O CONHECIMENTO CIENTÍFICO NA FRONTEIRA DAS DIVERSAS ÁREAS DA ECONOMIA

LUCCA SIMEONI PAVAN
(ORGANIZADOR)

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APRESENTAÇÃO

Em todos os momentos da nossa história, a produção, absorção e compartilhamento do conhecimento foram seu principal fator de desenvolvimento econômico e social. Este novo livro intitulado ‘’O Conhecimento Científico na Fronteira das Diversas Áreas da Economia” contribui para este processo divulgando diversos estudos realizados por pesquisadores de todo o Brasil.

A diversidade regional e de assuntos sempre foi um fato digno de destaque dos livros de divulgação científica da Atena Editora e esta edição não falhou à essa regra. Nesta coletânea apresentam-se trabalhos das mais respeitadas instituições de ensino, localizadas de norte a sul do país.

Os temas tratados aqui são dos mais diversos e qualificados. Aqui se encontram artigos de história do pensamento econômico e de economia institucional, modelos quantitativos aplicados ao agronegócio e à economia do crime. Também podemos ver preocupações muito adequadas aos dias de hoje, como a posição no mercado de trabalho dos mais idosos, o uso consciente da água na produção agrícola e o manejo adequado da pesca e seus impactos ao meio ambiente.

Enfim, parabenizo o trabalho de qualidade que vem sendo feito pela Atena Editora, contribuindo para divulgação da ciência no Brasil por meio de seus livros eletrônicos.

Lucca Simeoni Pavan

SUMÁRIO

CAPÍTULO 10

RATIONALITY IN ILLEGAL MARKETS: THE EFFECT OF ILLEGAL GOODS DEMAND ON CRIME RATE

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ABSTRACT: The objective of the present study is to analyze the demand for illicit goods as a determinant of the larceny rate increase that has occurred in the State of Rio Grande do Sul between 2002 and 2015. The methodology applied to develop this work are the Structural Equation Method (SEM) and the Panel with Generated Moment Method (GMM). The results showed that the demand for illicit goods suffers a positive influence of indicators such as unemployment rate, primary school dropout, and possession of narcotics and negative influence of indicators such as GDP per capita. Analyzing the rate of larceny, there was a negative influence from the GDP, family socioeconomic assistance, and mortality rate with drugs traffic.
KEYWORDS: Crime, Structural Equations, Generated Moment Method, Economy of Crime

RACIONALIDADE NO MERCADO ILEGAL: O EFEITO DA DEMANDA DE BENS ILÍCITOS NA TAXA DE CRIMINALIDADE

RESUMO: O objetivo do presente estudo é analisar a demanda por bens ilícitos como determinante do aumento da taxa de assaltos ocorrido no Estado do Rio Grande do Sul entre 2002 e 2015. A metodologia aplicada ao desenvolvimento deste trabalho é o Método da Equações Estruturais (SEM) e o Painel com o Método de Momento Generalizado (GMM). Os resultados mostraram que a demanda por bens ilícitos sofre influência positiva de indicadores como taxa de desemprego, abandono da escola primária e posse de entorpecentes e influência negativa de indicadores como PIB per

capita. Analisando a taxa de assaltos, houve influência negativa do PIB, assistência socioeconômica familiar e taxa de mortalidade no tráfico de drogas.
PALAVRAS-CHAVE: Crime, Equações Estruturais, Método dos Momentos Generalizados, Economia do Crime.

1 I INTRODUCTION

An investigation of crime in Economics was initiated within the microeconomics field with the development of Gary Becker's Crime and Punishment: An Economic Approach (1968), which introduced the act of committing crime as a result of a rational activity. The author considers that the agent before committing any action that fails to comply with the law, carries out a strictly rational cost-benefit analysis, weighing the pros and cons of its possible punishment, counterbalancing the expected profit of the action.

Becker (1976) did not disregard the fact that non-economic variables influenced the crime rate. In this sense, it would be important to understand human behavior and social influence with regard to crime inducers. This approach was brought to economics by the researchers using the Behavioral Economy. (KAHNEMAN & TVERSKY, 1979) as a theoretical basis.

The Economics of Crime is a field of studies that has been improved over the years by receiving incentives from governments or organizations interested in such insights that the line of criminology research can bring to the anticipation, prevention, prediction and even correction of criminal actions within society.

Studies such as Becker's (1993) have identified that individuals' behavior may be influenced by past experiences, income, time, imperfect memory, and other limited resources beyond the economic opportunities available to the decision maker. Sutton (1998) has identified the demand for illicit goods as a generator of incentives for criminal practices, and as a consequence, the policies aimed to reduce the crime rate of stolen goods should act to inhibit the demand for illicit goods. In this case, the demand configures itself as a factor stimulating the growth of the crime rate since an increase would lead to an elevation in prices and this would stimulate an increase in the quantity offered in a given market, leading to Becker's conception. (1976)

Regarding supply, the difficulty of accessing the formal market can be considered a factor influencing the increasing availability of labor. In this sense, crime rates become larger where and when average wages are lower. Unemployment is not a causal variable of increased crime, but the income from the formal, labor market is not lucrative enough to attract labor force for that market. However, both demand and supply depend on the likelihood of those who engage in criminal actions to be arrested and convicted, as noted in Machin and Meghir (2000).

In this way, it is noticed that there is an interaction between the elements that determine the demand and the supply of illicit goods, which impact the crime rate. These factors include the price of goods in illicit market, which are related to the incentives to criminal acts; and the availability to work in the legal market, considering the relative income between the legal and illegal markets and the magnitude of the penalties associated with the offenders being discovered and punished. Thus, it is considered that these aspects somehow shape the demand and supply of illicit goods present in illegal markets.

In terms of supply, the factors related to income opportunities in the formal market should act to reduce supply (less incentive to commit crime), but in Brazil and Rio Grande do Sul (RS), a different phenomenon occurred from December 2002 to the third quarter of 2014: GDP grew in real terms by 47.92% (IBGE, 2017), while vehicle theft rate increased by 64.33% (SSP / RS, 2017) in Rio Grande do Sul in the same period. Also, after 2014, the entire country faced a recession, and in the case of this state, between 2014 and 2015, the average salary of the employed population decreased by -7.5% and in the same period the robbery rate increased by 31.85% (SSP / RS, 2016). This pattern could indicate that there is a search for cheaper products by the population, since their real wages have decreased, factors associated with the demand for illicit goods.

It is important to notice the regional delimitation that this paper takes to account, which will be examining a state in Brazil called Rio Grande do Sul in the period from 2002 to 2015. This geographic cut is due to the need for a greater discussion of the implementation of policies applicable to the state, particularly considering that this state has proven to be one of the most violent in the country. (ATLAS DA VIOLENCIA 2017).

In sum, the research question, geographically located was developed as follows: was the demand for illicit goods determinant for the increase of larceny in Rio Grande do Sul between 2002 and 2015? Also, it is considered that crime is a set of crimes, and crime is “[...] a guilty violation of criminal law, an unlawful act, an act worthy of repression or punishment ...”. (FERREIRA et al., Pp. 574, 2009). This work has the intent to understand the growth of the crime rate in the state of Rio Grande of Sul, limiting the analysis to crimes of larceny against patrimony. The reason for choosing these indicators of crime is because theft or robbery of goods tend to be traded in some way. If there is commercialization of these goods by means of underground transactions, it is considered that there is demand and supply. As this study focuses on the demand for illicit goods, it is important to delimit what are the variables that in some way influence this demand by the illegal consumer.

Therefore, from The Economic Theory of Crime, the following hypotheses were corroborated:

i) Demand for illicit goods directly influences the state's crime rate as monetary returns from this market increase;

ii) As demand for illicit goods increases, the supply of available criminal labor increases its market share.

This paper is based on these two main hypotheses, and in the sections that follow the discussion of crime and economic theory, methodology and instrumental techniques necessary for the foundation of this research are presented, followed by the results, and its conclusions.

2 I ECONOMIC THEORY AND CRIMINALITY

Economics studies are very concerned about the optimal allocation of resources that, by nature, are limited. Studies in economics are not only limited to the understanding of macroeconomic or microeconomic issues but are continuously expanding in scope. It should also be noted that from the classical authors of economics, there was already a certain dedication to the reflection of adverse issues, such as crime and punishment.

From the studies of Gary Becker (1968), criminal behavior was explained as a rational decision-making process where the individual would assess the costs and benefits of his or her decisions before committing a crime. Each agent's "behavior can thus be defined by a set of values and preferences that each individual analyzes when faced with an environment of opportunity." (ARCARO, 25, 2009). In general, the Rational Crime Model focuses on three basic elements. i) profitability of crime; ii) the probability of being caught and iii) the punishment if caught. Therefore, when comparing the first component (expected gain) with the other two (costs), the rational decision maker determines whether it is worthwhile to commit such a crime. (ARIELY, 2012).

In addition, the rational approach to crime is related to the theory of incentives, seeking to understand the economic incentives for criminal practices. Mankiw (2005) considered that "rational people make decisions comparing marginal costs and marginal benefits and people change their behavior according to the incentives they face." (MANKIW, 2005, p.5). Even the incentive, whether monetary or not, is a means closely linked to a particular "manipulation" of behavior, which closely relates to studies from Behavioral Economics as well.

2.1 Applying the Economics of Crime

The economic theory of crime considers that the economic incentives that lead the decision maker to commit the crime are related to structural characteristics

acquired in the formation of its character. They consider the relation of factors involving characteristics and perspectives at the juncture where the individuals are inserted. In order to explain the systematic progression of crime, one must consider the educational and cultural levels of individuals, adding the possibilities of success in crime (structural characteristics) with the contextual characteristics. (FERNANDEZ & LOBO, 2005).

Using information from the British Crime Survey (BCS), Mike Sutton (1998), conducted a survey to understand who the illegal market demanders were and who the individuals were encouraging the supply of criminal labor. Therefore, Sutton (1998) considered that in order to reduce crime, especially in the case of stolen goods, it is necessary that security agencies work to inhibit the demand for illicit goods, and consequently there would be a lower supply of them and thus a reduction in crime rates.

However, it should be noted that while measures in the area of public security are important to control criminal rates in the country or region, other socioeconomic policies to effectively reduce crime should also be taken into account. (FERNANDEZ and LOBO, 2005).

2.2 Criminal Act and Its Incentives

Crime is classified as an act of transgression of the law in force in a given society, since the legislation differs from one place to another. The decision that an act is criminal, is carried out through legislation created and controlled by the Criminal Justice System. (BRENNER, 2009). The result expected from the laws is the justice and protection of the citizen, the non-criminal workers, without their social and economic life being impaired.

2.2.1 Incentives in Illegal Markets

Even if not explicitly stated, it can be considered that the incentive is present in most of the decisions that are taken by the agents. Draca & Machin (2015) assert that crime is motivated by the returns from the legal market versus the illegal market. As wages in the labor market increase, while the other variables remain unchanged, there may be a decrease in the supply of labor in the illegal market. There is a migration from illegal to legal work.

The supply of labor, being the criminal who will carry out the illegal act, seeks sufficient incentives, most of which are monetary, that justify the illegal act (assault). Considering that there is a search for quick monetary returns (SUTTON, 2008), it is reasonable to consider that products that are more desirable by criminals are those that have a quick resale in the illicit market.

The rapid sale in this market can be motivated by: i) the need for fast financial return; ii) the need to allocate the product quickly, avoiding being caught by the police; iii) after the product has been assigned, the conviction is delayed by the criminal justice system, as there is a need for more detailed investigation by the police.

According to Draca & Machin (2015), if the perceived incentives of the criminal market are greater than the legal market, the transactions will be carried out in this market. Among the incentives to illicit goods demand are: i) the price of goods in this market is lower; ii) the crime of receiving (Brazilian Law No. 9.426/1996) becomes difficult to condemn as the individual may be acting in good faith acquiring the good; iii) there is very little awareness within the media/state regarding the consequences of acquiring products with unknown origin; iv) as clandestine establishments are usually small, the citizen may still consider that he/she is assisting the owner to develop his small business.

Considering what is discussed in this section, it must be stressed that it is important for the state, together with the municipalities, to reassess their public policies, both in the area of security and in other social fields.

3 I METHODOLOGY

The development of this study is based on quantitative application of an econometric basis. As it tries to measure the effect of the demand on the crime rate, it should be considered that the demand is an unknown variable and lacks an indicator. Given the difficulty in estimating demand, the structural equations model is used in order to measure and search for variables that explain the demand for illicit goods. In the second part, after realizing the explanatory variables, the Panel Data estimation is used to corroborate both models.

3.1 Applying the Models

The basis of demand as a determinant variable in the growth of the crime rate is through the research carried out by Sutton (1998 & 2008) with the development of the field research with prisoners in order to measure the determinants of crime.

For the mapping of crimes occurring between 2002 and 2015 in the state of Rio Grande do Sul, data from the State Public Security Secretariat (SSP / RS) were used. Indicators included: theft, vehicle theft, robbery, vehicle robbery, and robbery followed by death. These indicators are part of the variable larceny rate.

The main sources of data are from the Brazilian Institute of Geography and Statistics (IBGE), Foundation of Economy and Statistics (FEE / RS); Secretariat of

Public Security (SSP / RS), Institute of Applied Economic Research (IPEA).

3.1.1 Structural Equation Model

According to Codes (2005), the modeling technique of structural equations (SEM) has been emphasizing among social researches of quantitative scope, since it allows a more advanced perception of the behavior of social variables.

The technique of quantitative analysis consists of testing the plausibility of a model constructed on the basis of a theory about an unknown phenomenon (latent) to be studied. (CODES, 2005). This procedure is characterized by allowing several variables to be correlated simultaneously, placing itself as a favorable alternative to the approach of complex phenomena, since it becomes capable of tracing how the various factors involved in the object of analysis (unknown variable) behave.

In order to construct the model of structural equations, the following are variables are utilized:

η = latent variable: unknown variable of the model, which is being observed. For each latent variable there may be indicator variables and causal variables;

X = observed exogenous (causal) variable: consist of data that condition the increase or decrease of η, that is, if there is any positive or negative correlation between the variables.

Y = observed endogenous variable (indicator): Indicators which can serve as reference measure of the latent variable studied, such as: in the case of the latent variable as the demand for illicit goods, and one of the indicators as crime rate.

Thus, the modeling of structural equations is a methodology capable of being applied to complex phenomena that involve multiple factors; characterized by its ability to specify, estimate, and test hypothetical relations between groups of variables. In the case of the present work, it is investigating two latent variables: i) demand for illicit goods and ii) supply of criminal labor.

It should be noted that structural equations have the objective of constructing models that seek associations between variables (concepts). Due to this, to support the construction of the model, a hypothetical test that represents such theoretical references is elaborated.

3.1.2 The Construction of The Model

The model of equations developed in this article was based on the Model of Multiple Causes and Multiple Indicators (MIMIC), elaborated by Joreskog & Goldberger (1975). The MIMIC belongs to a certain type of structural equations

(SEM), applied to a great extent in the research of the Underground Economy (Gomes, 2015, Ribeiro & Bugarin, 2003; TEDD & GILES, 2000) or for investigations in the area of sociology and psychology (MACANA & COMIM, 2015).

The adjustment tests of the structural equations, in general, consist in comparing the data covariance matrix (observed) with that implied by the model. In its simplest form, this notion is translated into a test run that calculates the difference between both matrices and analyzes the residuals between them.

The path model described on Figure 1 presents the main data to be considered, the observed endogenous and exogenous variables, and the relation that each one has among them. The relation for the theft, vehicle theft, robbery, vehicle robbery and robbery followed by death as indicator variables is due to the possibility of monitoring crime based on the number of Official Bulletins issued by the Civil Police.

For the identification of the model at Figure 1 the number of observations is $p = 16(16 + 1)/2 = 136$ and the number of parameters is 31, which is the sum of 22 estimated coefficients, 2 latent constructs, 2 errs of latent constructors and 5 indicators variables. The freedoms degree number is $df = 136 - 31 = 105$. Thus, the model is identified because has less parameters than observations, or $df > 0$.

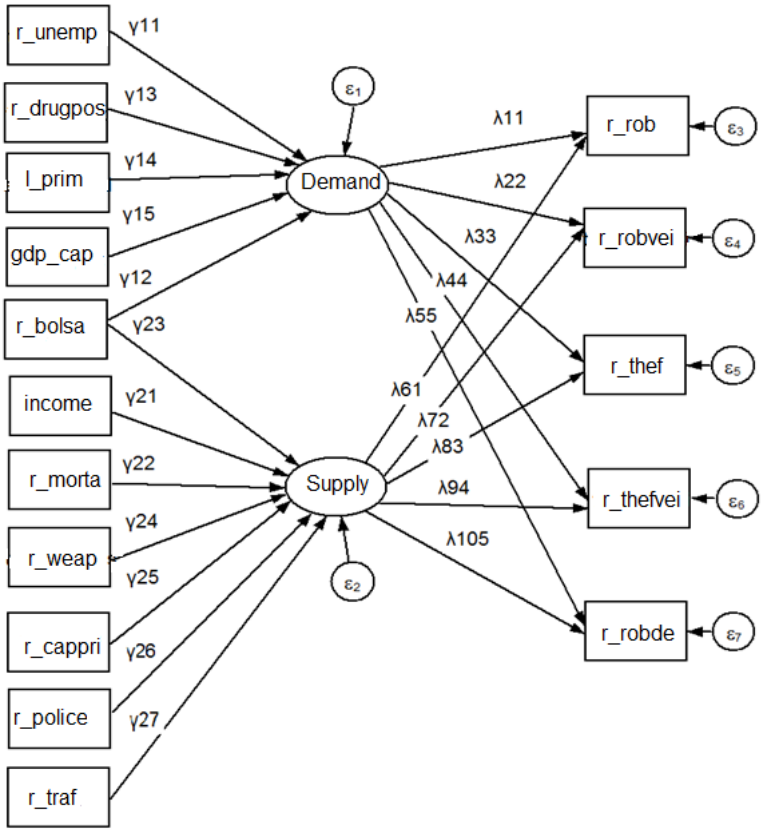


Figure 1: *Path model* from demand and supply

Source: Elaborated by the Author

3.1.3 Estimating the demand and supply variables

From the execution of the basic requirements to the construction of the model and effective validation, it is necessary to establish the calculation methodologies for the proper analysis. The statistical software used for the data to be run is STATA. Based on Figure 1 information, the following equations are constructed:

Structural equations:

$$\eta 1 = \gamma 11X1 + \gamma 12X2 + \gamma 13X3 + \gamma 14X4 + \gamma 15X5 + \varepsilon 1 \quad \textbf{(1)}$$

$$\eta 2 = \gamma 21X4 + \gamma 22X5 + \gamma 23X2 + \gamma 24X6 + \gamma 25X7 + \gamma 26X8 + \gamma 27X9 + \varepsilon 2 \quad \textbf{(2)}$$

Measuring equations:

$$Y1 = \lambda 11\eta 1 + \lambda 61\eta 2 + \varepsilon 3 \quad \textbf{(3)}$$

$$Y2 = \lambda 22\eta 1 + \lambda 72\eta 2 + \varepsilon 4 \quad \textbf{(4)}$$

$$Y3 = \lambda 33\eta 1 + \lambda 83\eta 2 + \varepsilon 5 \quad \textbf{(5)}$$

$$Y4 = \lambda 44\eta 1 + \lambda 94\eta 2 + \varepsilon 6 \quad \textbf{(6)}$$

$$Y5 = \lambda 55\eta 1 + \lambda 105\eta 2 + \varepsilon 7 \quad \textbf{(7)}$$

As in any latent variable (including residues) a metric scale must be assigned because latent variables do not have a specific measure or a natural scale. A metric scale that can occur through normalization should be assigned. This implies restrictions such as: i) assume that all exogenous latent variables have zero mean; ii) every endogenous latent variable has zero intercept and, iii) fix the coefficient (factorial load) of the direct effect of the latent variable on some observable endogenous indicator to be equal to one, which also means marking a variable to be a reference (MACAMA & COMIM, 2015).

Thus, the scale of the latent variable is defined in the same units as one of its indicators. STATA 14 by default uses the first indicator specified in the model as a reference.

3.2 Panel Data: GMM – Generalized Method of Moments

There is a wide literature that deals with the estimation of models with panel data, and for this study we use GMM - Generalized Moments Method. The basic idea of this instrument is to implement a parameter selection procedure that minimizes the weighted sample counterparts of the moment constraints that are derived from the estimated model. Being the fundamental problem consisting of the identification and therefore estimation of the parameters of interest such that the moments (or internal products) of the errors with the instruments are equal to zero. It is considered a linear regression model with the following general form:

$$y = x'\beta + \varepsilon \quad (8)$$

The vector of instruments in this analysis is represented by z. Then, theoretically, the problem is to estimate β so that:

$$E[z\varepsilon] = 0 \quad (9)$$

It is considered that the greater the number of instruments and, therefore, the set of incorporated moment constraints, the greater the efficiency of the estimator tends to be as additional information is used in the regression.

It should be noted that in this case the dependent variable is the burglary rate, where table 1 describes the variables that were used to estimate the Generalized Moments Method.Unlike SEM, the software used to estimate GMM was EVIEWS 8.

After establishing the demand and supply relationships, with their respective variables, a panel-based estimation was estimated by GMM with estimators in the form of generalized IV as defined by Arellano and Bond (1991). This estimation process is based on the conception that the instruments will be able to estimate the variables defined as demand mitigating the effect of endogeny existing in a system of demand and supply.

That is, with the estimation of the model in GMM, one can establish the demand based on the variables that are theoretically conceived as being of demand and cross those results with those obtained in the regressions of the structural equations, presenting, therefore, a more robust result in relation to the validation of demand as a relevant component in the crime rate.

Variable	Obs	Mean	Std. Dev.	Min	Max
r_larceny	476	230.5	101.2	27.0	683.4
r_rob	476	47.8	40.1	5.8	209.8
r_robvei	476	10.7	11.0	0.0	64.2
r_thef	476	157.9	58.8	18.2	436.1
r_thefvei	476	14.0	11.2	0.0	56.4
r_robde	476	0.1	0.2	0.0	1.4
gdp	476	1964.0	4821.1	26.0	38444.6
popula	476	120948.5	246273.3	4254.0	1480967.0
l_prim	408	2.2	1.5	0.0	9.2
r_morta	376	4.4	1.8	0.2	14.1
r_unemp	476	10.8	3.5	5.0	16.8
income	476	2067.2	110.5	1909.0	2265.0
r_weap	476	4.4	2.8	0.0	14.3
r_traf	476	5.1	5.4	0.0	45.0
r_drugpos	476	10.9	11.4	0.0	88.5
r_police	475	0.4	0.3	0.0	1.7
r_bolsa	476	321.0	139.5	50.0	811.0
r_cappri	476	37.2	160.4	0.0	987.4
gdp_capita	476	17.3	22.5	2.6	180.4

Table 2: Descriptive Data

Source: Elaborated by the author with the Software STATA.

Note 1: The variables of rate were normalized considering 10.000 inhabitant per city.

3.3 Structural Equation Model

The first model to estimate the demand for illicit goods derives from the structural equations, and among the SEM existing models the MIMIC (Model of Multiple Causes and Indicators) was used.

3.3.1 Model of Demand and Supply

The construction of the model of structural equations was carried out based on economic contexts, seeking to approach variables that according to latest economics research were factors that influenced the growth or decrease of criminal rates. Table 3 shows the descriptive statistics of the variables estimated by the model, such as the number of variables, the mean, standard deviation, the minimum, and maximum of each indicator and cause.

Variable	Obs	Mean	Std. Dev.	Min	Max
r_rob	476	47.78594	40.10204	5.757052	209.7963
r_robvei	476	10.71862	10.98487	0	64.23996
r_thef	476	157.874	58.82423	18.16903	436.0711
r_thefvei	476	14.00195	11.22111	0	56.41616
r_robde	476	0.1027021	0.1664594	0	1.352082
l_prim	408	2.244118	1.513827	0	9.2
r_morta	376	4.403177	1.78891	0.2145923	14.07186
r_unemp	476	10.81828	3.473379	5	16.8
income	476	2067.214	110.5401	1909	2265
r_weap	476	4.438986	2.800103	0	14.29337
r_traf	476	5.103317	5.428986	0	44.99714
r_drugpos	476	10.85743	11.39096	0	88.48812
r_police	475	0.3946389	0.2768391	0	1.681237
r_bolsa	476	320.9556	139.4849	49.95052	810.9609
r_cappri	476	37.24683	160.3745	0	987.4386
gdp_capita	476	17.27654	22.51114	2.644808	180.4187

Table 3: Descriptive Statistic ***- Path Model***

Source: Elaborated by the author using Software STATA.

Note 1: All the variables: Real values Base Jan/2002 = 1

Note 2: The variables rate were normalized by each 10.000 inhabitant per city.

The process to elaborate the model, represented by Figure 2, had to be done by carrying out several previous tests with different path models, in order to arrive at a model that established economic and statistical significance. This is in addition to considering the validity of the model through the SRMR <0.05 and CD >0.90, regarding the estimations of structural equations. A determination coefficient closer

to 1 indicates greater robustness and, consequently, acceptance of the model. (JORGEKOG, K; GOLDBERGER, 1975).

Table 4 presents the results of the variables, with the coefficients estimated as statistically significant (p-value <0.05).

From the table we can define the causalities between the variables as follows:

Structural Equation:

Demand = 0.392(r_unemp) + 0.712*(r_bolsa) + 0.0383*(r_drugpos) + 0.108*(l_prim) + (-0.025)*(gdp_cap) + 0.0019* **(8)**

Supply = (-0.04)(income) + 0.192*(r_mort) + (-0.157)*(r_bolsa) + 0.020*(r_weap) + (-0.0154)*(r_cappri) + (-0.872)*(r_police) + 0.074*(r_traf) + 0.0837* **(9)**

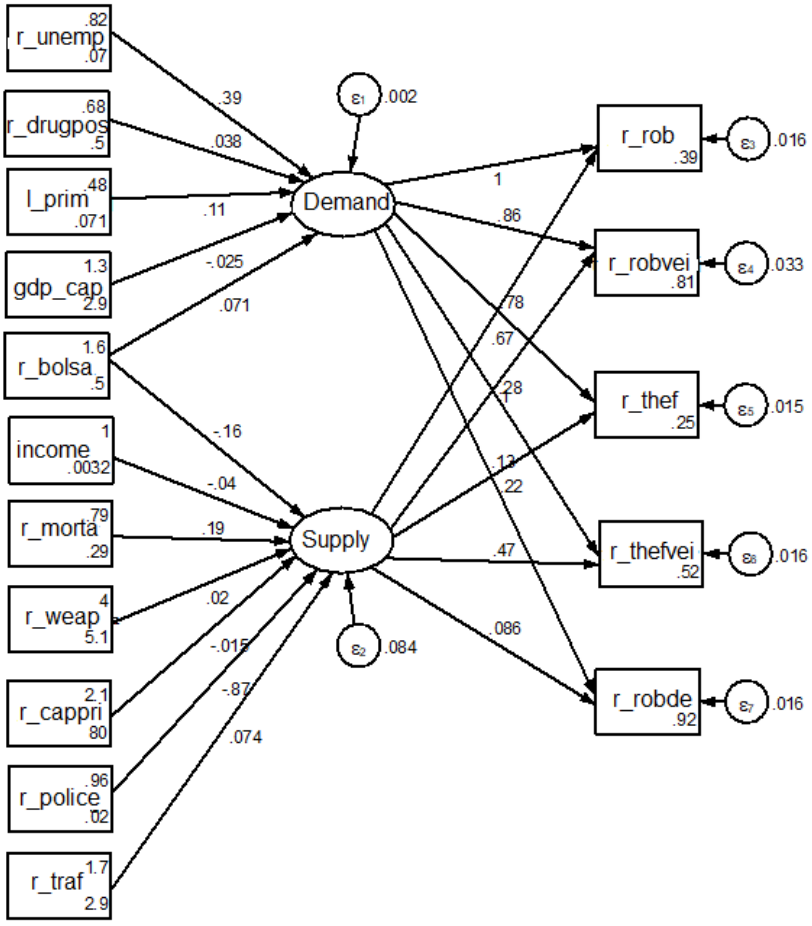


Figure 2: Path Model of Demand and Supply

Source: Elaborated by the author. Model construction using software STATA.

	Coefficient	Standard Deviation	z	P>|z|	[95% of Confidence]	
STRUCTURAL MODEL						
Demand <-						
r_unemp	0.392	0.045	8.590	0.000	0.304	0.481
r_bolsa	0.071	0.016	4.400	0.000	0.040	0.103
r_drugpos	0.038	0.013	3.000	0.003	0.013	0.063
l_prim	0.108	0.036	3.040	0.002	0.039	0.178
gdp_cap	-0.025	(constrained)				
Supply <-						
income	-0.040	(constrained)				
r_mort	0.192	0.031	6.200	0.000	0.131	0.253
r_bolsa	-0.157	0.029	-5.390	0.000	-0.214	-0.100
r_weap	0.020	0.008	2.590	0.010	0.005	0.035
r_cappri	-0.015	0.002	-7.190	0.000	-0.020	-0.011
r_police	-0.873	0.112	-7.770	0.000	-1.092	-0.652
r_traf	0.074	0.013	5.870	0.000	0.049	0.099
VARIABLES OF MEASURES						
r_rob <-						
Demand	1	(constrained)				
Supply	0.666	0.027	24.980	0.000	0.614	0.719
_cons	0.387	0.091	4.250	0.000	0.209	0.566
r_robvei <-						
Demand	0.865	0.102	8.450	0.000	0.664	1.065
Supply	1.000	(constrained)				
_cons	0.807	0.136	5.950	0.000	0.541	1.073
r_thef <-						
Demand	0.782	0.063	12.420	0.000	0.066	0.905
Supply	0.221	0.022	9.950	0.000	0.178	0.265
_cons	0.249	0.044	5.660	0.000	0.163	0.335
r_thefvei <-						
Demand	0.282	0.065	4.340	0.000	0.154	0.409
Supply	0.469	0.020	23.300	0.000	0.429	0.508
_cons	0.520	0.067	7.720	0.000	0.388	0.652
r_robde						
Demand	0.134	0.050	2.670	0.008	0.036	0.233
Supply	0.086	0.016	5.270	0.000	0.054	0.117
Supply	0.086	0.016	5.270	0.000	0.054	0.117
_cons	0.917	0.026	34.650	0.000	0.865	0.969
var(e.r_rob)	0.016	0.002			0.013	0.020
var(e.r_robvei)	0.033	0.004			0.026	0.041
var(e.r_thef)	0.015	0.001			0.013	0.018
var(e.r_thefvei)	0.016	0.001			0.014	0.019
var(e.r_robde)	0.016	0.001			0.014	0.018
var(e.Demand)	0.002	0.003			0.000	0.037
var(e.Supply)	0.084	0.008			0.069	0.101

Table 4: Estimation Result of the Path Model

Source: Elaborated by the author using Software STATA.

Related with the model acceptancy, the determination coefficient and the Square Root of Standardized Residual were tested as shown in table 5. With an SRMR <0.05, the model can be considered adequate and explanatory as to its variables. (KLINE, 2016). Considering that all the estimated variables presented significant values with p-values lower than 0.05.

Statistic	Value	Description
Residuals Size		
SRMR	0.039	Residuals Root Mean Square
CD	0.936	Determinant Coeficient

Table 5: Determination Coefficient

3.3.2 The impact of Demand and Supply

For the estimation of latent variables, all other variables estimated in the model were considered as index, beginning as base 2002, as previously considered the rate of causal and indicator variables for each 10.000 inhabitants. Thus, the estimated values for demand and supply do not reflect their absolute values, but the rate variation in relation to time. The demand rates during the period between 2002 and 2008 had always been positive, since supply rates in the same period are negative. The signs of these quantities are directly related to the behavior of these rates in the analyzed periods. To assist in the interpretation of possible supply and demand relationships with robbery rates (theft, vehicle theft, robbery, vehicle robbery, and robbery followed by death), a comparison of these variables was attempted graphically according with the Figure 3.

Carrying out a graphical analysis of Graph 1, the development of the demand rate follows almost all criminal indicators over time, especially robbery and theft rates. Also, the labor rate available to commit crimes has increased, presenting an increasingly less positive rate, it could lead one to think that the incentives to stay away from this market have diminished, so each year there are more entrants than in the previous year. In graph 1, all assault rates are presented compared to the development of the supply rate.

Over the period, the supply rate presented higher non-positive values in 2003, since the beginning of the series in 2002. The smaller decrease in labor occurred in 2013 compared to the whole period. The decrease has been lessening over time, where from 2002 to 2006 the supply rate represented -0.89, from 2006 to 2011, -0.79, and from 2011 to 2015, -0.73. These values may be indicative of the labor supplied or earned by new workers or that the criminals are working for longer.

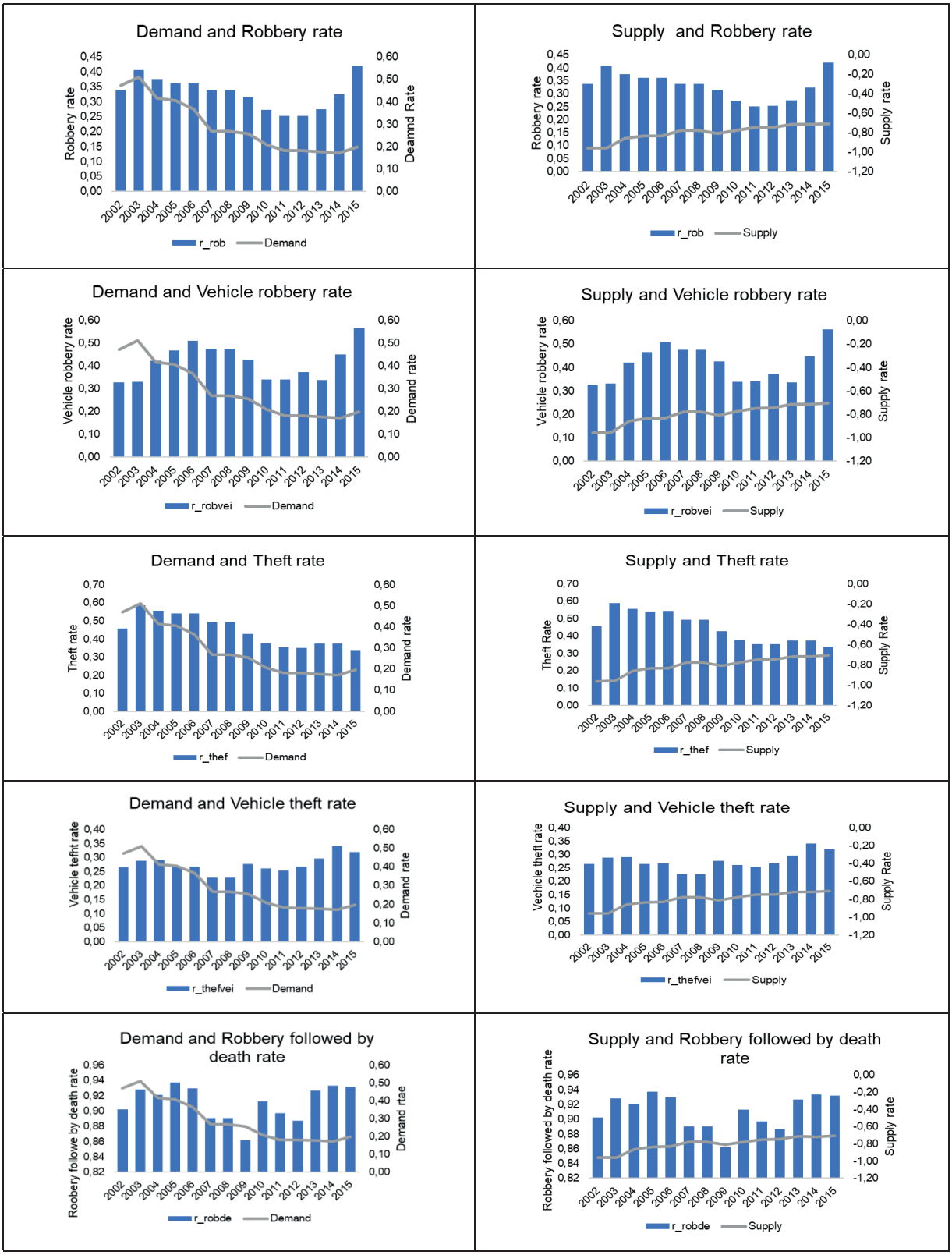


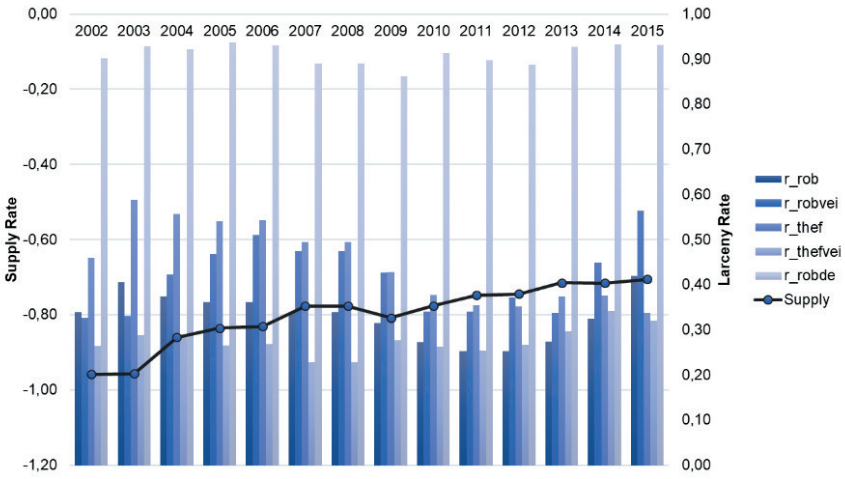
Figure 3: Demand and Supply

Source: Elaborated by the author.

When analyzing the demand rate curve in graph 2, the values tend to follow the growth of the assault rates in the state. In 2002 the demand for illicit goods represented a rate of 0.47 already in 2013, this rate reached 0.18, returning to grow in 2015 with 0.20. It should be noted that the growth of the demand rate has been reducing throughout the series, where from 2002 to 2006 the average rate was 0.43,

from 2006 to 2011 was 0.26, and from 2011 to 2015, 0.18.

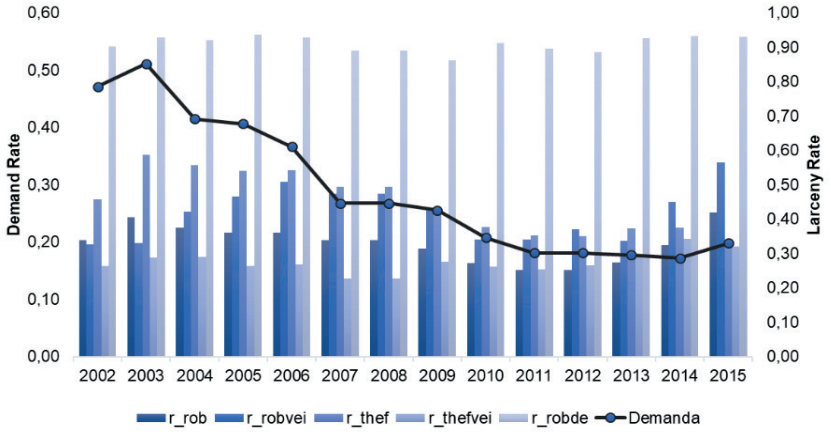
Even with this reduction in the growth of demand rates, it has a positive impact on the increase of criminal indicators, as there are more illegal transactions in this market when there is a higher incidence in the larceny rate



Graph 1: Supply Rate X Larceny Rate between 2002 and 2015

Source: Elaborated by the author.

Note 1: Larceny: Group considering robbery rate, vehicle robbery rate, theft, vehicle theft rate, and robbery followed by death.

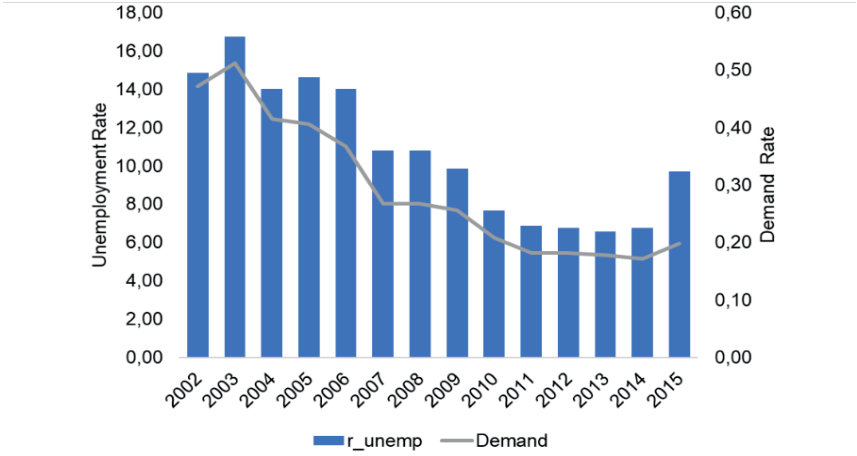


Graph 2: Demand Rate X Larceny Rate between 2002 and 2015

Source: Elaborated by the author.

Note 1: Larceny: Group considering robbery rate, vehicle robbery rate, theft, vehicle theft rate, and robbery followed by death.

When analyzing indicators through 2014, the unemployment rate stood at more than 16% in 2003, reducing over the years to less than 7% in 2013. However, in 2015, the number of unemployed increased significantly, leading to an unemployment rate of more than 9%. (FEE / RS). Graph 3 shows the comparisons.



Graph 3: Unemployment Rate X Demand Rate between 2002 and 2015

The graph above shows the demand rate compared to the development of the unemployment rate from 2002, with the demand representing a development very close to the unemployment rate. A considerable part of the demand rate is explained by the unemployment rate, abandonment in primary education, the rate of families receiving income through the income distribution program "*Bolsa Família*", drug consumption rate, and GDP per capita.

3.3.3 Results Presentation

From the estimated path model, the following results were obtained:

I. Regarding the increase in the unemployment rate, the demand for illicit goods is positively affected, and the unemployment rate plays an important role in explaining the demand for illicit goods. The increase of 1 percentage point in the unemployment rate affects the rate of demand for illicit goods by 0.39 pp.

II. The rate of families benefitting from the socioeconomic program (*Bolsa Família*), presented a negative coefficient when related to supply and positive with the demand. It can be considered that for the supply, the increase of beneficiary families reduces the supply of available labor to commit the crime, since it would have at its disposal income for the acquisition of goods. On the other hand, the demand, with the positive coefficient, could mean that an increase in the rate of beneficiary families generates an increase in demand, so it could be considered that some of the consumers who claim the illicit goods are low-income families, who through the opportunity to acquire cheaper goods, would acquire them on the illegal market;

III. Regarding drug possession and demand, there was a positive relation, that is, as there is an increase in the consumption of drugs there is an increase in demand of 0.037 pp.

IV. Dropout in primary education positively impacted the demand. As primary school dropout rates rise, the demand for illicit assets is affected by 0.10 pp. The results corroborate the idea that places with lower levels of education are more likely to be subject to criminal activities. (SUTTON, 2008).

V. GDP per capita had a negative relation to the demand, as there is a growth in the economy, the incentives to demand for illicit goods tend to decrease, since the population would tend to search for better goods in the stores themselves. According to Draca & Machin (2015) if the perceived incentives of the illegal market are greater than those present in the legal market, the transactions will be carried out in this market.

VI. The income of the employed population showed an expected negative relation, as the income of the employed population increases, the incentives to provide labor to the illegal market tend to decrease.

VII. The relationship of prisoner capacity in prisons had a negative impact on supply. That is, the increase of 1pp in the rate of capacity of prisons tends to inhibit the supply of available criminal labor in -0,015 pp;

VIII. The mortality rate presented positive values, an increase of 1 percentage point may correspond to an increase of 0.192 pp for the supply, meeting what was expected. Places with low schooling and high mortality rates tend to have a greater supply of labor. (SUTTON, 2008).

IX. The ratio of police stations available to every 10.000 inhabitants had a negative impact on supply. That is, the increase in the number of police stations would tend to inhibit the supply of available criminal labor.

X. As drug trafficking rates increase, the supply of criminal labor available to commit assault crimes increases.

XI. Regarding the complaints related to guns, the relationship was positive. As guns crime rate increase, the supply of illegal labor tends to increase. The increase of 1 percentage point in r_weap increases by 0.020pp the supply of labor.

3.3.4 The impact in the supply and demand reduction

In order to contribute to RS Public Security Policies, the model estimated were used to verify the sensitivity of the indicators against actions of inhibitions in supply and demand.

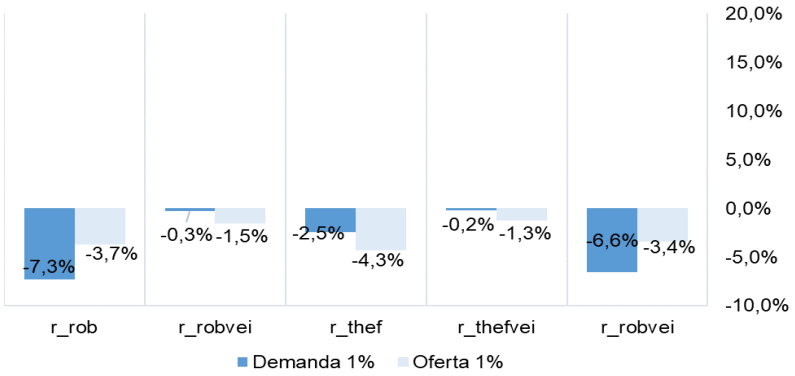
I. Robbery rate: As the demand rate increases by 1 pp., the theft rate increases by 1 pp. For the supply rate, theft would increase by 0.67 pp.

II. Vehicle Robbery Rate: As the rate of demand rises, vehicle theft increases by 0.864pp. Considering the offer rate, vehicle theft would increase by 1pp.

III. Theft rate: Theft increases by 0.78pp with a 1pp increase in the demand rate. For the supply rate this increase is lower at 0.22 pp.

IV. Vehicle theft rate and robbery followed by death are the lowest, corresponding to 0.28 pp and 0.13 pp respectively, regarding an increase in the demand rate. Already taking into account the increase in the rate of supply, vehicle theft impacts by 0.47 pp and the robbery rate increases by 0.085 pp.

However, it is worth analyzing the impact of 1% on the reduction of demand and supply for the assault rates, according to graph 4.



Graph 4: Reduction in 1% in the demand and supply rate

Source: Elaborated by the author.

Note1: These reductions are based on the total rate of each assault rate.

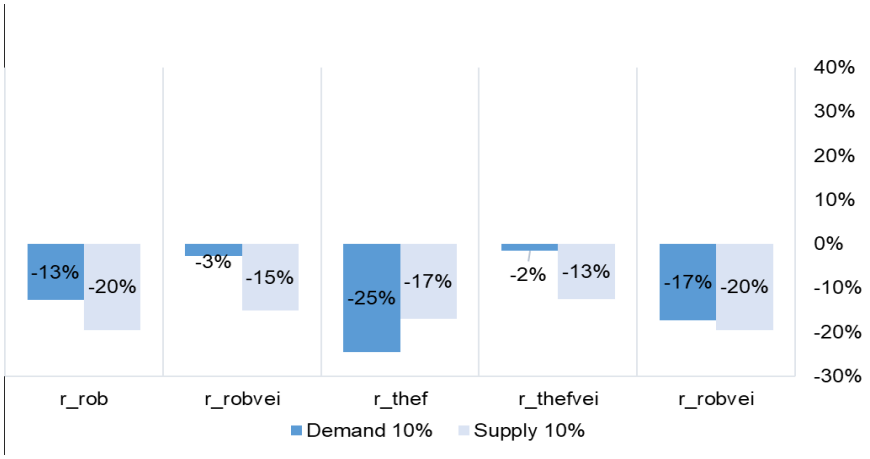
Note 2: If the theft rate is 100, with the reduction of demand for illicit goods by 1%, the value of 100 becomes 95.2. And with the 1% reduction in supply, the theft rate becomes 97.1.

When a reduction of 1% in the demand rate is applied, the variable robbery and vehicle robbery decrease by 7.3% and 0.3% respectively. The theft variable also has a considerable reduction of 2.5% as a reduction in demand is applied. It is worth mentioning that robbery followed by death shows a decrease of 6.6% when applied to the reduction in demand and a decrease of 3.4% for the supply. Also, when the 1% reduction in the labor supply rate is applied, the other variables that show most impact are the robbery rate, reducing by 3.7% and the theft rate by 4.3%.

The application of the 10% reduction in the demand rate and 10% in the supply rate was also applied, trying to verify what would be the impact on the assault rates as shown in graph 5.

When inserting a 10% reduction in the demand rate, significant results were found in the robbery rate with a 13% decrease, the robbery followed by death rate with a decrease of 17%, the theft rate with a 25% decrease, and in vehicle robbery rates and vehicle theft with decrease of 3% and 2% respectively. Considering the

10% reduction in the supply rate, the impact on the criminal indicators all showed above 10%, especially the theft of vehicles with a decrease of 13%. Hence, if an investment to inhibit crime rates was put to the test, application to public policies to inhibit demand rates would be a more rational and effective action.



Graph 5: Reduction in 10% on demand and supply

Source: Elaborated by the author.

Note1: These reductions are based on the total rate of each assault rate.

Note2: If the theft rate is 100, with the reduction of the demand for illicit goods by 10%, the value of 100 becomes 69. And with the 10% reduction in supply, the theft rate becomes 77.

3.4 Panel Data Estimation

From the initial analysis of the variables regarding statistical and economic significance for supply and demand, this work tried to estimate the independent variables for the rate of larceny that could somehow better explain the growth of crime rates in Rio Grande do Sul.

3.4.1 Estimation of Larceny Rate

Following the specification of Arellano-Bond for panel with dynamic instruments with lags that vary by observation and using the White Period matrix as covariance method, we obtained the results presented in table 6.

The instruments were adequate since they were 11 years old for the analysis, the instruments of classification (Instrument rank) were 18, and in the model there are six estimated variables, resulting in 12 instruments. These instruments were validated according to the *J* statistic that has as null hypothesis that the model is valid, i.e., that the instruments are adequate. As the p-value of this statistic (24,1899) was greater than 0.10 then, the null hypothesis is not rejected.

In terms of the significance of the variables, the result was acceptable, since

all of them are significant at 1%, indicating that those variables that were defined as being in demand did in fact have an impact on the criminal rate, as well being supported by theoretical view.

Dependent Variable: R_LARCENY				
Variables	**Coefficient**	**Standard Deviation**	**t-statistic**	**Prob.**
R_BOLSA	-0.234	0.013	-17.614	0.000
R_UNEMP	12.503	0.817	15.305	0.000
LOG(GDP)	-53.050	1.075	-4.935	0.000
LOG(POPULA)	664.613	9.202	7.223	0.000
R_DRUGPOS(-1)*L_PRIM(-1)	0.342	0.067	5.103	0.000
R_MORT(-1)*TX_TRAF(-1)	-0.180	0.068	-2.660	0.008
	Specification			
Cross-section fixed (first differences)				
Mean dependent var	-8,553	*S.D. dependent var*		29.67944
S.E. of regression	29.32900	*Sum squared resid*		249455.2
J-statistic	24.18996	*Instrument rank*		29

Table 6: Estimated parameter* for the demand

* Note: Dynamic panel by GMM, fixed effects, Arellano and Bond estimators (1991) and consistent White matrix for periods. N = 296 observations, with 28 cut-off observations and the period from 2003 to 2013.

Source: Elaborated by the author.

It should be noted that two variables of the model were transformed using logarithm in order to normalize them as a function of the magnitude differences of the same ones in the sample. This was the case of GDP and Population (POPULA). Another transformation that was made in the model was to add interaction between variables and to delay them in a period.

The first interaction was performed with the variables drug possession rate (R_DRUGPOS) and the dropout rate in primary education (L_PRIM). They have been multiplied among themselves, because it can be considered that places with higher dropout rates in primary education are associated with low-income communities with poorly structured and drug-laden families.

For the variables mortality rate (R_MORT) and drug trafficking rate (R_TRAF), trafficking is shown to affect the mortality rate as disputes over drug transaction areas have generated a significant rise in homicides in specific regions and these factional disputes would end up discouraging some of the demand. When analyzed individually, each result shows that:

I. Bolsa Família (R_BOLSA): It is a variable that helps to measure the economic conditions of the regions, since it is a program of income distribution of the federal government with the objective of supporting families in precarious conditions economically. Thus, an increase in the family stock exchange

rate would tend to decrease the rates of assault, as was corroborated by the estimated model. An increase in r_bolsa decreases by 0.23 pp the assault rates considering the other variables ceteris paribus.

II. Unemployment Rate (R_UNEMP): The increase in unemployment rates has been positively related to the increase in the rate of larceny. This result corroborates with the model of structural equations. Unemployment impacts on the development of criminal rates, given that in times of economic crisis in the country the first to be affected are those with lower levels of education. Therefore it becomes more difficult to find employment in the formal market, leading these individuals to commit crimes in search of income. (SUTTON, 2008).

III. Gross Domestic Product LOG (GDP): GDP can also be represented as an indicator of economic growth, so when we have an increase in GDP it means that the economy of that place is growing, generating employment and income. With GDP growth at 1%, there is a decrease of 53 units in the larceny rate.

IV. Population LOG (POPULA): Population growth was positively related to assault rates, considering that in larger regions, criminal rates tended to be higher.

V. Drug possession rate X Drop-out rate in primary school (R_DRUGPOS (-1) * L_PRIM(-1)): School dropout among young people becomes positively related to criminal practice. (GOULD, WEINBERG & MUSTARD, 2000). When relating possession of drugs with school drop-out, the aim was to verify the impact of these variables on the larceny rate. That is, the greater the school dropout and the consumption of drugs, the bigger is the influence in current crime rates.

VI. Mortality rate X Drug trafficking rate (R_MORT (-1) * R_TRAF (-1)): This variable presented a negative relation with the robbery rate. As there are more drug-related deaths, the theft rate tends to decline. Therefore, the cost of entering this market does not become so attractive on the part of the supply of criminal labor.

Therefore, when analyzing the assault rates, there is a relation with economic growth, considering that the variables that presented the highest coefficients, regardless of population, were the GDP and the unemployment rate.

3.5 Results Overview

In the present chapter, two statistical methods were used to estimate the effect of the demand for illicit goods on the crime rate in Rio Grande do Sul. Since the demand was an unknown variable, it was first estimated by the structural equations method and after the panel estimation by the generalized moments method. Both

models underwent tests of statistical robustness and were considered the variables that had statistical significance and economic meaning.

It should be noted that two hypotheses were tested, the first being whether the demand for illicit goods directly influences the crime rate of the state, as the monetary returns of this market increases.

It was verified first through the structural equations and then by the panel model that it has influence. The income of the employed population variable was used to measure the impact of the supply and the variables GDP per capita and unemployment rate for the average demand according to table 7.

	SEM				GMM	
	Demand		Supply		Larceny Rate	
VARIABLES	**Coefficient**	*p-value*	**Coefficient**	*p-value*	**Coefficient**	*p-value*
r_unemp	**0.392**	*0.000*			**12.502**	**0.000**
r_bolsa	**0.071**	*0.000*	**-0.157**	*0.000*	**-0.234**	**0.000**
r_cappri			**-0.015**	*0.000*		
r_weap			**0.020**	*0.010*		
r_morta			**0.192**	*0.000*		
r_police			**-0.873**	*0.000*		
r_traf			**0.074**	*0.000*		
gdp_cap	**-0.025**	*0.000*				
l_prim	**0.108**	*0.002*				
r_drugpos	**0.038**	*0.003*				
income			**-0.040**	*0.000*		
log(gdp)					**-53.049**	0.000
log(popula)					**664.61**	0.000
r_drugpos(-1)*l_prim(-1)					**0.342**	0.000
r_mort(-1)*r_traf(-1)					**-0.180**	0.008
r_rob	**1.000**	*0.000*	**0.666**	*0.000*		
r_robvei	**0.865**	*0.000*	**1.000**	*0.000*		
r_thef	**0.782**	*0.000*	**0.221**	*0.000*		
r_thefvei	**0.282**	*0.000*	**0.469**	*0.000*		
r_robde	**0.134**	*0.008*	**0.086**	*0.000*		

Table 7: Estimated Models

Source: Elaborated by the Author.

Note1: STATA 14 was used to estimate SEM. EVIEWS 8 was used to estimate GMM.

Both estimated models corroborate the variables unemployment and income as variables that affect criminal rates. Analyzing the demand, as there is an economic crisis affecting the growth rates of the country or state, crime rates tend to increase. One example is agents who formerly purchased original goods when employed, should they become unemployed may lack sufficient income leading them to look for cheaper goods without considering the origin of these goods.

At the same time as this market increases its rate of demanders the rate of supply tends to increase. In the formal market real income ends up not being so attractive, which corroborates the second tested hypothesis wherein as the demand

for illicit goods increases, the criminal labor force available in the market increases as well. In the analyzed period, the supply rate presented decreasing negative growth rates. These values may be indicative that the labor supply may have received new workers or that the criminals are working for longer.

4 I FINAL CONSIDERATIONS

This paper aimed to verify the effect of the demand for illicit goods on the crime rate in Rio Grande do Sul between 2002 and 2015, and from the results it was possible to test the hypothesis of influence of the demand on the crime rate. This positive impact that the demand rate generates on the assault rates is explained by the increase of the unemployment rate, income and level of education mainly. (WILLIAMS & MARTINEZ-PEREZ, 2014).

Demand rates are affected to a great extent by the economic condition into which the individual is inserted, where in times of economic crisis, in situations of loss, the decision-making agent will seek to avoid losses (KAHNEMAN & TVERSKY, 1979), in search of goods more amenable to their available income, even if they originate in the illegal market.

Just as demand has increased its share in the criminal market, supply rates have also been increasing, especially in 2015, which was when it hit its lowest negative rate. Incentives in the criminal market may be considered to be greater than those belonging to the formal market, leading to a migration of workers or more hours available to commit crimes.

The hypothesis of the participation of criminal labor force in the market increasing as there are more incentives proved to be valid. (DRACA & MACHIN, 2015). As legal market wages decrease, there is an increase in the supply of labor available for criminal activities. The supply of labor, search for sufficient incentives, these being in the majority monetary to justify the accomplishment of the illegal act.

From the results generated it is noticeable that public policies for public security that seek to inhibit the demand for illicit goods are important. The following recommendations stand out: i) greater awareness by the media/state as to the consequences of acquisition of illegal products; ii) review of the crime of receiving (Law No. 9.426, of 1996); iii) actions jointly between public security departments mainly in operations aimed at inhibiting the supply of illicit goods, going to places where these goods are marketed.

Therefore, for suggestions of future work, it would be possible to compare the results obtained at Rio Grande do Sul level with other states, such as Rio de Janeiro and São Paulo, in order to verify if there is difference in different samples.

Another analysis to be done would be the direct questioning with the criminals

as Sutton (2008) carried out, so it would be sought to understand directly with the offending agent the main factors that influenced them to commit illicit acts. As already analyzed in this work and in previous works cited, much refers to the question of employment and income, however this comparative analysis could be carried out aiming to find out more about the supply.

The demand for illicit goods on the other hand becomes a little more complicated regarding an attempt to conduct field research or some economic experiment, since the people who acquire these goods would have to admit the purchase and the will or disposition while doing so.

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