320
Govt Crises	.	1.000	0.265	0.100	0.204	−0.003
M/GDP	.	.	1.000	0.029	0.053	0.081
Coups	.	.	.	1.000	0.607	0.274
RevCoups	.	.	.	.	1.000	−0.009
Growth	.	.	.	.	.	1.000

†1960-85 Average Military Expenditures (M), Gross Domestic Product (GDP), Per Capita Growth (Growth), Constitutional Changes (Constl Changes), Coups (Coups), Government Crises (Govt Crises) and Revolutions + Coups (RevCoups) Per Million. Source: Barro (1991) and author's calculations.

Table 3: **Correlation Coefficients For Non-Democratic States**†

	Constl Changes	*Govt Crises*	*M/GDP*	*Coups*	*RevCoup*	*Growth*
Constl Changes	1.000	0.067	0.029	0.461	0.371	−0.185
Govt Crises	.	1.000	−0.102	0.535	0.629	−0.137
M/GDP	.	.	1.000	−0.192	−0.151	−0.128
Coups	.	.	.	1.000	0.860	−0.198
RevCoups	.	.	.	.	1.000	−0.296
Growth	.	.	.	.	.	1.000

†1960-85 Average Military Expenditures (M), Gross Domestic Product (GDP), Per Capita Growth (Growth), Constitutional Changes (Constl Changes), Coups (Coups), Government Crises (Govt Crises) and Revolutions + Coups (RevCoups) Per Million. Source: Barro (1991) and author's calculations.

coups and defense spending as a percentage of GDP are all positively correlated for democracies but are negatively correlated for authoritarian governments.[9]

Given the preliminary results, the paper develops a theory for non-democratic states.[10] The paper assumes that the role of defense in an authoritarian regime is threefold. First, there is an insurance effect. Intuitively, the military protects a dictator against being overthrown because of the military's inherent ability and interest in defending her. Second, there is a crowding out effect. Obviously, purchasing this insurance comes at some cost to society. The cost is measured by the amount of resources "crowded out" by defense. Finally, there is a spin-off effect. Following early research by Benoit *inter alia*, the paper assumes time spent in the military makes the labor force better educated and disciplined. This labor augmenting effect makes the economy more productive. The purpose of the paper is to sort out which effects are greater and how they relate to political instability and growth.

The paper finds empirical support for the view that increased political instability inhibits growth and increased military expenditure decreases political instability. The paper also finds that the defense burden decreases growth but not significantly. The weak relation implies the aforementioned crowding out effect is largely mitigated by the spin-off effect. None of these results are sensitive to the specification of the empirical model.

Section 2 of the paper describes the model in detail to include technology, endowments, preferences and scarcity. Section 3 provides the solution to the optimization problem and the various results derived. These results are tested in section 4. Finally, section 5 sums up the paper and concludes with suggestions for future research.

[9]Note, that one cannot reject the null hypothesis that coups & defense and growth & defense are uncorrelated at any conventional level in democracies. However, in non-democratic states, growth & coups and defense & coups are significant at the .1 level. Defense & growth are significant at the .2 level.

[10]The theory may be robust to democratic regimes, however, the model is better specified to analyze the non-democratic case.

2 The Basic Model

The model presented here is an endogenous growth model of an economy with "political" preferences. The basic technology follows work by Lucas (1988) and Barro (1990). The political aspects of the model are related to work done by Nordhaus (1989) and Hess & Orphanides (1991), while preferences are a synthesis of Uzawa's (1968) and Blanchard's formulations (1985). Definitions of the notation are provided in the appendix for the reader's convenience.

2.1 Technology and Endowments

Consider an economy comprised of N identical households and an authoritarian government. Households employ physical capital, K_t, and the quality adjusted labor force, $\tilde{Q}_t$, to produce output, Q_t, while the government provides for the common "defense", G_t.[11] Defense is used by the government to insure itself from insurrections. This point is discussed at length in Section 2.4.

Formally, the relationship between output and the factors of production are given by (1).

$$Q_t = \hat{F}(K_t, \tilde{Q}_t) = AK_t^{(1-\alpha)}\tilde{Q}_t^{\alpha} \tag{1}$$

where A is a measure of the embodiment of capital into output. For simplicity, there is assumed to be no physical depreciation of capital which implies that Q_t is gross rather than net output.[12]

By introducing defense into the economy, the government also enhances output. To formally define the effect of defense on output, assume that the sum of total defense investment, I_t^G, directly increases the quality of the labor force by making

[11]Defense is a human capital augmenting consumption good. It is eaten by the government but augments human capital over time. The assumption that defense has both consumption and investment characteristics is made in response to empirical studies which suggest that both factors are necessary to explain the heterogeneous patterns across countries.

[12]The assumption will not effect the analysis if the depreciation rate is assumed to grow exponentially.

it better educated, more disciplined, and better managed. Therefore the following relation holds:

$$\phi \int_0^t I_v^G dv = \tilde{Q}_t \tag{2}$$

where $\int_0^t I_v dv$ is equal to the aggregate defense stock to date, G_t, and ϕ measures the amount that defense augments human capital. Substituting (2) into (1) yields:

$$Q_t = \hat{F}(K_t, G_t) = \phi^{\alpha} A K_t^{(1-\alpha)} G_t^{\alpha}. \tag{3}$$

Notice, the effect of defense, G_t, on output comes through a spin-off effect on $\tilde{Q}_t$.[13] The assumption is made to support the belief that military expenditures foster growth in developing countries.[14]

Using the government budget restraint, $G_t = \tau Q_t$, rewrite (3) as (4).[15]

$$Q_t = F(K_t) = \phi^{\alpha} A^{(\frac{1}{1-\alpha})} \tau^{(\frac{\alpha}{1-\alpha})} K_t \tag{4}$$

Since the labor force is assumed to be constant, the analysis can be further simplified by normalizing N to unity. Thus, the relationship in per capita terms is

$$q_t = f(k_t) = \phi^{\alpha} A^{(\frac{1}{1-\alpha})} \tau^{(\frac{\alpha}{1-\alpha})} k_t \tag{5}$$

where lower case letters denote per capita values of these variables.

Finally, the economy is endowed with some initial physical capital which it uses to begin production, that is

$$k_o > 0.$$

[13]Historical studies, such as Rosenberg (1985) and Trebilcock (1969), show how military technology has stimulated productivity in various civilian industries. However, such an assumption is not necessary for growth to be endogenous, only that production is linear in capital.

[14]See Benoit (1973), (1978), Kennedy (1974), and Whynes (1979) for support of such an assumption.

[15]The government is assumed to finance defense contemporaneously by a flat rate income tax, $G_t = \tau Q_t$, so the government budget is balanced at every moment. Alternatively, one could assume taxes are lump sum or that the government floats debt without changing the general results.

2.2 Preferences

Individuals' welfare at time 0 is the present discounted value of the sum of their felicity functions, $u(.)$. The function, $u(.)$, is a continuously differentiable, increasing, concave function of c_t, per capita consumption. Individuals' discount the present relative to the future by a constant sub,.ctive rate of time preference, θ, which is assumed to be strictly positive. The government derives utility by pleasing her constituency and from economic rents received while in power, x_t. Hence, her instantaneous felicity, v, is a convex combination of individual welfare and personal welfare, $w(x_t)$.[16]

$$v(c_t, x_t) = (1 - \rho)u(c_t) + \rho w(x_t) \tag{6}$$

The parameter ρ measures the selfishness of the dictator.[17] In the limit, as $\rho \to 0$, the dictator is concerning only with consumer welfare. In contrast, as $\rho \to 1$, the dictator cares only for herself.

2.3 Scarcity

After tax output net of rents is either consumed or invested. Investment takes the form of accumulated physical capital. Formally, the dynamic budget constraint is[18]

$$\dot{k_t} = (1 - \tau)q_t - c_t - x_t. \tag{7}$$

However, the constraint, in itself, is not sufficient to bind the economy. In order to impose restrictions on borrowing, the following no-Ponzi-game condition must hold:

$$\lim_{t \to \infty} k_t e^{-\int_0^t (r_s + \pi_s) ds} = 0.$$

The condition is necessary to prevent the economy from borrowing indefinitely.

[16]For simplicity, assume $w(.)$ is also a continuously concave increasing function of rents, x_t.

[17]Since v is a positive linear transformation of u, it is also a continuously concave increasing function of c_t.

[18]The analysis is easily extended to allow for exogenous external aggression. For example, assume foreign countries take some percentage of output, νQ_t, and that percentage depends on defense insurance. Since, the general qualitative results are not sensitive to such a specification, such an assumption is not made.

To close the model, substitute (5) into (7) to yield

$$\dot{k}_t = A^* k_t - c_t - x_t \tag{8}$$

where $A^* = \phi^\alpha(1-\tau)A^{(\frac{1}{1-\alpha})}\tau^{(\frac{\alpha}{1-\alpha})}$.

2.4 Political Preferences

Assumption 1 *Dictators face some instantaneous probability of being overthrown because of their particular form of government.*

To ensure that she remains in power, the government must consider the possibility that she could be ousted with probability π, at any time. The probability is independent of the dictator's age.[19] It can take any value between 0 and infinity because π is given as per unit time. Therefore, define a random variable, Z, as the "time until death", given by the following density function:

$$f_z = \pi e^{-\pi t}$$

where

$$E_0 Z = \int_0^\infty t\pi e^{-\pi t} dt$$

and π^{-1} is an index of the dictator's effective horizon. In the special case where $\pi = 0$, the dictator lives forever.[20] This is the only source of uncertainty considered in the model.

Since individuals' are assumed to discount the present relative to the future exponentially, the effect of including the probability of death in the problem is to increase the discount rate by π.[21] Hence, the dictator's "political" rate of time preference is the sum of the subjective rate of time preference and the probability of death.

[19]This assumption allows the analysis to be tractable. However, considering the regularity in which dictators are overthrown in LDC's, the assumption is not terribly restrictive.

[20]Dictators can alternatively be thought of as families of dictators, e.g. the Kim dynasty in South Korea; the Duvallier dynasty in Haiti and Nicaragua.

[21]See Cass and Yaari (1967), for proof of the result.

Assumption 2 *Defense provides "imperfect" insurance against the probability of being overthrown.*

Unfortunately for the dictator, explicit insurance against the probability of being overthrown cannot be purchased.[22] However, the dictator does provide imperfect "insurance" for herself through military production.[23] To incorporate this into the model, π is assumed to be a function of defense as a percentage of output, $\frac{g_t}{q_t}$. The motivation for the assumption is as follows: if the dictator produces a large amount of defense, she deters her rivals from attacking and increases her chances of remaining in power. Hence, her probability of death declines. It is necessary to deflate g_t by q_t to show the extent to which an economy's resources are devoted to defense insurance. The specification is important when testing the model. The formulation allows the model's empirical results to be compared to earlier studies which regress economic growth on the defense burden, $(\frac{g_t}{q_t})$.[24] Formally, define the relation between π and $\frac{g_t}{q_t}$ in the following way:[25]

$$\pi = \pi(\frac{g_t}{q_t}) = \delta - \beta\frac{g_t}{q_t}$$

or

$$\pi = \pi(\tau) = \delta - \beta\tau \tag{9}$$

where the parameter β measures how effective defense is as an insurance against the probability of death. Political unrest, δ, measures the public level of dissatisfaction with the polity. A formal definition for δ, is difficult without reference to the empirical results. Section 4.2 devotes itself to a more rigorous treatment of how δ is measured.

[22]This differs from Blanchard (1985), where insurance companies insure agents against the probability of death.

[23]Defense insurance is "imperfect" because it does not fully insure a dictator from being overthrown. This market imperfection is necessary as otherwise $\pi = 0$.

[24]There is also a technical consideration for the assumption. If π were a function of g_t rather than the defense burden, π would no longer be stationary since it would depend on a variable which grows over time.

[25]Alternatively, one could allow π to be quadratic in $\frac{g_t}{q_t}$ without changing any of the general results in the paper. Motivation for such a specification would be supported by the preliminary data analysis in Table A.1 provided in the appendix.

3 Intertemporal Optimization

To analyze growth issues, felicity is assumed to be of the Constant Relative Risk Aversion variety (CRRA). The dictator chooses c_t, x_t, k_t, τ subject to the resource constraint. The optimization problem is

$$\max_{\{c_t,x_t,k_t,\tau\}} E_0 \int_0^{\infty} [(1-\rho)\frac{c_t^{1-\sigma}}{1-\sigma} + \rho w(x_t)] e^{-(\pi+\theta)t} dt$$

s.t. k_o given

$$\dot{k_t} = A^* k_t - c_t - x_t$$

where σ is the parameter which measures the intertemporal elasticity of substitution/relative risk aversion parameter. Notice, if the central planner is benevolent, $\rho = 0$, and the economy is politically stable, $\pi = 0$, the model collapses to the standard case with linear technology and CRRA utility.

For the more general case, optimality implies:[26]

$$(1-\rho)u'(c_t) = (1-\rho)c_t^{-\sigma} = \lambda_t \tag{10}$$

$$\rho w'(x_t) = \lambda_t \tag{11}$$

$$\frac{\dot{\lambda}_t}{\lambda_t} = (\pi + \theta) - A^* \tag{12}$$

$$\lim_{t\to\infty} \lambda_t k_t e^{-(\theta+\pi)} = 0 \tag{13}$$

$$A^*_\tau = \omega \pi_\tau \tag{14}$$

[26] See the mathematical appendix for the derivation.

where $A^*_\tau = \phi^\alpha A^{\frac{1}{1-\alpha}} \tau^{\frac{\alpha}{1-\alpha}} [\frac{\alpha(1-\tau)}{\tau(1-\alpha)} - 1]$, $\omega = \frac{\theta+\pi}{1-\sigma}$, and $\pi_\tau = -\beta$.

The relationship between the control and co-state variables are described by equation's (10) and (11). If $\rho = 0$, the usual relation between marginal utility and the co-state variable holds, i.e. $c^{-\sigma} = u_c = \lambda$. Equation (12) yields the growth path of the co-state variable. If $A^* < (\pi + \theta)$, the co-state variable grows overtime and vice-versa.

Combining equation's (10) and (11) yields

$$\frac{u'(c_t)}{w'(x_t)} = \frac{\rho}{1-\rho}. \tag{15}$$

Equation (15) defines the ratio of the marginal utility of consumption to rents to be directly proportional to the selfishness of the dictator. The dictator trades off social welfare with her own welfare–the tradeoff being higher the higher her degree of selfishness.

Equation (14) relates the marginal productivity of defense (i.e. A^*_τ) to the marginal propensity to insure (i.e. π_τ). To understand (14), one must first sort out the three individual effects of defense on productivity; (*i*) the spin-off effect; (*ii*) the crowding out effect; and (*iii*) the insurance effect. First, consider the spin-off effect. By assumption, any increase in defense increases the quality of the labor force. The extent to which this increase in labor quality spins off to production is seen in the amount of human capital employed in production, α. Hence, countries with a higher α gain more from increases in defense than countries with a lower α, *ceteris paribus.*

Second, there is a crowding out effect. As the dictator allocates more output to defense, she devotes less to everything else. This effect is captured by the rate at which defense is extracted from output, τ.

Finally, there is an insurance effect which is captured by $-\beta$. This effect is alternatively thought of as the marginal propensity to insure (MPI). When the military insurance is high (high β), the dictator buys time in office through the discretionary use of force. In this case, increases in defense decrease the probability of being overthrown (i.e. $\pi_\tau < 0$.).

Consider how these effects interact with one another. If the crowding out effect is greater than the spin-off effect, the marginal product of defense (MPD) is negative. Conversely, if the spin-off effect is greater than the crowding out effect, the MPD is positive. From equation (14), notice the sign of the MPD fundamentally depends on preferences. When $\sigma > 1$, it must be true that the MPD is positive, given that the MPI is negative. Similarly, when $\sigma < 1$, the MPD is negative. Hence, the equilibrium has the powerful implication that preferences ultimately decide the productivity of defense.

To analyze the implications derived from the equilibrium, first consider how the degree of "kleptocracy" affects consumption.

Proposition 1 *Dictators who are more selfish provide for less private consumption or value additional capital less.*

Proof:

From equation (10), optimality implies for any economy $i = A, B$

$$(1-\rho^i)(c_t^i)^{-\sigma} = \lambda_t^i$$

or

$$1-\rho^i = \lambda_t^i (c_t^i)^{\sigma}$$

Let economy A be more selfish than B, i.e. $\rho^A > \rho^B$. *Ceteris paribus*, this implies

$$1-\rho^A < 1-\rho^B$$

or

$$\lambda_t^A (c_t^A)^{\sigma} < \lambda_t^B (c_t^B)^{\sigma}$$

Hence,

$$\lambda_t^B > \lambda_t^B$$

or

$$c_t^B > c_t^A.$$

■

Logarithmically differentiating (10) with respect to time and combining (12) yields

$$\gamma_c \equiv \frac{\dot{c}_t}{c_t} = \frac{A^* - (\theta + \pi)}{\sigma} \tag{16}$$

where γ_c is the growth rate of consumption. To ensure growth rates are positive and a solution exists, $A^* > \theta + \pi > A^*(1 - \sigma)$.[27] Rewrite equation (16) as

$$A^* = \gamma_c \sigma + \theta + \pi. \tag{17}$$

Notice, from equation (17), in the long run, the return to investment (the left hand side) equals the return to consumption (the right hand side). The return to consumption is greater than in the modified golden rule case because the dictator receives a growth premium $(\sigma\gamma)$ in addition to her *political* rate of time preference, $(\theta + \pi)$.[28]

Now that the growth rate of consumption has been defined, the next task is to define the growth rate of capital. Divide the budget constraint by the capital labor ratio to reveal

$$\gamma_k \equiv \frac{\dot{k}_t}{k_t} = A^* - \frac{c_t^*}{k_t} \tag{18}$$

where γ_k is the growth rate of capital and c_t^* is aggregate consumption.[29] Logarithmically differentiating equation (18) implies growth rates for capital and consumption are equivalent given that γ_k is constant in the steady state.

Finally, by log differentiating equation (5), the growth rate of output is also shown to be equivalent to that of consumption and capital. Therefore, the results from a "politically" influenced program are that the rate of growth is identical, constant and positive across all relevant macroeconomic variables.

Now that the relevant growth rates have been defined, consider the welfare implications derived from the model.

[27]See the mathematical appendix for an explanation.

[28]The modified golden rule states that the steady state marginal product of capital is equal to the subjective rate of time preference. The powerful implication is that the productivity of capital is ultimately preference dependent.

[29]Aggregate consumption is the sum of private consumption and the dictator's consumption.

Proposition 2 *An economy with "political preferences" is Pareto inefficient.*

Define the private return to capital, A^*, as r. In equilibrium, $r > \theta + \sigma\gamma$ since $\pi > 0$. Therefore, the "growth-adjusted" modified golden rule (i.e. $r = \theta + \sigma\gamma$) does not hold which implies the equilibrium is not pareto optimal.[30]

In order to see why the equilibrium is pareto inefficient, notice that the interest rate in the economy, $r = \theta + \pi + \sigma\gamma$, is greater than the pareto optimal interest rate, $r^* = \theta + \sigma\gamma$. High interest rates are assumed to stifle growth. The result is driven by the assumption made on government behavior. Because dictators are uncertain with regards to their probability of "death", they behave differently than representative households. The government realizes its lifetime is finite and so it discounts the future by a greater amount. The increase in impatience implies an inefficient equilibrium characterized by generations that invest less for the future.

In addition to consumer welfare, there are other areas affected by "political" uncertainty. One such area is economic growth.

Proposition 3 *An increase in the level of "political" unrest, δ, decreases the rate of growth in an economy.*

Recall from equation (9), $\pi = \delta - \beta\tau$. Substitute this into equation (16) and the new reduced form equation for growth is

$$\gamma = \frac{A^* - \theta - \delta + \beta\tau}{\sigma} \tag{19}$$

Therefore, $\frac{\partial\gamma}{\partial\delta} = \frac{1}{\sigma}(\frac{\partial A^*}{d\tau}\frac{d\tau}{\partial\delta} - \frac{\partial\pi}{d\tau}\frac{d\tau}{\partial\delta} - 1) = \frac{1}{\sigma}[A^*_\tau(1 - \frac{1}{\omega}) - 1]$. The sign of $\frac{\partial\gamma}{\partial\delta}$ is negative given that $A^*_\tau < 0$. Intuitively, increases in political unrest decrease growth as long as the resulting increase in defense does not greatly increase productivity.

[30]See Sala-i-Martin (1990b) for a detailed explanation.

Proposition 4 *An increase in the level of "political" instability, π, due to an increase the level of political unrest, δ, decreases the rate of growth in an economy.*

Recall from equation (16), $\frac{\partial \gamma}{\partial \pi} = -\frac{1}{\sigma}$. Since π is increasing in δ (see equation 9), $\frac{\partial \gamma}{\partial \delta} = \frac{\partial \gamma}{d\pi}\frac{d\pi}{\partial \delta} < 0$.

While the presence of political uncertainty has unfortunate welfare and growth implications, the use of defense by itself can actually stimulate economic growth. Before explaining how this can be so, to aide in the exposition, the paper defines certain conditions under which the economy may operate. It is necessary to define these conditions because the three effects of defense on technology and preferences (i.e. crowding out, spin-off and insurance effects) may be offsetting.

The first condition characterizes a situation where the marginal propensity to insure is negligible and the marginal product of defense is negative.

Case 1 *The insurance effect is arbitrarily small (i.e. $\beta \approx 0$) and the crowding out effect is greater than the spin-off effect.*

The second condition characterizes a situation where the marginal product of defense is positive.

Case 2 *The spin-off effect is greater than the crowding out effect.*

Proposition 5 *An increase in the defense burden, τ, decreases the rate of growth in* **Case 1** *but increases the rate of growth in* **Case 2**.

Substitute equation (9) into equation (19) to yield

$$\gamma = \frac{\hat{A}^*(\tau) - \theta - \delta - \beta\tau}{\sigma} \tag{20}$$

where $\hat{A}^*(\tau) = \phi^\alpha(1-\tau)A^{\frac{1}{1-\alpha}}[\tau]^{\frac{\alpha}{1-\alpha}}$. Note, $\frac{\partial \gamma}{\partial \tau} = \frac{\phi^\alpha A^{\frac{1}{1-\alpha}}\tau^{\frac{\alpha}{1-\alpha}}[\frac{\alpha(1-\tau)}{\tau(1-\alpha)}-1]-\beta}{\sigma}$. If **Case 1** holds, then $\beta \approx 0$ and $\tau > \alpha$ which implies $\frac{\partial \gamma}{\partial \tau} < 0$. However, if **Case 2** holds, the sign inside [.] is positive causing $\frac{\partial \gamma}{\partial \tau} > 0$.

The intuition behind the result is straight forward. If increasing defense sufficiently increases the quality of the labor force or makes the dictator behave prudently enough to mitigate the crowding out effect, productivity increases. If it does not, productivity declines. Such a result explains why the effect of defense on growth cannot be arbitrarily signed.

This illuminates one of the crucial aspects of the paper. It is not necessarily military expenditure that stifles growth *per se*; it is the political uncertainty usually associated with defense that harms productivity. Hence, previous research (see introduction) which solely examined the relationship between defense and growth has focused on the wrong factors. By empirically testing the correlation between defense and growth without considering political instability, researchers have left an important issue unexplored. A central contribution of this paper is to better define the relationship between political instability, military expenditure, and growth.

4 Testing the Model

There are three results derived in the paper that are tested. Namely, one tests whether (i) Political unrest, δ, hinders economic growth; (**Proposition 3**) (ii) Political instability, π, is associated with low economic growth; (**Proposition 4**) and (iii) defense spending as a percentage of GDP, $\frac{g_t}{q_t}$, is used to buffer political instability and hinders economic growth; (**Proposition 5**). To test these implications, parameter estimates for the relevant political and economic variables are examined in the empirical counterparts of the growth and political instability equations [i.e. equations' (16), (9)].

4.1 Methodology and Data

As pointed out by Levine & Renelt (1992), cross-country growth regressions are extremely sensitive to the explanatory variables chosen in estimation. Therefore, the paper adopts a comprehensive approach by defining political and economic variables in a variety of ways using a variety of data sets and specifications. The data sets are taken from Barro (1991), Alesina *et al* (1991) and WMEAT (1991). The Barro data set selects data from a cross-section of 118 countries and provides time series averages for political and economic variables over the period 1960-85. The Alesina *et al* data set combines both cross-sectional and time-series data for 119 countries over the period 1950-82. WMEAT reports defense data for 144 countries over years 1967-90. For the purposes of the study, the paper selects a subsample of 69 countries defined to exhibit the characteristics described in the paper.[31] All of the political and economic variables but defense as a percentage of GDP come from the Alesina *et al* data set. The "defense burden" data comes from WMEAT. The Barro data set is primarily used for the preliminary analysis described in the introduction. The individual data is collected from a variety of sources including Banks (1979), Gastil (1987), IMF Government and International Financial Statistics, Summers & Heston (1991), ILO, SIPRI and UNESCO Statistical Yearbooks, and the World Bank World Tables.

The methodology to test the model is fairly straight forward. Recall from section 3 that the model puts forth three predictions relating political instability, defense and growth.

Prediction 1 *An increase in the level of "political" instability decreases the rate of growth in an economy.*

Prediction 2 *The effect of the defense burden on growth is positive, negative, or neutral depending on the magnitude of the spin-off, crowding-out and insurance effects.*

Prediction 3 *An increase in the level of "political" unrest increases the level of political instability.*

In order to test these predictions, the empirical counterparts of the growth and political instability equations [i.e. equations' (16), (9)] are estimated.[32]

[31]The countries are chosen because they are classified as non-democratic in Alesina *et al* (1991) and Jodice & Taylor (1983) over the majority of years 1967-82.

[32]It is also possible to estimate a three equation system, where the third equation relates variables

$$\gamma_{it} = \alpha_0 + \alpha_1 \frac{g_{it}}{q_{it}} + \alpha_2 X_{1it} + \sum_{j=3}^{5} \alpha_j Z_{1it} + \alpha_6 \pi_{it} + \varepsilon_{it}^1 \tag{21}$$

$$\pi_{it} = \beta_0 + \beta_1 \frac{g_{it}}{q_{it}} + \sum_{h=2}^{3} \beta_h X_{2it} + \sum_{k=4}^{6} \beta_k Z_{2it} + \beta_7 \gamma_{it} + \varepsilon_{it}^2 \tag{22}$$

where α_i, β_i are constants, X is an identifying vector of variables, Z is a vector of exogenous variables, and ε are errors whose variance-covariance matrix allow for cross-equation correlations. The subscript i denotes country and the subscript t denotes time. The specification differs from Benoit *inter alia* because it allows π_{it} to enter into the problem and differs from Alesina *inter alia* because it introduces $\frac{g_{it}}{q_{it}}$ into the problem.

The null hypotheses are as follows:

$$H_{01} : \alpha_6 \geq 0.$$

If $\alpha_6 > 0$, political instability is associated with higher not lower economic growth.

$$H_{02} : \alpha_1 = 0.$$

If $\alpha_1 = 0$, the defense burden does not directly affect economic growth.

$$H_{03} : \beta_1 \geq 0.$$

If $\beta_1 > 0$, a higher defense burden increases political instability.

$$H_{04} : \beta_h \leq 0.$$

If $\beta_h < 0$, increases in political unrest decrease political instability.[32]

The model predicts the null hypotheses H_{01}, H_{03}, H_{04} will be rejected. For simplicity, the paper specifies H_{02} as such since the effect of defense on growth cannot be arbitrarily signed.

converge using maximum likelihood estimation. Furthermore, while estimating the system using three stage least squares does yield consistent estimates of the parameters, the variance-covariance matrix is not efficient which implies low confidence for hypothesis testing. Hence, the paper analyzes the two equation system, but tests for the exogenity of $\sum_{k=0}^{p} \alpha_k \frac{g_{it-k}}{q_{it-k}}$ using Granger Causality tests. Results from the test imply that political instability and growth do not "Granger-cause" defense.

[32]The identifying vector of variables, X_{2it}, in the political instability equation is political unrest, δ. This point is made in the following subsection.

4.2 Empirical Results

This section begins by discussing the different definitions employed in the empirical estimation. Political unrest, δ, is measured both through observed discontent with the polity and through standard of living measures.[33] Unfortunately, δ is an unobservable phenomenon despite its real consequences. It is possible, though, to observe the effects caused by political unrest. For example, if a society is unhappy with its polity, one expects that the dictator may "shake-up" her government by changing its composition. Therefore, executive adjustments may serve as a proxy for political unrest. To incorporate this into the empirical model, the paper considers a variety of definitions for δ which include executive adjustments and economic growth (i.e. a proxy for reduced standard of living). In this way, δ encompasses both political and economic factors that are fundamental to political instability.

There is also ample empirical support for such a specification. Table 4 summarizes previous research which shows that economic growth and executive adjustments significantly impact political instability. Column one in Table 4 reports each of the explanatory variables used in previous research. Column's 2 & 3 report the findings of Londregan & Poole while column 4 reports the findings of Alesina *et al.* Note that none of the authors have included the defense burden in the analysis which may imply a misspecification of the empirical model. Both groups of authors find that growth significantly inhibits the probability of a coup. This is seen by examining the sign and significance of the growth coefficient in each column. In each case, the coefficient is properly signed and significant at the .01 level. Alesina *et al* also show that lagged executive adjustments are a determinant of political instability. In this case, the coefficient on lagged executive adjustments is also properly signed and significant at all conventional levels. Hence, there is both empirical and theoretical support for specifying δ as executive adjustments and reduced standard of living measures. An additional implication from this specification is that it identifies the political instability equation.

To identify the growth equation, the paper includes a measure of human capital

[33]See Londregan & Poole (1990,1991a,b) for a detailed explanation of why decreased standard of living measures increase the probability of a coup.

Table 4: **Previous Joint Estimation of Growth and Political Instability**†

Authors	L & P (1990)		L & P (1991a)		A,O,R, & S (1991)	
Dependent Variable	*Growth*	*Coups*	*Growth*	*Coups*	*Growth*	*Coups*
Growth	.	.	.	− 9.703***	.	− 45.047***
Coups	.	.	.	.	−0.006***	.
Intercept	0.067***	0.830*	0.077***	0.851*	−0.007*	− 1.530***
Recent Coups	.	0.189***	.	0.171***	.	.
Past Coups	.	0.035	.	0.055***	.	.
Africa	−0.017***	− 0.184	−0.023***	− 0.246*	−0.009	− 0.239
Europe & North America	0.012***	− 0.052	0.011***	− 0.290	.	.
Latin America	−0.006*	0.533***	−0.008***	0.376***	−0.006**	0.100
Middle East	.	.	−0.003	0.147	.	.
Lagged Income	−0.359***	− 0.006***	−0.007***	− 0.356***	.	.
Lagged Growth	−1.097	0.148***	0.159***	.	0.118	4.465
Lagged Coups	.	.	.	.	.	0.559
Lagged Executive Adj	.	.	.	.	.	0.227**
Lagged World Growth	.	.	.	.	0.418***	19.600***
Human Capital	.	.	.	.	0.009*	.

†Source: Londregan & Poole (1990,1991a) and Alesina et al (1991). The data is in an annualised panel format where regions (e.g. Africa) are dummies, Lagged World Growth is the log weighted average of per capita growth for the G-7 countries lagged one period and Human Capital is primary school enrollment. *=significant at the .1 level, **=significant at the .05 level, ***=significant at the .01 level.

in equation (21). The motivation for the specification is both theoretical and empirical. The theoretical support comes from section 2, where output is assumed to depend on human capital. The empirical support comes from previous research done by Alesina *et al* (1991) and Barro (1991) among others. These results are reported in Table 5. Column one lists the various explanatory variables included in the regressions. The columns numbered (1) to (5) refer to various specifications which restrict certain variables to be zero. Note that the *economic* variables that are important to growth across each specification include initial Gross Domestic Product (GDP60), initial human capital measures (Prim60), and government consumption (Gov). Any of these measures would seem appropriate to identify the growth equation. However, including Gov is somewhat redundant since defense is also included in the regression. Furthermore, since the emphasis of the paper is not to examine the "convergence" hypothesis, there is little theoretical support for including GDP60 in the regression. The only consistently significant explanatory variable that remains is human capital. Therefore, the paper identifies the model by including annual primary school enrollment in the growth equation.

The paper also includes regional dummies for Africa and Latin America (Dum_{Africa}, $Dum_{LatAmer}$) and lagged world growth in each equation. The inclusion of such dummy variables is supported by Lipset (1959), Londregan & Poole (1990,1991a,b) and Alesina et al (1991) who show that certain political and economic shocks are idiosyncratic to specific regions of the world. Lagged world growth is included to capture the idea of a "world business cycle". In this case, the equation for growth is

$$\gamma_{it} = \alpha_0 + \alpha_1 \frac{g_{it}}{q_{it}} + \alpha_2 \tilde{q}_{it} + \alpha_3 Dum_{Africa} + \alpha_4 Dum_{LatAmer} + \alpha_5 \gamma^{w}_{t-1} + \alpha_6 \pi_{it} + \varepsilon^1_{it}. \quad (23)$$

and the equation for political instability is

$$\pi_{it} = \beta_0 + \beta_1 \frac{g_{it}}{q_{it}} + \beta_2 \delta_{exadj} + \beta_7 \delta_{growth} + \beta_4 Dum_{Africa} + \beta_5 Dum_{LatAmer} + \beta_6 \gamma^{w}_{t-1} + \varepsilon^2_{it} \quad (24)$$

where the subscript $i = exadj, growth$ indicates which measure of δ_i is chosen.

Initially, other instruments were included in preliminary estimation of (24) but were excluded from the final estimation because the other instruments failed to improve the log likelihood of the model. For example, both recent and lagged coups were included in the regression. In each case, one fails to reject the null hypothesis

Table 5: **Cross Section Regressions on Growth**†

Dependent Variable: Average Per Capita Growth 1960-85

Explanatory Variables	(1)	(2)	(3)	(4)	(5)
Constant	0.035***	0.066***	0.062***	0.031***	0.054***
GDP60	−0.007***	−0.001***	−0.006***	−0.006***	−0.006***
Sec60	0.011	0.015*	0.014*	0.010	0.015*
Prim60	0.026***	0.031***	0.028***	0.030***	0.028***
Gov	−0.100***	−0.093***	−0.101***	−0.083***	−0.090***
PPI60DEV	−0.014***	−0.017***	−0.013***	−0.018***	−0.014**
Latin	−0.014***	−0.021***	−0.019***	−0.016***	−0.001
Africa	−0.012***	−0.024***	−0.021***	−0.011**	−0.010**
RevCoup	−0.016***	.	−0.014**	.	.
AssAss	−0.002	.	.	.	.
Instability	.	−0.112***	−0.090**	.	.
Maj Instability	.	.	.	.	−0.026**
Democracy	.	.	.	−0.001	.
Adjusted R^2	0.58	0.58	0.60	0.55	0.57

†Log per capita GDP (GDP60), 1960 secondary school enrollment rate, (Sec60), 1960 primary school enrollment rate (Prim60), 1960-85 Average of the real government consumption net of defense and education to GDP (GOV), Mean Deviation of PPP investment deflator (PPI60DEV), Dummy for Latin America (Latin), Dummy for Africa (Africa), Average number of Revolutions + Coups per million (RevCoup), Average number of assassinations (AssAss), Average probability of government change per country (Instability), Average probability of major government change per country (Maj Instability), Dummy variable for democracy, (the higher the number the less democratic), (Democracy) Source: Barro (1991), (1), and Alesina et al (1991) [(2), (3), (4), (5)].
*=significant at the .1 level, **=significant at the .05 level, ***=significant at the .01 level.

that either variable matters separately or together. The values of the likelihood ratio test statistic are insignificant at any reasonable level.[34]

4.2.1 Joint Reduced Form Estimation

As a baseline, the paper estimates the reduced form equations for political instability and growth. For a formal derivation of the econometric framework employed, see the appendix.[35] The growth and the political instability equations are estimated by joint maximum likelihood and their results are reported in Table 6. Column one in Table 6 lists the explanatory variables in the regression. The second column reports the results for the growth equation while the third column reports the results for the coup equation.

The results in Table 6 show that the African and Latin American experiences are not identical. Both African and Latin American countries experienced low growth relative to the other countries in the sample. The p-values associated with the coefficients are .002 for Africa and .012 for Latin America which imply statistically insignificance at most conventional levels. However, Latin American countries are more politically unstable as seen by the positive coefficient for the Latin American dummy in the coup equation. The coefficient for the African dummy is negative and significant in the coup equation. This implies that, on average, African countries are more stable than other non-democratic countries. These results are not terribly surprising considering they duplicate the work of Londregan & Poole and Alesina *et al.* (See Table 4.)

Next, the paper examines **Prediction 2**–the effect of defense on growth. The parameter estimate of defense as a percentage of GDP is negative and significant which is not surprising considering what was found in the preliminary analysis in Table 3. One interpretation of the result is that the crowding out effect is greater than the spin-off effect in these economies. But, before accepting such an interpretation,

[34] It should also be noted that one rejects the hypothesis that lagged executive adjustments do not matter at all conventional levels.

[35] The appendix is an abridged version of Londregan & Poole's appendix (1990). For a more formal description see Londregan & Poole (1990).

Table 6: **Joint MLE of the Reduced Form Equations**[†]

$$\gamma_{it} = \alpha_0 + \alpha_1 \frac{g_{it}}{q_{it}} + \alpha_2 \tilde{q}_{it} + \alpha_3 Dum_{LatAmer} + \alpha_4 Dum_{Africa} + \alpha_5 \gamma^w_{t-1} + \alpha_7 \delta_{exadj-1} + \alpha_8 \delta_{exadj-2} + \varepsilon^1_{it}$$

$$\pi_{it} = \beta_0 + \beta_1 \frac{g_{it}}{q_{it}} + \beta_2 \delta_{exadj-1} + \beta_3 \delta_{exadj-2} + \beta_4 Dum_{LatAmer} + \beta_5 Dum_{Africa} + \beta_6 \gamma^w_{t-1} + \beta_8 \tilde{q}_{it} + \varepsilon^2_{it}$$

Dependent Variable	γ_{it}	π_{it}
intercept	0.0150	−1.0392***
Human Capital	0.0001**	−0.0075***
$\frac{g_{it}}{q_{it}}$	−0.0013*	−0.0048
Ex Adj_{t-1}	−0.0006	0.0776***
Ex Adj_{t-2}	−0.0007	−0.0618***
$Dum_{LatAmer}$	−0.0218***	0.3535***
Dum_{Africa}	−0.0210***	−0.0781**
γ^w_{t-1}	0.4032***	0.3984
Covariance	$\hat{\rho} = -0.3018$***	
Parameters	(.0585)	
	$\hat{\sigma} = 0.0839$***	
	(.0032)	

[†]1967-82 annual growth rates (γ_{it}), number of coups (π), military spending as a percentage of GDP ($\frac{g_{it}}{q_{it}}$), primary school enrollment (Human Capital, $\tilde{q}_{it}$), executive adjustments (Ex Adj), and the log weighted average of per capita growth for the G-7 countries lagged one period (γ^w_{t-1}) for the 69 country sample. (Standard errors are in parentheses.) Source: WMBAT (1991) and Alesina et al. (1991)

*=significant at the .1 level, **=significant at the .05 level, ***=significant at the .01 level.

one must consider the simultaneity problems involved in reduced form estimation.

The paper next examines the effect of variables on political instability. Since π is a discrete variable, the political instability equation, (9), is estimated using PROBIT. To examine the effect of political unrest on political instability, the paper chooses a linear combination of executive adjustments and reduced economic growth as proxies for δ. The results support the conjectures made in the theoretical portion of the text. In each case, the coefficient of political unrest is significant and properly signed.

More importantly, the coefficient on $\frac{g_{it}}{q_{it}}$ is properly signed in the coup equation. This may lead one to conclude that the model is empirically supported. But, before accepting such an interpretation, consider the technical problems associated with estimating the model in this manner. First, there is a fundamental problem if the error terms in the two equations are correlated. In that case, the dependent variables, π_{it} and γ_{it}, cannot be treated as predetermined. Failure to account for this joint endogeneity results in biased parameter estimates. Notice, in this case, the correlation coefficient is -0.3018 with a standard error of 0.0585 implying significance at the .99 significance level. (See Table 6) Hence, more advanced techniques, such as simultaneous equations systems, must be employed. Second, there may be a technically spurious problem. Since π_{it} and $\frac{g_{it}}{q_{it}}$ are negatively correlated with each other, (9), separating their individual effects on growth cannot be done without considering a more complex system of equations.

4.2.2 Simultaneous Equations Estimation

The methodology to estimate the structural model [equations' (23) and (24)] follows Alesina *et al* (1991) and Londregan & Poole (1990, 1991a). Therefore, rather than concentrate on the technical complexities, the paper refers the reader to the appendix and the other authors for a detailed explanation. In summary, the structural parameters are extracted from the reduced form by employing GLS. Newey (1987) showed that such a procedure is asymptotically equivalent to maximum likelihood estimation but more tractable.

The model's predictions are tested using simultaneous equations methods and are reported in Table 7. Column one lists the explanatory variables in the system. Column two lists the values of the coefficients in the growth equation and column three lists the values of the coefficients in the coup equation. The results found in Table 6 generally carry through to the simultaneous equations estimation.

Prediction 1 states that increased political instability decreases the rate of growth in an economy. The null hypothesis associated with the prediction implies that, in the growth equation, the coefficient on coups should be non-negative. Table 7 shows that such a hypothesis is indeed rejected. The coefficient is negative and significant at the .01 level. Hence, **Prediction 1** holds–political instability hinders growth as was previously shown by Alesina *et al* (1991).

Prediction 2 describes the effect of defense on growth and political instability. First, examine the effect of defense on growth. Recall that the effect of defense on growth is positive, negative or neutral depending on the magnitude of the crowding out and spin-off effects. The null hypothesis I choose for simplicity implies, in the growth equation, the coefficient on defense should be zero. The null hypothesis is not rejected. Such a result confirms the paper's conjecture that the true variable anathema to growth is political instability and not defense.

Second, examine the effect of defense on political instability. The effect of defense on political instability should be negative given Table 3 and the theory. The null hypothesis implies the coefficient of defense in the coup equation should be positive. The data rejects the hypothesis. The coefficient of defense in the growth equation is not only negative but is associated with a p-value of .0005. Hence, there is empirical evidence to support **Predictions' 1** and **2**.

Prediction 3 states that political unrest decreases the rate of growth in an economy. The prediction means that decreased growth and increased executive adjustments should both increase the probability of a coup. The null hypothesis associated with the conjecture implies that, in the coup equation, the coefficient on growth should be nonnegative and the coefficient on executive adjustments should be non-positive. Table 7 provides results to reject the null in favor of the paper's predictions. However, in the case of lagged executive adjustments, the coefficient is not terribly significant. The t statistic associated with one period lagged executive adjustments

Table 7: **Simultaneous Equations Estimation**†

$$\gamma_{it} = \alpha_0 + \alpha_1 \frac{g_{it}}{q_{it}} + \alpha_2 \tilde{q}_{it} + \alpha_3 Dum_{LatAmer} + \alpha_4 Dum_{Africa} + \alpha_5 \gamma^w_{t-1} + \alpha_6 \pi_{it} + \varepsilon^1_{it}$$

$$\pi_{it} = \beta_0 + \beta_1 \frac{g_{it}}{q_{it}} + \beta_2 \delta_{exadj-1} + \beta_3 \delta_{exadj-2} + \beta_4 Dum_{LatAmer} + \beta_5 Dum_{Africa} + \beta_6 \gamma^w_{t-1} + \beta_7 \gamma_{it} + \varepsilon^2_{it}$$

Dependent Variable	γ_{it}	π_{it}
intercept	0.0072	−0.4173
	(0.0085)	(0.2784)
Human Capital	0.0001	.
	(0.0001)	.
$\frac{g_{it}}{q_{it}}$	−0.0013	−0.0595***
	(0.0011)	(0.0173)
$Dum_{LatAmer}$	−0.0189	−0.5652
	(0.2743)	(7.3098)
Dum_{Africa}	−0.0216***	−0.9451***
	(0.0065)	(0.2893)
Ex Adj_{t-1}	.	0.0522
	.	(0.0437)
Ex Adj_{t-2}	.	−0.0991
	.	(1.7707)
γ^w_{t-1}	0.4062***	17.0005***
	(0.1267)	(5.3880)
π_{it}	−0.0075***	.
	(0.0007)	.
γ_{it}	.	−41.1887***
	.	(10.5606)
χ^2 test of one over-identifying restriction	$\chi^2 = 0.611$ $p = 0.435$	

†1967-82 annual growth rates (γ_{it}), number of coups (π_{it}), military spending as a percentage of GDP ($\frac{g_{it}}{q_{it}}$), primary school enrollment (Human Capital, $\tilde{q}_{it}$), executive adjustments (Ex Adj) and the log weighted average of per capita growth for the G-7 countries lagged one period (γ^w_{t-1}) for the 69 country sample. (Standard Errors are in Parentheses). Source: WMEAT (1991) and Alesina et al (1991). *=significant at the .1 level, **=significant at the .05 level, ***=significant at the .01 level.

is 1.193.

In addition, the paper does not reject the model at better than a .4 significance level, using the χ^2 test of one over-identifying restriction. While, one would be more comfortable with a higher p value, such a value is not too shabby given what has been previously reported. Furthermore, to underscore the importance of defense in the analysis, the paper excluded defense altogether and found the p value plummets to .009.

In summary, **Predictions 1, 2** and **3** are empirically supported by the data. Defense provides insurance against political instability and political instability inhibits growth. The crowding out effect is found to be greater than the spin-off effect, but not significantly so. Therefore, the overall effect of defense on growth is positive and the effect the political instability on growth is negative.

4.2.3 Sensitivity Analysis

Following Levine and Renelt (1992), the paper studies how sensitive the results are to alternative sample periods and the inclusion of other explanatory variables. Specifically, the paper reexamines the coefficient estimates under the assumption that economic and political decisions in non-democratic countries depend on different information. If the significance or sign of the relevant coefficients in section 4.2.2 are sensitive to the information set, one would consider such results "fragile." The task of this section is to see if the results in section 4.2.2 are fragile.

To incorporate this into the framework, the paper tests for sensitivity in three different ways. First, the paper reconsiders the basic model with a different set of explanatory variables. Second, the paper examines the model over different time periods. Third, the paper examines the model excluding certain countries that might bias the results.

In the first case, the paper includes all lagged coups instead of executive adjustments as additional explanatory variables in the coup equation. The new system is

$$\gamma_{it} = \alpha_0 + \alpha_1 \frac{g_{it}}{q_{it}} + \alpha_2 \tilde{q}_{it} + \alpha_3 Dum_{LatAmer} + \alpha_4 Dum_{Africa} + \alpha_5 \gamma^w_{t-1} + \alpha_6 \pi_{it} + \varepsilon^1_{it}$$

$$\pi_{it} = \beta_0 + \beta_1 \frac{g_{it}}{q_{it}} + \beta_2 \delta_{coup-1} + \beta_3 \delta_{coup-2} + \beta_4 Dum_{LatAmer} + \beta_5 Dum_{Africa} + \beta_6 \gamma^w_{t-1} + \beta_7 \gamma_{it} + \varepsilon^2_{it}$$

The sensitivity analysis works in the following way: the system of equations are reestimated. Then, the relevant coefficients, (e.g. α_6, β_1) are examined. If the coefficients remain the same sign and significant, then the results in the previous section are robust.

The results from estimating the alternative model are reported in Table A.2 in the appendix and support the earlier conjectures. Replacing executive adjustments with coups does not harm the sign or significance of the relevant variables. Political instability in the growth equation is still significant at all conventional levels and defense is still significant in the coup equation at the .05 level. Hence, **Prediction's 1, 2** and **3** are robust to this alternative specification. However, the fit of the model does appear to be a bit worse as the p value for over identifying restriction falls to .004.

In the second case, one finds similar results to support the model. Table A.3 reports the results over different time samples. Column one reports the results from 1970-82, while column two reports results from 1972-82.[36] In each case, high political instability is significantly associated with low growth and low growth with high political instability. In addition, defense significantly decreases the probability of a coup but has no significant effect on growth.

In the third case, the paper excludes countries who actively engaged in external conflicts over the sample period. The rationale is as follows: the predictions in the paper are predicated on the assumption that defense exists primarily as a deterrent to internal rather than external aggression. However, it is possible that the level of defense could be more closely associated with wars rather than coups. In response to the criticism, the paper excludes all countries in the sample that were directly

[36]The model was estimated over a broader range of samples with the general results remaining unchanged. For simplicity, only these two samples are reported.

involved in an external conflict during the sample period. The results are reported in Table A.4 in the appendix. As in the other cases, the general results are not sensitive to this specification. However, in this case, defense is ***significantly*** negative in the growth equation. Hence, the MPD seems to be negative when controlling for external aggression.

4.2.4 Summary of Empirical Findings

The empirical results confirm the conjectures made in the model. Increases in political instability are found to decrease growth and increases in defense are found to decrease political instability. Any positive "spin-off" effect from defense spending is largely offset by the crowding out effect, leaving a weak direct relation between growth and defense. These results are robust to alternative specifications and information sets.

5 Conclusions

When a dictator uses defense as insurance against the probability of being overthrown, the economy does not operate pareto efficiently. Both consumption and investment decisions are made inefficiently because the uncertainty associated with the probability of death causes the economy to move away from the growth-adjusted modified golden rule levels of consumption and capital stock.

In addition, it is shown that political instability also effects growth. Higher levels of political instability mean lower growth rates for an economy. If a dictator insures herself against political instability by increasing the defense burden, some of this effect is mitigated.

The empirical evidence also supports the hypotheses that political instability reduces growth and defense is used as an insurance against political instability. These findings are robust to alternative empirical specifications. Such results imply previous research which failed to incorporate both political instability and defense may have left an important issue unresolved.

Appendix A

Appendix A.1 Notational Definitions

Uppercase letters = actual values; Lowercase letters = per capita values

A, A^* = measurement of technologies

G, g = defense

$E(.)$ = mathematical expectations operator

$\hat{F}(.), F(.), f(.)$ = private production function

f_z=marginal density function of the time until death

K, k = physical capital stock

N = labor force

Q, q = private output

$\tilde{Q}, \tilde{q}$ = human capital stock

r = "risk-free" interest rate

$u(.), v(.), w(.)$ = instantaneous "felicity" functions

$U(.)$ = social welfare function

x = rents

Z, z = time until death

α = share of defense in output

$(1-\alpha)$ = share of physical capital in output

β = effectiveness of defense as insurance against the probability of death.

δ= level of political unrest

γ_i = rate of growth of variable "i"

λ=co-state variable

θ = subjective rate of time preference

π = probability of being overthrown or "death"

ϕ = embodiment of defense in human capital

ρ = selfishness of dictator

σ = intertemporal elasticity of substitution/relative risk aversion parameter

τ = marginal tax rate

Appendix A.2 Solving the Optimization Problem

Consider the following optimization problem described in section 3.

$$\max_{\{c_t, k_t, x_t, \tau\}} E_0 \int_0^\infty v(c_t, x_t) e^{-(\pi+\theta)} dt$$

s.t.

$$k_o \text{ given}$$

$$\dot{k_t} = A^* k_t - c_t - x_t$$

The Hamiltonian is given by

$$H = [(1-\rho)u(c_t) + \rho w(x_t) + \lambda_t(A^* k_t - c_t - x_t)] e^{-(\pi+\theta)}.$$

The following first order conditions are due to Pontryagin's maximum principle:

$$H_c = 0; (1-\rho)c_t^{-\sigma} = v_c = \lambda_t \tag{A.1}$$

$$H_x = 0; \rho w'(x_t) = \lambda_t \tag{A.2}$$

$$\frac{d\lambda_t}{dt} = -H_k; \frac{\dot{\lambda}_t}{\lambda_t} = \theta + \pi - A^*. \tag{A.3}$$

$$H_\tau = 0; A_\tau^* = \pi_\tau \left(\frac{v(c_t, x_t)}{\lambda_t k_t} + \frac{\dot{k}_t}{k_t}\right) \tag{A.4}$$

where $A_\tau^* = \phi^\alpha A^{\frac{1}{1-\alpha}} \tau^{\frac{\alpha}{1-\alpha}} [\frac{\alpha(1-\tau)}{\tau(1-\alpha)} - 1]$ and $\pi_\tau = -\beta$.

Substituting the definition for societal and the dictator's consumption and (A.1) into (A.4) yields

$$A_\tau^* = \frac{\pi_\tau}{k_t(1-\sigma)} [\frac{c_t^{1-\sigma}}{c_t^{-\sigma}} + \frac{x_t^{1-\sigma}}{x_t^{-\sigma}} + \dot{k}_t (1-\sigma)]$$

or

$$A_\tau^* = \pi_\tau\left(\frac{c_t + x_t + \dot{k}_t}{k_t(1-\sigma)} - \gamma\left(\frac{\sigma}{1-\sigma}\right)\right)$$

Using the resource constraint and the definition for growth implies

$$A_\tau^* = \omega\pi_\tau$$

where $\omega = \frac{\theta+\pi}{1-\sigma}$.

Logarithmic differentiation of (A.1) and substitution of (A.3) yield

$$\frac{\dot{c}_t}{c_t} = \gamma_c = \frac{A^* - (\theta+\pi)}{\sigma}.$$

Appendix A.3 Proof of Existence

In order for a solution to exist in section 3, the objective function must be bounded, given the continuity of U on a closed technology. To prove this, take the limits of U_0 as $t \to \infty$ and show that the function goes to zero. Therefore, the limits of the term in the integral must satisfy[37]

$$\lim_{t\to\infty}(1-\rho)\left(\frac{c^{1-\sigma}}{1-\sigma}\right) + \rho w(x_t))e^{-(\pi+\theta)t} = 0.$$

By definition, $c_t = c_o e^{\gamma t}$. Substitute this above. Therefore,

$$\lim_{t\to\infty}(1-\rho)\left(\frac{c_o e^{\gamma(1-\sigma)-(\pi+\theta)t}}{1-\sigma}\right) + \rho w(x_t)e^{-(\pi+\theta)t} = 0.$$

Hence, if $\theta + \pi > \gamma(1-\sigma)$ or rewritten $\theta + \pi > A^*(1-\sigma)$ in the limit, then U_0 is bounded. ∎

[37] For simplicity, let $w(.)$ also be of the CIES variety, then an analogous argument can be made for $w(.)$

Appendix A.4 Estimation of the Model

This section is an abridged discussion of Londregan & Poole (1990). For a more detailed description see Londregan & Poole (1990). Consider the system of equations described in section 4. Define the vector of dependent variables as Y_{it}; the vector of variables that enter either equation as X_{it}; the I by 2 vector of errors by $\bar{\varepsilon}_{it}$; and the vector of coefficients, as $\bar{\beta}_{it}$.

Using the notation in section 4.1, let $E(\bar{\varepsilon}\bar{\varepsilon}') = \Omega$ and define the vector functions $\Gamma(\bar{\beta}_{it})$ and $\Lambda(\bar{\beta}_{it})$ as

$$\Gamma(\bar{\beta}) = \begin{bmatrix} I & -\alpha_6 \\ -\beta_7 & I \end{bmatrix} \tag{A.5}$$

$$\Lambda(\bar{\beta})' = \begin{bmatrix} \alpha_0, \alpha_1, \alpha_2, \alpha_j \\ \beta_0, \beta_1, \beta_h, \beta_k \end{bmatrix} \tag{A.6}$$

Therefore, the system of equations is rewritten as:

$$Y_{it}\Gamma(\bar{\beta}_{it}) = X_{it}\Lambda(\bar{\beta}_{it}) + \bar{\varepsilon}_{it}. \tag{A.7}$$

The reduced form of $(A.7)$ is

$$Y_{it} = X_{it}\Pi(\bar{\beta}_{it}) + \bar{\epsilon}_{it} \tag{A.8}$$

where $\Pi(\bar{\beta}_{it}) = \Lambda(\bar{\beta}_{it})[\Gamma(\bar{\beta}_{it})]^{-1}$ is the matrix of reduced form parameters and $\bar{\epsilon}_{it}$ is the vector of disturbances which satisfies $\bar{\epsilon}_{it} = \bar{\varepsilon}_{it}[\Gamma(\bar{\beta}_{it})]^{-1}$.

Denote the variance-covariance matrix of the reduced form parameters as

$$\Sigma = [\Lambda(\bar{\beta}_{it})^{-1}]'\Omega[\Lambda(\bar{\beta}_{it})^{-1}] \tag{A.9}$$

For notational convenience, let ω_{ij} and σ_{ij} denote the $(i,j)^{th}$ elements of Ω and Σ. This implies

$$\omega_{22} = I - 2\beta_7\alpha_6 + \beta_7^2\alpha_6^2 - 2\alpha_6\omega_{I2} - \alpha_6^2\omega_{II}$$

and

$$\Sigma = \begin{bmatrix} \sigma^2 & \rho\sigma \\ \rho\sigma & I \end{bmatrix} \tag{A.10}$$

where ρ is the correlation between the disturbances and σ^2 is the variance of the error in the first equation.

Assume each $(\bar{\epsilon}_{it})$ is normally distributed. Therefore, the disturbances are distributed as a bivariate normal with joint density[38]

$$f(\bar{\epsilon}) = \frac{I}{2\pi\sigma(1-\rho^2)^{\frac{1}{2}}} e^{-\frac{1}{2}(\bar{\epsilon})'\Sigma^{-1}(\bar{\epsilon})}. \tag{A.11}$$

or

$$f(\bar{\epsilon}) = \frac{I}{2\pi\sigma(I-\rho^2)^{\frac{1}{2}}} e^{-\frac{1}{2(1-\rho^2)\sigma^2}(\bar{\epsilon}_I^2 - 2\rho\sigma\bar{\epsilon}_I\bar{\epsilon}_2 + \sigma^2\bar{\epsilon}_2^2)}. \tag{A.12}$$

The equation is further simplified by completing the square,

$$f(\bar{\epsilon}) = \frac{I}{2\pi\sigma(I-\rho^2)^{\frac{1}{2}}} e^{-\frac{1}{2(1-\rho^2)\sigma^2}(\bar{\epsilon}_I^2(I-\rho^2) + (\sigma\bar{\epsilon}_2 - \rho\bar{\epsilon}_I)^2)}. \tag{A.13}$$

By appealing to conditional normal theory, the above equation is factored into two multiplicative arguments, each conditional on the parameters of the other. Hence, $f(\bar{\epsilon})$ is

$$f(\bar{\epsilon}) = \hat{f}(\bar{\epsilon}_I|\sigma)\hat{f}(\bar{\epsilon}_2 - \frac{\rho\bar{\epsilon}_I}{\sigma}|(I-\rho^2)^{\frac{I}{2}}). \tag{A.14}$$

Considering that the product of densities across states makes up the likelihood function, the corresponding log-likelihood function is

$$lnL = \pi^* ln(\int_{-\infty}^{X\Pi_2(\bar{\beta})} \hat{f}(\bar{\epsilon}_2 - \frac{\rho}{\sigma}(\bar{\epsilon}_I|(I-\rho^2)^{\frac{I}{2}})d\bar{\epsilon} + (1-\pi^*)ln(\int_{X\Pi_2(\bar{\beta})}^{\infty} \hat{f}(\bar{\epsilon}_2 - \frac{\rho}{\sigma}(\bar{\epsilon}_I|(I-\rho^2)^{\frac{I}{2}})d\bar{\epsilon} + ln\hat{f}(\bar{\epsilon}_I|\sigma)$$

where π^* is a function that assumes a value of "I" if π is positive, and equals zero otherwise.

Substitute the reduced form equation for $\bar{\epsilon}_I$ and change the appropriate variables to yield

$$lnL = \pi^* ln\Phi(\frac{X\Pi_2(\bar{\beta}) - \frac{\rho}{\sigma}\bar{\epsilon}_I}{(I-\rho^2)^{\frac{I}{2}}}) + (1-\pi^*)ln[I - \Phi(\frac{X\Pi_2(\bar{\beta}) - \frac{\rho}{\sigma}\bar{\epsilon}_I}{(I-\rho^2)^{\frac{I}{2}}})] + ln\hat{f}(\bar{\epsilon}_I|\sigma)$$

[38]For simplicity, suppress the time subscripts from the immediate discussion.

where Φ is the cumulative density function corresponding to the marginal density functions.

Having defined the likelihood function, the paper could proceed using maximum likelihood estimation. However, due to the inherent non-linearities in the problem, it is more practical to employ Amemiya's generalized least squares (GLS). Direct application of GLS is possible because GLS is asymptotically equivalent to Full Information Maximum Likelihood (FIML) estimation. See Newey (1987).

Therefore, proceed as follows:

- **Step One:**

Estimate the first reduced form equation using OLS, where the estimator is given by:

$$\hat{\Pi}(\bar{\beta})_{OLS} = (X_1'X_1)^{-1}X_1'Y_1.$$

Next, collect the residual, $\hat{\epsilon}$ from the estimation and estimate a probit model with $\hat{\epsilon}$ and X as independent variables and ψ as the dependent variable where

$$\psi = I$$

if there is a probability of being overthrown and

$$\psi = 0$$

if not.

The argument of the cdf is taken from the earlier

$$\frac{X\Pi_2(\bar{\beta}) - \frac{\rho\bar{\epsilon}_I}{\sigma}}{(I-\rho^2)^{\frac{I}{2}}}.$$

- **Step Two:**

Once **Step One** is completed, one has the maximum likelihood estimates of the reduced form parameters, $\hat{\Pi}, \hat{\sigma}$ and $\hat{\rho}$. To recover the structural parameters from $\hat{\Pi}$, the paper could employ minimum χ^2 estimation. (See Rothemberg (1973).) However, for simplicity, the paper chooses to use GLS.

To accomplish this, denote a matrix of zeros corresponding to the number of independent variables by $\hat{O}$. Then, consider the following equations:

$$S_1 = \left[\frac{\hat{\Pi}_2'}{\hat{O}'} \right] \tag{A.15}$$

and

$$S_2 = \left[\frac{\hat{O}}{\hat{\Pi}_I'} \right]. \tag{A.16}$$

Define the identity matrix as $I[a:b]$, where a, b denote the relevant columns, and let

$$H_{i,j} = I[a:b]$$

for $i = 1, 2$ equations and $j = 1, ..., K$ independent variables.

Once the preceding is accomplished, use OLS to estimate the following equation:

$$vec(\hat{\Pi}) = g_I\alpha_6 + g_2\beta_7 + \sum_i^2 \sum_j^{K-2} H_{i,j}\bar{\beta}^*$$

where $vec(\hat{\Pi})$ is the column vector consisting of the columns of $\hat{\Pi}$ stacked one atop the other, beginning with the first column on top, ending with the last column at the bottom. This means that $\bar{\beta}^*$ is the matrix of structural parameters minus α_6 and β_7.

Next, estimate the variance-covariance matrix of $vec(\hat{\Pi})$, Δ_π, using the bootstrap technique pioneered by Efron (1979).

Then, using the OLS estimates, $\hat{\alpha}_6$ and $\hat{\beta}_7$, redefine the matrix Γ as $\hat{\Gamma}$. Now, estimates of the following variance-covariance matrix of the entire model are the true values.

$$\Sigma_\pi = (I_k \otimes \hat{\Gamma})\Delta_\pi(I_k \otimes \hat{\Gamma})'$$

From Newey (1987), it is shown that the estimate of $\bar{\beta}$ is fully efficient, and the standard errors from the GLS estimator are the true standard errors.

One further advantage to estimating the model in this manner is that the predicted value of $vec(\hat{\Pi})$ given by $E[vec(\hat{\Pi})]$ is easily manipulated to test model specification. If there are m overidentifying restrictions,

$$(E[vec(\hat{\Pi})] - vec(\hat{\Pi}))'\Delta_{\pi}(E[vec(\hat{\Pi})] - vec(\hat{\Pi}))$$

is asymptotically χ^2 distributed with m degrees of freedom. Hence, the specification of the model is tested by comparing the tested value to the actual value.

Appendix A.5 Additional Tables and Figures

Table A.1: **Political & Economic Factors by Defense Burden Quintile**†

Quintile	*Coups*	*Growth*
Lowest	.128	.0220
	(.107)	(.0240)
Second Lowest	.150	.0178
	(.098)	(.0193)
Middle	.105	.0005
	(.071)	(.0085)
Second Highest	.108	.0139
	(.058)	(.0202)
Highest	.064	.0207
	(.046)	(.0139)

†1960-85 Average Defense Burden, Per Capita Growth (Growth), and Coups (Coups) Per Million of non-democratic states with at least one coup. Source: Barro (1991) and author's calculations. Lowest is defined as less than 1.4%; Second Lowest is between 1.41% and 1.98%; Middle is between 1.99% and 2.5%; Second highest is between 2.51% and 3.58%; and Highest is at least 3.59%. Standard Errors are in parenthesis.

Table A.1 shows that for non-democratic countries the relationship between defense, coups and growth is non-linear. Column one in Table A.1 divides the sample of countries into five quintiles-lowest to highest. The second and third columns report the average incidence of coups and the rate of growth for the countries in each quintile. Table A.1 shows that the incidence of coups rises at the lower tail of the defense burden distribution but falls after the second quintile. It also shows that growth rates fall at the lower end of the distribution but rise after the third quintile.

Table A.2: **Simultaneous Equations Estimation for Alternative Model**†

$$\gamma_{it} = \alpha_0 + \alpha_1 \frac{g_{it}}{q_{it}} + \alpha_2 \tilde{q}_{it} + \alpha_3 Dum_{LatAmer} + \alpha_4 Dum_{Africa} + \alpha_5 \gamma^w_{t-1} + \alpha_6 \pi_{it} + \varepsilon^1_{it}$$

$$\pi_{it} = \beta_0 + \beta_1 \frac{g_{it}}{q_{it}} + \beta_2 \delta_{exadj-1} + \beta_3 \delta_{exadj-2} + \beta_4 Dum_{LatAmer} + \beta_5 Dum_{Africa} + \beta_6 \gamma^w_{t-1} + \beta_7 \gamma_{it} + \varepsilon^2_{it}$$

Dependent Variable	γ_{it}	π_{it}
intercept	0.0005	−0.6797*
Human Capital	0.0001	.
$\frac{g_{it}}{q_{it}}$	−0.0014	−0.0553**
$Dum_{LatAmer}$	−0.0183	−0.4629
Dum_{Africa}	−0.0212***	−0.8307**
π_{it-1}	.	0.3514*
π_{it-2}	.	0.8491
γ^w_{t-1}	0.4050***	14.4656***
π_{it}	−0.010***	.
γ_{it}	.	−35.1296**
χ^2 test of one over-identifying restriction	$\chi^2 = 4.089$, $p = 0.043$	

†1967-82 annual growth rates (γ_{it}), number of coups (π_{it}), average military spending as a percentage of GDP ($\frac{g_{it}}{q_{it}}$), primary school enrollment (Human Capital, $\tilde{q}_{it}$), executive adjustments (Ex Adj) and the log weighted average of per capita growth for the G-7 countries lagged one period (γ^w_{t-1}) for the 69 country sample. (Standard Errors are in Parentheses). Source: WMEAT (1991) and Alesina et al (1991).

*=significant at the .1 level, **=significant at the .05 level, ***=significant at the .01 level.

Table A.3: **Simultaneous Equations Estimation for Varying Sample Periods**†

$$\gamma_{it} = \alpha_0 + \alpha_1 \frac{g_{it}}{q_{it}} + \alpha_2 \tilde{q}_{it} + \alpha_3 Dum_{LatAmer} + \alpha_4 Dum_{Africa} + \alpha_5 \gamma^w_{t-1} + \alpha_6 \pi_{it} + \varepsilon^1_{it}$$

$$\pi_{it} = \beta_0 + \beta_1 \frac{g_{it}}{q_{it}} + \beta_2 \delta_{exadj-1} + \beta_3 \delta_{exadj-2} + \beta_4 Dum_{LatAmer} + \beta_5 Dum_{Africa} + \beta_6 \gamma^w_{t-1} + \beta_7 \gamma_{it} + \varepsilon^2_{it}$$

	Sample Period 1970-82		Sample Period 1972-82	
Dependent Variable	γ_{it}	π_{it}	γ_{it}	π_{it}
intercept	0.0056	− 0.5230***	0.0101	− 0.7689***
Human Capital	0.0001**	.	0.0001**	.
$\frac{g_{it}}{q_{it}}$	−0.0015	− 0.0595**	−0.0016	− 0.0676***
$Dum_{LatAmer}$	−0.0178	− 0.7000	−0.0110	− 0.2016
Dum_{Africa}	−0.0217***	− 0.8005***	−0.0197***	− 0.6064***
Ex Adj_{t-1}	.	0.0462	.	0.0875**
Ex Adj_{t-2}	.	− 0.0988	.	− 0.0720
γ^w_{t-1}	0.4489***	14.5533**	0.4091***	13.9420**
π_{it}	−0.0092***	.	−0.0046***	.
γ_{it}	.	− 37.6607***	.	− 40.8555***
χ^2 test of one over-identifying restriction	$\chi^2 = 2.003$, $p = 0.157$		$\chi^2 = 1.10$, $p = 0.294$	

†Annual growth rates (γ_{it}), number of coups (π_{it}), average military spending as a percentage of GDP ($\frac{g_{it}}{q_{it}}$), primary school enrollment (Human Capital, $\tilde{q}_{it}$), executive adjustments (Ex Adj), and the log weighted average of per capita growth for the G-7 countries lagged one period (γ^w_{t-1}) for the 69 country sample. Source: WMEAT (1991) and Alesina et al (1991).
*=significant at the .1 level, **=significant at the .05 level, ***=significant at the .01 level.

Table A.4: **Simultaneous Equations Estimation Excluding War Data**†

$$\gamma_{it} = \alpha_0 + \alpha_1 \frac{g_{it}}{q_{it}} + \alpha_2 \tilde{q}_{it} + \alpha_3 Dum_{LatAmer} + \alpha_4 Dum_{Africa} + \alpha_5 \gamma^w_{t-1} + \alpha_6 \pi_{it} + \varepsilon^1_{it}$$

$$\pi_{it} = \beta_0 + \beta_1 \frac{g_{it}}{q_{it}} + \beta_2 \delta_{exadj-1} + \beta_3 \delta_{exadj-2} + \beta_4 Dum_{LatAmer} + \beta_5 Dum_{Africa} + \beta_6 \gamma^w_{t-1} + \beta_7 \gamma_{it} + \varepsilon^2_{it}$$

Dependent Variable	γ_{it}	π_{it}
intercept	0.0018	-0.7839^{***}
Human Capital	0.0001	.
$\frac{g_{it}}{q_{it}}$	-0.5005^{**}	-0.1459^{*}
$Dum_{LatAmer}$	-0.0149	-0.2889
Dum_{Africa}	-0.0142^{**}	-0.5532^{***}
Ex Adj_{t-1}	.	0.1090^{*}
Ex Adj_{t-2}	.	0.0338
γ^w_{t-1}	0.4459^{***}	15.2225
π_{it}	-0.0081^{***}	.
γ_{it}	.	-32.1757^{*}
χ^2 test of one over-identifying restriction	$\chi^2 = 3.287$, $p = 0.069$	

†1967-82 annual growth rates (γ_{it}), number of coups (π_{it}), average military spending as a percentage of GDP ($\frac{g_{it}}{q_{it}}$), primary school enrollment (Human Capital, $\tilde{q}_{it}$), executive adjustments (Ex Adj) and the log weighted average of per capita growth for the G-7 countries lagged one period (γ^w_{t-1}) for the 69 country sample. (Standard Errors are in Parentheses). Source: WMEAT (1991) and Alesina et al (1991).

*=significant at the .1 level, **=significant at the .05 level, ***=significant at the .01 level.

Table A.5: **Listing of Non-Democratic Countries**

Country	*Country*	*Country*
Algeria	Haiti	Nicaragua
Angola	Honduras	Niger
Argentina	Hong Kong	Nigeria
Bangladesh	Indonesia	Pakistan
Somolia	Iran	Panama
Benin	Iraq	Paraguay
Bolivia	Ivory Coast	Peru
Brazil	Jordan	Philippines
Burma	Kenya	Saudi Arabia
Burundi	Korea, South	Swaziland
CAR	Lesotho	Syria
Chad	Liberia	Taiwan
Congo, Peop. Rep.	Madagascar	Tanzania
Ecuador	Malawi	Thailand
Egypt, Arab Rep.	Sudan	Togo
El Salvador	Mauritania	Tunisia
Ethiopia	Mauritius	Uganda
Gabon	Morocco	Papua New Guinea
Gambia	Kuwait	Suriname
Ghana	Sierra Leone	Rwanda
Guinea	Mozambique	Zaire
Guatemala	Nepal	Zambia
Senegal	Sri Lanka	Zimbabwe

Table A.6: **Listing of Democratic Countries**

Country	*Country*
Australia	Ireland
Austria	Israel
Barbados	Italy
Belgium	Jamaica
Botswana	Japan
Canada	Luxembourg
Columbia	Mexico
Costa Rica	Netherlands
Cyprus	New Zealand
Denmark	Norway
Fiji	Singapore
Finland	Sweden
France	Switzerland
Gambia	Trinidad & Tobago
Germany, Fed. Rep	United Kingdom
Greece	United States
Iceland	Venezuela
India	

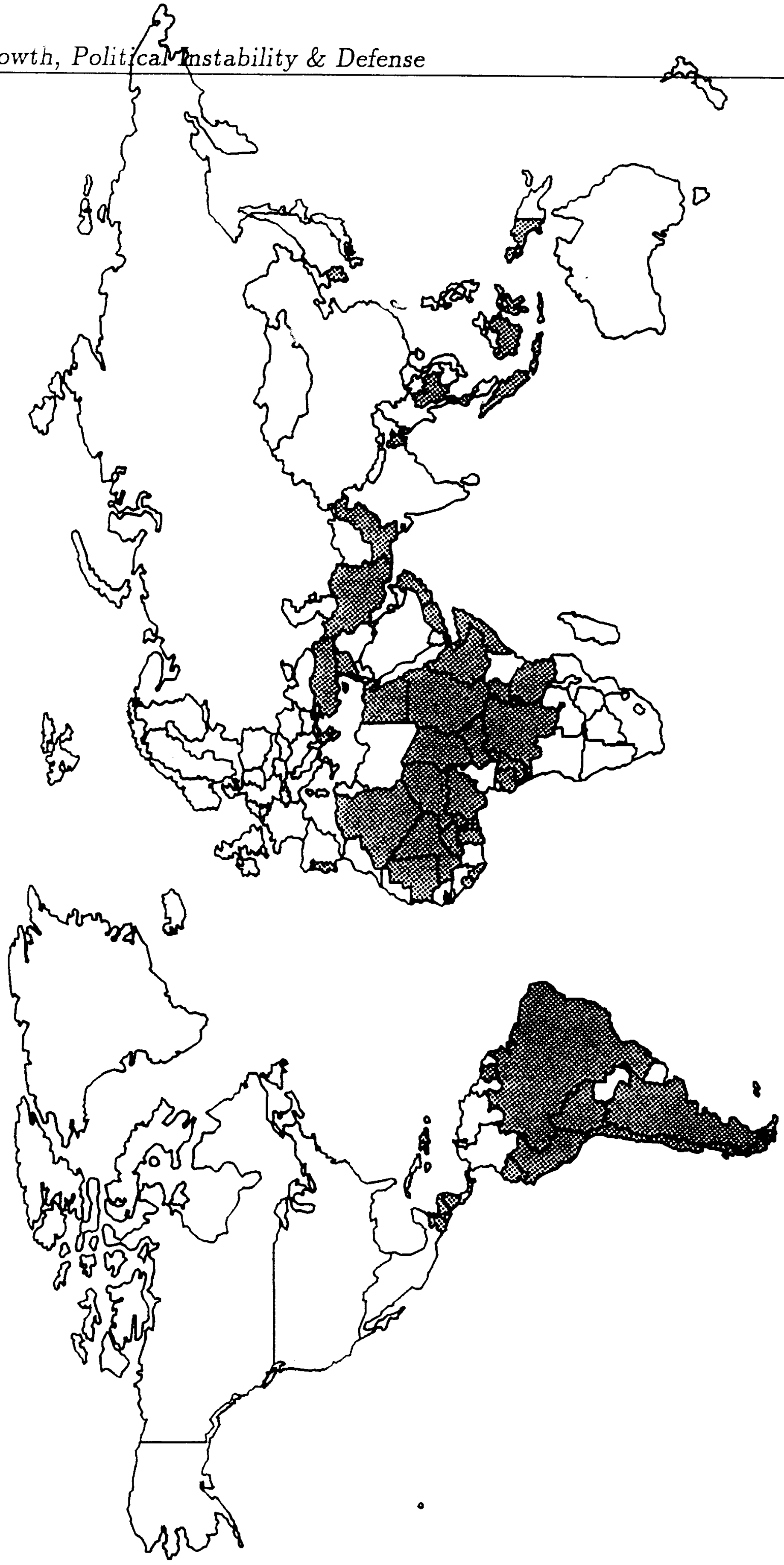
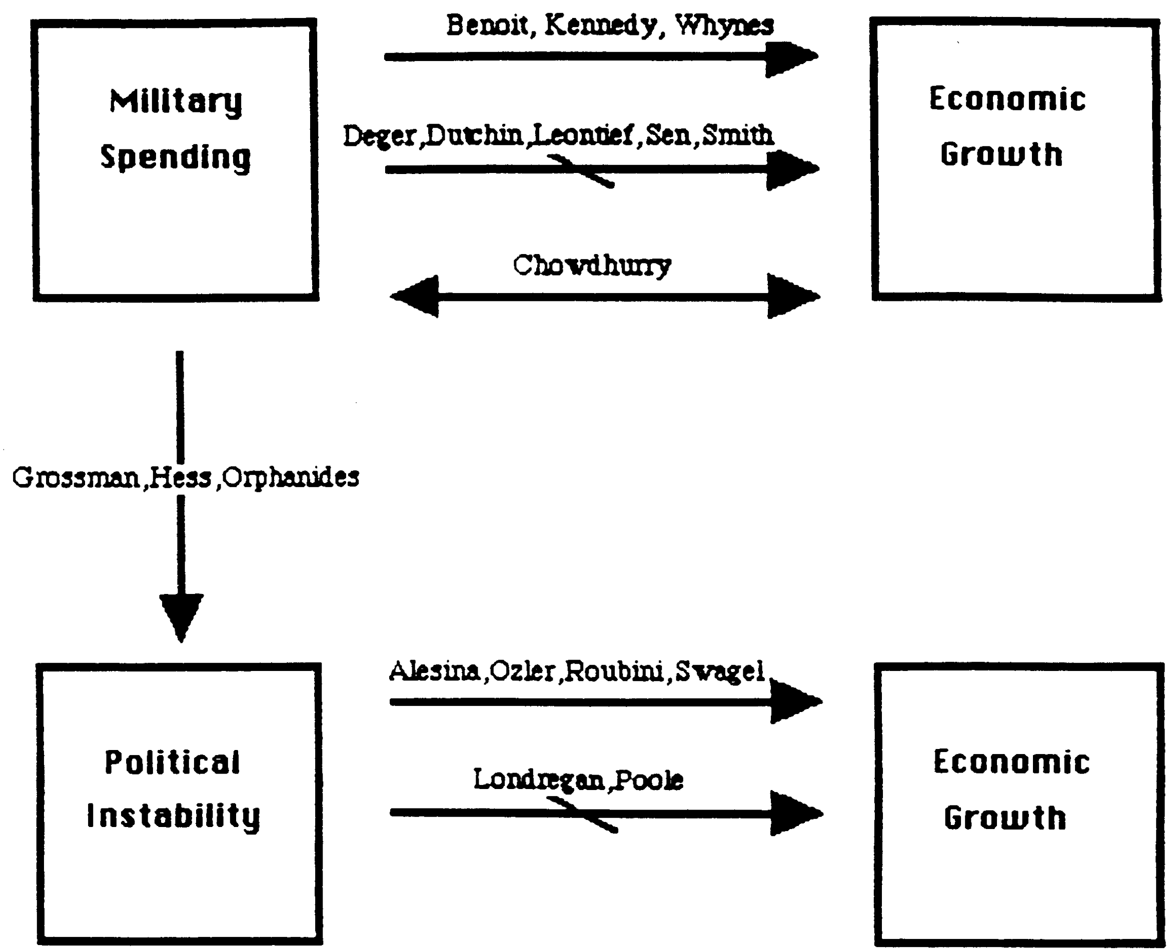


Figure A.1

Countries with at least one coup d'etat from 1960–85.

Source: Barro (1991).

Figure A.2: **Schematic Diagram of the Literature**



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