How Crime can Affect Economic Performance through the Application of an ECM-Model: the Case of Guatemala

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Abstract

Crime has a potentially large impact on economic growth but measuring their economic impact is subject to a great deal of uncertainty. The central objective of this paper is to set forth a model – the economics of crime monitoring model (ECM-Model) – to evaluate the impact of crime can affect economic performance. The model is based on five basic indicators – (i) the total crime frequency rate (β); (ii) the national crime vulnerability rate (μT); (iii) the crime devastation magnitude rate (λ); (iv) the economic desgrowth rate (δ); (v) and the crime vulnerability surface (VV-Surface). In addition, this research applies the ECM-Model in the case of Guatemala to evaluate how crime affects economic performance in a small developing country.

1. Introduction

The idea to write this paper is originated by the paper wrote by Gary Becker (1968). According to our research Becker's paper is given origin to the first theoretical framework of the economics of crime. Hence, Baker's paper presents a basic explanation about the economic cost of crime. Additionally, the same paper introduces a basic model that is presenting a serial of equations, limits, and conditions that facilitate the explanation between exogenous and endogenous variables relationship. In fact, the same model applies first derivatives to represent the marginal cost and marginal revenue to analyze the benefit/cost effect of crime, at the same time, the application of welfare economics to analyze the relationship between crime and punishment. Finally, the great contribution of Becker's paper is the introduction of the theory of collusion to support the legalization and punishment through the establishment of strict and applicable legal frameworks respectively. Therefore, we can mention that in our research we find that major part of models in analyzing economics of crime is based on the analysis of benefit/cost (opportunity/punishment), comparative historical data (absolute and relative values), correlations and forecasting (Bertrand, Marianne, Duflo, and Mullainathan, 2004). Another important research papers about economics of crime need to be mentioned in this research is from Passell and Taylor (1977), Goldstein (1985), Cameron (1988), Cronwell (1994), Freeman (1999), Dills, Miron, Summers (2008), and Costa (2010). All these authors were mentioned before extend the theoretical framework and analysis of economics of crime by using different research approaches such as qualitative (legal) and quantitative (economics) respectively. In our case we like to propose a new model to monitoring economics of crime. The central objective of our paper is to set forth a model – the economics of crime monitoring model (**ECM-Model**– to evaluate the impact of crime on GNP growth. The model is based on five basic indicators - (i) the total crime frequency rate (**β**); (ii) the national crime vulnerability rate ($\boldsymbol{\mu_T}$); (iii) the crime devastation magnitude rate (**λ**); (iv) the economic desgrowth rate (**δ**); (v) and the crime vulnerability surface (**VV-Surface**). Furthermore, this model is also based on elements from an alternative mathematical approach analysis framework from a multidimensional perspective. We look at different types of crimes that occurred around Guatemala between 1997 and 2012. To illustrate and illuminate the ECM-Model, we apply it to assess the economic impact of different events of crime on Guatemala. For comparative purposes, we also apply the model to an earlier Guatemala case. We hope that the ECM-Model will contribute toward a more systematic and accurate measurement of the economics of crime on the economic growth of any nation. Almost 95% of whole research about economics of crime was applied on the case of U.S. In this opportunity we are interested to apply economics of crime in the case of Guatemala to study the economics of crime from a small developing country point of view.

A General Overview about Guatemala

Guatemala consists of approximately 108,889 sq. Km. that is distributed in 22 departments. The population in Guatemala was estimated to be more than 14 million in the year 2,012 (INE, 2012). Guatemala is located along the narrow isthmus that links North America with South America at Mexico, El Salvador, and Honduras respectively. The Pacific Ocean lies on the West, and the Caribbean Sea on the Eastern part. In the case of land extension .in Guatemala is the third largest country in Central America. Guatemala land has the following characteristics: arable 14%, pastures 6%, and forest 80% respectively (Banguat, 2011).

The distribution of the land in Guatemala has the same agrarian structural characteristics by large farms are called in Spanish "Latifundios". The Latifundios definition is originated from the colonial Spanish monarchy period on Guatemala around 1800's (Peláez Almengor, 1973). The distribution of the land in Guatemala can show a large concentration of 65% that is distributed among 10% of the total population of Guatemala according to the GINI coefficient. Whole land is used for plantation of coffee, cotton, bananas, sugar cane, and tropical crops. In the high lands of Guatemala we can find the traditional subsistence agriculture sector that in Spanish is called "Minifundios." This type of agriculture structure is used basically to produce beans, corn, and vegetables. This means that 90% of the total Guatemalan population is owner of 35% of the total land in Guatemala.

Concerning the population aspect of Guatemala, the most populous country in Central America is Guatemala with 14 million people around one-third of Central America total population. In order of importance are El Salvador, Honduras, Nicaragua, Costa Rica, and Panama (SIECA, 2010). The population structure in Guatemala is distributed by Meztizos (mixed of Amerindian and Spanish immigrants that long time ago arrive to Guatemala) that is representing more than 50% of the Guatemalan population. The Amerindian (Mayans) represents 47% and the rest of the Guatemalan population is distributed among other minorities groups such as Europeans and Asians is 3% (INE, 2011).

The annual growth population rate in Guatemala is around 2% and infant mortality is 26 births/1000 populations respectively. 60% of Guatemala population is between 15 and 65 years. Life expectancy average is around 55 years in Guatemala (WHO, 2012). The literacy rate is approximately 65% of the total Guatemalan population (United Nations, 2012). For income per-capita Guatemala is $5,200 per year. The largest GDP shares in Central America belong to Guatemala with 75 billion U.S. Dollars (Banguat, 2011). The Guatemalan economy is based on the service sector that represents the 63% of the total GDP. In the case the Agriculture sector has a participation of 15% and the industrial sector with 25% according to World Bank (2012).

The Evolution of Crime and Violence in Guatemala between 1980's and 1990's

Between 1980's and 1990's Guatemala experienced difficult moments with armed conflict that affected this country. The economic and social problems that Guatemala face such as high inflation, unemployment and poverty (population growth rate didn't respond to the total Growth National Production growth rate –GNP-). Three countries suffered the greatest per-capita income losses; in order Guatemala, El Salvador, and Nicaragua. Actually, these economic and social problems were mentioned before persist until the present days. Therefore, the International Monetary Fund (IMF) and the World Bank (WB) recommend a serial of policies for Guatemala to improve its economic performance. These policies suggested by IMF and WB is following by (i) the floating exchange rate to keep competitive exports in the international market and attract Foreign Direct Investments (FDI); (ii) more controls on money supply by the central bank; (iii) the increment taxation (direct and indirect taxes); (iv) the reduction of government expenditure justified by the large bureaucracy and inefficient public companies results; (v) the privatization of public services and companies (such as electricity power, water

supply, transportation systems, telecommunications systems, infrastructure systems, public education, low cost housing, and public health care system). But these policies implemented by Guatemala only generate a negative impact on major part of its population. It is possible to be observed by the fast and high poverty growth rates in Guatemala. Additionally, Guatemala experiences other structural problems such as:

1. The Guatemalan production and international trade structure has been vulnerable to the international prices of the traditional agriculture products such as Coffee, cotton, and bananas.

2. The constant movements of capital flights from Guatemala to other countries.

3. The fast expansion of external contract debts and public contract debts.

4. The Monetary reserves become scarce, a constant devaluation of the domestic currency (Quetzal vs. US$), and the fast expansion of black markets of foreign exchange.

5. High inflation rates (high production costs plus over money supply) and high unemployment rates that was the major reason to generate large flows of immigration from Guatemala to United State.

6. The investment in public services were reduced such as the health care, public education, and low cost housing credit.

7. The fast expansion of large national budget deficit by the uncontrolled corruption in different government management levels.

Since 1980' to 1990's Guatemala was created a higher dependency on American, Japanese and European products. Therefore, the imports flows of Guatemala keeps a constant growth rate that was estimated in 31% annually (Banguat, 2012), Guatemala under the weight of an increasingly negative balance of payments in trade and escalating external debt. This time is referred by many economists as the "lost decade". In our case, this paper will call to this specific period of the Guatemalan economy as ***"the Guatemalan larges economic desgrowth".*** From an ideological and political point of view Guatemala was affected by an external conflict such as the Cold War between capitalism and socialist. Consequently, the external conflict was generated the internal conflict such as the confrontation between revolutionary groups and national army forces that was stopped the Guatemalan economy develop and progress.

The position of Guatemala has been become a crucial geopolitical and military issue in the cold war for United States because of recent events within the region. The United State administration was preoccupied with threat of the Soviet Union/Pro-Cuban communism expansion in Central American such as the case of Nicaragua. United States sent a huge military logistic cooperation to dictators, military cupola and right wing political parties to contain the communism advances in Guatemala and Central America. In this period the different military groups in power keeps control on the civilian society by using violence, repression and coercion on different social groups. From 1980's to 1990's Guatemala has been sacrificed around 200,000 dead and missing Guatemalans and large losses in economic resources (PDH, 2012). But in the middle of 1990's, Guatemala made a significant progress towards in stability and a notable improvement in his democratic

process and human right aspects through the sign of peace treaties in such as Nicaragua (1991), El Salvador (1992), and Guatemala (1996).

Hence, the cold war in Guatemala left viciousness of violence and criminal organizations in this small developing country such as paramilitary groups, militaries groups, guerrilla, anti-social groups (Maras), cartel of drugs and gangster groups that continue articulating until our days in different form but with the same criminal focus. In addition, this paper is interested to introduce a new concept that is called ***"social terrorism is defined as legal and non-legal armed groups that use violence and crime on the civil society through the uses of physical, physiological, sexual, mass media, and legal violence."*** Moreover, according to this research the crime can be simplified as an integral social decomposition on different social groups in the society. The fast expansion of crime that any country can experience is based on the evolution and crime stages in different periods of time and geographical spaces. In the case of Guatemala is possible to observe that the crime levels are growing in geometrical proportions compare to the rest of Central American countries such as El Salvador, Honduras, Nicaragua and Costa Rica respectively. To evaluate the crimes expansion rate (**ξ**) of Guatemala, we are considering evaluate the total crimes events (total sum of causalities or cases of crime per year = γ) that is divided by the total population (э) and multiply by k=1000 (k is a constant to quantified more clearly the final result of our indicator) see Expression 1.

$$\xi = \Sigma\gamma/э \times k \Rightarrow \Pi \geq 1000 \qquad (1)$$

The evaluation of the crimes expansion rate (ξ) is categorized into four different levels of vulnerability (see Expression 2)

Level 1: Soft Alert: 1 - 250
Level 2: Yellow Alert: 251-500
Level 3: Red Alert: 501-750
Level 4: Uncontrollable Situation: 751 – 1000 (**2**)

The evolution of crime expansion rate of Guatemala is keeping in a constant growth according to domestic and international statistics. According to our research the crime expansion rate (ξ) in Guatemala increases dramatically from 435 in 1997 (Yellow Alert) to 835 in 2012 (Uncontrollable Situation) (see Table 1 and Figure 1). We can find that the fast expansion of the crime in Guatemala is originated from ***the crime trans-nationalization*** that we are considering as part of the globalization. ***The crime trans-nationalization "is defined as the mobility of overseas criminal groups that implements different systems of logistic, technologies, and knowhow (techniques and methods) to implement a serial of criminal acts."*** In the past twenty eight years, the whole world has been experiencing dramatic changes in the economic, technological, political and social arenas. Many academicians and researchers in the fields of economics, politics and sociology refer to these transformations as "globalization[2]". Globalization started as a general concept among certain specialized academic groups in the middle of the 1980's, with reference to regionalism and the rapid development of new advanced technologies.

[INSERT TABLE 1 AND FIGURE 1]

[2] Held and McGrew (2000) defines **globalization** as a process (or set of processes) which embodies a transformation in the spatial organization of social relations and transactions - assessed in terms of their extensity, intensity, velocity and impact - generating transcontinental or inter-regional flows and networks of activity. For Juan Jose Toribio (2000) define globalization as an accelerated process of the world economies integrated through the integration of the production, trade, financial flows, technological diffusion, information networks, and cultural currents. Both authors show that globalization is a dynamic and global process based on regional integration.

Later, the concept and uses of the word "globalization" started to expand in the universal language, until it became adapted into our common lexicon. It is no longer a special term used by economists, political scientists and sociologists. It is regarded to as the most relevant economic phenomenon these days. Probably, there is no other concept that can better define the fundamental challenges in the world economy in this century than "globalization". But it was not until the 1990's that globalization made its formal appearance and consolidation in the international context. Furthermore, globalization is a complex and multidimensional phenomenon taking place simultaneously in different levels and transforming the political, social, economic and technological scenarios in different parts of the world. However, globalization embodies particular characteristics which are as follows:

The first characteristic of Globalization is the institutional and political reforms based on less public sector participation into the economic activity or market. The institutional focus is supported by the idea to reduce public sector participation into the economic activity under the argument of unnecessary bureaucracy (non-efficient allocation of resources and production factors). The elimination of unnecessary bureaucracy uses the mechanism of privatization based on the sale of assets from the public sector enterprises (products and services) to the private sector. The selling of public sector to the private sector assumes a better performance in the productivity and efficiency of public services and products. The mission of privatization is to look for an efficient allocation of resources into the economy of any country under the private sector management. The new institutional focus and deep political reforms that constitute the first pillar of globalization is based on less public sector participation in economic activity. The idea behind the reduced public sector participation is that unnecessary bureaucracy creates non-efficient allocation of resources and production factors. The elimination of the unnecessary bureaucracy is implemented through the mechanism of privatization, where goods and services from the public enterprises are sold to the private sector. The sale of public sector assets to the private sector is assumed to give rise to higher productivity and efficiency in the public sector. This is in line with the mission of privatization, that is, to achieve efficient allocation of resources in a country's economy. Since the end of the Cold War -- with the collapse of the bipolar order (communism and capitalism) that reigned since 1945, a new phase of reform in the economic, institutional and political arenas has been created. A new institutional world order has been structured under deep political, economic, technological and social challenges (Gaspar, 2000). Indeed, the analysis of post-Cold War regionalization process and international order cannot be separated from the globalization process (Hveem, Stubbs, & Underhill, 2002) and (Sideri, 2000). The new international order in the political and institutional is supported by the strong promotion of democracy (more participation of the civil society into the democratization process) and human rights. The end of the cold war left deep social, economic, political and technological problems to Guatemala that persists until our days. Guatemala is not available to find an efficient growth model and better income distribution.

The second characteristic of globalization is the development of information communication technologies and transportation (ICTT) tools resulting in the use of advanced technologies. The ICTT sector uses technological innovative tools such as Internet services (Web), sophisticated software and hardware, satellite T.V., massive transportation systems and satellite mobile phone systems. These tools enable quick accessibility of information and hence, easier business transactions. The present advances in technology have come a long way since the industrial revolution in England. With advanced technology, new Research & Development (R&D) methods and tools emerged, which in turns led to expansion in world production and business. However, the above benefits of technological revolution are mainly enjoyed by high income countries. This results in concentration of high technology amongst high income countries.

Therefore, middle income and low income countries continue to be highly dependent on high income[3] countries for their technological needs.

The final characteristic is the expansion of regional integration agreements (RIA's) around the world based on custom union (CU) and free trade areas (FTA) schemes. Hence, the RIA's can help to facilitate the easy mobility of goods and services among different continents and the standardization of the consumption, production, and distribution respectively.

2. The economics crime monitoring model (ECM-Model)

The economics crime monitoring model (**ECM-Model**) assumes that any country is vulnerable to crime anytime and anywhere. Additionally, each event of crime has its own level of potential damage and impact on the final GDP for any country. Hence, our world is in a constant dynamic imbalanced state. This means that, at anytime and anywhere, there exists the possibility of an event of violence and that can generate different magnitudes of crimes levels. When this model refers to an economics of crime, we are referring to any event of crime beyond human control that can generate massive destruction anytime, anywhere, without any advance warning. The quantification and monitoring of economics of crime is inherently difficult, and we cannot evaluate and predict them with any degree of accuracy, but we can compute series of events of crime within a fixed period of time (per year or decades). In addition, this ECM-Model is useful for demonstrating how the GNP growth rate is directly connected to the presences of natural hazards.

In the context of the ECM-Model, we would like to propose five new indicators - (i) the total crime frequency rate (**β**); (ii) the national crime vulnerability rate ($\boldsymbol{\mu_T}$); (iii) the crime devastation magnitude rate (**λ**); (iv) the economic desgrowth rate (**δ**); (v) and the crime vulnerability surface (**VV-Surface**). These five indicators aim to simultaneously show the different levels of vulnerability and devastation arising from different events of crime. These five indicators are determined by the collection of historical data of different events of crime that have been impacted in any country whereby any event of crime is defined according to certain intervals of time and the magnitude of destruction on loss of material resources (infrastructure) and non-material resources (human lives). According to our model the analysis of any event of crime from an economic point of view must take into account the production reduction (national output) and human capital mobility (labor). In this part of our model, we introduce a new concept is called "economic desgrowth (**δ**)**"** (Ruiz Estrada, 2010). The economic desgrowth rate (**δ**) is defined as a leakage of economic growth due to any event of crime. The main objective of the economic desgrowth rate (**δ**) is to determine the ultimate impact of any event of crime on the final GNP growth rate behavior over a certain period of time. The basic data used by the ECM-Model is based on the use of sixteen different possible criminal events. These include human trafficking cases; murders cases; drugs trafficking cases; arms trafficking cases; robberies cases; kidnapping cases; massacres cases; terrorist actions; anti-social groups attacks; extortionist groups cases; illegal prostitution cases; smuggling; child abuses cases; illegal gambling cases; money laundering cases; cyber crime cases respectively.

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[3] **"High-income country** is a country having an annual gross national product (GNP) per capita equivalent to $9,361 or greater in 1998. Most high-income countries have an industrial economy. There are currently about 29 high-income countries in the world with populations of one million people or more. Their combined population is about 0.9 billion, less than one-sixth of the world's population. In 2003, the cutoff for high-income countries was adjusted to $9,206 or more".
(see: http://www.worldbank.org/depweb/english/modules/basicdata/datanotbasic.html)

2.1. The National Crime Vulnerability Rate (μ_T)

According to the ECM-Model, we assume an irregular oscillation into different crime events all the time. To measure each the total crime frequency rate (β_i) is based on generate a ratio that is comprising in $\beta_{i,t=T}$ as the numerator which is the frequency of occurrence of the said a specific event of violence in the year **t=T** divided by the cumulate total frequency of the same event of crime over the past 10 years including the year T in question (see Expression 3).

$$\beta_i = \beta_{i,t=T} / \sum_{t=T-9}^{t=T} \beta_{i,t} \qquad (3)$$

Therefore, the total crime frequency rate (β) cannot be larger than 1 or less than 0 according to our model. (see Expression 4) .

$$0 \leq \beta i \leq 1 \qquad (4)$$

It suggests that our world is going to be in a permanent dynamic imbalanced state under to presumptions risk of having a crime event at anytime. The ECM-Model allows for different types of crimes. Therefore, we have different crime events frequency rates (β_i) as described in expression 3. Therefore, we assume that the national crime vulnerability rate (μ_T) is proportional to combined frequency of all 16 types of crime events. In our case "**T=t**" is a specific period of time in study and "**i**" represents the type of crime event which is according to our classification, a range of sixteen different types of crime events. Hence, the national crime vulnerability rate (μ_T) includes a total of sixteen possible crime activities frequency rates that are as follows: human trafficking (β_1); murders (β_2); drugs trafficking (β_3); arms trafficking (β_4); robberies (β_5); kidnapping (β_6); massacres (β_7); terrorist actions (β_8); anti-social groups attacks (β_9); extortionist groups (β_{10}); illegal prostitution (β_{11}); Smuggling (β_{12}); child abuses (β_{13}); illegal gambling (β_{14}); money laundering (β_{15}); cyber crime (β_{16}) respectively. Each crime event has its magnitude of intensity according to their geographical positions and social conflicts problems. We assume that if any crime event is follows distantly from each other then it is not possible to be predicted with accuracy while it can be described in expression 7. Hence, we can calculate the national crime vulnerability rate (μ_T) is expressed in Expression 5. In our research we use sixteen different crime events.

$$\mu_T = (\mathrm{Ln}\sqrt{1-\beta}) \qquad (5)$$

$$\mu e = \mathrm{Ln}[\,|\beta_{Tj} - \beta_{Tj-1}|\,] \quad \forall\ \mu e \neq 0 \qquad (6)$$

$$\mu p = \mathrm{Ln}[(\beta_{max})_{Tj}] - [(\beta_{min})_{Tj}] \quad 0 > \beta_{max} \leq 1 \text{ or } 0 \geq \beta_{min} < 1 \qquad (7)$$

Note: Where βi_{max} refers to the most frequently occurring not had and βi_{min} the least frequency occurring not has both in the same country of reference.

In expression 6 and 7 shows the effective national crime vulnerability rate (μe) and the potential national crime vulnerability rate (μp). The effective the national crime vulnerability rate (μp) is based on actual past and present crime events frequency rates. We assume that the effective national crime vulnerability rate μe cannot be equal to zero (see Expression 6). However, the potential national crime vulnerability rate (μp) is based on the use of natural logarithms in the maximal and minimal crime frequency rates into a determinate period of time (T_j) (see Expression 7). Additionally, we need to assume that the potential national crime vulnerability rate (μp) yields a random database which makes it possible for the ECM-Model to analyze unexpected results from different crime events which cannot be predicted and monitored with the traditional methods of linear and non-liner mathematical modeling. Hence, the effective crime frequency rate (β) is identified in Expression 4. Finally, our identity about the potential crime

events frequency rate needs to be equal to the effective crime events frequency rate in the short run or long run. This is because we assume at the very outset that our world is in a dynamic imbalanced state. Results from the $\boldsymbol{\mu_T}$ is given you need to recalculate based on amendments in table 2 for different countries that is using different $\boldsymbol{\beta_i}$ and a single $\boldsymbol{\mu_T}$. The evaluation of the national crime vulnerability rate ($\boldsymbol{\mu_T}$) is categorized into three different levels of vulnerability (see Expression 8)

Level 1: High vulnerability (red color alert): 1 - 0.75
Level 2: Average vulnerability (yellow color alert): 0.74 – 0.34
Level 3: Low vulnerability (green color): 0.33 – 0 (**8**)

[INSERT TABLE 2]

However, in Figure 2, it is possible to observe diminishing returns between the economic desgrowth rate ($\boldsymbol{\delta}$) and the national crime vulnerability rate ($\boldsymbol{\mu_T}$). We can have three possible scenarios of analysis in this relationship between the economic desgrowth rate ($\boldsymbol{\delta}$) and the national crime vulnerability rate ($\boldsymbol{\mu_T}$). First scenario, if the national crime vulnerability rate ($\boldsymbol{\mu_T}$) is very high then the economic desgrowth rate ($\boldsymbol{\delta}$) will be high. Second scenario, if the national crime vulnerability rate ($\boldsymbol{\mu_T}$) is very low then the economic desgrowth rate ($\boldsymbol{\delta}$) will be low. Finally, we assume that never the national crime vulnerability rate ($\boldsymbol{\mu_T}$) can intercepts the economic desgrowth rate ($\boldsymbol{\delta}$), because we are using "The Dynamic Imbalanced State (DIS)" (Ruiz Estrada and Yap, 2013). The DIS never keeps static but constantly keeps changing. Hence, we suggest the application of the Omnia Mobilis assumption (Ruiz Estrada, 2011) to keep the DIS in the long run. It changes according to changes in the national crime vulnerability rate ($\boldsymbol{\mu_T}$).

[INSERT FIGURE 2]

2.2. The Crime Devastation Magnitude ($\boldsymbol{\lambda}$)

Basically, we are using two main variables to calculate the crime devastation magnitude rate ($\boldsymbol{\lambda}$). The first main variable is capital devastation ($\boldsymbol{\Phi k}$) is computed by the total of crime geographical space (Km^2) in the same geographical space dividing the area of zone destroyed by any violence event (km^2). The second main variable is human capital devastation ($\boldsymbol{\Psi L}$). We compute human capital devastation ($\boldsymbol{\Psi L}$) by dividing the number of people killed by or missing due to crime by the total population in the same geographical space. After calculating both main variables, we can then multiply the results to get our crime devastation magnitude rate ($\boldsymbol{\lambda}$). In short, the crime devastation magnitude rate ($\boldsymbol{\lambda}$) is equal to the product of the capital devastation ($\boldsymbol{\Phi k}$) and the human capital devastation ($\boldsymbol{\Psi L}$). Finally, we generate the natural logarithm. The final crime devastation magnitude rate ($\boldsymbol{\lambda}$) is expressed in the expression 9.

$$\boldsymbol{\lambda} = \text{Ln}\,[(\Phi k) \times (\Psi L)] \qquad (\mathbf{9})$$

We decide to apply the product rule of differentiation in the expression 10 to obtain the first derivative test to find the relative maximum and minimum in the capital devastation ($\boldsymbol{\Phi k}$) and capital devastation ($\boldsymbol{\Phi k}$). We assume inherent functions of capital ($\boldsymbol{\Phi k}$) and labor ($\boldsymbol{\Psi L}$) but use actual crime devastation geographical values as proxies for the function.

$$\mathbf{d}\boldsymbol{\lambda} = \Phi'(k)\,\Psi(L) + \Phi(k)\,\Psi'(L) \qquad (\mathbf{10})$$

Moreover, we can also observe that the crime devastation magnitude rate (λ) is directly proportional to the national crime vulnerability rate ($\boldsymbol{\mu_T}$). Refer to table 2 and figure 3 respectively.

[INSERT FIGURE 3]

2.3. The Economic Desgrowth (δ)

We define economic desgrowth ($\boldsymbol{\delta}$) (Ruiz Estrada, 2010) as a macroeconomic indicator that show the final impact of any crime event on the GNP. We can say that the final GNP post-violence event effect is a function of the crime devastation magnitude rate ($\boldsymbol{\lambda}$) (see Expression 10). At the same time, the crime devastation magnitude rate ($\boldsymbol{\lambda}$) is directly dependent on the national crime vulnerability rate ($\boldsymbol{\mu_T}$) (see Expression 9) according to Figure 2. In expression 10 we calculate the preliminary GNP post- crime effect under the uses of economic desgrowth ($\boldsymbol{\delta}$). Hence, the $\boldsymbol{\delta}$ is in function of $\boldsymbol{\lambda}$**.** Therefore, the economic desgrowth ($\boldsymbol{\delta}$) is equal to multiply the $\boldsymbol{\mu_T}$ by $\boldsymbol{\lambda}$ according to expression 11. Therefore, the economic desgrowth rate ($\boldsymbol{\delta}$) should be in negative range (see Table 2).

$$\boldsymbol{\delta = (\mu_T)\ (\lambda)} \qquad (\mathbf{11})$$

In the last instance, always the economic desgrowth rate (δ) behavior is directly depends on "$\boldsymbol{\beta}$**"** (see Figure 2). In figure 3 we can observe that exist a strong relationship between the "$\boldsymbol{\lambda}$**"** and "$\boldsymbol{\mu_T}$**"**. Basically, the empirical results show that if $\boldsymbol{\lambda}$ and $\boldsymbol{\mu_T}$ are higher, then the economic desgrowth ($\boldsymbol{\delta}$) shows the same behavior. Our experiment is based on the uses of different rates from 0.00 to 0.99 in the case of "$\boldsymbol{\beta}$". The finals results calculated for the economic desgrowth rates ($\boldsymbol{\delta}$) show that when the $\boldsymbol{\lambda}$ and $\boldsymbol{\mu_T}$ are high the effect on the economic desgrowth ($\boldsymbol{\delta}$) is magnified. Hence, the $\boldsymbol{\delta}$ is directly proportional to $\boldsymbol{\lambda}$ and $\boldsymbol{\mu_T}$ in the long run (see Table 2). Finally, we assume that the economic desgrowth ($\boldsymbol{\delta}$), $\boldsymbol{\lambda}$, and $\boldsymbol{\mu_T}$ are intimately connected (see Expression 12 and 13). Always $\boldsymbol{\delta}$ start from zero and keep negative values in whole its trajectory according to our model.

$$\boldsymbol{\uparrow\delta = (\uparrow\lambda)\ (\uparrow\mu_T)} \qquad (\mathbf{12})$$

$$\boldsymbol{\downarrow\delta = (\downarrow\lambda)\ (\downarrow\mu_T)} \qquad (\mathbf{13})$$

2.4. The Crime Vulnerability Surface (VV-Surface)

The construction of the VV-Surface is based on the crime frequency rates ($\boldsymbol{\beta_i}$) results and the mega-surface coordinate space (see Expression 14 and Figure 6). The crime vulnerability surface is a four by four matrix that contains the individual results of all sixteen variables (taken from Table 3). However, the sixteen variables are plotted in a four by four array with the vertical value on the VV-Surface. The idea is to produce a surface for a quick pictorial representation of the overall propensities for any one country. The underlying idea here is to use the results of sixteen variables in the crime frequency rates ($\boldsymbol{\beta_i}$) to build a symmetric surface. When the VV-coordinate-system ($\boldsymbol{\eta}$) has strictly the same number of rows as the number of columns, then the violence frequency rates ($\boldsymbol{\beta i}$) can always be perfectly symmetric.

$$\eta = \begin{pmatrix} \theta_1 \\ \theta_2 \\ \theta_3 \\ \theta_4 \\ \theta_5 \\ \theta_6 \\ \theta_7 \\ \theta_8 \\ \theta_9 \\ \theta_{10} \\ \theta_{11} \\ \theta_{12} \\ \theta_{13} \\ \theta_{14} \\ \theta_{15} \\ \theta_{16} \end{pmatrix} \quad (\mathbf{14})$$

The final analysis of the VV-Surface depends on any changes that this surface can experience in a fixed period of time.

[INSERT FIGURE 4]

[INSERT FIGURE 6]

3. The Application of the ECM-Model in the case of Guatemala

Applying the ECM-Model in the case of Guatemala will give us a much better idea of how ECM-model works. Before we do so, it is useful to have a look at general data about Guatemala such as the geographical distribution of crime. In terms of the geographical distribution of crime Guatemala City shows the highest impact of crime compare to rest of Guatemala regions with 67% of the total of crime activities. Therefore, the major crime activities are following this order: murder, drugs, and kidnapping respectively. Finally, other regions of Guatemala is showing low rates of crimes such as North region 37%, South region 35%, West region 32%, and East part 30%. These four regions of Guatemala account about 33% of the total crime activities in Guatemala.

The Total Crime Frequency Rate (β_i)

In this section, we first examine the crime vulnerability propensity rate in Guatemala then we take a closer look at Guatemala crime vulnerability propensity rate. Table 3 shows the crime growth rates (α_i) in Guatemala. Guatemala show a wide range of probability of crime events based on their historical data. We use three different colors to classify crime activities that affect more Guatemala according to their criminal growth rates (α_i). Firstly, the red color represents high vulnerability, the yellow color represents medium vulnerability and the green color represents low vulnerability. We can observe in Table 3 that the highest risk of criminal activities is by anti-social groups (also called in Spanish Maras such as Salvatruchas and 18) with 0.97. In second place is shared by murders (β_2) and extortionist groups (β_{10}) with 0.95. Finally, the third place in crime activities with high risk is drugs trafficking (β_3) and money laundering (β_{15}) with 0.93 respectively. Figure 6 shows the criminal vulnerability surface in sixteen crime activities such as human trafficking (β_1); murders (β_2); drugs trafficking (β_3); arms trafficking (β_4); robberies (β_5); kidnapping (β_6); massacres (β_7); terrorist actions (β_8); anti-social groups attacks (β_9); extortionist groups (β_{10}); illegal prostitution (β_{11}); Smuggling (β_{12}); child abuses (β_{13});

illegal gambling (β_{14}); money laundering (β_{15}); cyber crime (β_{16}) in the year 1997, 2004, and 2012 (see Figure 6). These results show that Guatemala face the higher risk of crime than the other neighbor countries in our sample such as the rest of Central America countries (El Salvador, Honduras, Nicaragua and Costa Rica).

The Guatemalan Crime Vulnerability Rate (Ω_T): Max and Min

In the case of Guatemala, we find large differences between the maximum and minimum of the crime vulnerability rate (Ω_T). According to historical data of crime, Guatemala City has the higher vulnerability, with a Ω_{Tmin} of only 0.85 and Ω_{Tmax} of 0.98. In the rest of Guatemala, the crime vulnerability propensity rates are lower. More specifically, vulnerability rate ranges from Ω_{Tmin} = 0.27 to Ω_{Tmax} = 0.47 in South part of Guatemala, from Ω_{Tmin} = 0.35 to Ω_{Tmax} = 0.57 in the North part of Guatemala, and from Ω_{Tmin} = 0.25 to Ω_{Tmax} = 0.45 in the Western part of Guatemala.

The Crime Devastation Magnitude Rate (Π)

In addition, we would like to compare the crime devastation magnitude rate (**Π**) of Guatemala between 1997 and 2012. This paper estimates and compares the magnitude of the impact of those crime activities on Guatemala. According to our results the devastation resulting from the 1997 was quite limited at -0.49. But the devastation caused by the 2012 was much larger at -5.34 according to our computations below. In Figure 4, we can observe more clearly from a graphical perspective that the Crime Devastation Magnitude Rate (Π) in 2012 caused a much larger devastation several times than the Crime Devastation Magnitude Rate (Π) in 1997.

The crime devastation magnitude rate (Π_{1997})			(**Π**)
Φk			
245M		0.0245	
ΨL			
18000	9000000	0.2000	**-0.49**
The crime devastation magnitude rate (Π_{2012})			
Φk			
990M		0.0990	
ΨL			
75000	14000000	0.5400	**-5.34**

[INSERT FIGURE 5]

3.b. The Economic Desgrowth (δ)

Finally, to measure the impact of the crime on economic growth, we use the new concept of "economic desgrowth (**δ**)" introduced by Ruiz Estrada (2010). According to the concept of economic desgrowth, we try to discover possible leakages that can adversely affect GNP performance. Basically, this new concept assumes that in the process of the GNP formation, leakages may arise due to different factors, in our case crime. According to our estimates, the economic desgrowth caused by violence in Guatemala has an impact of -0.250 the year 1997 on the Guatemala economic desgrowth (**δ**). Our estimates indicate that the economic desgrowth caused by the generalized crime and violence in Guatemala of 1997 has been much larger, at -0.650 in 2012. Therefore, the economic desgrowth difference between these two periods can show -0.400 according to our final result in Table 4.

[INSERT TABLE 4]

4. Concluding Observations and Policy Implications

Crime can have a significant negative impact on economic performance but measuring this impact with any degree of certainty is inherently challenging. In this paper, we propose a new model for evaluating the impact of crime on economic performance. The economics of crime monitoring model (**ECM-Model**) – to evaluate the impact of crime on the economic performance. The model is based on five basic indicators – (i) the total crime frequency rate (**β**); (ii) the national crime vulnerability rate ($\boldsymbol{\mu_T}$); (iii) the crime devastation magnitude rate (**λ**); (iv) the economic desgrowth rate (**δ**); (v) and the crime vulnerability surface **(VV-Surface**). The underlying intuition is that the economic impact of crime depends on a country's vulnerability to violence and the devastation caused by crime, which jointly determines the leakage from economic growth and hence the impact on growth. We hope that our model will contribute to a better and deeper understanding of measuring the economic impact of crime.

A more useful measurement of impact is conducive for appropriate policies, both for dealing with the effects of crime and also for anticipatory policy measures which seek to lessen the impact of crime before they occur. For example, underestimating the impact may lead to the government allocating too few resources for addressing the impact of crime – e.g. public investment in security physical infrastructure and support for special areas most affected by the crime. On the other hand, overestimating the impact may cause the allocation of too many resources, raising the risk of inefficiency and waste. By the same token, determining the appropriate level of anticipatory investments to limit the impact of future crime activities would benefit from an accurate ex-ante assessment of their impact. The ECM-Model can also help in determining the appropriate mix of crime management and prevention policies. For example, the model may allow policymakers to better estimate and compare the impact of different types of crime activities.

The application of our model in Guatemala is to evaluate how crime can affect on the economic performance in developing countries. Nevertheless, they need to provide more fiscal resources for rebuild the legal and security forces efforts to re-build the Guatemala devastated physical infrastructure which, in turn, will lay the foundation for the recovery of the Guatemalan productive activities, in particular manufacturing and services. In addition to rebuilding the security infrastructure, the government should provide public security investment for the civil society has been destroyed by crime. While Guatemala high public debt level constrains the Guatemalan government's fiscal space, concerted fiscal support is nevertheless vital for Guatemalan security system recovery.

At a broader level, our results confirm that crime can have a significant economic impact even in developed countries with high security infrastructure and high level of preparedness. The inescapable policy implication for developing countries, which tend to suffer the bulk of crime, is that investing in anticipatory measures may yield sizable benefits in the medium and long term even though they can be costly in the short run. Anticipatory measures can reduce the extent of damage, loss of life and disruption to economic activity. Such measures include: (1) Good design and adherence to rigorous application of law to gains crime; young prevention programs; creation of multitask special forces; security stabilization programs, and other measures related to the crime environments, (2) Early warning system for crime. (3) Emergency response plans for crime: evacuation systems; emergency response; training and uses of equipment; emergencies attention- e.g. hospitals and police stations. Given the high opportunity costs of using fiscal resources to mitigate the effects of crime in developing countries, the ECM-

model's more accurate measurement of the economic impact of crime is all the more valuable. Better measurement allows for more efficient and better targeted use of fiscal resources. One interesting direction for future research is to examine the importance of effective communication in mitigating the adverse impact of crime. It is widely believed that more effective communication by the Guatemalan government to the general public, for example about the magnitude and crime of the damage, could have limited the damage from the violence and crime. The failure of authorities to quickly and reliably inform the public led to widespread concerns and fear, which further dented consumer and business confidence. Therefore, more and better information is likely to reduce the impact of crime, and looking at the role of information would contribute to a more accurate measurement of crime impact.

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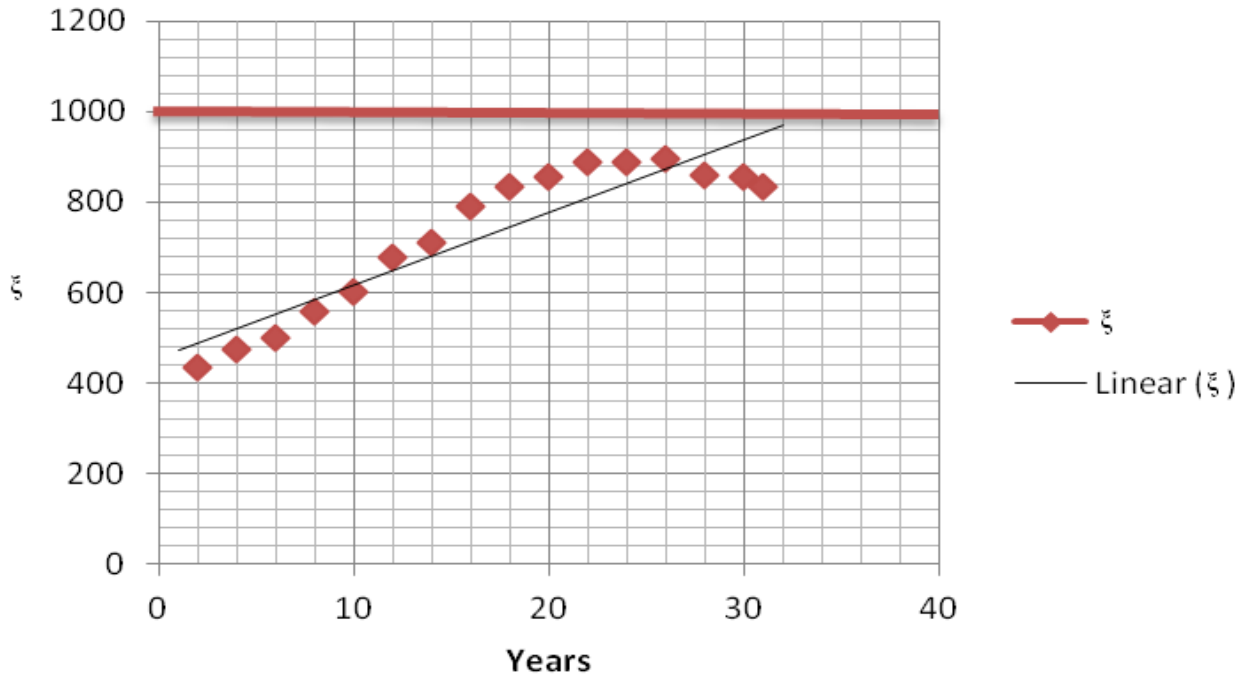
TABLES AND FIGURES

Table 1 and Figure 1: The Crime Expansion Rate (ξ) in Guatemala (1997-2013)

	Year	ξ	Level of Risk
1	1997	435	**Yellow Alert**
2	1998	487	**Yellow Alert**
3	1999	501	**Red Alert**
4	2000	559	**Red Alert**
5	2001	600	**Red Alert**
6	2002	678	**Red Alert**
7	2003	709	**Uncontrollable**
8	2004	789	**Uncontrollable**
9	2005	835	**Uncontrollable**
10	2006	855	**Uncontrollable**
11	2007	889	**Uncontrollable**
12	2008	879	**Uncontrollable**
13	2009	897	**Uncontrollable**
14	2010	859	**Uncontrollable**
15	2011	857	**Uncontrollable**
16	2012	835	**Uncontrollable**



Source: United Nations commission in Guatemala and Procudaria de los Derechos Humanos de Guatemala.

Table 2: The National Crime Vulnerability Rate (μ_T), The Final Crime Devastation Magnitude Rate (λ), and the Economic Desgrowth (δ)

β	1-β	√1-β	μ_T=Ln√1-β	ψL	Φk	λ	δ
0.00	1	1	0.0000	0.00	0.00	**0.000**	**0.000**
0.01	0.99	0.99	-0.0050	0.01	0.01	**0.000**	**0.000**
0.02	0.98	0.99	-0.0101	0.02	0.02	**0.000**	**0.000**
0.03	0.97	0.98	-0.0152	0.03	0.03	**0.001**	**0.000**
0.04	0.96	0.98	-0.0204	0.04	0.04	**0.002**	**0.000**
0.05	0.95	0.97	-0.0256	0.05	0.05	**0.003**	**0.000**
0.06	0.94	0.97	-0.0309	0.06	0.06	**0.004**	**0.000**
0.07	0.93	0.96	-0.0363	0.07	0.07	**0.005**	**0.000**
0.08	0.92	0.96	-0.0417	0.08	0.08	**0.006**	**0.000**
0.09	0.91	0.95	-0.0472	0.09	0.09	**0.008**	**0.000**
0.10	0.90	0.95	-0.0527	0.10	0.10	**0.010**	**-0.001**
0.11	0.89	0.94	-0.0583	0.11	0.11	**0.012**	**-0.001**
0.12	0.88	0.94	-0.0639	0.12	0.12	**0.014**	**-0.001**
0.13	0.87	0.93	-0.0696	0.13	0.13	**0.017**	**-0.001**
0.14	0.86	0.93	-0.0754	0.14	0.14	**0.020**	**-0.001**
0.15	0.85	0.92	-0.0813	0.15	0.15	**0.023**	**-0.002**
0.16	0.84	0.92	-0.0872	0.16	0.16	**0.026**	**-0.002**
0.17	0.83	0.91	-0.0932	0.17	0.17	**0.029**	**-0.003**
0.18	0.82	0.91	-0.0992	0.18	0.18	**0.032**	**-0.003**
0.19	0.81	0.90	-0.1054	0.19	0.19	**0.036**	**-0.004**
0.20	0.80	0.89	-0.1116	0.20	0.20	**0.040**	**-0.004**
0.21	0.79	0.89	-0.1179	0.21	0.21	**0.044**	**-0.005**
0.22	0.78	0.88	-0.1242	0.22	0.22	**0.048**	**-0.006**
0.23	0.77	0.88	-0.1307	0.23	0.23	**0.053**	**-0.007**
0.24	0.76	0.87	-0.1372	0.24	0.24	**0.058**	**-0.008**
0.25	0.75	0.87	-0.1438	0.25	0.25	**0.063**	**-0.009**
0.26	0.74	0.86	-0.1506	0.26	0.26	**0.068**	**-0.010**
0.27	0.73	0.85	-0.1574	0.27	0.27	**0.073**	**-0.011**
0.28	0.72	0.85	-0.1643	0.28	0.28	**0.078**	**-0.013**
0.29	0.71	0.84	-0.1712	0.29	0.29	**0.084**	**-0.014**
0.30	0.70	0.84	-0.1783	0.30	0.30	**0.090**	**-0.016**
0.31	0.69	0.83	-0.1855	0.31	0.31	**0.096**	**-0.018**
0.32	0.68	0.82	-0.1928	0.32	0.32	**0.102**	**-0.020**
0.33	0.67	0.82	-0.2002	0.33	0.33	**0.109**	**-0.022**
0.34	0.66	0.81	-0.2078	0.34	0.34	**0.116**	**-0.024**
0.35	0.65	0.81	-0.2154	0.04	0.04	**0.001**	**0.000**
0.36	0.64	0.80	-0.2231	0.36	0.36	**0.130**	**-0.029**
0.37	0.63	0.79	-0.2310	0.37	0.37	**0.137**	**-0.032**
0.38	0.62	0.79	-0.2390	0.38	0.38	**0.144**	**-0.035**

0.39	0.61	0.78	-0.2471	0.39	0.39	**0.152**	**-0.038**
0.40	0.60	0.77	-0.2554	0.40	0.40	**0.160**	**-0.041**
0.41	0.59	0.77	-0.2638	0.41	0.41	**0.168**	**-0.044**
0.42	0.58	0.76	-0.2724	0.42	0.42	**0.176**	**-0.048**
0.43	0.57	0.75	-0.2811	0.43	0.43	**0.185**	**-0.052**
0.44	0.56	0.75	-0.2899	0.44	0.44	**0.194**	**-0.056**
0.45	0.55	0.74	-0.2989	0.45	0.45	**0.203**	**-0.061**
0.46	0.54	0.73	-0.3081	0.46	0.46	**0.212**	**-0.065**
0.47	0.53	0.73	-0.3174	0.47	0.47	**0.221**	**-0.070**
0.48	0.52	0.72	-0.3270	0.48	0.48	**0.230**	**-0.075**
0.49	0.51	0.71	-0.3367	0.49	0.49	**0.240**	**-0.081**
0.50	0.50	0.71	-0.3466	0.50	0.50	**0.250**	**-0.087**
0.51	0.49	0.70	-0.3567	0.51	0.51	**0.260**	**-0.093**
0.52	0.48	0.69	-0.3670	0.52	0.52	**0.270**	**-0.099**
0.53	0.47	0.69	-0.3775	0.53	0.53	**0.281**	**-0.106**
0.54	0.46	0.68	-0.3883	0.54	0.54	**0.292**	**-0.113**
0.55	0.45	0.67	-0.3993	0.55	0.55	**0.303**	**-0.121**
0.56	0.44	0.66	-0.4105	0.56	0.56	**0.314**	**-0.129**
0.57	0.43	0.66	-0.4220	0.57	0.57	**0.325**	**-0.137**
0.58	0.42	0.65	-0.4338	0.58	0.58	**0.336**	**-0.146**
0.59	0.41	0.64	-0.4458	0.59	0.59	**0.348**	**-0.155**
0.60	0.40	0.63	-0.4581	0.60	0.60	**0.360**	**-0.165**
0.61	0.39	0.62	-0.4708	0.61	0.61	**0.372**	**-0.175**
0.62	0.38	0.62	-0.4838	0.62	0.62	**0.384**	**-0.186**
0.63	0.37	0.61	-0.4971	0.63	0.63	**0.397**	**-0.197**
0.64	0.36	0.60	-0.5108	0.64	0.64	**0.410**	**-0.209**
0.65	0.35	0.59	-0.5249	0.65	0.65	**0.423**	**-0.222**
0.66	0.34	0.58	-0.5394	0.66	0.66	**0.436**	**-0.235**
0.67	0.33	0.57	-0.5543	0.67	0.67	**0.449**	**-0.249**
0.68	0.32	0.57	-0.5697	0.68	0.68	**0.462**	**-0.263**
0.69	0.31	0.56	-0.5856	0.69	0.69	**0.476**	**-0.279**
0.70	0.30	0.55	-0.6020	0.700	0.700	**0.490**	**-0.295**
0.71	0.29	0.54	-0.6189	0.71	0.71	**0.504**	**-0.312**
0.72	0.28	0.53	-0.6365	0.72	0.72	**0.518**	**-0.330**
0.73	0.27	0.52	-0.6547	0.73	0.73	**0.533**	**-0.349**
0.74	0.26	0.51	-0.6735	0.74	0.74	**0.548**	**-0.369**
0.75	0.25	0.50	-0.6931	0.75	0.75	**0.563**	**-0.390**
0.76	0.24	0.49	-0.7136	0.76	0.76	**0.578**	**-0.412**
0.77	0.23	0.48	-0.7348	0.77	0.77	**0.593**	**-0.436**
0.78	0.22	0.47	-0.7571	0.78	0.78	**0.608**	**-0.461**
0.79	0.21	0.46	-0.7803	0.79	0.79	**0.624**	**-0.487**
0.80	0.20	0.45	-0.8047	0.80	0.80	**0.640**	**-0.515**
0.81	0.19	0.44	-0.8304	0.81	0.81	**0.656**	**-0.545**
0.82	0.18	0.42	-0.8574	0.82	0.82	**0.672**	**-0.577**

0.83	0.17	0.41	-0.8860	0.83	0.83	**0.689**	**-0.610**
0.84	0.16	0.40	-0.9163	0.84	0.84	**0.706**	**-0.647**
0.85	0.15	0.39	-0.9486	0.85	0.85	**0.723**	**-0.685**
0.86	0.14	0.37	-0.9831	0.86	0.86	**0.740**	**-0.727**
0.87	0.13	0.36	-1.0201	0.87	0.87	**0.757**	**-0.772**
0.88	0.12	0.35	-1.0601	0.88	0.88	**0.774**	**-0.821**
0.89	0.11	0.33	-1.1036	0.89	0.89	**0.792**	**-0.874**
0.90	0.10	0.32	-1.1513	0.90	0.90	**0.810**	**-0.933**
0.91	0.09	0.30	-1.2040	0.91	0.91	**0.828**	**-0.997**
0.92	0.08	0.28	-1.2629	0.92	0.92	**0.846**	**-1.069**
0.93	0.07	0.26	-1.3296	0.93	0.93	**0.865**	**-1.150**
0.94	0.06	0.24	-1.4067	0.94	0.94	**0.884**	**-1.243**
0.95	0.05	0.22	-1.4979	0.95	0.95	**0.903**	**-1.352**
0.96	0.04	0.20	-1.6094	0.96	0.96	**0.922**	**-1.483**
0.97	0.03	0.17	-1.7533	0.97	0.97	**0.941**	**-1.650**
0.98	0.02	0.14	-1.9560	0.98	0.98	**0.960**	**-1.879**
0.99	0.01	0.10	-2.3026	0.99	0.99	**0.980**	**-2.257**

Source: */ The data is used on this table is pure experimental.

Note: We assume that the capital devastation (**Φk**) and the human capital devastation (**ΨL**) are sharing the same level of devastation. But in the reality both results can be totally different according to this research.

Table 3: The Total Crime Frequency Rate (β_i) **&** The Total Crime Frequency Rate (β)

No.	Variable	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	βi
1	β1	0.55	0.57	0.60	0.68	0.68	0.61	0.68	0.70	0.75	0.83	0.85	0.90	0.98	0.99	1	1	0.77
2	β2 (3)	0.68	0.70	0.75	0.83	0.95	0.95	0.98	0.99	0.99	0.99	1	1	1	1	1	1	**0.93**
3	β3 (2)	0.80	0.83	0.85	0.89	0.92	0.95	0.95	0.98	0.98	1	1	1	1	1	1	1	**0.95**
4	β4	0.51	0.53	0.55	0.60	0.66	0.70	0.75	0.76	0.80	0.89	0.90	0.90	0.95	0.95	0.95	1	0.78
5	β5	0.7	0.67	0.65	0.72	0.75	0.77	0.80	0.82	0.87	0.88	0.88	0.89	0.90	0.91	0.95	0.10	**0.77**
6	β6 (4)	0.7	0.75	0.78	0.83	0.85	0.90	0.93	0.95	0.95	0.99	1	1	1	1	1	1	**0.91**
7	β7	0.6	0.63	0.65	0.65	0.68	0.70	0.72	0.75	0.75	0.77	0.79	0.80	0.83	0.88	0.88	0.85	0.75
8	β8	0.35	0.35	0.38	0.40	0.38	0.39	0.40	0.40	0.43	0.43	0.4	0.39	0.40	0.45	0.48	0.49	0.41
9	β9 (1)	0.90	0.93	0.93	0.95	0.96	0.96	0.97	0.99	1	1	1	1	1	1	1	1	**0.97**
10	β10 (2)	0.80	0.83	0.85	0.89	0.92	0.95	0.95	0.98	0.98	1	1	1	1	1	1	1	**0.95**
11	β11	0.45	0.55	0.60	0.63	0.65	0.68	0.72	0.75	0.75	0.70	0.72	0.85	0.86	0.89	0.90	0.90	0.73
12	β12 (5)	0.88	0.87	0.95	0.90	0.88	0.88	0.83	0.80	0.80	0.80	0.75	0.78	0.80	0.85	0.88	0.88	**0.85**
13	β13	0.29	0.33	0.33	0.33	0.37	0.39	0.40	0.49	0.59	0.65	0.67	0.70	0.72	0.72	0.75	0.80	0.53
14	β14	0.50	0.52	0.48	0.59	0.60	0.60	0.55	0.53	0.60	0.62	0.62	0.58	0.50	0.65	0.63	0.68	0.58
15	β15 (3)	0.98	0.97	0.99	0.99	0.95	0.90	0.92	0.94	0.95	0.95	0.83	0.88	0.90	0.91	0.91	0.90	**0.93**
16	β16	0.25	0.25	0.29	0.30	0.31	0.31	0.35	0.35	0.37	0.33	0.35	0.35	0.37	0.30	0.55	0.60	0.35
	TOTAL	0.61	0.63	0.65	0.69	0.71	0.72	0.74	0.76	0.77	0.80	0.80	0.81	0.83	0.84	0.87	0.88	**0.76**

β_i = The Crime Frequency Rate

β1	Human trafficking	**β4**	Arms	**β7**	Massacres	**β10**	Extortionist groups
β2	Murders	**β5**	Robberies	**β8**	Terrorism	**β11**	prostitution
β3	Drugs trafficking	**β6**	kidnapping	**β9**	Anti-social	**β12**	Smuggling

High level of risk

β9

β13 Child abuses
β14 Illegal gambling
β15 Money laundering

2 **β2/ β10**

3 **β3/ β15**

β16 Cyber crime

Source: United Nations commission in Guatemala.
Note: We applied probabilities according to the record of all crime events are mentioned in this table. Hence, we are taking 16 illegal criminal activities in the past 16 years from 1997 to 2012.

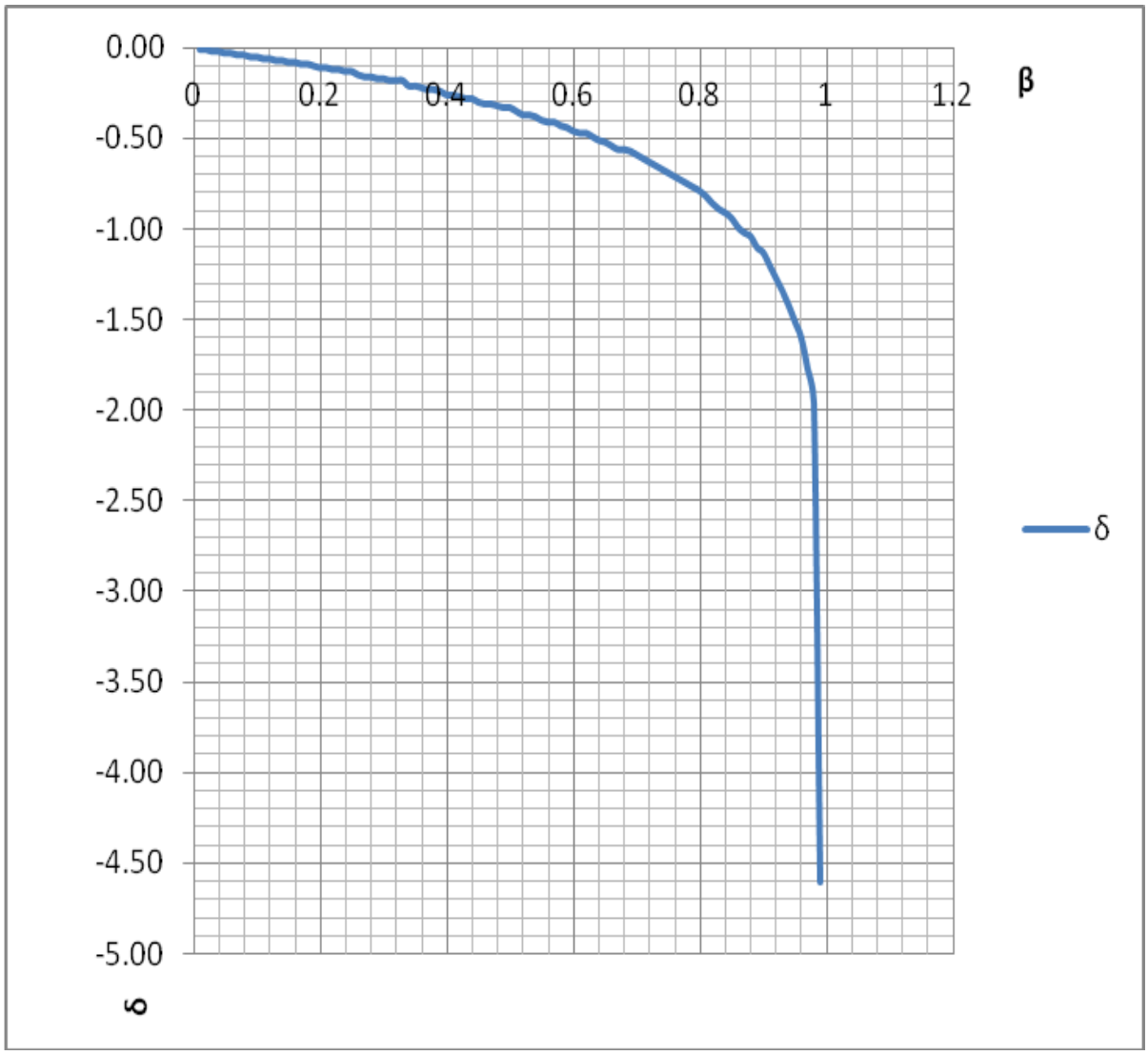
TABLE 4: Economic Growth Rates & Economic Desgrowth Rates from Guatemala (1997-2012)

1	1997	4.4	**δ = -0.250**	**β = 0.61**	**Π = - 0.49**
2	1998	5.0			
3	1999	3.8			
4	2000	3.6			
5	2001	2.3			
6	2002	3.9			
7	2003	2.5			
8	2004	3.1			
9	2005	3.3			
10	2006	5.4			
11	2007	6.3			
12	2008	3.3			
13	2009	0.6			
14	2010	2.9			
15	2011	3.9			
16	2012	3.1	**δ = -0.650**	**β = 0.88**	**Π = -5.34**

Variables:
δ = GNP desgrowth rate μ_T = The National CrimeVulnerability Rate λ = The Final Crime Devastation Magnitude Rate

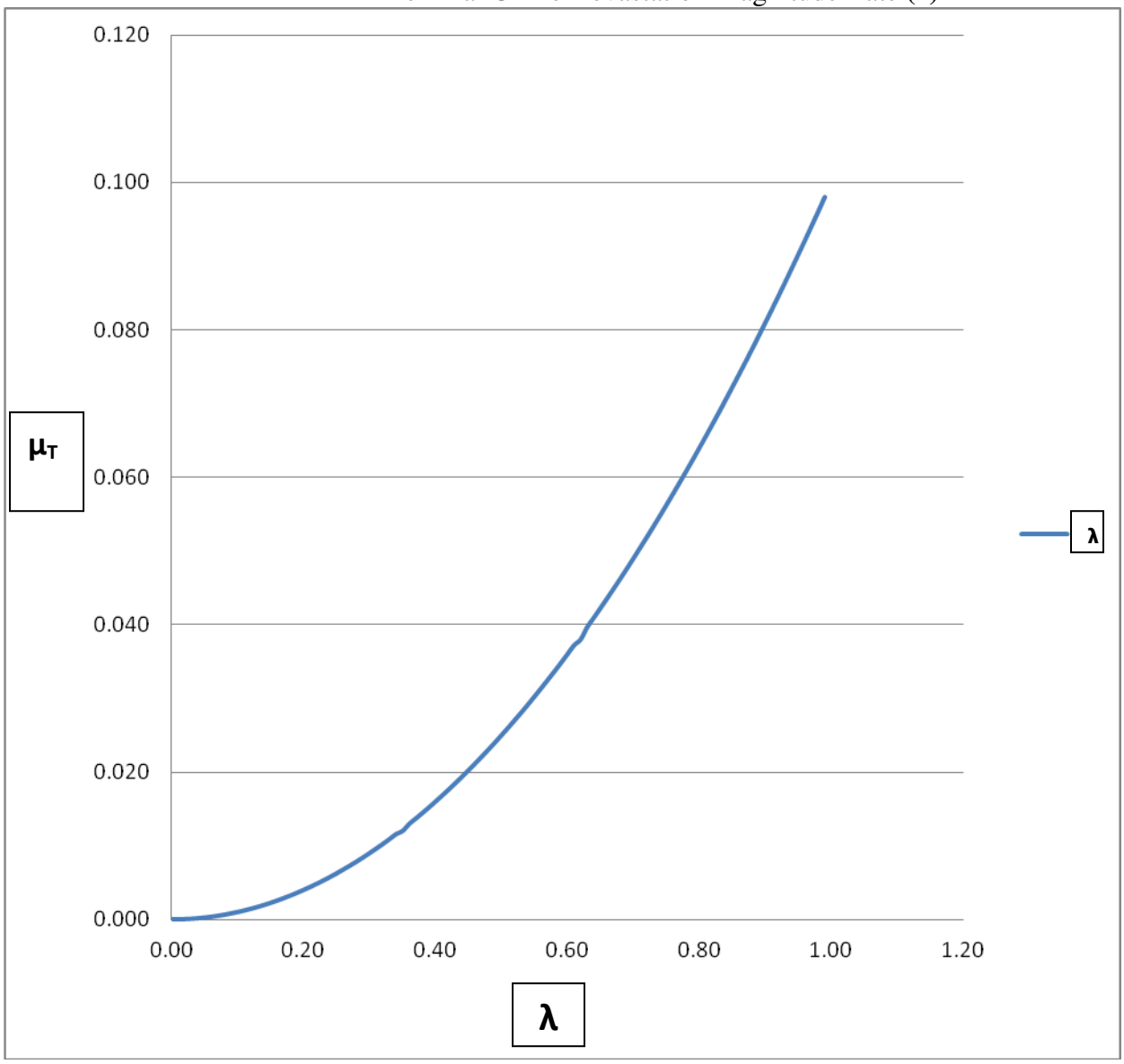
Source: World Bank (WB)

Figure 2: The Total Crime Frequency Rate
(**β**) and the Economic Desgrowth (**δ**)



Source: See Table 2

Figure 3: The National Crime Vulnerability Rate (μ_T)
&
The Final Crime Devastation Magnitude Rate (λ)



Source: See Table 2

Figure 4: The Mega-Surface Coordinate Space

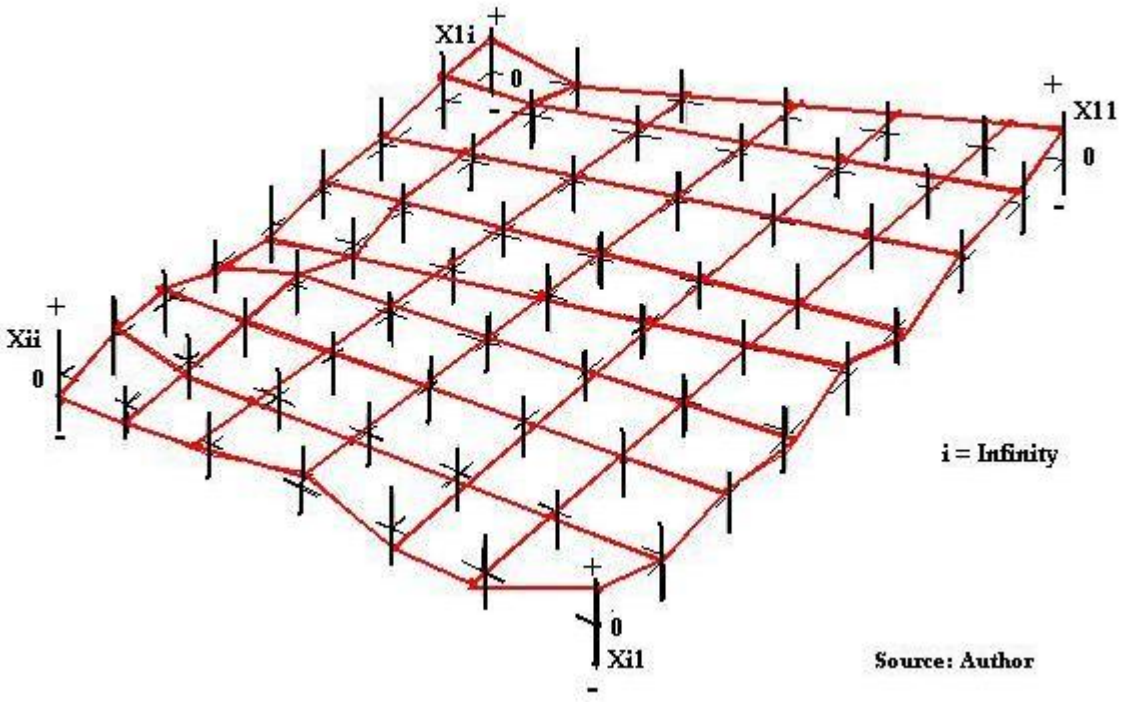
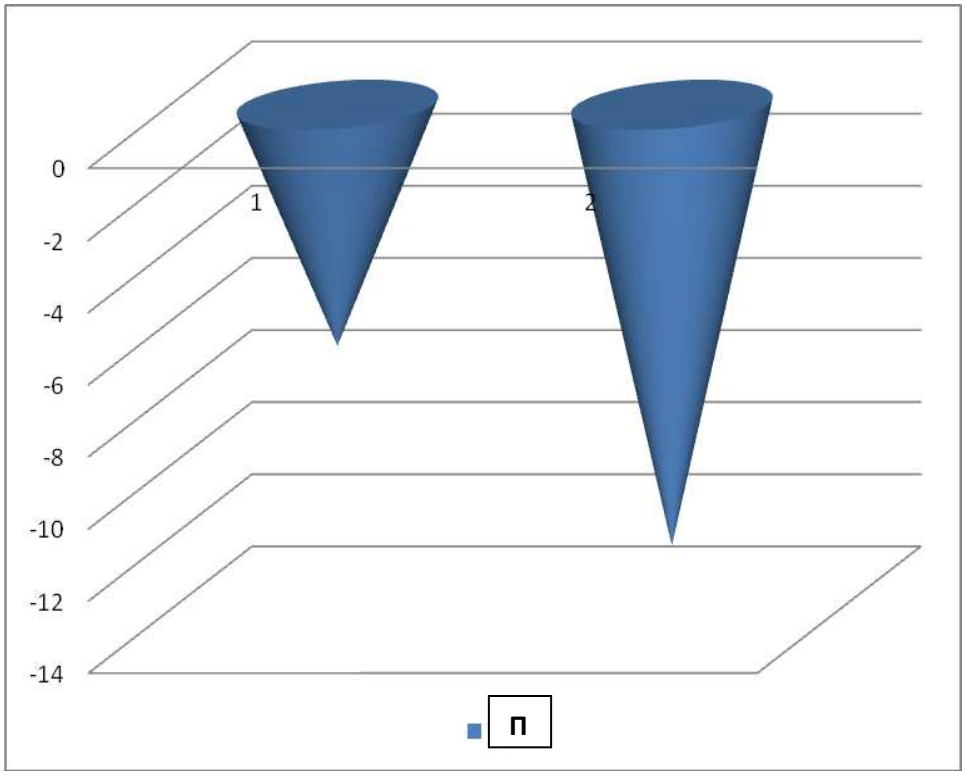


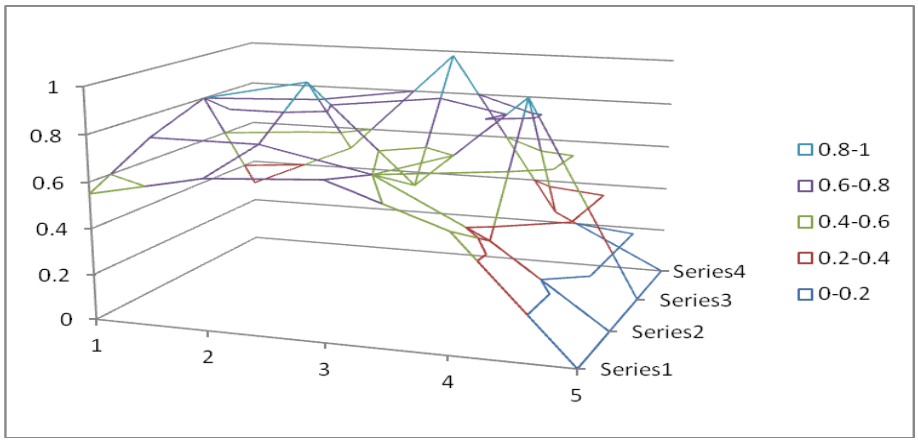
Figure 5: The Final Crime Devastation Magnitude Rate (**Π**) of Guatemala between year 1997 and year 2012



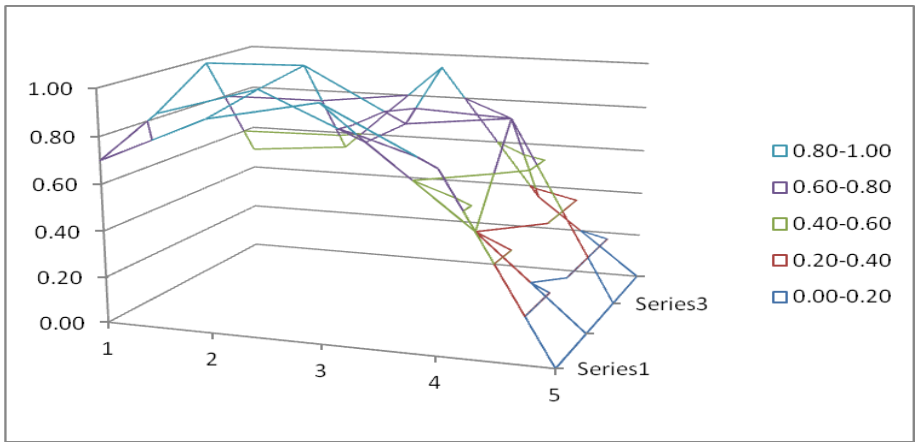
Source: See Table 2
Note: Final results from ECM-Model

Figure 6: The Crime Vulnerability Surface (**VV-Surface**) for Guatemala 1997, 2004 and 2012

Year 1997



Year 2004



Year 2012