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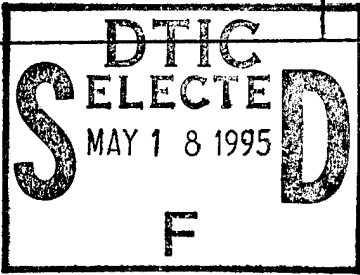(229 words)

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Strengthening Economic Performance & Competitiveness in an LDC: The Effects of Military Expenditure in Ecuador.

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Abstract

The development of a qualitative framework is combined with statistical results from the construction of quantitative models to provide a robust, integrative approach to describing the relationship between military expenditure (ME) and economic performance in Ecuador. Quantitative models use time-series data to empirically measure direct and indirect effects. ME provides a direct Keynesian stimulus to increase output, but also indirectly *crowds out* private investment, limiting long-term growth opportunities. A three-stage least square regression is required to satisfactorily model the complex system of simultaneous equations that incorporates GDP growth, private investment, and the military expenditure burden. A multiplier is derived to quantify the net effect of ME on GDP growth. For the case of Ecuador, every 1% increase in ME leads to a 1.484% decline in economic growth. Other models are proposed to measure the effects of ME on the current account, industrial output, market security, and unemployment. These models suggest ME has a negative effect on the current account, provides some impetus for increased production for certain industries, and has a stabilizing effect on market security. The effect of ME on unemployment cannot be determined with any statistical significance. Recommendations are made to modify the Ecuadorian military budget (i.e., to shift allotments away from capital purchases) to help maximize long-term economic gains. Suggestions as to how to achieve these changes given the realities of Ecuadorian politics are also provided.

Executive Summary

The goal of this Policy Analysis Exercise is to not to produce a prescription for an ideal Ecuadorian development strategy, but rather to provide Ecuadorian policy-makers essential insights needed to produce more robust, long-term economic performance when considering military expenditures (ME). Combining statistical results from quantitative models with the development of a qualitative framework to analyze the net effects of ME allows for a more powerful, integrative approach than would otherwise be the case.

Long-term opportunity costs of military spending outweigh short-term benefits. In other words, ME has a net negative effect on the rate of real economic growth. ME immediately increases output, employment, and production through a number of mechanisms:

♦ Keynesian demand creation.
♦ Civilian use of military infrastructure.
♦ Productivity-enhancing byproducts of military training.
♦ Military production of close substitutes for civilian goods, allowing a higher share of civilian output be devoted to investment.
♦ Suppression of social unrest to maintain short-term market stability.
♦ Increased exploitation of available resources.
♦ Protection of national interests and security required for economic progress.
♦ Attraction of larger amounts of foreign economic and military aid.
♦ Disruption of "traditional patterns of political and social organization, [encouraging the] promulgation of modern ideology."·

Investment, savings, inflation, employment, the current account, industrial productivity, and economic growth all suffer in the long-run because:

♦ ME crowds out civilian investment.
♦ ME displaces government spending for civilian programs.
♦ Military production is characterized by lower commercial productivity and efficiency.
♦ Distortionary increases in demand cause inflation.
♦ Military technological gains are of little benefit to rural populations.
♦ Material and human resources are displaced from the civilian sector.
♦ Military purchases of capital equipment largely consists of imports, aggravating the balance of trade.
♦ Military loyalty in LDC's is often linked to the wealthiest portion of the population, helping to preserve conditions under which capital can be transferred out of the country.
♦ Military establishments often are conservative institutions that work to preserve the status quo and inhibit societal "progress."

Military spending in Ecuador rose at an alarming rate throughout the 1970's and the beginning of the 1980's. Thereafter, Ecuador's military budget has remained at a high level, absorbing much of the productive capacity of the economy. Quantitative models using Ecuadorian economic and military time-series data provides a measurement of the opportunity cost of devoting a substantial portion of their national resources—US $232 in 1991—for military purposes. Major findings can be summarized as follows:

♦ The marginal effect of changes in ME expressed as a multiplier equals:
  (GDP growth) / ∂ (ME Burden) = - 1.484
  A reduction of 1% in the military expenditure burden will increase Ecuador's GDP growth rate by a massive 1.484%. Of course, the cumulative effect over a number of years will be much higher. For example, assuming the Ecuadorian government had cut the ME burden by 1% in 1989 and no other year, the cumulative GDP

growth foregone in 1992 equals 1.67%. Assuming that the ME burden was cut 1% every year over the same time period, the cumulative GDP foregone equals 6.61%. In terms of US dollars, this translates into a national economic loss of $559 million. A 1% decline is not unreasonable, especially considering the sizable potential gains in the growth rate of the economy.

♦ The effect of ME on the current account is sizable and negative. For every real Sucre (base year = 1990) spent on the military, the current account declines by 3.7 Sucres. In 1990, Ecuador had a current account deficit equal to US $166. A reduction of US $44.49 million in military spending would cover that deficit. In other words, a 22% reduction in military spending would have replaced Ecuador's need to rely on any foreign capital inflows (given the same level of investment).

♦ Statistical tests suggested ME is beneficial in only two sectors of the economy—the *Transport, Storage, and Communication* category and *Community, Social, and Personal Services* category. In general, ME contributes little "spin-off" benefit to Ecuadorian industry.

♦ Tourism and market "security" improve with higher ME. Quantifying improved "security" is a difficult task and cannot be measured directly.

♦ The effect of ME on structural unemployment is ambiguous.

Historical data may not always be the best predictor of future effects of ME. Economic conditions in Ecuador may change or more conclusive data/tests may become available that modify the measured relationships between critical variables. Interpretation of quantitative analysis to produce specific recommendations should be completed considering the qualitative framework listed earlier. The current structure of the Ecuadorian economy and military spending suggests policy-makers should ideally proceed with the following:

♦ Reduce ME to the minimum level necessary to protect against changing internal and external threats and shift funding to programs that build the national infrastructure. Reducing capital purchases recovers proportionally more opportunity cost than reducing troop levels since personnel support is comparable to transfer/welfare payments.

♦ If political factors prevent cutbacks in the military budget, the best alternative is to hold military spending constant. Any rise in GDP will shrink the defense burden and will allow a larger percent of the goods and services available in the economy to go towards civilian use.

Getting the Ecuadorian political elite to shift their decision calculus to weigh long-term, sustainable growth more heavily than the satisfaction of short-term interests is essential. Given the present state of Ecuadorian politics, fast rate and large scope changes in the military budget are not feasible. But, this paper's quantitative analysis indicates only small reductions in ME are needed to produce enormous gains in economic growth. Policy entrepreneurs could entice the military leadership into accepting cuts by offering to expand the military's role in society to include other functions besides combat. For example, ready-reserve troops could augment civilian agencies to provide disaster relief, flood control, and riot prevention. Military leaders would preserve their influence and status in society, but their expanded role would be more beneficial to Ecuadorian economic prosperity.

Before any changes can realistically be implemented, Ecuador must first resolve its current border dispute with Peru. If the dispute continues or explodes into a full-blown war, economic costs will exponentially increase. Reducing tensions with Peru and other neighboring countries through peace treaties would help alleviate perceived external threats, allowing for a reduced level of military expenditure. The involvement of a regional organization such as the Organization of American States to help monitor and enforce a treaty would lessen the volatility of the perceived Peruvian threat because it would reduce the chance either country would back away from promises after

entering into an agreement. Treaties that improve relations with other countries, such as those that encourage trade, would shrink the need for military readiness and would translate into spending cuts.

Other secondary recommendations include the following:

♦ Working to improve the democratic process in Ecuador.
♦ Diversifying export industries to reduce dependence on world market prices, thus helping to dampen boom-bust cycles.
♦ Exploring domestic arms production facilities to help keep money used to purchase arms within Ecuador's borders.
♦ Improving Ecuador's statistics collection system—especially for regional economic and military expenditure data—to allow for further study of this topic and to pinpoint more effective development programs.

Acknowledgments

Table of Contents

Chapter 1 — Introduction

Military coup d'ètat and rule sporadically interrupt Ecuador's tradition of democratic governance. The current democracy remains fragile due to political fragmentation and economic distress, resulting from mounting medium- and long-term debt—totaling US $13.1 billion[1] at the end of 1993. During the 1978 transition to civilian control after the military's brief seizure, the slow-changing yet powerful military establishment provided balance and stability to the political process. Using the size of budgetary allotments as a rough proxy for political influence, increases in military personnel and budget figures during that period map the military's increasing control and sway over Ecuadorian government policy.

Military spending rose at an alarming rate throughout the 1970's and the beginning of the 1980's. Thereafter, Ecuador's military budget has remained at a high level, absorbing much of the productive capacity of the economy (i.e., the opportunity cost of not devoting those resources to more efficient civilian uses). Figure 1 illustrates this rapid increase in military expenditure (ME).
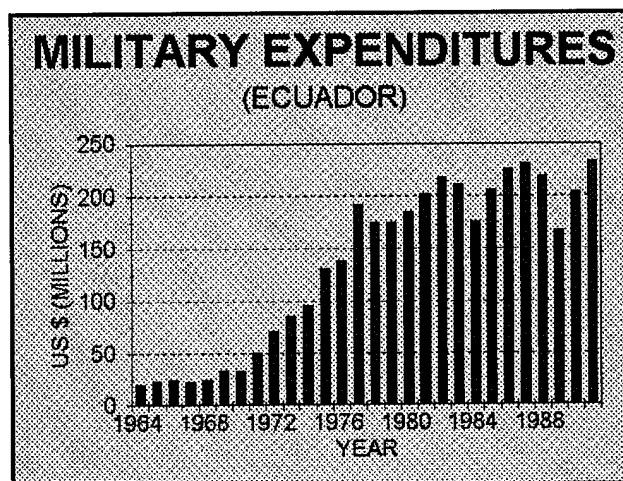
Figure 1 *Time-Series Graph of Nominal Military Expenditures*

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[1] Trends in Developing Economies. pp. 142.

The number of military personnel has increased in proportion to spending levels. Recent statistics indicate Ecuador has over 5.0 soldiers[2] per 1000 people. Figure 2 graphically depicts the expansion in force levels. (For a comparison of ME and gross domestic product time-series data, reference Appendix A.1.1 and A.1.2)
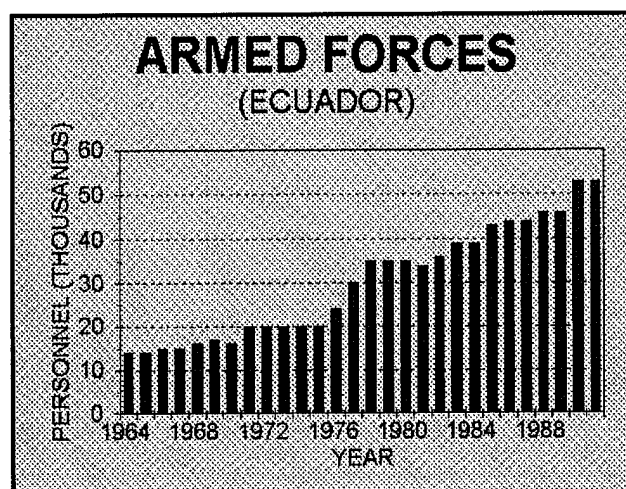
Figure 2 *Time-Series Graph of the # of Ecuadorian Military Personnel*

Ecuador's rising military expenditure is of concern not only because of the absolute numbers involved, but because of its increasing size relative to the Ecuadorian economy. In recent years, ME has reached levels as high as 23.3% of central government expenditures and 3.5% of the gross national product.[3] Going beyond economic considerations, the primary purpose of defense spending is to provide security against internal and external threats. However, military spending also effects the socio-political process—a larger, better-equipped force has more of an ability to quell popular unrest The economics of militarization are "crucial" because it both affects the Ecuadorian people directly and because "evaluation of the effectiveness of security-related spending, relative to its direct and indirect opportunity costs, is not meaningful unless we have analyzed the economic consequences of defense."[4] The goal of this Policy Analysis Exercise (PAE) is to not to produce a prescription for an ideal Ecuadorian development strategy. Rather, this PAE provides policy-makers essential insights needed to produce more robust, long-term economic performance when confronted with difficult budget/resource allocation decisions.

The structure of this PAE is organized to logically address the above goal. Chapter 2 provides a list of key questions to be examined, a discussion of economic theory related to defense spending , a summary of econometric findings using cross-country data, and regional context information. Chapter 3 develops a qualitative framework in response to the key questions asked in the preceding chapter. Chapter 4 details the construction of quantitative models and associated statistical results designed to measure the net economic cost of military spending on various economic performance variables. Chapter 5 contains conclusions and recommendations based on the qualitative

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[2] US Arms Control & Disarmament Agency.

[3] US Arms Control & Disarmament Agency.

[4] Deger (1986). pp. 1.

and quantitative analysis. The Appendix contains regression results, statistical tests, and further supporting information.

Summary
- Military spending in Ecuador has remained high since its alarming rise in the 1970's and early 1980's.
- This PAE constructs a qualitative framework and quantitative models to analyze the net effect of military expenditure on economic performance. This combination allows for a more robust and integrative analysis than would otherwise be the case.
- The PAE does not produce a prescription for an ideal Ecuadorian development strategy. Rather, it provides ME recommendations to produce more robust, economic performance.

Chapter 2 — Econometric Background, Context, & Theory

2.1 Econometric Background

In the early 1970's, Emile Benoit "shocked" development economists when he published a cross-country study[5] showing a positive correlation between military spending and economic growth in LDC's. Furthermore, he hypothesized a causal link between a high defense burden and a high growth rate.

Benoit's early attempts to quantity the relationship between military spending and economic performance using simple, single-equation regressions have since been shown inadequate.[6] More complex, structural models are needed to explain both the direct and indirect effects. Recent work incorporating sophisticated regression techniques using cross-sectional data have found results contradicting Benoit's findings. Indirect negative effects seem to outweigh direct benefits. In other words, military spending has a net negative effect on the rate of real economic growth.

However, the search for a universal rule quantifying this negative relationship has been "disappointing."[7] The extent of lost opportunity and stifled growth varies among nations. Scholarly literature now calls for "discriminating diachronic studies of individual countries."

In examining the Ecuadorian economy, this PAE seeks to add to the understanding of both the direction and intensity of the relationship between military expenditure and economic performance. Specifically, this PAE develops a qualitative framework and quantitative models to address the following questions: [8]

- What are the effects? How do they occur?
- What are the timing consequences?
- What are the opportunity costs?
- What are the policy implications?

Any insight gained from analysis must be judged in its proper context. In other words, an understanding of Ecuadorian geographic, socioeconomic, and political issues is necessary before any conclusions can be offered.

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[5] Benoit (1973).

[6] Grobar and Porter. pp. 319.

[7] Chan. pp. 433.

[8] Chan. pp. 410.

2.2 Context

2.2.1 Geographic & Socioeconomic

Located on the west coast of South America, Ecuador is characterized by geographic, ethnic, and cultural diversity[9] common to other Andean countries. Ecuador has three regions, distinct in natural resource endowment. Consequently, each have been relatively isolated from each other until very recently. [10] The coastal region, dominated by the port city of Guayaquil, has traditionally been associated with agricultural exports and the trade of natural-resource based manufactured goods. The inhabitants of highland region, which includes the capital of Quito, tend to be small-scale domestic farmers more traditional in their social organization. In contrast to the coastal region's attentiveness to export production, highlanders—a majority of whom are mestizos and Indians—survive from the profits of protected import-substituting industries. Lastly, the Amazon region is sparsely populated but valuable since it holds most of the country's main natural resource, petroleum.

In addition to the incompatibility of regional economic interests, Ecuadorian society is divided along lines of wealth and ethnicity. Indigenous people for whom Spanish is a second language comprise approximately 40 percent of the population.[11] The indigenous population has been "impoverished and exploited by government, local, and national economic elites since the time of the Spanish conquest in the sixteenth and seventeenth centuries." This group has only recently been afforded greater access to the political process and economic opportunity. Although Ecuador's population of 11 million is evenly divided between urban and rural areas, a disproportionate number of native Indian live in rural areas. Since the price of rural products has not increased as much as those of the urban sector, income inequality has surged to a wider margin. Since the 1960s, the percentage of the Ecuadorian population below the poverty has remained significantly higher than other Latin American countries. "Differences in income and wealth distribution contribute to weak national identity and cohesion and a high potential for social conflict."[12]

2.3.2 Political

Ecuadorian politics are not conducive to the introduction of new policies. To effectively induce change, recommendations have to consider the limited opportunity for changing the rate and scope of current Ecuadorian policy. Rivalry between the highland and coastal regions leads to mistrust and resistance to changes in power. Highland elites have traditionally controlled "social status, government patronage, and the military." Coastal politicians have resented Quito's political domination, especially since most government revenue before the oil boom was derived from foreign trade taxes on imports entering coastal ports.

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[9] Trends in Developing Economies. pp. 140.

[10] Thoumi. pp. 29.

[11] Grindle and Thoumi. pp. 126.

[12] Grindle and Thoumi. pp. 126.

The structure of Ecuador's political system discourages long-term strategic planning. When the military returned government to civilian rule in 1978, presidential terms were limited to two years and office holders were barred from successive terms or holding that position again. Constitutional provisions for party registration and electoral competition[13] encourage the proliferation of "highly opportunistic and nonprogrammatic [political parties whose] clientistic support is purely instrumental and disintegrate rapidly if leaders cannot readily distribute the expected patronage of 'works' such as roads, electricity, housing, water, and recreational facilities. The segmented and highly competitive party system increase the vulnerability of political leadership to electoral and partisan pressures."[14] Frequent elections increase the visibility of interest groups pushing a specific agenda or vying for a piece of *political pork.*

In general, the primary concern of the ruling elite is regime survival.[15] In order to remain in power, leaders must produce short-term benefits for their constituencies. Robust, sustainable growth is sacrificed to quell short-term *addictions.* Government appropriations often are not designed to satisfy the immediate or long-term welfare needs of the most poor, but rather to gain support from political elite and wealthy supporters.

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[13] Conaghan. pp. 14.

[14] Grindle and Thoumi. pp. 128.

[15] Deger and West. pp. 141.

2.2.3 Relative (Economic and ME Figures)

The following chart[16] provides a comparison of key Ecuadorian economic and military figures with those of Peru—Ecuador's rival neighbor to the South—and the United States of America. The chart frames Ecuador's current situation in a regional and developed-world context while highlighting some important differences.

Category	Unit of Measurement	Ecuador	Peru	USA
GNP	US $ (billion)	10.910	46.660	5,695
Government Spending	US $ (billion)	1.562	4.096	1,432
Military Expenditure	US $ (million)	232	506	280,300
GNP Per Capita	US $	1,020	2,090	22,550
G / GNP	%	14.3	8.8	25.1
ME / GNP	%	2.1	1.1	4.9
ME / G	%	14.8	12.4	19.6
ME Per Capita	US $	22	23	1110
Armed Forces Per 1000 People	people	5.0	5.5	8.4
Arm Imports	US $ (million)	40	30	N/A
Peak Arm Imports (Year)	US $ (million)	290 (1982)	360 (1980 & 1981)	N/A
Population	people (millions)	10.98	22.45	257.59

Note: GDP, G, ME and X—1991. Population—1993. Arms imports—1988. The peak years for arms imports are as specified.

Refer to Appendix A.1.3 for a table showing countries categorized according to relative burden of military expenditure and GNP per capita for the year 1991. Ecuador falls in a middle grouping.

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[16] Sources: International Financial Statistics Yearbook, US Arms Control & Disarmament Agency, and the Statistical Abstract of Latin America.

2.2.4 Force Structure

The chart[17] below shows a breakdown of personnel levels as well as aircraft and vessel numbers for selected countries for the year 1991.

Country	Total Armed Forces	Army	Reserves	Navy	Air Force	Marines	Para-military	Total Vessels	Total Aircraft
Argentina	83,000	45,000	377,000	25,000	13,000	5,000	15,000	47	713
Bolivia	31,000	23,000	0	4,000	4,000	0	13,850	37	217
Brazil	296,700	196,000	1,115,000	35,000	50,700	15,000	243,000	138	1,408
Chile	91,800	54,000	45,000	25,500	12,800	5,200	27,000	47	537
Ecuador	**57,800**	**50,000**	**100,000**	**3,300**	**3,000**	**1,500**	**200**	**48**	**259**
Peru	105,000	72,000	188,000	16,100	15,000	2,500	70,000	16	500
USA	2,029,600	735,700	1,966,700	708,160	521,500	195,700	68,000	1,099	classified

In addition to proper context, a thorough understanding of theory is before a qualitative framework or quantitative model can be constructed.

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[17] Source: <u>Statistical Abstract of Latin America</u>. Table 1204.

2.3 Theory

The relationship between national security, military expenditure, and economic development is complex and multi-directional. Incorporating the idea of feedback, figure 3 diagrams the interrelationship of the variables. Changes in one box directly or indirectly influence changes in another.
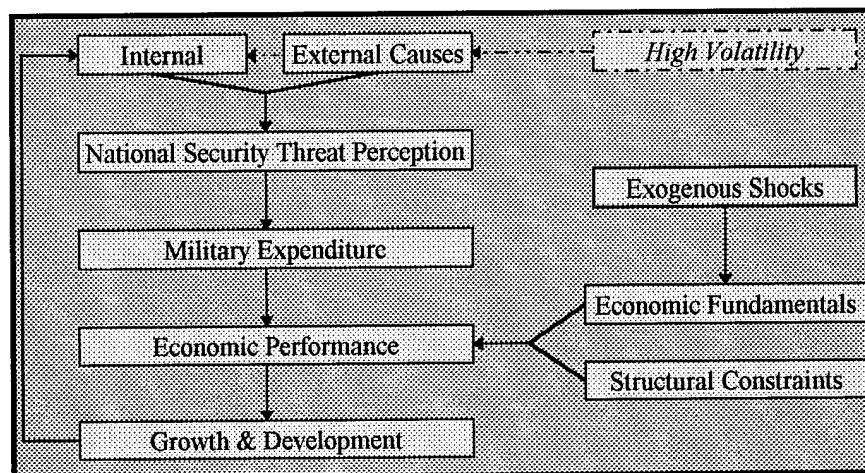
Figure 3 *Diagram of the Link Between National Security and Economic Development[18]*

The perception of threats to national security threat is formed from changing external and internal conditions. Attenuated by political considerations, ideology, resource constraints, competing-program considerations, etc., this perception is the core force driving a country's military budget. Because threats to national security are based on perception, they are highly volatile. The high rate of change mirrors popular opinion and shift in world/regional situations.

Although not the sole determinant of the performance of the Ecuadorian economy, defense spending has a distortionary effect on the market. Military expenditure combined with changes in economic fundamentals, structural constraints, and exogenous shocks—for Ecuador, examples include adverse developments in the oil, banana, and shrimp industries—determine the level of economic activity within a country's borders.

Economists disagree about the mechanism by which economic growth is translated into development. One theory states growth "trickles-down"[19] through economic classes, thereby enhancing the standard of living for all. This "trickle-down" can occur either through direct redistribution (i.e., tax collection to finance government programs for the economically depressed) or though increased opportunity (i.e., more employment available to support the economic expansion). The amount of "trickle-down" will vary from country to country. This PAE does not provide analysis of or commentary about the link between growth and development. Rather, the assumption is made that military expenditure, in so far as it reduces growth, leads to an adverse effect on long-term development.

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[18] Chart modified from Deger and West. pp. 3.

[19] Deger and West. pp. 4.

World Bank literature describes Ecuador's economic/development performance over the past decade as "disappointing"[20]—meaning Ecuador's progress has not achieved potential gains and has not kept pace with other Latin American *success stories*, such as Argentina or Costa Rica. While not ranking in the region, Ecuador has the potential to improve its economic performance and achieve robust, long-term growth. Persistently high military expenditure, the debt crisis in 1982, a major earthquake, and unfavorable shocks to export industries have contributed to growing public frustration over "failed attempts to re-establish sustainable economic growth, the government's inability to meet the basic needs of the population, deteriorating publicly provided services, and a general decline in living standards." This PAE serves to help identify and measure the effects of ME on economic performance to inform Ecuadorian policy-makers. Ideally, the conclusion and recommendations of this PAE will be used to formulate an economically beneficial military budget (or at least to minimize negative effects).

Summary
- The relationship between national security, ME, and economic development is complex and multi-directional.
- Complex, structural models are needed to explain both the direct and indirect effects.
- Military spending has a net negative effect on the rate of real economic growth.
- Ecuador is a society deeply divided along lines of region, wealth, ethnicity, and economic interest.
- Ecuadorian politics are not conducive to the introduction of new policies and discourage long-term planning. To effectively induce change, recommendations have to consider the limited opportunity for changing the rate & scope of current Ecuadorian policy.

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[20] Trends in Developing Economies. pp. 140.

Chapter 3 — A Qualitative Framework

3.1 What are the Effects? How do they occur?

3.1.1 Favorable Growth Effects of Military Expenditure[21]

Military spending immediately increases output, employment, and production through the following means:

- A "Keynesian type [of demand creation, promoting a] fuller use of resources than would otherwise have occurred." However, this increase in aggregate demand is tempered by a corresponding increase in inflation. As a general rule, LDC's do not have sticky prices and are particularly susceptible inflation.
- *Availability (at least partly) of military infrastructure for civilian use.* Examples of these quasi-public goods include roads, airports, disaster relief, mapping, R&D, etc. The military may also serve as a conduit for new technologies to be introduced into society.
- *Military production of close substitutes for civilian goods, which makes it "possible for the civilian economy to devote a higher share of its total output to investment."* Net resource savings occur when the military produces "socially necessary goods and services" (e.g., security) more cheaply than the private sector.
- *Productivity-enhancing byproducts of military training and experience.* Demobilized personnel take discipline and technical skills learned from military training to the civilian sector. Military training may also "socialize rural labor to accept industrial discipline."[22]
- Increased exploitation of available resources. The coercive power of a strong military may increase aggregate supply by mobilizing surplus labor, developing raw material production, transferring agrarian surplus to industry, and suppress labor disputes.[23]
- Protection of national interests and security required for economic progress. High defense spending may increase investor confidence in the stability of a country's leadership and therefore reduce the expected risk of investing in their market.
- Attraction of larger amounts of foreign economic and military aid due to the creation of a stable environment. Increase aide allows a country to maintain unusually high defense burdens. However, that may be a mixed blessing because of the distortionary effects it has on the market.
- Disruption of "traditional patterns of political and social organization, [encouraging the] promulgation of modern ideology."[24]

3.1.2 Negative Growth Effects of Military Expenditure

Negative effects of military spending are more apt to occur in the medium- to long-run. Investment, savings, inflation, employment, the current account, industrial productivity, and economic growth all suffer. However, development theory has not come to a consensus as to how these indirect, negative effects emerge. The following perspectives[25] offer some explanation:

- *Military spending* (to the extent that it increases taxes or government borrowing) *crowds out civilian investment.*

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[21] Grobar and Porter. pp. 323-325.

[22] Deger and Smith. pp. 338.

[23] Deger and Smith. pp. 338.

[24] Deger and Smith. pp. 339.

[25] Chan. pp. 415-422.

- For any given level of government expenditure, increasing military spending necessarily curtails the amount of money allocated for civilian programs. Hence, the civilian domestic product is reduced.
- *Compared with the civilian sector, the government sector is characterized by lower productivity.* The differential is greater in a developed country, but this statement still holds true for LDC's.
- "Military investment in technology may also be restricted to capital-intensive modes of production that are of little use to the majority of the population living in the rural hinterland of LDC's."[26] Military spending to improve infrastructure may be in remote areas with little civilian use.
- Material and human resources lost to the military sector have a *detrimental long-run effect on a country's productivity and technological position.* The civilian sector loses an opportunity for growth because valuable resources are employed outside of the civilian sector.
- Economic stagnation results from a *chronic and serious displacement of capital and talent* from export industries to military production. *Slower export growth in turn causes slower economic growth, further reducing a country's trade competitiveness.* A high proportion of military spending in LDC's tends to be composed of imports, further degrading their current account.
- Military loyalty in LDC's is often linked to the wealthiest portion of the population, thereby creating conditions under which capital can be transferred out of the country. Most wealthy investors do not like the idea of having their profits taxed to support development programs.
- "Military establishments, by their very nature, are often conservative institutions with rigid hierarchical structures, and their concern for stability and maintenance of the status quo may inhibit them from taking positive steps in the transformation of society."[27]
- Defense spending may raise demand without increasing supply. Inflation results—the level depending on the fiscal and monetary policies of the government. As such, defense does not contribute to the current or future standard of living. Costs associated with personnel are not much different from social welfare policies and hence, contribute less inflationary pressure than expenditure for capital equipment.

3.2 What are the Timing Consequences?

Depending on the economic environment, the effects of military spending on performance can either be magnified or lessened. The cyclical economic position of a country (i.e., whether the country is experiencing a recessionary trough or a booming peak) determines the economy's absorption capacity. For example, inflationary pressures will be less in an economy with slack. Other timing concerns include the government's financing policies, "its technological and currency advantages over trade competitors, its vulnerability to foreign threats,"[28] and the effects of global shocks. In Ecuador's case, interest rates have had to be kept at high levels to control inflation and to finance budget deficits before they were able to manage a surplus in 1989. Raising additional money to pay for increases in ME would put further upward pressure on interest rates. Businesses may find increases in the interest rate above and beyond the already high lending rates (e.g., 47.04% in 1993) to be prohibitively expensive and thus, may cut-back investments.

3.3 What are the Opportunity Costs ?

Assessing the opportunity costs of changes in military expenditure involves quantifying resulting changes in investment, unemployment, inflation, economic growth, etc. If for example military expenditure is reduced, what level of economic activity would the country then be able to achieve? What would happen to the performance

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[26] Deger and Smith. pp. 338-339.

[27] Deger and Smith. pp. 339.

[28] Chan. pp. 429.

of related economic variable? For example, a smaller defense burden could either lead to increased private consumption or increased private investment. The purpose of the mathematical models presented in this study is to document the specific opportunity costs for military spending in Ecuador.

Money saved from reduced defense spending can either be used to lessen the financial strain of the country or to finance existing or additional welfare/social measures. However, calculating possible gains from increased welfare spending is beyond the scope and focus of this PAE and requires an in-depth cost/benefit evaluation of the programs involved. Instead, this PAE seeks to determine aggregate changes in economic performance rather than provide an evaluation of other social programs.

It's important to note that the losses entailed by increases in ME may be "small in absolute dollar amounts but significant in terms of its multiplier effect."[29] In cumulative terms, the opportunity costs are even greater because of the compounding effect of lost production capacity.

3.4 What are the Policy Implications?

The government of an LDC is confronted with conflicting demands to provide resources for more rapid development, expanded welfare services, and greater national security.[30] Often, the success or failure of a politician in reconciling these competing agendas will determine not only his political future, but also the survival of the government. Over the past decade, there has been an exponential rise in aggregate military spending for developing countries due to finance expanded stockpiles, personnel build-ups, regional arms races, guerrilla insurgencies, and the sharp rise in modern weaponry prices has led to growing instability and violence.

High defense spending leads to a vicious circle. Countries spend more to compete with their neighbors due to a perceived greater external threat. Increased military spending negatively effects economic growth. To the extent this decline in growth translates into a socio-economic set-back, the country becomes less stable. "The consequent feedback of development failure on internal dissension (and enhanced threat to the established regime) can induce yet higher defense spending."[31]

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[29] Chan. pp. 433.

[30] Deger and West. pp. xi.

[31] Deger and West. pp. 4.

Summary

♦ Short-term economic benefits of military spending include increases output, employment, and production.

♦ Investment, savings, inflation, employment, the current account, industrial productivity, and economic growth all suffer in the medium- to long-run.

♦ The economic environment will either magnify or lessen the effects of military spending on growth.

♦ In cumulative terms, opportunity costs from ME are even greater because of the compounding effect of lost production capacity.

♦ The distortionary effect of ME on the market has policy implication, especially for leaders of LDC's whose political influence is particularly sensitive to economic fluctuations.

Chapter 4 — Quantitative Models

An understanding of the interrelationships between military expenditure and other variables is crucial to measuring the net effect on GDP growth and economic performance. The following sections discuss the rationale behind each model, the reasons for selecting the structural form and for including certain variables, and the empirical results.

4.1 Net Effect on GDP Growth—The Investment Model

While military expenditure may provide a short-term Keynesian stimulus through the creation of additional aggregate demand, it also has a negative effect on GDP growth. Military spending "crowds out" investment, strains the *absorptive capacity* of the economy, and puts pressure on available supplies of capital, skilled labor, and foreign exchange."[32] Because the slope of the regression line adjusts to reflect the economic conditions, the model inherently takes into account slack. Comparing the degree of stimulus to amount of investment foregone determines both the sign (i.e., positive or negative) and the magnitude of the net effect of military spending on GDP growth. A regression technique using a system of equations to estimate the effects incorporates the interrelationship of the variables. Individual equations yield specific effects, whereas the whole taken together gives the overall cost/benefit.

The complete investment model is as follows:

$$\text{GDP growth} = a_0 + a_1 \, (\text{I/GDP}) + a_2 \, (\text{ME/GDP}) + a_3 \, (\text{net capital transfers/GDP}) \qquad [1]$$
$$\text{I/GDP} = b_0 + b_1 \, (\text{GDP growth}) + b_2 \, (\text{ME/GDP}) + b_3 \, (\text{net capital transfers/GDP}) \qquad [2]$$
$$\text{ME/GDP} = c_0 + c_1 \, (\text{PPP}) + c_2 \, (\text{population}) + c_3 \, (\text{GDP}) \qquad [3]$$

where I = investment, ME = military expenditure, and PPP = the difference between per capita income measured at purchasing price parity and the official exchange rate. For calculations, the current account (exports - imports) was substituted for net capital transfers. (Refer to Appendix A.5.3 for specifics about the format of the model used into the computer regression package. Refer to Appendix A.5.2 for an explanation of regression variables.)

GDP Growth and Investment/GDP are endogenously determined in this system of equations. In other words, changes in either variable cause changes in the other.

Although equation [3] includes gross domestic product, ME/GDP is not a function of GDP growth. The Granger Test in Appendix A.6.2 does not indicate causality between the two variables. (Refer to Appendix A.6.1 for a discussion of the theory behind and the procedure for the Granger Test). Even though ME/GDP is exogenously determined, equation [3] is still estimated jointly in a system of equations using three-stage least-squares because its error variance can be correlated with the others.[33]

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[32] Grobar and Porter. pp. 337.

[33] Deger (1986). pp. 262.

4.1.1 Primary Dependent Variable: Choice of GDP instead of GNP

The growth rate in the investment model measures annual growth in gross domestic product. Because it "measures the volume of production within a country's borders,"[34] GDP gives a *better* indication of national economic activity than gross national product. Officials in LDC's appropriately are more concerned with the performance of domestic industries and foreign-owned plants operating within their borders than they are with the return wealthy individuals receive on funds invested abroad. Foreign-owned companies in Ecuador employ native workers, boost the local economy, etc. Funds invested abroad, although they add to the national income, do not directly contribute to the development of the Ecuadorian economy.

4.1.2 Using the ME/GDP Ratio Instead of Absolute Military Spending Data

The defense burden is defined as military expenditure as a percent of GDP, thereby measuring the "real resource expenditure"[35] on defense. The defense burden is included in the investment model because it gauges the proportion of the economic resources diverted from employment in the civilian sector. Expressing ME in terms of GDP is important because absolute numbers do not reflect the relative pressure placed on the economy to expand and hence, will not adequately estimate *crowding out* pressures on private investment.

4.1.3 Choice of Other Variables

Especially when examining LDC's, development theory does not precisely predict behavioral and equilibrium relations on a macro-economic level. There are numerous determinants of military spending, investment levels, and GDP growth. The above model does not seek to include every possible input, but rather uses several variables for system identification purposes. Variables that are "intuitively plausible"[36] are included in order to make estimation of the system possible.

A country's investment equals total savings minus the current account (i.e., I = S - CA). (Refer to Appendix A.2 for the derivation of this identity.) Rearranging terms, investment equals savings plus a country's trade surplus. A trade surplus boosts national income and provides a stimulus to economic growth. Assuming national savings do not fall, increases in a country's trade surplus is also expected to increase overall investment. This occurs either through income-multipliers or through trade taxes.[37]

PPP attempts to "measure the degree of integration of a country's economy with the rest of the world."[38] As the economy becomes more open to trade and the importance of trade grows, PPP shrinks. Often the case for LDC's, a positive PPP term means the official exchange rate is over-valued on the world market. A national income calculated using an over-valued currency translates into lower true value. Hence, fewer arms can be

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[34] Krugman and Obstfeld.

[35] Benoit (1973). pp. 29.

[36] Deger (1986). pp. 260.

[37] Deger and Smith. pp. 349.

[38] Grobar and Porter. pp. 340.

purchased on the world market. In summary, the PPP term captures two effects—"the direct effect of variations in per capita income itself and the effect of variations in economic structure."[39]

Lastly, theory suggests a large population has more security needs and by definition more human resources available to form large armies. Military expenditures are expected to increase with increases in population.

4.1.4 Empirical Results

For the time period 1964 - 1991, the estimated model is as follows:

GDP growth = -0.4147 + 2.3842 (I/GDP) + 4.1492 (ME/GDP) + 1.7210 (net capital transfers/GDP)   [4]
       (-4.92)   (5.51)   (2.14)   (1.72)

I/GDP = 0.1845 + 0.3473 (GDP growth) - 1.8473 (ME/GDP) - 0.6511 (net capital transfers/GDP)   [5]
       (9.22)   (5.31)   (-2.29)   (-4.76)

ME/GDP = 0.0090 - 3.588E-10 (PPP) + 0.0049 c_2 (population) - 3.281E-09 (GDP)   [6]
       (0.493)   (-2.59)   (1.03)   (-0.878)

(t-ratios in parentheses)

At a 90% confidence level (i.e., $\propto = .10$), all the parameters in equations [4] and [5] are statistically significant. For equation [6], the null hypothesis that the population and GDP coefficients do not equal zero cannot be rejected.

Figure 4 depicts a graph of the predicted versus actual GDP growth rates. It is included below to show the degree of accuracy the model has in describing the historical data.
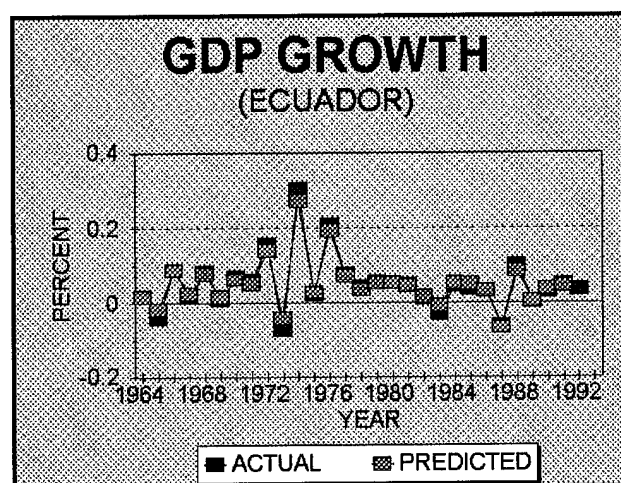
Figure 4 *Graph of the Predicted Versus Actual GDP Growth Rates*

4.1.5 Discussion of Results

The mathematical model confirms theoretical predictions of the effect of military spending on both investment and GDP growth. The results are both significant and substantial. The signs (i.e., positive or negative) of coefficients in equation [1] are all consistent with expectations. The positive value for a_2 indicates military spending directly increases GDP growth through Keynesian demand creation. The positive value for a_1 indicates investment also provides a stimulus to GDP growth. However, the negative value for b_2 show military spending

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[39] Deger and Smith. pp. 343.

has a negative effect on investment. If the military expenditure burden is increased by one percentage point, investment as a proportion of GDP will decrease by 1.84%. Because of the endogenous nature of the system, the net effect of military spending on GDP can only be determined through the calculation of a multiplier. (Refer to Appendix A.3). The following multiplier incorporates both direct and indirect effects:

$$\partial \text{ (GDP growth)} / \partial \text{ (ME Burden)} = -1.484$$

A reduction of 1% in the military expenditure burden will increase Ecuador's GDP growth rate by a massive 1.484%. Of course, the cumulative effect over a number of years will be much higher. For example, assuming the Ecuadorian government had cut the ME burden by 1% in 1989 and no other year, the cumulative GDP growth foregone in 1992 equals 1.67%. Assuming that the ME burden was cut 1% every year over the same time period, the cumulative GDP foregone equals 6.61%. (Refer to Appendix A.4 for the specific calculations.) In terms of US dollars, this translates into a national economic loss of $559 million. A 1% decline is not unreasonable, especially considering the sizable potential gains in the growth rate of the economy.

4.1.6 Qualifier

When constructing the investment model, many different specifications were regressed to assess the system's sensitivity to change. Substituting different independent variables for the exogenous variables included in the final model produced marginally different results. Many variables intuitively thought to be related to GDP growth (e.g., population growth) were found not to be statistically significant. These factors, in actuality, may be related to or contribute to GDP growth, however the limited time-series data available for the Ecuadorian economy do not suggest a statistically significant relationship. In modeling macroeconomic systems, the introduction of some degree of omitted variable bias cannot be avoided because of the large number of inter-connected parts of a national economy. Parsimony, especially important for models using small data sets, may sacrifice some coefficient estimation precision. Hence, an exact calculation of a multiplier per se is not as meaningful as determining the sign and size of the value. In this case, the multiplier is negative in direction and has a substantial magnitude. Increasing Ecuadorian military expenditures will have a massive negative effect on GDP growth.

Summary
♦ The negative effects of "crowded-out" investment outweigh the benefits of Keynesian demand creation.
♦ $\partial \text{ (GDP growth)} / \partial \text{ (ME Burden)} = -1.484$
     A 1% reduction in ME will increase GDP growth by 1.484%.

4.2 The Current Account Model

The increasing technological nature of warfare has contributed to skyrocketing weaponry prices and the high cost of equipping a modern army. Since LDC's rarely produce their own tanks, personnel carriers, advanced tactical fighters, and other vital systems, LDC's must spend an increasingly large portion of their military budget importing these arms. To gain an understanding of the magnitude, arms imports can be expressed as a percentage of total imports. Although this ratio has declined somewhat, 13.4%[40] of all goods imported into Ecuador in 1982 were arms. Hence, country's imports are expected to vary according to the level of military expenditure.

There is a second, indirect channel through which military spending affects the current account. Increases in military spending, without reductions in other government programs, will necessarily increase government spending. Depending on the state of economy, an increase in government spending financed either by deficit spending or by the printing press will cause inflation. Speculators will put pressure a depreciation or devaluation of the LDC's currency, hence affecting the current account.

The complete current account model is as follows:

$$CA = a_0 + a_1(S) + a_2(S(-2)) + a_3(\log(GDP)) + a_4(ME) + a_5(G-ME) \qquad [7]$$

where CA = current account (measured in real Sucres), S = spot exchange rate, $S(-1)$ = exchange rate from previous year, $S(-2)$ = exchange rate from two years prior, and G = government spending.

4.2.1 Choice of Other Variables

One factor influencing the volume of exports and imports is the price of goods. The exchange rate plays a huge role in determining the relative price to each party. If the Sucre is depreciated, foreign goods in Ecuador become more expensive to natives and Ecuadorian products become more attractive to other countries. Exports are expected to increase and imports decrease. However, the *J-curve* phenomenon predicts the current account will initially worsen after a depreciation and then improve over time. Because contracts are negotiated in advance, export and import volumes initially will reflect buying decisions that were made on the basis of the old real exchange rate.[41] Hence, current and lagged current exchange rate variables are included in the model.

The difference between total government and military spending is included to isolate associated effects.

A country's trade surplus or deficit accounts for one component of national economic activity. Holding other components such as private consumption constant, the current account is expected to increase when economic growth occurs. The *log* of GDP rather than the absolute number is included for ease of modeling. The coefficient a_5 represents the change in the current account for every 1% change in GDP

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[40] Statistical Abstract of Latin America 30. pp. 369.

[41] Krugman and Obstfeld. pp. 464.

4.2.2 Empirical Results

For the time period 1964 - 1991, the estimated model is as follows:

$$CA = -2.393E07 - 2853(S) + 4942(S(-2)) + 1.661E06(\log(GDP)) - 3.698(ME) - 2.733(G-ME) \qquad [8]$$
$$(-3.12) \quad (-3.36) \quad (3.00) \qquad (3.13) \qquad\qquad (-3.37) \qquad (-3.45)$$

(t-ratios in parentheses)

At a 90% confidence level (i.e., $\propto = .10$), all the parameters are statistically significant.

(Refer to Appendix A.5.4 for more detailed regression results.)

4.2.3 Discussion of Results

As expected, increases in military spending reduce the current account. For every real Sucre (base year = 1990) spent on the military, the current account declines by 3.7 Sucres. In 1990, Ecuador had a current account deficit equal to US $166.[42] A reduction of US $44.49 million in military spending would cover that deficit. In other words, a 22% reduction in military spending would have replaced Ecuador's need to rely on any foreign capital inflows (given the same level of investment).

A reduction in other government expenditures would also improve the current account. However, the effect of other government spending on the CA is less than the effect of ME (i.e., absolute value (-3.7) < absolute value (-2.73)). To eliminate the current account deficit in 1990, Ecuador would have to reduce it's other government outlays besides ME by US $60.7 million.

The exchange rate also influences the current account. Initially, a depreciation of the Sucre (i.e., S increases) will decrease the current account due to the *J-curve* effect. After two years, the current account will show a net increase from a currency depreciation.

Summary

♦ Increases in military spending reduce the current account.

   For every real Sucre increase in ME, the current account declines by 3.7 Sucres.

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[42] International Financial Statistics Yearbook. pp. 335.

4.3 The Industrial Output Model

Development economists theorize military spending stimulates industrial output through two channels: demand creation for under-employed industrial capital and an indirect contribution to the civilian sector's technological progress.[43] The quantitative model below tests for "spin-off" effects in Ecuador:

$$X_i = a_0 + a_1 (X_i(-1)) + a_2 (ME) \qquad [9]$$

where X_i = the output of 8 industries in real prices (base year = 1990), $X_i(-1)$ = lagged output, and ME = real military spending.

Because these "spin-off" effects may take time to cycle through the economy, another model using a lagged value for military spending also is tested.

$$X_i = b_0 + b_1 (X_i(-1)) + b_2 (ME(-1)) \qquad [10]$$

4.3.1 Empirical Results

Below is a table of the 16 estimated equations for the time period 1980 - 1991:

Kind of Activity	Is a_2 statistically significant?	Is b_2 statistically significant?
Agriculture, Hunting, Forestry, and Fishing		
Mining and Quarrying		
Manufacturing		
Electricity, Gas, and Water		
Construction		
Wholesale and Retail Trade, Restaurants, and Hotels		
Transport, Storage, and Communication	√	
Community, Social, and Personal Services		√

Note: tests for statistical significant accomplished at the 90% confidence level (i.e., $\propto= .10$).

(Refer to Appendix A.5.5 for more detailed regression results.)

4.3.2 Discussion of Results

For the 16 equations fitted, military spending has a positive, statistically significant coefficient in only two industries. The current ME term for the *Transport, Storage, and Communication* category equals 0.8715. The lagged ME term for the *Community, Social, and Personal Services* equals 0.2186.

The above results indicate that for every one US dollar increase in ME, the proportion of the gross domestic product classified as *Transport, Storage, and Communication* increases by approximately 87 cents. A one percent increase in ME in 1990 will increase *Transport, Storage, and Communication* by US $1.78 million. However, given the negative effects of investment on overall GDP growth, the opportunity cost for this industrial stimulus is expensive.

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[43] Grobar and Porter. pp. 337.

Summary

♦ ME contributes little "spin-off" benefit to Ecuadorian industry.

♦ The opportunity cost for an industrial stimulus is expensive.

4.4 Market Security/Tourism Models

       Increased military spending buys a developing country greater resources to maintain internal "security" and to fight external threats. Native and foreign investors will be hesitant to commit capital unless they believe in the stability of the nation. The tourism model uses the number of tourists as a proxy to measure the perceived security of Ecuador. However, the sign of the relationship is not known *a priori*. A country at war will spend large amounts of money to finance military operations, but will attract little tourism. Consequently, a dummy variable (i.e., a 0 value for *peace* and 1 for *war*) should be included as an additional explanatory variable. Since Ecuador has not been at war during the sample period, the war dummy variable is omitted from the model. Additionally, a powerful military may increase the probability of a coup d'ètat and decrease the "security" of a developing country.

       The complete market security/tourism model is as follows:

$$\text{\# of tourists} = a_0 + a_1(\log(ME)) + a_2(\log(S)) + a_3(PPP.Z) \tag{11}$$

where ME = real military spending, S = the exchange rate, and PPP.Z is a measure of purchasing price parity. (Refer to Appendix A.5.6.1 for more detailed regression information.)

4.4.1 Choice of Other Variables

       As the exchange rate increases (i.e., currency depreciation), the # of tourists are expected to increase because travel in Ecuador becomes less expensive for foreigners. The PPP term attempts to capture this same idea but as applied to purchasing power.

4.4.2 Empirical Results

       For available data between the years 1970 and 1990, the estimated model is as follows:

$$\text{\# of tourists} = -1.058E06 + 94968(\log(ME)) + 35017(\log(S)) + 38009(PPP.Z) \tag{12}$$
$$\quad\quad (-2.18) \quad\quad (2.13) \quad\quad\quad (2.42) \quad\quad\quad (2.12)$$
(t-ratios in parentheses)

At a 90% confidence level (i.e., $\alpha = .10$), all the parameters are statistically significant.

4.4.3 Discussion of Results

       For Ecuador, there is a positive correlation between military spending and the # of tourists. The ME coefficient predicts the # of tourists will increase by approximately 95 thousand for every increase 1% increase in military spending.

       Since the investor perception of "security" cannot be explicitly quantified, the exact relationship between ME and "security" cannot be measured. However, use of the # of tourists as a proxy variable permits a general description of the relationship. If Ecuador spends more on the military, investors will believe the markets to be more secure.

       The market security/tourism model does not measure Ecuador's relative success attracting tourists. Hence, it may introduce a bias if tourism to Latin America in general increases. Therefore, another model that includes the variable LATIN to control for this potential bias is estimated. This model yields results similar to the

first model. (Reference Appendix A.5.6.2 for more detailed regression information.) Regression estimation shows the LATIN variable to be statistically insignificant. In other words, the model suggests the total number of tourists visiting Latin America does not influence Ecuador's success at attracting tourists. The coefficient associated with military expenditure remains positive and significant. The first model estimates the ME coefficient to be 94,968 while the second yields a 95,087 value. Again, the results of the two models are comparable.

Summary

♦   Tourism increases and market "security" improves with higher ME.

4.5 Net Effect on Unemployment

Military training develops the discipline and technical skills of conscripts, thereby making them more attractive to potential employers. Many of the skills learned from military training—for example, learning to fly ground-support bombing missions in a high-performance fighter—are not likely to be directly transferable to the commercial world. The benefits of military indoctrination and schooling may appear in less than obvious ways, such as an increased awareness of technology, the ability to operate complex machinery, an increased aptitude for teamwork, etc. However, as indicated in the investment model, military spending is negatively related to Ecuadorian GDP growth. Lost growth opportunities may decrease the amount of employment available. Hence, the direction of the relationship is not known *a priori*.

4.5.1 Empirical Results

Simple regression models—using the urban unemployment rate as the dependent variable and the military defense burden and various economic performance measures as independent variables—do not indicate any statistically significant relationship.

Granger tests using both the defense burden and military expenditure figures expressed in 1990 Sucres show similar results. Changes in military spending or the defense burden do not cause changes in unemployment rates. (Reference Appendix A.6.3 for test calculations.) In fact, the test incorporating the R.ME variable suggests the opposite. Changes in the employment may influence military expenditure. Unemployment adds to social unrest and may instigate revolution. Military spending may have to be increased to counter and quell the unrest.

The number of personnel Ecuador retains in their armed forces does seem to have an effect on the unemployment rate. A log-log regression indicates unemployment elasticity with respect to force level equals 1.37. In other words, urban unemployment is positively correlated to unemployment. Every 1% increase in the force level will increase unemployment by 1.37%.

The results of the estimation are as follows:

$$\log(\text{unemployment}) = -3.063 + 1.375 \ (\log(\text{\# of military personnel})) \hspace{2cm} [13]$$
$$\hspace{3.5cm} (-1.52) \hspace{0.5cm} (2.52)$$

(t-ratios in parentheses)

At a 95% confidence level (i.e., $\alpha = .05$), the military personnel coefficient is statistically significant. (Refer to Appendix A.5.7 for more detailed regression information.)

4.5.2 Discussion of Results

The failure of the above regressions and Granger tests to measure the relationship between military spending and unemployment may be due to insufficient data available. Compilation of employment figures in developing countries is difficult because of a lack of accounting resources. The government's inability or unwillingness to measure black market commerce may complicate counting procedures. The Statistical Abstract of Latin America only offers national average figures for selected years between 1975 and 1991. The effect of specific

changes in military programs on regional employment needs to be analyzed to further explore the relationship. However, current regional data for Ecuadorian provinces is inaccurate and unreliable.

Although the results of the log-log model using the # of military personnel as an independent variable suggests a positive relationship between the force level and unemployment, caution should be used interpreting the results. The data used for this model is sketchy. In addition, only figures for sporadic years were available. Hence, no definitive conclusion can be made about the effect of the force level on employment levels.

Summary

♦   The effect of ME on structural unemployment is ambiguous.

Chapter 5 — Conclusion & Recommendations

5.1 Conclusion

Increasing the readiness and number of personnel in the Ecuadorian armed forces does not provide a long-term solution to social and development problems. A large standing force equipped with high-tech weapons may stifle social unrest in the short-term, but will contribute to lost economic growth opportunities. Economic gain and development help directly fulfill the basic needs of the Ecuadorian people and will increase faith in government programs and institutions designed to help combat poverty. Hence, from both a political and economic perspective, military expenditure should be reduced to a minimum level necessary to maintain *social order* and to protect Ecuador's territorial integrity. The term *social order* does not mean stifling of popular unrest. Rather, it refers to the ability of the State to enforce lawful rule through policing functions and to prevent armed revolution. Other cross-country studies[44] support the finding of this PAE—military spending has a net negative effect on the rate of real economic growth. Of course, the effects of ME are different for every country because of varying market pressures and economic environments. This PAE is particularly useful because it provides a qualitative framework to identify what, how, and why effects occur as well as quantitative models to measure Ecuador's unique situation.

In spite of a resistance to change from such factors as culture, interest groups, inertia, and a political system that does not reward fiscal responsibility, Ecuador can achieve tremendous gains in economic performance by making small adjustments to the military budget. Small changes will not threaten a regime's survival but will substantially help growth. A 1% reduction in ME will lead to approximately a 1.5% increase in GDP growth. Statistical results also suggest the current account declines by 3.7 Sucres for every Sucre spent to support the military. Again, military spending has a negative relationship—substantial in magnitude—with GDP growth and the current account. The investment and current account models suggest the benefits from cutting ME overshadow the relatively minor positive relationships described by the other models. Military spending provides only a small Keynesian stimulus for two of the Ecuadorian industries analyzed. Tourism and (more importantly) market "security" are predicted to increase with increases in military spending. But, the degree of "security" benefits cannot be determined. It's likely that economic prosperity accomplished through the reduction of military expenditure is a more powerful tool to attract foreign and domestic investment than benefits achieved from increased "security" from a military buildup. Lastly, the effects on structural unemployment are ambiguous.

5.2 Recommendations

5.2.1 Cuts in the Military Budget

Since determining the minimum force level adequate to protect against changing internal and external threats involves analysis of other than economic factors, this report cannot set an absolute target for military

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[44] Grobar and Porter.

expenditure. Rather, only a general recommendation to cut military spending can be made. However, if a target for economic growth is set and military concerns are made subservient, then the statistical analysis in this report can be used to calculate reductions in military spending required to meet that goal. For example, if the Ecuadorian government would like to achieve an immediate 3% increase in economic growth, roughly a 2% decrease (i.e., 3% divided by -1.484) in military expenditure is required. The log-log regression in Appendix A.5.8 yields the relationship between the number of military personnel and the spending level. A 1% decrease in manpower decreases the amount of ME by 1.17%. Fewer personnel means the Ecuadorian government has to purchase fewer weapons, equipment, systems, uniforms, etc. Less money has to be spent to train, educate, house, feed, and care-for troops. Accordingly, a 1.7% reduction in the troop level would eventually feed through the economy and result in a 3% gain in GDP growth. If political factors prevent cutbacks in the military budget, then the best alternative is to hold military spending constant. Any rise in GDP will shrink the defense burden and allow a larger proportion of the goods and services available in the economy to go towards civilian use.

Rather than attacking this problem from an aggregate level, military expenditure can be broken down into two categories—procurement of capital goods and personnel. "Some of the consequences attributed to military spending (e.g., cost-push inflation, production shortages in the capital gods industries) are accounted for by the non-personnel part of the defense budget and not by the entire budget. The economic impact of the military's personnel costs is similar to that of the government's civilian programs of income transfer."[45] Specific procurement programs that do not provide sufficient strategic return for the amount of Sucres invested should be cut. For example, Ecuador's purchase of the latest generation of Mirage fighter-jets does little to advance internal security. *Prestige-building* items should be sacrificed to advance economic prosperity. Military programs that construct dual-use infrastructure such as airports and roads should be bolstered.

5.2.2 Achieving Cuts in ME & Secondary Recommendations

"One of the most striking characteristics of the political economy of LDC's is that politics control economics as much as the latter influences the former".[46] Hence, getting the Ecuadorian political elite to shift their decision calculus to weigh long-term, sustainable growth more heavily than the satisfaction of short-term interests is essential. In addition to entrenched interests, the problem of inertia also needs to be overcome. Mobilizing Ecuadorian masses to rally for change is extremely difficult since the poor have traditionally been *de facto* disenfranchised. People below the *poverty line*—defined here as an inability to meet basic needs such as caloric intake, housing, and medical care—are more concerned with survival than relatively small budgetary changes that do not effect their everyday lives.

Especially given the current fighting with Peru over the disputed border area, immediate changes may not be politically feasible. National pride is hard to swallow when politicians frame the border dispute as a fight to

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[45] Chan. pp. 424.

[46] Park. pp. 79.

protect Ecuadorian sovereignty and territorial integrity to whip-up patriotic fever. Public pressure to maintain a strong military becomes particularly potent when Ecuadorian soldiers are dying at the hands of *aggressors*. Politicians benefit from crisis in the short-run as public attention is diverted away from economic hardship, but lose in the long-run as costs mount and growth opportunities are lost. Economists estimate the cost of fighting at over $400 million[47] for each country. If the dispute continues or explodes into a full-blown war, the economic costs will exponentially increase.

Accordingly, changing the perception of external and internal threats challenging Ecuadorian security should be the first subject to be addressed. Reducing tensions with Peru and other neighboring countries through peace treaties would help alleviate external threats and allow for a reduced level of military expenditure. Involving a regional organization such as the Organization of American States to help monitor and enforce the treaty would help reduce the volatility of the threat because it would reduce the chance either country would back away from promises after entering into an agreement. Other covenants, for example treaties to encourage trade would improve relations, reduce the need for military readiness, and translate into spending cuts.

Reducing internal threats can be approached from many different ways. Working to improve the democratic process in Ecuador would strengthen people's faith in the system, helping to reduce guerrilla activity. Political reforms to reduce the emphasis on short-term constituency benefits (e.g., reducing the need for coalition building in the electoral process) should be explored and implemented. Encouraging the establishment of industries not dependent on world market prices would help reduce the frequency of boom-bust cycles. Currently, Ecuador's economy is very susceptible to economic shocks because its vital export industries—oil, shrimp, and bananas—are few in number. Diversification would reduce economic shocks which feed through to minimize economic hardship and internal threats.

To entice the military establishment into accepting cuts in their war-fighting budget, policy entrepreneurs could offer to expand the military's role in society to include other functions besides combat. For example, ready-reserve troops (similar to the US National Guard force) could augment civilian agencies to provide disaster relief, flood control, riot prevention, etc. Military leaders would preserve their influence and status in society, but their expanded role would be more beneficial to economic prosperity.

Domestic arms production facilities could be built to help keep money used to purchase arms within Ecuador's borders. Rather than paying foreigners to manufacture simple weapons such as machine-guns, Ecuador should study the costs and benefits associated with the construction of their own plants. Even though Ecuador may not have a comparative advantage in machine-gun production and the end product may be more expensive, any money spent would serve to employ Ecuadorian workers.

Ecuador needs to improve its statistics collection system—especially for both regional economic and military expenditure data—to allow for further study of this topic. Improved accounting procedures would allow for greater analytical and quantitative assessment of the marginal benefits of specific programs. Statistical

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[47] "Cost of Hostilities." A14.

examination to better understand the effect of military expenditure on economic performance is required to educate the Ecuadorian leadership about the implications of difficult policy choices.

Lastly, the relationship between increased economic activity/growth and development (e.g., distribution of wealth, the availability of health care, etc.) needs to be examined in order to translate benefits from a reduction in ME into a more equitable distribution of national income and into programs that serve the basic needs of Ecuadorian citizens.

5.2.3 Costa Rica: Model for Success?

Costa Rica's elimination of their armed forces provides a positive example for other Latin American countries. After their undisciplined army was humiliated by popular civilian forces during the Revolution of 1948, the new constitutional government disbanded the army and replaced it with a small, national police force. "Unique among [Latin America,] Costa Rican policy-makers are free of the anxieties created by an activist military."[48] Government officials do not fear military intervention in policy or a coup d'état in response to implementation of long-term beneficial, but short-term unpopular programs. The government is able to devote more resources to productive civilian uses, while still maintaining internal order in a region full of turmoil. Consequently, Costa Rica has enjoyed growth rates consistently above Latin American averages. That's not to say that there aren't negative aspects to the Costa Rican experience. Some Costa Rican presidents have had difficulty controlling popular demands for the rapid expansion of social and economic services. "When faced with fiscal crisis, Costa Rican presidents have found remedial policy options to be limited by popular expectations, past policy commitments, and active opposition to welfare policy reductions."[49]

The political atmosphere, internal conditions, and history of Ecuador and other Latin American countries may not permit the abolition of armed forces, but lessons from Costa Rica's relative success should studied. Comparable programs tailored to Ecuador's and other country's specific circumstances should be designed and implemented with fervor.

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[48] Wynia. pp. 16.

[49] Wynia. pp. 195.

Summary of Recommendations

♦ Reduce ME to the minimum level necessary to protect against changing internal and external threats.

In spite of a resistance to change, Ecuador can achieve tremendous gains in economic performance by making small adjustments to the military budget.

♦ Reduce expenditures for capital purchases (i.e., equipment and systems) and shift funding to programs that build the national infrastructure.

♦ If reducing ME is not feasible, hold level constant and use ME funding to advance personnel training.

♦ Pursue policy options that reduce the perception of threat to national security.

♦ Expand the military's role to encompass more civilian-related functions.

♦ Evaluate the economics of constructing domestic arms production facilities.

♦ Improve statistics collection systems and accounting procedures.

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Appendix

A.1.1 Table of Ecuadorian Military Expenditures

Year	Military Expenditure[50] US $ (Millions)
1964	21
1965	23
1966	24
1967	23
1968	24
1969	34
1970	33
1971	51
1972	71
1973	85
1974	96
1975	131
1976	139
1977	193
1978	175
1979	175
1980	185
1981	202
1982	218
1983	212
1984	176
1985	206
1986	226
1987	231
1988	219
1989	168
1990	204
1991	232

[50] US Arms Control & Disarmament Agency.

A.1.2 Table of Ecuadorian GDP

Year	GDP[51] Sucres (Millions)
1964	19,414
1965	20,700
1966	22,596
1967	25,238
1968	27,412
1969	30,144
1970	35,019
1971	40,048
1972	46,859
1973	62,229
1974	92,763
1975	107,740
1976	132,913
1977	166,376
1978	191,345
1979	234,000
1980	293,000
1981	349,000
1982	416,000
1983	560,000
1984	813,000
1985	1,110,000
1986	1,383,000
1987	3,020,000
1988	5,171,000
1989	8,204,000
1990	12,201,000
1991	19,452,000

[51] International Financial Statistics Yearbook.

A.1.3 Table of Relative Burden of Military Expenditures—1991[52]

		GNP Per Capita					
		< $200	$200-499	$500-999	$1,000-2,999	$3,000-9,999	>$10,000
ME / GNP	>10%	Ethiopia Afghanistan Mozambique Cambodia		Iraq Yemen	North Korea Syria Jordan	Saudi Arabia Oman Soviet Union	Kuwait Qatar UAE
	5-9.99%	Rwanda	Pakistan Chad Liberia	Angola Burma Zimbabwe Albania	Sudan Iran Turkey	Libya Bahrain Cyprus Yugoslavia Greece Taiwan	Israel Singapore
	2-4.99%	Tanzania Uganda Burundi Sierra Leone	Vietnam Nicaragua Laos Togo Kenya India Zambia Haiti	Sri Lanka Lesotho Mauritania Egypt Bolivia Philippines	Botswana Morocco Cuba South Africa Malaysia Venezuela Lebanon Chile China Congo El Salvador Thailand Colombia Uruguay Ecuador	Poland Romania Bulgaria South Korea Portugal Czechoslovakia Hungary	US UK France Norway Sweden Australia Netherlands Germany Belgium Italy Denmark Canada Finland
	1-1.99%	Somalia Bangladesh Nepal	Mali Zaire Guinea Niger Madagascar Guyana	Senegal Honduras Cameroon Indonesia Ivory Coast	Algeria Paraguay Swaziland Brazil Peru	Argentina	Switzerland
	<1%	Nigeria Ghana	Guatemala Dominican Republic	Jamaica Costa Rica Panama	Malta Trinidad & Tobago Mexico		Japan Luxembourg Iceland

[52] US Arms Control & Disarmament Agency.

A.2 Derivation of Savings Identity

GNP = Y = C + I + G + CA   [A1]

where GNP = gross national product, Y = national income, C = private consumption, I = investment, G = government spending, and CA = current account (exports - imports).

Solving for CA yields:

CA = Y - (C + I + G)   [A2]

Rearranging terms:

Y - C - G = CA + I   [A3]

In simple terms, savings in an economy equals the amount of money earned minus the amount of money spent. This translates into the following equation:

S = Y - C - G   [A4]

Substituting equation [A3] into equation [A4] yields the identity:

S = CA + I   [A5]

Solving for I yields:

I = S - CA

investment = savings - current account

Rewriting the CA as exports (X) minus imports (M):

I = S - (X - M)   [A7]

I = S + (M - X)   [A8]

investment = savings + trade surplus

A.3 Derivation of the Multiplier Effect of Military Expenditure on GDP Growth

Substituting the investment equation into GDP growth yields:

GDP growth = a_0 + a_1 (b_0 + b_1 (GDP growth) + b_2 (ME/GDP) + b_3 (net capital transfers/GDP)) + a_2 (ME/GDP) + a_3 (net capital transfers/GDP)

Rewritten, this equation becomes:

GDP growth = a_0 + a_1 (b_0)+ a_1 (b_1)(GDP growth) + a_1 (b_2)(ME/GDP) + a_1 (b_3)(net capital transfers/GDP) + a_2 (ME/GDP) + a_3 (net capital transfers/GDP)

Solving for GDP growth yields:

GDP growth - a_1 (b_1)(GDP growth) = a_0 + a_1 (b_0) + a_1 (b_2)(ME/GDP) + a_1 (b_3)(net capital transfers/GDP) + a_2 (ME/GDP) + a_3 (net capital transfers/GDP)

GDP growth (1- a_1 (b_1)) = a_0 + a_1 (b_0) + a_1 (b_2)(ME/GDP) + a_1 (b_3)(net capital transfers/GDP) + a_2 (ME/GDP) + a_3 (net capital transfers/GDP)

GDP growth = [a_0 + a_1 (b_0) + a_1 (b_2)(ME/GDP) + a_1 (b_3)(net capital transfers/GDP) + a_2 (ME/GDP) + a_3 (net capital transfers/GDP)] / [1 - a_1 (b_1)]

Taking the derivative of GDP growth with respect to the military expenditure burden yields:

∂ GDP growth) / ∂ ME Burden) = [a_1 (b_2) + a_2] / [1 - a_1 (b_1)]

Substituting the estimated coefficients into the multiplier yields:

∂ GDP growth) / ∂ ME Burden) = [(2.3841670)(-1.8473313) + 4.1491756] / [1 - (2.3841670)(.3473052)]

∂ GDP growth) / ∂ ME Burden) = - 1.483840557

A.4 Example Calculations of GDP Growth Foregone

This calculation is designed to show the cumulative effects of GDP growth over time. In other words, there is a compounding effect over time.

Growth rates for Ecuador for the years 1989 to 1992 are 0.255%, 2.923%, 4.765%, and 3.453% respectively.

If X equals the GDP in 1988, then the Ecuadorian economy at the end of 1992 equals:

X (1.00255) (1.02933) (1.04765) (1.03453) = 1.1183 X

The Ecuadorian economy grew almost 12% over that time period.

Case #1
Assuming the Ecuadorian government had cut the military expenditure burden by 1% in 1989 and no other year, then the growth is calculated as follows:

X (1.00255+0.01484) (1.02933) (1.04765) (1.03453) = 1.1350 X

The difference in the historical growth rate and for the reduced ME burden scenario equals:

1.1350 X - 1.1183 X = 0.0167 X

GDP foregone = 1.67%

Case #2
Assuming the Ecuadorian government had cut the military expenditure burden by 1% every year from 1989 to 1992, then the growth forgone calculation changes to:

X (1.00255+0.01484) (1.02933+0.01484) (1.04765+0.01484) (1.03453+0.01484) = 1.1844 X

GDP foregone = 1.1844 X - 1.1183 X =

6.61%

Translating this into Sucres lost:

0.0661 * (1992 GDP) = 0.0661 * (19,452E09 Sucres) = 1.2857772E12 Sucres

Converting this into US $ at an exchange rate = 2300 Sucres / US $ yields:

(1.2857772E12) / 2300 =

US $559 million .

A.5 Regression Results

A.5.1 Explanation of Estimation Techniques[53]

Ordinary Least Squares (OLS)

OLS is a mathematical method for identifying the *best* fitted line for a set of data. OLS chooses a line that minimizes the *sum of squares* of the vertical deviations of the actual points from the fitted line.[54] OLS produces the *best linear unbiased estimators*. The term *best* refers to minimum variance.

Three-Stage Least Squares (3SLS)

3SLS is a mathematical method of estimating a system of equations. "3SLS involves the application of generalized least-squares estimation to the system of equations, each of which has first been estimated using two-stage least squares (2SLS). In the first stage of the process, the reduced form of the model system is estimated. The fitted values of the endogenous variables are then used to get 2SLS estimates of all the equations in the system. Once the 2SLS parameters have been calculated, the residuals of each equation are used to estimate the cross-equation variances and covariances. In the third and final stage of the estimation process, generalized least-squares parameter estimates are obtained."[55]

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[53] Statistical analysis completed using Micro TSP Version 7.0, an IBM computer package offering time series analysis, regression, and forecasting. TSP is a product of Quantitative Micro Software.

[54] Hillier and Lieberman. pp. 757.

[55] Pindyck and Rubinfeld. pp. 310-311.

A.5.2 Glossary of Data

Abbreviation	Explanation	Unit of Measurement	Source/Derivation
AG	agriculture, hunting, and fishing	Sucres (millions)	Statistical Abstract of Latin America
BURDEN	military expenditure burden	fraction	R.ME/R.GDP
CA	current account	US $ (millions)	International Financial Statistics Yearbook
CA.Z	current account as a proportion of GDP	fraction	R.CA/R.GDP
COMM	community, social, and personal services	Sucres (millions)	Statistical Abstract of Latin America
CONST	construction	Sucres (millions)	Statistical Abstract of Latin America
CPI	consumer price index (Ecuador)	base year = 1990	International Financial Statistics Yearbook
DIFF	government spending minus military expenditure	constant Sucres (millions)	R.G-R.ME
ELEC	electricity, gas, and water	Sucres (millions)	Statistical Abstract of Latin America
FORCE	# of personnel in armed forces	people	US Arms Control & Disarmament Agency
G	government spending	Sucres (millions)	
G.GROW	growth in government spending (annual)	percent	log(R.G)-log(R.G(-1))
GDP	gross domestic product	Sucres (millions)	International Financial Statistics Yearbook
GDP.GROW	GDP growth (annual)	fraction	log(R.GDP)-log(R.GDP(-1))
GDPDEF	GDP deflator	base year = 1990	International Financial Statistics Yearbook
I	investment	Sucres (millions)	International Financial Statistics Yearbook
I.PRCNT	investment as a proportion of GDP	fraction	R.I/R.GDP
INFL	inflation	percent	100*(log(GDPDEF)-log(GDPDEF(-1)))
LATIN	# of tourist visiting Latin America (annual)	people	Statistical Abstract of Latin America
MAN	manufacturing	Sucres (millions)	Statistical Abstract of Latin America
ME	military expenditure	current US $ (millions)	US Arms Control and Disarmament Agency
MINE	mining and quarrying	Sucres (millions)	Statistical Abstract of Latin America
POP	population	people (millions)	International Financial Statistics Yearbook
POP.GROW	population growth (annual)	fraction	log(POP)-log(POP(-1)
PPP	difference between Purchasing Price Parity & the exchange rate (assumes equilibrium in 1990)	Sucres / US $	((CPI/USCPI)*1249.4-S)

PPP.Z	PPP as a proportion of the spot exchange rate	ratio	PPP/S
R.AG	agriculture, hunting, forestry, and fishing	constant Sucres (millions)	AG/(GDPDEF/100)
R.COMM	community, social, and personal services	constant Sucres (millions)	COMM/(GDPDEF/100)
R.CONST	construction	constant Sucres (millions)	CONST/(GDPDEF/100)
R.ELEC	electricity, gas, and water	constant Sucres (millions)	ELEC/(GDPDEF/100)
R.G	government spending	constant Sucres (millions)	G/(GDPDEF/100)
R.GDP	real gross domestic product	Sucres (millions)	GDP/(GDPDEF/100)
R.I	investment	constant Sucres (millions)	I/(GDPDEF/100)
R.MAN	manufacturing	constant Sucres (millions)	MAN/(GDPDEF/100)
R.ME	military expenditure	constant Sucres (millions)	(ME*S)/(GDPDEF/100)
R.MINE	mining and quarrying	constant Sucres (millions)	MINE/(GDPDEF/100)
R.RETAIL	wholesale and retail trade, restaurants, and hotels	constant Sucres (millions)	RETAIL/(GDPDEF/100)
R.REV	government revenue	constant Sucres (millions)	R/(GDPDEF/100)
R.S.CA	current account	constant Sucres (millions)	S.CA/(GDPDEF/100)
R.TRANS	transport, storage, and communication	constant Sucres (millions)	TRANS/(GDPDEF/100)
R.Y	income	constant Sucres (millions)	Y/(GDPDEF/100)
RETAIL	wholesale and retail trade, restaurants, and hotels	Sucres (millions)	Statistical Abstract of Latin America
REV	government revenue	Sucres (millions)	International Financial Statistics Yearbook
S	spot exchange rate	Sucres per SDR	International Financial Statistics Yearbook
S.CA	current account	Sucres (millions)	CA*S
TOUR	# of tourist visiting Ecuador (annual)	people	Statistical Abstract of Latin America
TRANS	transport, storage, and communication	Sucres (millions)	Statistical Abstract of Latin America
UNEMP	urban unemployment	percent	Statistical Abstract of Latin America
USCPI	consumer price index (United States)	base year = 1990	International Financial Statistics Yearbook
Y	national income	Sucres (millions)	International Financial Statistics Yearbook

NOTE: X(-1) = previous year's level of X

A.5.3 Investment Model

System of Equations:
1:GDP.GROW = C(1) + C(2)*(R.I/R.GDP)+ C(3)*(R.ME/R.GDP) + C(4)*CA.Z
2:I.PRCNT = C(5) + C(6)*GDP.GROW + C(7)*(R.ME/R.GDP) + C(8)*CA.Z
3:BURDEN = C(9) + C(10)*PPP.Z*R.Y/POP + C(11)*POP + C(12)*R.GDP

Instrumental Variables:
R.GDP R.S.CA POP R.Y PPP.Z G.GROW R.REV

Method of Estimation:
Three-Stage Least-Squares Regression

Sample Range:
1964 - 1991

Number of Observations: 27

A.5.3.1 Summary of Results

```
=====================================================================
                           Coefficients
=====================================================================
   C(1)   -0.414669   C(2)    2.384167   C(3)    4.149176   C(4)    1.721037
   C(5)    0.184519   C(6)    0.347305   C(7)   -1.847331   C(8)   -0.651104
   C(9)    0.008978   C(10)  -3.59E-10   C(11)   0.004937   C(12)  -3.28E-09
=====================================================================
                    Residual Covariance Matrix
=====================================================================
   1,1    0.009472   1,2   -0.003820   1,3   -0.000417   2,2    0.001573
   2,3    0.000197   3,3    5.78E-05
=====================================================================
                    Residual Correlation Matrix
=====================================================================
   1,1    1.000000   1,2   -0.989423   1,3   -0.562873   2,2    1.000000
   2,3    0.652686   3,3    1.000000
=====================================================================
 Determinant(Residual Covariance Matrix)   4.485E-12
=====================================================================
```

A.5.3.2 Equation 1—GDP Growth

GDP.GROW = C(1) + C(2)*(R.I/R.GDP)+ C(3)*(R.ME/R.GDP) + C(4)*CA.Z

```
=====================================================================
              COEFFICIENT   STD. ERROR    T-STAT.    2-TAIL SIG.
=====================================================================
   C(1)       -0.4146694    0.0842742   -4.9204815    0.0000
   C(2)        2.3841670    0.4326340    5.5108172    0.0000
   C(3)        4.1491756    1.9371986    2.1418431    0.0357
   C(4)        1.7210374    0.3948393    4.3588297    0.0000
=====================================================================
                      Unweighted Statistics
=====================================================================
R-squared                 -0.605740   Mean of dependent var    0.051241
S.D. of dependent var      0.078265   S.E. of regression       0.105446
```

```
Sum of squared resid      0.255733    Durbin-Watson stat      1.791708
===================================================================
```

A.5.3.2.1 Graph of Predicted Versus Actual GDP Growth Rates

Reference Figure 4 in Chapter 4.

A.5.3.3 Equation 2—Investment Ratio

I.PRCNT = C(5) + C(6)*GDP.GROW + C(7)*(R.ME/R.GDP) + C(8)*CA.Z

	COEFFICIENT	STD. ERROR	T-STAT.	2-TAIL SIG.
C(5)	0.1845186	0.0200095	9.2215728	0.0000
C(6)	0.3473052	0.0653081	5.3179491	0.0000
C(7)	-1.8473313	0.8056334	-2.2930173	0.0249
C(8)	-0.6511040	0.1368262	-4.7586197	0.0000

Unweighted Statistics

R-squared	-0.047014	Mean of dependent var	0.190803
S.D. of dependent var	0.039504	S.E. of regression	0.042977
Sum of squared resid	0.042481	Durbin-Watson stat	1.409312

A.5.3.3.1 Graph of Predicted Versus Actual Investment Ratios
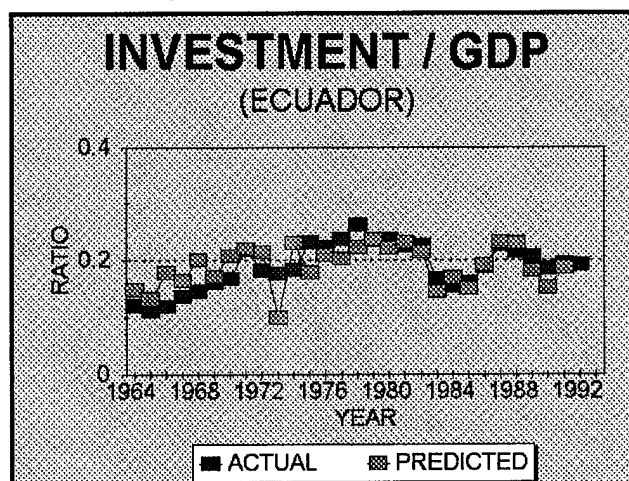
A.5.3.4 Equation 3—Military Burden Ratio

BURDEN = C(9) + C(10)*PPP.Z*R.Y/POP + C(11)*POP + C(12)*R.GDP

	COEFFICIENT	STD. ERROR	T-STAT.	2-TAIL SIG.
C(9)	0.0089778	0.0181924	0.4934915	0.6232
C(10)	-3.588E-10	1.385E-10	-2.5908308	0.0117
C(11)	0.0049375	0.0048183	1.0247409	0.3091
C(12)	-3.281E-09	3.733E-09	-0.8788548	0.3825

Unweighted Statistics

R-squared	0.343752	Mean of dependent var	0.026471
S.D. of dependent var	0.009566	S.E. of regression	0.008240

```
Sum of squared resid        0.001562    Durbin-Watson stat        0.645815
========================================================================
```

A.5.3.4.1 Graph of Actual Versus Predicted Military Burden Ratios
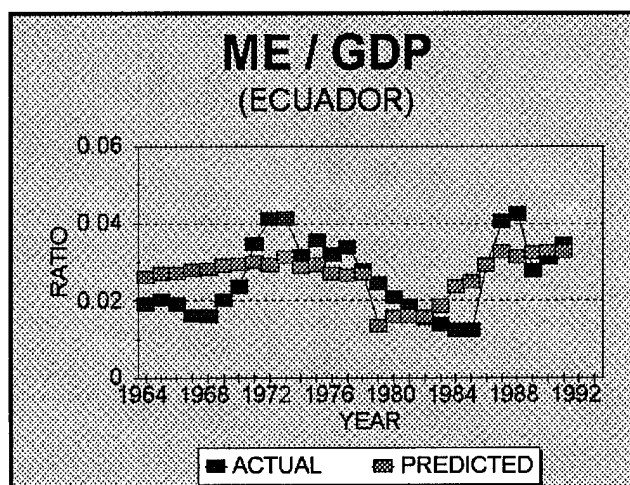
A.5.4 Current Account Model

Method of Estimation:
Ordinary Least Squares

Sample Range:
1964 - 1991

Number of Observations:
26

Dependent Variable:
R.S.CA

```
=============================================================
    VARIABLE      COEFFICIENT   STD. ERROR     T-STAT.    2-TAIL SIG.
=============================================================
       C          -23931408.    7666506.6    -3.1215531    0.0054
       S          -2853.2923    848.83648    -3.3614158    0.0031
     S(-2)         4942.3007    1645.4369     3.0036404    0.0070
      R.ME         -3.6980527   1.0988846    -3.3652786    0.0031
      DIFF         -2.7329463   0.7919786    -3.4507831    0.0025
      LGDP          1661384.7   530993.61     3.1288223    0.0053
=============================================================
R-squared               0.732874   Mean of dependent var   -346550.1
Adjusted R-squared      0.666092   S.D. of dependent var    340138.3
S.E. of regression      196548.1   Sum of squared resid     7.73E+11
Log likelihood         -350.3869   F-statistic              10.97419
Durbin-Watson stat      1.887103   Prob(F-statistic)        0.000035
=============================================================
```

A.5.5 Testing Industry Output for Spin-offs

Method of Estimation:
Ordinary Least Squares

Sample Range:
1981 - 1991

Number of Observations:
11

A.5.5.1 Agriculture, Hunting, Forestry, and Fishing

Dependent Variable:
R.AG

VARIABLE	COEFFICIENT	STD. ERROR	T-STAT.	2-TAIL SIG.
C	303113.75	265491.37	1.1417085	0.2866
R.AG(-1)	0.6989000	0.2889128	2.4190690	0.0419
R.ME	0.6583337	0.5949369	1.1065606	0.3006

R-squared	0.833117	Mean of dependent var	1286105.
Adjusted R-squared	0.791397	S.D. of dependent var	209266.6
S.E. of regression	95578.57	Sum of squared resid	7.31E+10
Log likelihood	-140.0016	F-statistic	19.96894
Durbin-Watson stat	1.909164	Prob(F-statistic)	0.000776

Dependent Variable:
R.AG

VARIABLE	COEFFICIENT	STD. ERROR	T-STAT.	2-TAIL SIG.
C	14380.251	258706.13	0.0555853	0.9570
R.AG(-1)	1.0862507	0.2730712	3.9779031	0.0041
R.ME(-1)	-0.3226294	0.5967429	-0.5406506	0.6035

R-squared	0.814357	Mean of dependent var	1286105.
Adjusted R-squared	0.767947	S.D. of dependent var	209266.6
S.E. of regression	100807.7	Sum of squared resid	8.13E+10
Log likelihood	-140.5875	F-statistic	17.54677
Durbin-Watson stat	2.602923	Prob(F-statistic)	0.001188

A.5.5.2 Community, Social, and Personal Services

Dependent Variable:
R.COMM

```
=============================================================
    VARIABLE     COEFFICIENT   STD. ERROR     T-STAT.    2-TAIL SIG.
=============================================================
        C         111322.54    112742.20    0.9874079     0.3524
   R.COMM(-1)    0.7238095     0.2597535    2.7865243     0.0237
      R.ME       0.1539488     0.0938438    1.6404782     0.1395
=============================================================
R-squared                0.709344   Mean of dependent var    476138.7
Adjusted R-squared       0.636680   S.D. of dependent var    40571.05
S.E. of regression       24454.63   Sum of squared resid     4.78E+09
Log likelihood          -125.0072   F-statistic              9.761954
Durbin-Watson stat       1.961799   Prob(F-statistic)        0.007137
=============================================================
```

Dependent Variable:
R.COMM

```
=============================================================
    VARIABLE     COEFFICIENT   STD. ERROR     T-STAT.    2-TAIL SIG.
=============================================================
        C         161003.96    108377.08    1.4855906     0.1757
   R.COMM(-1)    0.5962331     0.2538683    2.3485919     0.0468
     R.ME(-1)    0.2185909     0.0973330    2.2458047     0.0549
=============================================================
R-squared                0.761765   Mean of dependent var    476138.7
Adjusted R-squared       0.702206   S.D. of dependent var    40571.05
S.E. of regression       22139.83   Sum of squared resid     3.92E+09
Log likelihood          -123.9133   F-statistic              12.79012
Durbin-Watson stat       1.613975   Prob(F-statistic)        0.003221
=============================================================
```

A.5.5.3 Construction

Dependent Variable:
R.CONST

VARIABLE	COEFFICIENT	STD. ERROR	T-STAT.	2-TAIL SIG.
C	442130.65	330508.60	1.3377282	0.2178
R.CONST(-1)	0.4991016	0.3326351	1.5004478	0.1719
R.ME	0.0060259	0.3548349	0.0169824	0.9869

R-squared	0.233438	Mean of dependent var		897597.9
Adjusted R-squared	0.041798	S.D. of dependent var		103603.6
S.E. of regression	101415.3	Sum of squared resid		8.23E+10
Log likelihood	-140.6536	F-statistic		1.218104
Durbin-Watson stat	1.543906	Prob(F-statistic)		0.345294

Dependent Variable:
R.CONST

VARIABLE	COEFFICIENT	STD. ERROR	T-STAT.	2-TAIL SIG.
C	445832.53	302930.26	1.4717332	0.1793
R.CONST(-1)	0.4972462	0.3192830	1.5573838	0.1580
R.ME(-1)	-0.0047171	0.3614443	-0.0130508	0.9899

R-squared	0.233427	Mean of dependent var		897597.9
Adjusted R-squared	0.041783	S.D. of dependent var		103603.6
S.E. of regression	101416.0	Sum of squared resid		8.23E+10
Log likelihood	-140.6537	F-statistic		1.218027
Durbin-Watson stat	1.544920	Prob(F-statistic)		0.345314

A.5.5.4 Electricity, Gas, and Water

Dependent Variable:
R.ELEC

```
=================================================================
     VARIABLE      COEFFICIENT   STD. ERROR    T-STAT.    2-TAIL SIG.
=================================================================
         C         107305.82     44764.520    2.3971178     0.0434
    R.ELEC(-1)      0.1628850     0.3277645    0.4969574     0.6326
        R.ME        0.0491461     0.0468884    1.0481506     0.3252
=================================================================
R-squared               0.154429   Mean of dependent var    138954.9
Adjusted R-squared     -0.056964   S.D. of dependent var    13538.06
S.E. of regression      13918.31   Sum of squared resid     1.55E+09
Log likelihood         -118.8074   F-statistic              0.730529
Durbin-Watson stat      1.662120   Prob(F-statistic)        0.511212
=================================================================
```

Dependent Variable:
R.ELEC

```
=================================================================
     VARIABLE      COEFFICIENT   STD. ERROR    T-STAT.    2-TAIL SIG.
=================================================================
         C         116970.06     44180.849    2.6475286     0.0294
    R.ELEC(-1)      0.0844280     0.3368310    0.2506539     0.8084
      R.ME(-1)      0.0586544     0.0511356    1.1470378     0.2845
=================================================================
R-squared               0.174132   Mean of dependent var    138954.9
Adjusted R-squared     -0.032335   S.D. of dependent var    13538.06
S.E. of regression      13755.19   Sum of squared resid     1.51E+09
Log likelihood         -118.6777   F-statistic              0.843390
Durbin-Watson stat      1.601466   Prob(F-statistic)        0.465203
=================================================================
```

A.5.5.5 Manufacturing

Dependent Variable:
R.MAN

```
=============================================================
    VARIABLE     COEFFICIENT   STD. ERROR     T-STAT.    2-TAIL SIG.
=============================================================
       C         745085.15     525065.37    1.4190331     0.1937
    R.MAN(-1)    0.7582393     0.1827841    4.1482770     0.0032
      R.ME       1.8937895     1.3310305    1.4227995     0.1926
=============================================================
R-squared              0.905585    Mean of dependent var    4015082.
Adjusted R-squared     0.881981    S.D. of dependent var    705301.7
S.E. of regression     242298.5    Sum of squared resid     4.70E+11
Log likelihood         -150.2340   F-statistic              38.36609
Durbin-Watson stat     2.459602    Prob(F-statistic)        0.000079
=============================================================
```

Dependent Variable:
R.MAN

```
=============================================================
    VARIABLE     COEFFICIENT   STD. ERROR     T-STAT.    2-TAIL SIG.
=============================================================
       C         306967.88     590328.97    0.5199946     0.6171
    R.MAN(-1)    0.9720653     0.2044329    4.7549362     0.0014
     R.ME(-1)   -0.0762904     1.5798198   -0.0482906     0.9627
=============================================================
R-squared              0.881728    Mean of dependent var    4015082.
Adjusted R-squared     0.852160    S.D. of dependent var    705301.7
S.E. of regression     271188.2    Sum of squared resid     5.88E+11
Log likelihood         -151.4731   F-statistic              29.82037
Durbin-Watson stat     3.008253    Prob(F-statistic)        0.000196
=============================================================
```

A.5.5.6 Mining and Quarrying

Dependent Variable:
R.MINE

VARIABLE	COEFFICIENT	STD. ERROR	T-STAT.	2-TAIL SIG.
C	1210620.7	644861.27	1.8773351	0.0973
R.MINE(-1)	0.3642569	0.3295879	1.1051891	0.3012
R.ME	-0.5049854	1.0720805	-0.4710331	0.6502

R-squared	0.171541	Mean of dependent var	1742971.
Adjusted R-squared	-0.035573	S.D. of dependent var	310034.6
S.E. of regression	315500.9	Sum of squared resid	7.96E+11
Log likelihood	-153.1379	F-statistic	0.828243
Durbin-Watson stat	1.542754	Prob(F-statistic)	0.471068

Dependent Variable:
R.MINE

VARIABLE	COEFFICIENT	STD. ERROR	T-STAT.	2-TAIL SIG.
C	834106.87	676854.09	1.2323289	0.2528
R.MINE(-1)	0.4497332	0.3357184	1.3396141	0.2172
R.ME(-1)	0.7296147	1.1588805	0.6295858	0.5465

R-squared	0.188760	Mean of dependent var	1742971.
Adjusted R-squared	-0.014051	S.D. of dependent var	310034.6
S.E. of regression	312205.1	Sum of squared resid	7.80E+11
Log likelihood	-153.0224	F-statistic	0.930720
Durbin-Watson stat	1.831245	Prob(F-statistic)	0.433110

A.5.5.7 Wholesale and Retail Trade, Restaurants, and Hotels

Dependent Variable:
R.RETAIL

VARIABLE	COEFFICIENT	STD. ERROR	T-STAT.	2-TAIL SIG.
C	100666.38	190303.42	0.5289783	0.6112
R.RETAIL(-1)	0.9261503	0.1348997	6.8654710	0.0001
R.ME	0.8885759	0.6322318	1.4054589	0.1975

R-squared	0.960048	Mean of dependent var	2147886.
Adjusted R-squared	0.950060	S.D. of dependent var	489986.7
S.E. of regression	109498.6	Sum of squared resid	9.59E+10
Log likelihood	-141.4972	F-statistic	96.12006
Durbin-Watson stat	2.474517	Prob(F-statistic)	0.000003

Dependent Variable:
R.RETAIL

VARIABLE	COEFFICIENT	STD. ERROR	T-STAT.	2-TAIL SIG.
C	-68449.647	217116.44	-0.3152670	0.7606
R.RETAIL(-1)	1.1109119	0.1548353	7.1747992	0.0001
R.ME(-1)	-0.1829727	0.7700916	-0.2375986	0.8182

R-squared	0.950532	Mean of dependent var	2147886.
Adjusted R-squared	0.938165	S.D. of dependent var	489986.7
S.E. of regression	121842.9	Sum of squared resid	1.19E+11
Log likelihood	-142.6722	F-statistic	76.86086
Durbin-Watson stat	2.683887	Prob(F-statistic)	0.000006

A.5.5.8 Transport, Storage, and Communication

Dependent Variable:
R.TRANS

```
================================================================
     VARIABLE     COEFFICIENT  STD. ERROR    T-STAT.   2-TAIL SIG.
================================================================
          C       414232.48    160375.14    2.5828971    0.0325
   R.TRANS(-1)    0.4879817    0.1976312    2.4691532    0.0388
        R.ME      0.8715002    0.3656147    2.3836574    0.0443
================================================================
R-squared              0.861538   Mean of dependent var    1092491.
Adjusted R-squared     0.826922   S.D. of dependent var    169297.1
S.E. of regression     70432.06   Sum of squared resid     3.97E+10
Log likelihood        -136.6433   F-statistic              24.88872
Durbin-Watson stat     2.882252   Prob(F-statistic)        0.000368
================================================================
```

Dependent Variable:
R.TRANS

```
================================================================
     VARIABLE     COEFFICIENT  STD. ERROR    T-STAT.   2-TAIL SIG.
================================================================
          C       354906.93    206710.62    1.7169264    0.1243
   R.TRANS(-1)    0.6047562    0.2599609    2.3263350    0.0484
      R.ME(-1)    0.5927168    0.5103681    1.1613515    0.2790
================================================================
R-squared              0.797361   Mean of dependent var    1092491.
Adjusted R-squared     0.746701   S.D. of dependent var    169297.1
S.E. of regression     85205.16   Sum of squared resid     5.81E+10
Log likelihood        -138.7378   F-statistic              15.73956
Durbin-Watson stat     2.608943   Prob(F-statistic)        0.001686
================================================================
```

A.5.6.1 The Market Security/Tourism Model

\# of Tourists = f(Military Expenditure, Exchange Rate, PPP variable)

Method of Estimation:
Ordinary Least Squares

SMPL range:
1970 - 1990

Number of Observations:
12

Dependent Variable:
TOUR

```
===============================================================
       VARIABLE      COEFFICIENT    STD. ERROR     T-STAT.    2-TAIL SIG.
===============================================================
          C          -1058506.7     485579.38    -2.1798839    0.0609
      log(R.ME)       94968.044     44600.403     2.1293091    0.0659
      log(S)          35017.257     14481.064     2.4181412    0.0420
      PPP.Z           38009.138     17964.212     2.1158255    0.0673
===============================================================
R-squared                 0.849866   Mean of dependent var     245545.1
Adjusted R-squared        0.793566   S.D. of dependent var      87027.03
S.E. of regression        39540.76   Sum of squared resid       1.25E+10
Log likelihood          -141.6155    F-statistic                15.09525
Durbin-Watson stat        1.607691   Prob(F-statistic)           0.001173
===============================================================
```

A.5.6.2 Ecuador's Relative Success Attracting Tourism

of Tourists = f(Military Expenditure, Exchange Rate, PPP Variable, Total # of Tourists Visiting Latin America)

Method of Estimation:
Ordinary Least Squares

SMPL range:
1970 - 1990

Number of Observations:
11

Dependent Variable:
TOUR

VARIABLE	COEFFICIENT	STD. ERROR	T-STAT.	2-TAIL SIG.
C	-1263839.5	572759.77	-2.2065786	0.0695
log(R.ME)	95087.323	49642.966	1.9154239	0.1039
log(S)	69620.884	19949.792	3.4898050	0.0130
PPP.Z	57094.852	22808.542	2.5032223	0.0463
LATIN	-0.0015018	0.0041139	-0.3650562	0.7276

R-squared	0.884803	Mean of dependent var	237727.8
Adjusted R-squared	0.808005	S.D. of dependent var	86743.46
S.E. of regression	38008.60	Sum of squared resid	8.67E+09
Log likelihood	-128.2758	F-statistic	11.52116
Durbin-Watson stat	1.436824	Prob(F-statistic)	0.005587

A.5.7 Unemployment = f(# of Military Personnel)

Method of Estimation:
Ordinary Least Squares

Sample Range:
1979 - 1989

Number of Observations: 11

Dependent Variable:
log(UNEMP)

```
===========================================================================
      VARIABLE     COEFFICIENT   STD. ERROR      T-STAT.    2-TAIL SIG.
===========================================================================
         C         -3.0627076    2.0143391     -1.5204528     0.1627
     log(FORCE)     1.3755401    0.5463879      2.5175157     0.0329
===========================================================================
R-squared                0.413218   Mean of dependent var    2.006103
Adjusted R-squared       0.348020   S.D. of dependent var    0.250237
S.E. of regression       0.202055   Sum of squared resid     0.367435
Log likelihood           3.086750   F-statistic              6.337885
Durbin-Watson stat       1.086973   Prob(F-statistic)        0.032902
===========================================================================
```

A.5.8 Military Expenditure = f(# of Military Personnel)

Method of Estimation:
Ordinary Least Squares

Sample Range:
1964 - 1991

Number of Observations: 28

Dependent Variable:
log(R.ME)

```
=======================================================================
      VARIABLE     COEFFICIENT   STD. ERROR     T-STAT.    2-TAIL SIG.
=======================================================================
         C          13.509919    1.8515391     7.2965884     0.0000
    log(FORCE)       1.1699474    0.1809385     6.4659966     0.0000
=======================================================================
R-squared                 0.616571   Mean of dependent var    25.47098
Adjusted R-squared        0.601823   S.D. of dependent var     0.664958
S.E. of regression        0.419597   Sum of squared resid      4.577592
Log likelihood          -14.37584   F-statistic              41.80911
Durbin-Watson stat        0.387092   Prob(F-statistic)         0.000001
=======================================================================
```

A.6 Granger Test Results

A.6.1 Theory

The Granger test determines whether changes in one variable are a cause of changes in another. In other words, the Granger test is a check of causality.

"If X causes Y, then changes in X should *precede* changes in Y. In particular, to say that *X causes Y*, two conditions should be met. First, X should help to predict Y, i.e., in a regression of Y against past values of Y, the addition of past values of X as independent variables should contribute significantly to the explanatory power of the regression. Second, Y should not help to predict X. The reason is that if X helps to predict Y and Y helps to predict X, it is likely that one or more other variables are in fact *causing* both X and Y."[56]

Procedure
Test "X does not cause Y."
1. Regress Y against lagged values of Y and lagged values of X (the "unrestricted" regression).
2. Regress only against lagged values of Y (the "restricted" regression).
3. Use an F-test to determine whether the lagged values of X contribute significantly to the explanatory power of the first regression.

Test "Y does not cause X."
(Test in the same manner as above.)

If the test rejects the hypothesis "X does not cause Y" <u>and</u> fails to reject the hypothesis "Y does not cause X," then X *Granger causes* Y.

---

[56] Pindyck and Rubinfeld. pp. 216.

A.6.2 Do changes in the GDP growth rate cause changes in the Military Expenditure Burden?

```
Null hypothesis:                             F-statistic  Probability
=====================================================================
GDP.GROW is not Granger Caused by BURDEN      19.89821      0.0487
BURDEN is not Granger Caused by GDP.GROW       1.401155     0.4814
=====================================================================
```

Changes in GDP growth do NOT cause changes in Burden.

Note: this test suggests the opposite—changes in Burden cause changes in GDP growth.

A.6.3 Do changes in the Military Expenditure level cause changes in the Urban Unemployment Rate?

```
Null hypothesis:                          F-statistic  Probability
==================================================================
UNEMP is not Granger Caused by BURDEN       0.589097     0.7164
BURDEN is not Granger Caused by UNEMP       21.17151     0.1581
==================================================================
```

Changes in the Burden do NOT cause changes in unemployment.