Illegal Trade in the Iranian Economy: A MIMIC Approach[1]

Mohammad Reza Farzanegan

FIRST DRAFT

2007 Labsi International Conference
on
Political Economy and Public Choice: Theory and Experiments

27 - 29 September 2007

Certosa di Pontignano, Siena - Italy

Abstract

This study investigates the main causes and indicators of smuggling in both import and export sections of the Iranian Economy and estimates of absolute index of smuggling in Iran during the period of 1970-2002. To this effect, I have applied the Multiple Causes -Multiple Indicators (MIMIC) econometric modelling by LISREL software which enables me to do a comprehensive analysis of the latent variable of smuggling. The main results of this paper indicate that the rate of fine for smuggling and the total unemployment rate have negative and significant effects on smuggling and that the tariff burden has a positive effect on smuggling. Regarding the measurement part of the model, smuggling has a negative effect on real governmental revenues and import price index. Furthermore, the positive effect of smuggling on the petroleum product consumption is also significant.

Keywords: Smuggling, Structural Equation Model, Iran, Illegal Trade

JEL Classification: O17, C39, H26.

[1] Correspondence to: Dresden University of Technology, Faculty of Business Management and Economics, Chair in Economics esp. Public Economics, D-01062 Dresden (Germany). Email: Mohammad_Reza.Farzanegan@mailbox.tu-dresden.de. I wish to thank Marcel Thum and Mohammad Akhbari for their invaluable comments. I also acknowledge the financial support of DAAD. The remaining errors are mine. .

1 Introduction

Smuggling can be defined as the clandestine import of goods from one jurisdiction to another (Deflem and Henry, 2001). The other definition says that smuggling is the evasion of excise taxes on goods by circumvention of border controls (Merriman, 2002). Regardless of different approaches to definitions of this complex multi-aspect issue, the effects of smuggling are numerous and economically significant. For instance, smuggling creates loss in public revenues, it affects the internal structure of a society by creating powerful illegal institutions, and it changes the patterns of consumption (Dominguez, 1975). Furthermore, it may have a negative effect on official indicators such as growth and income distribution. Basically, it can be argued that smuggling is driven by the primary forces of supply and demand. Whenever state intervention drives a wedge between gross and net prices (through excise duties, trade restrictions and custom duties), there is an incentive for underground activities. Smuggling is an activity that is used to earn income from carrying goods through the state border in violation of existing rules. Smugglers seek to generate income by avoiding state control, regulations and related costs (Lithuanian Free Market Institute, 2004). It involves bribery and other forms of corruption and is of a criminal nature in macroeconomics.

While a large body of literature is devoted to theoretical aspects of the effects of smuggling on social welfare[2], this paper estimates the determinants and effects of smuggling in a natural resource abundant economy. Estimating the true nature of smuggling is challenging because it is an illegal and hidden activity. A number of useful and reliable methods to estimate smuggling are available, but each method has its limitations. The methods usually applied to estimate smuggling can be classified into direct and indirect approaches. Direct methods are based on contacts with or observations of persons and/or firms, to gather direct information about smuggled products. Indirect methods of estimating smuggling can be categorized as : (1) Discrepancies between the sale of goods under study and the estimated consumption of those products by using household surveys; (2) discrepancies between the sale of goods and the estimated consumption of those products by using econometric estimation; (3) discrepancies between the imports of goods in the target country with the exports of the trade partner in order to find "under-invoicing"; (4) the model approach or MIMIC (Multiple Indicator and Multiple Choice) method.

The principal technique of detecting illegal trade – the partner-country-data comparison technique – has its origins in the work of Morgenstern (1950) on the accuracy of foreign trade statistics. The technique was further developed by Naya and Morgan (1969) and Bhagwati (1964). Bhagwati (1964) compared the import data of Turkey from the other countries with the recorded figures of export from trade partners of Turkey. He found under-invoicing in Turkey official imports. Naya and Morgan

[2] For example, Bhagwati and Hansen (1974), Bhagwati and Srinivasan (1974), Martin and Panagariya (1983)., Norton .,D.(1988), and Thursby, M., Jensen,R., Thursby J(1991)

Email: Mohammad_Reza.Farzanegan@mailbox.tu-dresden.de

(1969) followed the similar methodology for the case of South East Asian countries. He observed irregular patterns in this region's trade, suggesting a large degree of inaccuracy and discrepancy in trade related data. Alano (1984) carried out an econometric analysis of import smuggling in the Philippines during 1965-1978. The dependent variable in his study is import smuggling which was calculated based on partner-country trade data discrepancies. This information was generated by comparing export figures of major trade partners of the Philippines with import figures of this country from its major partners. Probable discrepancies are assumed for possible smuggling amounts. This calculation provides required data for dependent variables in regression analysis. Alano then proceeded to identify the following variables: the level of income, probability of getting caught, the black market premium, penalty rate, and nominal rate of duty. His estimation of smuggling for the Philippines ranged from 28.95% to 53.81% of the reported exports to this country from the partner-countries considered in his study. Phylaktis (1992) applied an OLS model for the case of Chile during the period of 1974-1984. He showed that import tariff raises the black market premium in the long run affecting the flow demand for black dollars by smugglers. Yavari (2000) followed the methodology of Bhagwati (1964) and estimated the import smuggling and over-valuation of imports in Iran for the period of 1977-1997.By using import tariff as a proxy for smuggling in a panel data for 70 developing countries over the period of 1956-98, Oskooee et.al. (2003) demonstrated the positive effect of smuggling on the black market premium. Pajoyan and Madah (2005) estimated smuggling in Iran through Structural Equation Modelling. However, their estimation has not included the export side of smuggling as well as the effects of business cycles effects on the smuggling in Iran. Meanwhile, they have not controlled for the effects of smuggling on the black market premium (BMP).

The estimation of smuggling through the investigation of discrepancies between the figures of import and export between the host country and its trading partners has its own limitations. In fact, these discrepancies do not always refer to the existence of smuggling, but can be due to transport costs (in the case of reporting export data in F.O.B while corresponding import data are reported in C.I.F), existence of different exchange rates; time lags in recordings, differences in commodity classification and coverage, and faking of export declaration and inaccuracies in export reporting (Alano (1984)).

This paper contributes to existing literature on the subject by assuming import and export smuggling as a latent variable. Empirical studies of smuggling, as explained earlier in this section, used proxies for the unobservable variable of smuggling which by no means illustrate the comprehensive picture of this complex phenomenon. The modern econometric tool of Structural Equation Modelling with a latent variable enables us to take into account a larger number of key causal and indicator variables of smuggling. The estimated absolute index on the base of this methodology will be much more reliable than building the smuggling index on the base of one proxy or calculation of discrepancies in trade figures. This study also sheds light on the negative effect of smuggling on the natural resource wealth

Email: Mohammad_Reza.Farzanegan@mailbox.tu-dresden.de

of a developing country. Furthermore, it explains the effect of the country's rule of law, parallel market of exchange rate and potential rents in this market; total unemployment rate as a sign of general healthiness of an economy, foreign trade openness, and also specific effect of smuggling on the real government revenue; import price index and growth rate of petroleum product consumption. The analysis uses the time series data for the case of Iran over the period of 1970-2002.

Every year billions of rials worth of goods are smuggled into Iran through different illegal channels as the country has some 700 km of coastlines and 800 km of borders with Afghanistan, Pakistan and the former Soviet Union states. The total estimated value of smuggled goods in Iran is $5.5 billion- $6 billion annually. Approximately 80 percent of these goods enter the country through unregistered ports and jetties in the Persian Gulf.[3] According to Ghalibaf- the former head of the Iranian Police, there are 33 illegal jetties in the Persian Gulf. There are also 15 militarian jetties in this region, 40 per cent of which have a smuggling record. Considering the governmental ownership of 89 percent of all jetties in Iran, the role of governmental agents on smuggling of goods can be more tangible. The main problems of managing smuggling in Iran besides those issues already mentioned are the lower quality and higher prices of domestic brands compared to smuggled goods, high tariff burden and weak institutional quality. Of all the imported smuggled goods in Iran in 2005, home appliances have the highest share according to the findings of the police (24%), followed by automobile (12%), alcoholic drinks (9%), textiles (8.5%), chemical goods (8%), accessories (4.7%), gold (3.1%), and tea (3.1%), to name a few. On the side of export smuggling in 2005, Gas Oil had the highest share (60%) of total discovered exports smuggled followed by Kerosene with the share of 17.6%, other petroleum goods (11%) and Gasoline (2.5%).[4] As it is clear from the figures, the most attractive goods for export smugglers are highly subsidized petroleum products. According to Yunesi, the former Minister of Iranian Intelligence, the estimated amount of petroleum smuggled to neighbouring countries is about 4-6 million litres per day.[5]

While smuggling could be a lucrative business for criminal gangs, it is the only source of income for many people living in impoverished border areas. Indeed, it would be very difficult for such people to earn a living if they were to stop smuggling goods to and from the country. In fact, smuggling is not looked at as a "wicked activity" in border areas. The illegal activities of this group of people can be categorized under the title of "pure smuggling" as opposed to "technical smuggling". The former refers to ignoring the legal channels of importation and exportation completely. The main characteristics of this kind of smuggling can be seen in its rather small scale and the simple organization of smuggling groups. The latter, however, refers to more specialized and technical methods of smuggling through legal channels. Technical smugglers manipulate the technical process

[3] BBC-Persian online news: http://www.bbc.co.uk/persian/business/story/2005/02/050211_he-ka-smuggling.shtml (Interview with Ghalibaf, ex-head of Iran Police).
[4] Eghtesade Penhan website: http://www.eqtesadepenhan.com/comments.asp?category=12&id=36
[5] BBC-Persian online news: http://www.bbc.co.uk/persian/iran/story/2005/01/050123_a_iran_fuel_smuggling.shtml

Email: Mohammad_Reza.Farzanegan@mailbox.tu-dresden.de

and documents in order to evade legal duties and tariffs on imports. They have extensive networks within banking system, custom offices and the police. Alami, a member of parliament, admitted that organized smuggling operations could not be possible without the support of governmental agents and bodies in executive and judiciary branches. He refers to an example that in Jolfa, one of the Iranian border cities, a well-connected technical smuggler managed to change the head of local Police who had refused to cooperate.

Natural resource wealth of Iran is also heavily damaged by smuggling. Every year, some $1.5 billion worth of gasoline goes to waste in Iran[6]. It is either smuggled out of the country, frittered away at pumping stations or over-consumed by decrepit vehicles. Surprisingly, the per capita fuel consumption in border areas is 10-60 percent higher than in central provinces, which indicates that huge quantities of fuel are being illegally shipped to neighbouring countries.[7] Overall, bureaucratic red tape, unstable laws, low risks of smuggling, high tariffs on imported goods, and corruption are described as major factors paving the way for smuggling.

The paper is organised as follows. In section 2, the theoretical literature on smuggling is reviewed. The empirical methodology is presented in section 3. The empirical Model and explaining the variables are presented in section 4. Finally, empirical results and main conclusions are presented in sections 5 and 6, respectively.

2 Review of Theoretical Literature

The welfare aspects of smuggling have attracted some attention by economists. Bhagwati and Hansen (1973) study the welfare levels under tariffs with and without smuggling. They conclude that the achievmnet of a given degree of protection to domestic importable production, in the presence of smuggling, leads to lower levels of welfare than if smuggling were absent.

Pitt (1981) proposes a model of smuggling consistent with the coexistence of smuggling, legal trade and price disparity. By his definition, price disparity can be calculated by comparing the domestic price of the goods (Pd, in domestic currency units) to the quantity of domestic exchange that can be earned through legal trade (that is the world price, Pf, which has quoted in USD times the legal effective exchange rate for the exportables, EER). Mathematically, price disparity equals with ((Pd/Pf*EER)-1)*100. The presence of price disparity can be an indicator of existence of smuggling. He emphasizes on “technical smuggling” domination in the case of Indonesia. According to him, the greater the legal trade, the easier it is to hide smuggling from enforcement agencies and naturally smuggling would be less costly. Furthermore, He discusses that the quantity of legal trade and subsequently governmental tax revenues in the smuggling situation exceeds that of non-smuggling situation. He, then, concludes that the policy of complete and effective enforcement against smuggling may not maximise the level of legal trade. This is in contrast with Bhagwati and Hensen (1973)

[6] Iran Daily,'' Fuel Piracy'', Thu, Sep 08, 2005
[7] Ibid.

Email: Mohammad_Reza.Farzanegan@mailbox.tu-dresden.de

statement, which implies by presence of smuggling, we have to expect lower level of welfare resulted from reduction in public revenues. Pitt(1981), then uses his theoretical concept for the case of export smuggling of rubber in Indonesia within a simple OLS model during 1949-1972. He established a linear relationship among legal export of rubber as dependant variable with rainfall, incentive to smuggling defined as the rupiah return to a dollar's worth of smuggling relative to the rupiah return to a dollar's worth of legal trade which is the ratio of the black market exchange rate to the legal effective exchange rate for rubber export. Furthermore, he includes the contemporaneous domestic price of rubber relative to price of its domestic competing activity (rice). The dominant share of explaining variances in legal trade of rubber belongs to the incentive to smuggle with a negative coefficient.

Martin and Panagariya (1983) show that increased enforcement of anti-smuggling laws raises real per unit costs of smuggling and also the domestic price of imports but lowers the absolute quantity and the share of illegal imports in total imports. However, their model does not illustrate an unambiguous effect of smuggling on the welfare.

Norton (1988) provides a theoretical model for smuggling of agricultural goods within EEC countries, by focusing his empirical test on Republic of Ireland and Northern Ireland (in the UK). He entered the transport cost for smuggling as well as the probability of detection into his model. He shows that an increase in the tax rate will increase the optimal choice of smuggled goods and the number of firms that are involve in this operation. As tax rates increase, intra-marginal smugglers will increase their expected rents from smuggling and the distance-margin for worthwhile smuggling will be extended. However, still there are some firms which depending to their transport costs will not smuggle goods. His model also indicates that by increasing the rate of fine in the case of detection will reduce the expected value of their profits. Nevertheless, empirical messages and applications of Norton model can be focused on showing the negative relationship between rate of fine on smuggling and the amount of smuggled goods, on one side, and positive links between increased taxes and tariffs on legal imports and the amount of smuggled products on the other side.

Thursby et.al. (1991), propose a model which smuggling is camouflaged by legal sales. They want to evaluate the effects of market structure and enforcement of law on smuggling and welfare. In their model, if the price effect of smuggling is greater than its cost, then it is possible that smuggling improves the welfare. They indicate that by increasing enforcement of law against smugglers, government reduce the welfare of society. Finally, they applied the model for the case of cigarette smuggling in the US during 1975-1982.

3 Empirical Methodology

In this study, structural equation modelling has used. This kind of modelling allows a set of relationships between one or more independent variables and one or more dependant variables to be examined. Both of these sets of variables can be unobservable (factors) or measured variables

Email: Mohammad_Reza.Farzanegan@mailbox.tu-dresden.de

(indicators). The important issue is that the observed variables are nearly perfectly representing the latent variable(s) in model. As Bollen (1989) mentioned: The structural equation models are "regression equations with less restrictive assumptions that allow measurement error in the explanatory as well as the dependent variables". So this method is theoretically superior to the regression analysis as it explores all information contained in the covariance matrix and not only in the variance. It also allows variables to be measured with error. Compared to regression and factor analysis, SEM is a relatively unknown tool in economics.[8]

The general specification of a SEM can be illustrated as follow:

$$x = \Lambda_x \xi + \delta, \tag{1}$$

$$y = \Lambda_y \eta + \varepsilon, \tag{2}$$

$$\eta = \mathrm{B}\eta + \Gamma\xi + \zeta, \tag{3}$$

Where x = (x1,….,xq)' and y = (y1,….,yp)' are the observed indicators of the latent exogenous and endogenous factors ξ = (ξ1,…., ξn)' and η = (η 1,…., η n)' , respectively. A δ (q x 1 vector) and ε (a p x 1 vector) are the measurement errors for x and y, respectively. Λx is a q x n matrix of coefficients (loadings) relating manifest exogenous variables x to exogenous latent variable ξ. Λy, on the other side, is a p x m matrix of coefficients (loadings) relating manifest endogenous variables y to endogenous latent variables η. B is a m x m coefficient matrix, implying the influence of the latent endogenous variables on each other. Γ is the m x n coefficients matrix for the effects of latent exogenous variables ξ on the latent endogenous variables η. The equation (1) is called the exogenous measurement model and equation (2) is called endogenous measurement model. The equation (3) illustrates the structural part of model.

In this study, we only have one endogenous latent variable (smuggling) and there are not any exogenous latent variables. Therefore, in equation (1) x=I ξ, where x is a vector of exogenous variables. In this situation, the observed exogenous variables contain no measurement errors. (δi = 0) . The measurement model of the latent endogenous variable (here smuggling) which has illustrated in equation (2) can be written as follow:

$$\begin{cases} y_1=\lambda_{11}\eta_1+\varepsilon_1 \\ y_2=\lambda_{21}\eta_1+\varepsilon_2 \\ y_3=\lambda_{31}\eta_1+\varepsilon_3 \\ y_4=\lambda_{41}\eta_1+\varepsilon_4 \end{cases} \tag{4}$$

[8] Just to cite the most comprehensive discussions of its applications: for the sociology: Bielby and Hauser (1977), for the psychology: Bentler (1986), for the economics: Goldberg (1972), Aigner et al. (1984) and for an overview about SEM: Hayduk (1987), Bollen (1989), Hoyle (1995), Maruyama (1997), Byrne (1998).

Email: Mohammad_Reza.Farzanegan@mailbox.tu-dresden.de

Where;

yi: one of the observed measures of smuggling (real government revenues, import price index, black market premium, and growth rate of petroleum products consumption) ,

λ_{i1}: factor loadings

η_1: latent variable (smuggling)

ε_i: measurement error terms.

The equation (4) indicates that the latent factor of smuggling η1 causes the observed dimensions of smuggling. The presence of measurement error terms indicates that we can not observe the extent of smuggling at the four mentioned levels without measurement errors.

The specification of the measurement part of smuggling model in matrix form can be written as follow:

$$\begin{bmatrix} \ln\_real\_government\_revenue \\ \ln\_import\_price\_index \\ black\_market\_premium \\ growth\_rate\_petrolume\_consumption \end{bmatrix} = \begin{bmatrix} \lambda_{11} \\ \lambda_{21} \\ \lambda_{31} \\ \lambda_{41} \end{bmatrix} .[smug] + \begin{bmatrix} \varepsilon_1 \\ \varepsilon_2 \\ \varepsilon_3 \\ \varepsilon_4 \end{bmatrix} \quad (5)$$

On the side of structural part of model demonstrated in equation (3), as far as we have just one latent factor of smuggling in the model, then B=0. As I explained earlier, x=Iξ, then the structural equation can be written as follow:

$$\eta_1 = \gamma_{11}x_1 + \gamma_{12}x_2 + \gamma_{13}x_3 + \gamma_{14}x_4 + \gamma_{15}x_5 + \zeta \quad (6)$$

The specification of the structural part of smuggling model in matrix form can be written as follow:

$$[smug] = [\gamma_{11}, \gamma_{12}, \gamma_{13}, \gamma_{14}, \gamma_{15}] . \begin{bmatrix} inverse\_fine\_rate \\ \ln\_official\_ex \\ \ln\_black\_ex \\ tariff \\ unemployment \end{bmatrix} + [\zeta_1] \quad (7)$$

In this study, I use ML method which is by far the most common method in the literature. ML makes estimates based on maximizing the probability that observed covariance are drawn from a population assumed to be the same as that reflected in the coefficient estimates.

Email: Mohammad_Reza.Farzanegan@mailbox.tu-dresden.de

4 Model Variables

4-1 Explanatory variables (Causes)

a) Rate of Fine

In the literature, the most popular determinants of smuggling are the rate of fine, punishment and enforcement of law (Martin, et.al (1983), Norton (1988)). The common hypothesis is that an increase in the rate of fine increases transaction costs of the smuggling and reduces the expected profit. So a negative sign for the parameter associated to this variable is expected. In the case of Iran, the rate of fine on smuggling products calculated in rial amount of very USD value of smuggled goods. The rate of fine till 1993-94 was very low and negligible. But in mentioned year, the punishment regulation on smuggling revised and the fine rates increased substantially.

b) Black and Official Exchange Rates

Macedo (1987) constructs a detailed model of the relationship between trade taxes, smuggling and black markets in foreign exchange. The behaviour of importers and exporters, and their choice between legal trade and smuggling is the basis of his analysis. Smuggled imports are paid for with black market foreign exchange obtained from undetected smuggled exports.

The message of this model is that the behaviour of exports and importers determines both the black market premium and the ratios of smuggled to legal exports and imports. For a given black market premium, importers and exporters choose their mix of smuggling and legal trade by equating marginal revenue to marginal cost in both activities. Since smuggled imports must be paid for with black market foreign exchange, importer's choices between smuggling and legal trade depend not only to the level of the import tariff and probability of detection, but also on the black market premium.

Barnett (2003) describes a model of a dual exchange rate regime, where one rate (the official rate) presides over the trade account and the other (a parallel rate) presides over informal internal transactions involving currency substitutions. The two exchange rates are determined simultaneously, and their movements are driven in large by speculative actions of agents in the currency markets. If the spread between the two rates becomes large enough, agents have the incentive to engage in smuggling activities. Agents at each date self-select to be one of the two possible types, a smuggler or an entrepreneur in the legal sector. Profits, illegal trade, and the distribution of income in the economy all vary with the parallel market premium. Smuggling also affects the dollarization of the economy. His model suggests that if an aim of policy is to eliminate illegal trade, the policy maker should pursue a strategy of liberalizing current and capital accounts simultaneously.

In this paper, we assume that the parallel market of exchange rate (US dollar against Rial) serves the needs of smugglers, since the foreign exchange necessary to import goods is restricted due to currency

Email: Mohammad_Reza.Farzanegan@mailbox.tu-dresden.de

exchange controls. That means those groups of smugglers that do not access to subsidized USD within banking system must finance their smuggling operations by black market USD. Therefore, increasing the black exchange rate will raise the financing costs of their operations, lowering their profit margin of smuggling.

On the other side, technical smugglers who have access to subsidized exchange rate have the incentive to over-valuation of their imports. This fake valuation enables them to obtain much more foreign exchange rates under official rates. The extra illegal received USD for over-valued imported goods will be selling in black market. By increasing the official exchange rate to the levels of black exchange rate, the incentives for fake over-valuation of imports will be reduced. Therefore, the expected signs of official and black foreign exchange rates are negative.

c) Unemployment rate

The most part of literature has evaluated the role of unemployment on the shadow economy. We can assume that smuggling because of its hidden nature and tax evasion is a part of bigger puzzle of shadow economy.

As Giles and Tedds (2002) state, there are two antagonistic forces which determine the relationship between unemployment rate and the shadow economy. On the one hand, an increase in unemployment could imply a decrease in the black economy as the underground economy could be positively related to the growth rate of GDP and the latter is negatively correlated to unemployment. On the other hand, some "official" unemployed spend part of their time working in the black economy, thus we may find a positive correlation in latter scenario.

Tanzi (1999) also writes that "…the relation between the shadow economy and the unemployment rate is ambiguous". Therefore, economic theory does not give a clue to determine whether the expected sign of this variable is positive or negative, it has to be solved by the empirical analysis in each country.

d) Tariff on Imports

An increase of taxes on legal imports provides ample incentives for smuggling and operating in the black market, so a positive sign for the parameter associated to this variable is expected. In the econometric framework, the tariff burden is measured by means of the share of import taxes in total imports.

4.2 Indicators

e) Total Governmental Revenue

Smuggling has a significant impact on government revenues. We can assume that total governmental revenue is a function of national income (Y). Increasing national income can be a sign of business prosperity and higher levels of obtainable taxes. Also increasing legal imports leads to higher levels of tax on imports revenues. Consequently, I expect that government's revenues (GR) also increase (Total

Email: Mohammad_Reza.Farzanegan@mailbox.tu-dresden.de

GR= F(Y, IMPL)). By assuming that total domestic demand (Q) is met by legal import and illegal imports, we have Q=IMPL+IMPIL and naturally Total GR= F(Y, Q-IMPIL). According to this assumption, total government revenues will be reduced by an increasing flow of illegal trade because of tariff evasion by smugglers.

f) Import Price Index

An import price index measures the change in prices for goods imported by Iran. Theoretical justification for this variable can be found in Thursby et.al. (1991) study of the welfare effects of smuggling. His model indicates that if the price effect of smuggling is greater than its cost, then it is possible that smuggling improves the welfare. Therefore, he believes in this situation, the combating against smuggling might reduce the consumer welfare. In the case of Iran, whenever the government has intensified his combating against smugglers, the price of smuggled goods has increased.

Smugglers because of evading legal duties and tariffs have a cost advantage compare to legal importers in the domestic market. Therefore, they are able to earn their expected profit margin with lower prices than market equilibrium price. Depending on the share of smuggled product in the domestic market, market equilibrium price of that product will reduce. For clarification, we can assume 2 legal and illegal importers.

The profit function of legal importer: $\Pi_L = TR_1\text{-}TC_1$ and for smuggler is: $\Pi_S = TR_2\text{-}TC_2$, by assuming that in market both similar goods have a similar selling price and assuming that $Q_1=Q_2$ (similar quantity of goods are selling by both of the groups), then we have $TR_1=TR_2$. By knowing that because of tax evasion and considering the weak enforcement of law (low risk of detection and low rate of fine) the total cost of smuggler compare to legal importer is lower: $TC_2<TC_1$. Simply, we have $\Pi_2>\Pi_1$. That means smuggler have this financial advantage to limit itself to profit margin of legal importer, but on the other side, capture a larger share of market by reducing the price of smuggled goods. The reduction of price of smuggled goods will continue till $\Pi_1=\Pi_2$.

g) Consumption of Petroleum Products

The idea of using this indicator in this study is taken from the pioneering work of Kaufmann and Kaliberda (1996) which used the Physical Input approach (electricity consumption) to measure overall (official and unofficial) economic activity in an economy. They assumed that electric-power consumption is the single best indicator of overall economic activity. By having a proxy measurement for the overall economy and subtracting it from the official GDP, Kaufmann and Kaliberda derived an estimate of unofficial GDP. In the other words, any change in energy consumption which does not correspond to changes in the measured total activity level of the country indicates a change in the size of the shadow economy. As I explained in introduction of this paper, one of the main export smuggling goods in Iran are petroleum derived ones.

Email: Mohammad_Reza.Farzanegan@mailbox.tu-dresden.de

h) Black Market Premium

Oskooee et al. (2003), shows that more smuggling results to corruption in customs officials that allow illegal activities in exchange for bribes in terms of cash dollars from importers. These illegal bribery obtained by custom oficial flow into black market. If there are a large black market Premium, there would be higher incentive to ask for a bribe. They also argued that most of the illegal payments of smuggling are cleared via Hundi.[9] The Hundi business is specially implemented through black markets and considered as a safe heaven to smugglers.

In a panel data regression for 70 countries and for 43 years, Oskooee et al. (2003) show that smuggling which in their model has measured by tariff rates increases black market Premium (BMP) in developing countries. Besides their study, Phylaktis (1992) shows the same relationship for the case of Chile.

5 Estimation and Results

In this section, estimations of different MIMIC- models to calculate the absolute index of smuggling in Iran during the period of 1970-2001 are presented. In order to select the best model specification, both theoretical justification and fit indices have taken into account. In the most general model specification (M1), the inverse of rate of fine on smuggling (arf), natural logarithms of official exchange rate (lnef), Natural logarithm of black market exchange rate (lnei), tariff on imports(t), and unemployment rate (unemp) are included as a causal variables and natural logarithm of real government revenues (lnrg), natural logarithms of import price index (lnim), black market premium (bmp), and growth rate of petroleum products consumptions(gpconsum) are as an indicators. All the variables in the model have normal distributions which is an essential assumption for convergence of the model. Considering the sample size, the maximum likelihood method is selected for estimation. Table 1 presents some of the estimated models.

- The inverse of rate of fine (arf) is statistically significant in all models and has the expected positive sign[10]. The rate of fine has a negative relationship with the level of smuggling in all of the estimated models.
- The other causal variable, natural logarithm of official exchange rate (lnef) also is statistically significant when has included in selected models. The sign of this variable meet the expectation which is negative effect on technical smuggling. While increasing official exchange rate can be desirable for the Iranian exporters (When they export products and receive the foreign exchange, they can change them to devaluated rial and earning more rilas),

[9] Hundi is defined as a negotiable instrument like as a bill of exchange or promissory note, used by native bankers in India, also money remitted by such an instrument. This term has gained popularity because of increasing trend of transfers of black money across borders. Businessmen, engaged in unhealthy 'hundi' trade, send money to the exporters in countries like India, Japan, Australia, Sweden, Hong Kong, Singapore, Myanmar etc. The local businessmen open LC showing lesser price and quantity of goods, and later, they send the actual price of the goods to the foreign exporters through 'hundi'.

[10] Using of inverse index of rate of fine is because of meeting the essential assumption of normality.

Email: Mohammad_Reza.Farzanegan@mailbox.tu-dresden.de

but for legal importers, it would be extra financial burden. They have to pay more rials to obtain required exchange rate for importing goods. That makes legal imports more expensive. At first glance, this seems to increase incentive for smuggling, but negative sign of this factor in all of estimated models indicate the costly effects of increasing official rate on technical smuggling. That may be an indicator of dominant role of technical smugglers in Iran.

- The black exchange rate (lnei) in all of the selected models has demonstrated expected negative sign and is highly significant in all of included models which confirms theoretical discussions. Smugglers and criminal bands in most occasions finance their illegal business by black foreign exchange market. The negative sign of this variable shows that by increasing the exchange rate in black market, the financing cost of smuggling will increase, leading to lower levels of technical and pure import smuggling in Iran
- The coefficient for tariff rate (T) confirms the theoretical discussions. The positive sign and high statistical significance (except model 5) of this factor shows the considerable effect of the tariff rate on increasing illegal business in Iran.
- The unemployment rate shows positive sign in models 1, 5, 7, and 8; in the other models demonstrate negative signs. However, it is not statistically significant in all of those models which illustrate a positive role on smuggling. Its negative impact on the level of smuggling in Iran has statistically significance in model 4 and marginally significant (at 10% level) in model 9. This may confirm the Giles and Tedds (2002) idea on existence of two antagonistic forces which determine the relationship between unemployment rate and shadow economy (naturally smuggling because of evading legal taxes can categorize in total shadow economy).
- Regarding smuggling indicator variables, it should be emphasized that including black market premium (BMP) in the selected models (1, 4 and 8) make the adjustment diagnostics poor and the sign is also opposite to that expected. This variable is not also statistically significant in selected models.
- As factors represent theoretical constructs, it is seldom the case we have a clear definition for the measurement scale of the concept. For our example, we do not know in advance what type of a scale to choose a priori for the general factor of smuggling. Moreover, the observed measures we employ for constructing the factor often come with different measurement scales. For making estimation possible, a scale of latent variable (smuggling) must be assigned on the scales of measured indicators. For this goal, it is enough to fix one of the measurement loadings to unit. The positive or negative sign of scale depends on theoretical discussion.
- In the case of opting lnim as a scale variable, the impact of smuggling on real government revenues (lnrg) and growth rate of petroleum products consumption (gpconsum) meet the

Email: Mohammad_Reza.Farzanegan@mailbox.tu-dresden.de

expected sign and highly significant. In this scenario the impacts of smuggling on gpconsum is approximately two times larger than its impact on import price index.

- In the case of selecting real government revenues as a scale variable, the impact of smuggling on petroleum products consumption still is much higher than its impact on government revenue and import price index , meeting the expected sign and statistically significant.

- Taking into account the Chi-square and the root mean squared error of approximation (RMSEA) as adjustment diagnostics, we can reject the models 1, 4, 6, 7, and 8 because of their poor fit indices. Among the remaining models, model 5 which meet the fit indices but include the unemployment variable which is not statistically significant. Also, this model excludes the reverse index of rate of fine (arf). Therefore, I prefer to focus on the models 2, 3, 9 and 10. In spite of acceptable overall fit indices of models 3 and 10, the PSI matrix (Ψ)[11] is not positive definite in both models.[12] Model 2 which meet the major part of theoretical expectations about the effects of casual variables on smuggling face the problem of negative error variance for indicator of smuggling namely import price index (lnim). Therefore, despite of acceptable sign of variables and their high significancy, the diagnostic evaluations do not recommend using this model for projection of smuggling index. Consequently, the model 9 selected for further analysis. In general, this model covers the major fit requirements and will be use for estimating latent variable.

- Figure 1 (path diagram for model 9, unstandardized estimation) summarizes the causal relationships between the different variables and the smuggling. The path estimations in this figure are not standardized. Figure 2 demonstrates the standardized estimates for the model 9. The interpretation of unstandardized parameter estimates is straightforward. Their magnitude illustrates the resulting change in a dependent variable (here smuggling) from a unit change in an independent variable, with all other independent variables being held constant. The direction of the change is captured by sign of the relevant parameter. These estimates demonstrate the effect that variables have in absolute value. Any change in the measurement unit of causal and indicator variables changes the value and comparability of parameters across population. On the other side, figure 2 by representing standardization paths helps identify the relative contribution of independent variables in influencing the latent variable. (Diamantopoulos and Siguaw, 2000).

- Although in appendices D and E there are more details of the diagnostics from the model, it is interesting to illustrate how the indicator variables, import price index (lnim), real government revenues (lnrg), and growth rate of petroleum products consumption (gpconsum), explain 96,

[11] m*m symmetrical variance-covariance matrix among the m residual errors for the m endogenous latent variables.
[12] For more details on these problematic results refer to Byrne.B (1998), pp: 174-175.

Email: Mohammad_Reza.Farzanegan@mailbox.tu-dresden.de

33, and 25 percent of the variation of the smuggling, as shown by the model's measurement equations in table 2.

- The structural equation model which has depicted in table 2 also demonstrates that the causal variables explain up to about 70% of the variability of the smuggling in Iran. By applying standardized structural coefficient estimates, analysing of total effects will be possible. These estimates are used to compare the direct effects on a given endogenous latent variable and relative importance of the independent variables.

- Table 3 shows the dominant share of causal variables on explaining the smuggling in Iran. An increase in the standard deviation of tariff (t) variable makes an increase of 0.76 standard units in the smuggling, while the inverse of fine rates cause increases of 0.53 standard deviation (equivalently, the rate of fine reduces the level of smuggling by 0.53 unit). Also, an increase in the standard deviation of unemployment rate causes a decrease in smuggling by 0.21 standard units. Finally, the increase in a standard deviation in the smuggling causes an increase of 0.50 in growth rate of petroleum products consumption, and decrease of (0.98) and (0.57) standard units in import price index (lnim) and real government revenues (lnrg), respectively.

Now, the absolute index of smuggling in Iran over the period under study can be estimated. For this purpose, I apply the coefficients of structural equation in order to obtain ordinary estimations of smuggling. By predicting this index, then, the analysis of fluctuation of the level of smuggling in Iran will be possible. The trend of estimated smuggling over the period of 1970-2002 is illustrated in figure 3. The growth rate of ordinal smuggling index is demonstrated in figure 4.

- As can be seen in figure 3, the smuggling index experienced a high record in the period of 1970-1973. By analyzing the main casual variables in structural equation, the high tariff rates on imports and the real fine rates play an important role. During the period of 1973-1976 we can observe the rapid reduction in the index which mainly rooted in considerable decrease in real tariffs and import tax burden.

- According to the model, increasing unemployment and recession reduce the level of consumption by consumers and consequently lower incentives for illegal imports. Negligible rates of fine till 1979 and steady increase of tariff rates caused a rapid jump in the smuggling index and higher incentives for smugglers. According to official figures, Iranian economy since 1975 experienced a decreasing trend of unemployment which by itself demonstrated the boom cycle caused by considerable increase of oil revenues during this period.

- In the first five years after revolution and implementation of economic policies which favour central planning and protection of domestic industry by import substitution polices, we observe the rapid increase in tariff rates on imports. On the other side, nothing changed on the extremely low levels of fine rates on smuggling. Also, unemployment rate at the end of this

Email: Mohammad_Reza.Farzanegan@mailbox.tu-dresden.de

period remained at the initial year of revolution. This period covers the first half period of war with Iraq. In the second half period of war, Iranian economy faced serious challenges originated in weak and fragile situation of oil prices which caused a high burden on government budget and macreconomy. The natural consequence of this situation was considerable rise in unemployment rate till 1988-89.On the other side, government must facilitated the way of import considering destroyed domestic factories and inability of domestic producers on meeting consumers' needs. The tariff rate in the second half part of the war decreased rapidly. Despite lack of any changes in fine rates in this period, because of general macroeconomy situation which to some extent illustrated by the model, the smuggling index reduced.

- After ending the eight years war in 1988-89, liberalization in foreign trade followed. During 1980-1995, the smuggling index shows a decreasing trend. The rapid fall of the index, especially around the year 1992-1995 is mainly rooted in revision of governmental punishment regulations on smuggling. The most important development in regulation area is re-evaluation and approving the new version of punishment codes on smugglers in 1993-94 instead of its old version of 1990 by Expediency Council of Iran. By approving and implementing the new regulations, the rate of fine on smuggling increased by about 45 times in 1994 compared to 1993.
- Among other contributing factors which are not included in model 9, we can also refer to the increasing trend of foreign exchange rate in black markets over this period, leading to rising costs of smuggling into the country. Since 1995 the smuggling index has increased steadily, mainly because of growth of real tariff rates and reduction of fine rate. Increasing unemployment rate, on the other side, has controlled to some extent the increasing trend of smuggling in recent years.

6 Conclusions

The main objective of this paper was to estimate the size of smuggling of products in Iran, by applying the structural equation models and MIMIC approach. The estimation of several models and their results provide some specific policy recommendations. The main conclusions of this study are as follows:

- **Tariff rate:** State interventions and protectionist policies in the foreign trade sector which reflected by higher tariff rates and other taxes on legal imports play the greatest role compare to other causal variables in selected model on affecting smuggling fluctuations. It has a significant and positive affect on smuggling in all of the models. The policy message of this factor is that by liberalisation of foreign trade, gradual elimination of inefficient subsidies to domestic industries, and providing the competition opportunities for them will enhance the

Email: Mohammad_Reza.Farzanegan@mailbox.tu-dresden.de

quality and management of domestic industry and increasing the demand of their products on one side and on the other side reduction of legal imports charges.

- **Rate of Fine**: The second greatest effect on smuggling (according to standardized coefficients) relate to the level of fine on smuggling. This variable in all of the models which has included has a significant and negative impact on the dynamic of smuggling during the period under sturdy. (Its reverse index has a positive relationship with smuggling). The clear message of this behaviour is by increasing transparency and efficiency in judicial system and political will against illegal business, we will expect the increasing risk of involving into smuggling by agents .That will make illegal trade not economical and profitable for smugglers. That means increasing the quality of institutions and rule of law will have an obvious affect on controlling and reducing illegal business in Iran.

- **Unemployment:** The behaviour of this variable in models is interesting. The common believe is that by increasing unemployment in official economy, we have to expect increasing tendency toward illegal business such as smuggling. On the other side, there is another school of though that believes higher unemployment within an economy reflects general recession in economy which reduces the power of purchase and consumption of consumers of products regardless of their legal or illegal nature. This study on the case of Iran demonstrates both positive and negative links from this variable to smuggling fluctuations. However, just negative links are statistically significant. That indicates lack of significant shift of resources from official economy to illegal business, and that higher unemployment levels are not accompanies by increases in the size of illegal business, e.g. smuggling in Iran.

- **Exchange Rates:** The goal of including exchange rates in black and official markets was to evaluate the Macedo (1987) and Barnett (2003) theories in the case of Iran. The literature says that smugglers and agents active in illegal business finance their operations through black foreign exchange markets. Therefore, increasing foreign exchange rate in black market raises the financial charges of smuggling operation. Thus, negative relationship among (Ei) and smuggling is expected. This thesis has been approved by illustrating significant and expected sign in all of the models which included this variable as a casual factor. In the other side, initial expectation on the behaviour of official exchange rate as a cost element of legal imports might not achieved in those models which include it. Increasing this factor may increase the financial costs of legal imports, making illegal imports more attractive to smugglers. That means initially, one may expect a positive effect of this variable on smuggling. However, it is not the case in models. All of them show a negative impact of this factor on smuggling in Iran.

- **Real Government Revenue:** As one of indicators of latent variable which in some of the models has used as scale variable, the prior expectation of the negative effects of smuggling

Email: Mohammad_Reza.Farzanegan@mailbox.tu-dresden.de

on the government revenues has approved empirically in the case of Iran. The negative affect of smuggling on this indicator in all of the models which allow estimation of its coefficient freely is clear and significant. This means by increasing illegal business which evade legal taxes and social contributions, government lost an important source of revenues every year. The result of these lost revenues is lower quality of public goods and social services which could add to welfare of citizens.

- **Growth Rate of Petroleum Products Consumption:** Another interesting finding in this study is significant inflationary effects of smuggling on the petroleum consumption in Iran. The gap between domestic subsidized petroleum products' prices and their regional prices has provided a high incentive for illegal trade of this strategic material. The high consumption of these products has become a great challenge for the government. In 2006, the amount of energy subsidy reached to $ 40 billion or about 17.5% of the Iranian GDP. According to an official source, the amount of 30 million litre of gasoline disappears in Iran daily. The transport and traffic vice president of Tehran Mayor explains that the total number of 6 million autos which uses gasoline as fuel should consume about 33 million litre per day and also the daily consumption of 5 million motorcycles in Iran is about 7.5 million litres which together give the amount of 40.5 million litres per day. By comparing this figure with real current real figure of 73.5 million litres per day, the lost amount of gasoline reaches to 32.5 million litre daily.[13] It is indeed a considerable amount. There are a great number of reports and news on the illegal export of petroleum products from Iran to neighbouring countries such as Afghanistan, Turkey, and Iraq. This study confirms empirically the positive role of smuggling on this variable over the past 30 years.

- **Black Market Premium:** The goal of including this indicator in some of models was to evaluate the theses of Winston (1969) and Oskooee et al. (2003) on positive effects of smuggling on the balck market perimium. However, inclusion of this indicator not only shows a negative relationship but also make poor the general robosutness of models . Meanwhile, its coefficient implies no statistical significance.

- **Import Price Index**: In the majority of models, this indicator has been selected as a scale variable, fixing its loading to -1. The rational behind selecting the negative unit for this indicator is that by increasing the level of smuggling, assuming that total domestic consumption is covered by imports, we expect a higher level of price competition. This fact reflects itself in reducing import price index for an affected economy. In some other models which government revenue selected as scale variable, the negative impact of smuggling on import price index is observed, too.

[13] Meeting of Hashemi with a group of journalists: http://www.eqtesadepenhan.com/comments.asp?category=1&id=2197 (Access: 12 March, 2007 in Persian)

Email: Mohammad_Reza.Farzanegan@mailbox.tu-dresden.de

Table1: Estimations of MIMIC-model

	M1:5-1-4	M2:4-1-3	M3:3-1-3	M4:3-1-4	M5:3-1-3	M6.4-1-3	M7:3-1-3	M8:5-1-4	M9:3-1-3	M10:3-1-3
Causal variables										
Arf	32.61 (4.18)	32.65 (4.20)	51.38 (8.44)	112.27 (4.65)		32.65 (4.20)	31.43 (3.99)	3.92 (2.86)	113.84 (4.69)	5.90 (3.34)
Lnef	-0.31 (-3.18)	-0.30 (-3.05)				-0.30 (-8.92)		-0.04 (-2.47)		
Lnei	-0.64 (-8.95)	-0.64 (-8.92)	-0.84 (-25.56)		-0.96 (-17.28)	-0.64 (-8.92)	-0.99 (-25.10)	-0.08 (-3.60)		-0.10 (-3.60)
T	6.45 (4.36)	6.54 (4.46)	8.96 (6.39)	31.20 (6.66)	3.04 (1.45)	6.54 (4.46		0.77 (2.92)	31.33 (6.69)	1.03 (3.16)
Unemp	0.02 (0.82)			-0.21 (-2.04)	0.02 (0.42)		0.03 (0.88)	0.00 (0.80)	-0.20 (-1.96)	

Email: Mohammad_Reza.Farzanegan@mailbox.tu-dresden.de

Indicator variables										
Lnim	-1*	-1*	-1*	-1*	-1*	-1*	-1*	-8.33 (-3.95)	-1*	-8.70 (-3.60)
Lnrg	-0.12 (-3.95)	-0.12 (-4.02)	-0.11 (-3.60)	-0.10 (-3.01)	-0.12 (-4.07)	-0.12 (-4.02)	-0.12 (-3.68)	-1*	-0.123 (-3.47)	-1*
BMP	-24.81 (-1.53)			-27.58 (-1.85)				-206.68 (-1.44)		
gpconsum	2.02 (3.04)	1.95 (2.93)	2.32 (3.53)	1.93 (2.88)	1.59 (2.44)	1.95 (2.93)	2.22 (3.34)	16.86 (2.43)	2.19 (2.95)	20.15 (2.53)
Selected Fit Indices										
Chi^2 P value	50.94 (0.01)	18.44 (0.43)	11.67 (0.47)	24.75 (0.10)	10.50 (0.57)	18.44 (0.07)	12.83 (0.04)	50.94	10.59 (0.56)	11.67 (0.47)
RMSEA	0.14	0.028	0.0	0.12	0.0	0.15	0.19	0.14	0.0	0.0
df	32	18	12	17	12	11	6	32	12	12

Email: Mohammad_Reza.Farzanegan@mailbox.tu-dresden.de

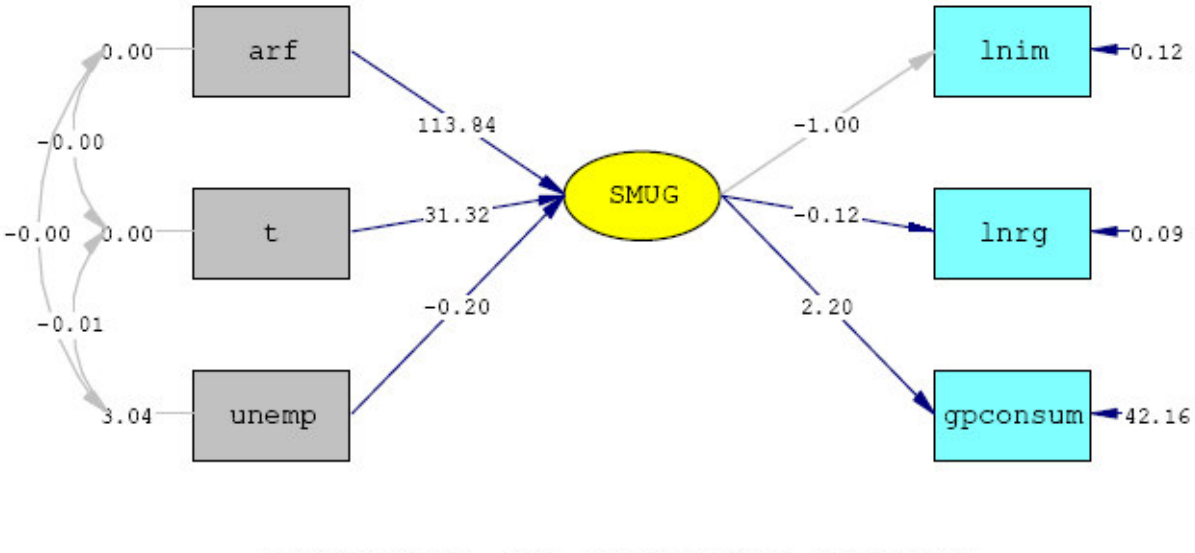

Fig.1 Path diagram for model 9 (Non-Standardized Solution)

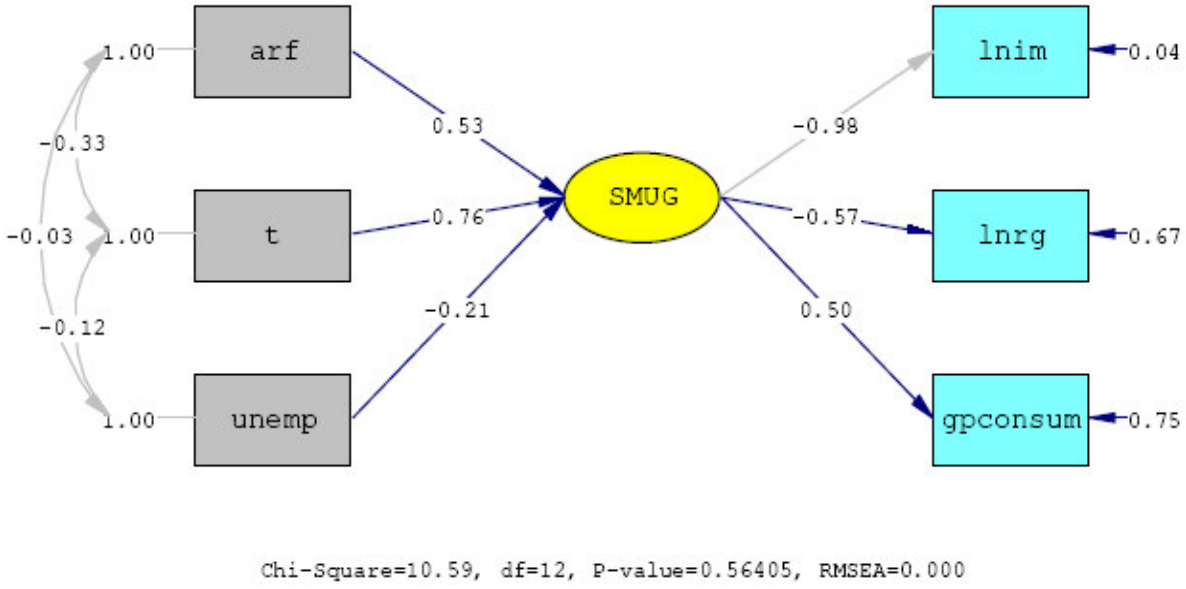

Fig.2 Path diagram for model 9 (Standardized Solution)

Email: Mohammad_Reza.Farzanegan@mailbox.tu-dresden.de

Table 2: Measurement and Structural Equations from Model 9

Measurement Equations:

pconsum = 2.20*SMUG, Errorvar.= 42.16 , R^2 = 0.25
(0.74) (10.78)
2.95 3.91

lnim = - 1.00*SMUG, Errorvar.= 0.12 , R^2 = 0.96
(0.40)
0.29

lnrg = - 0.12*SMUG, Errorvar. = 0.090 , R^2 = 0.33
(0.036) (0.023)
-3.47 3.84

Structural Equation:

SMUG = 113.84*arf + 31.32*t - 0.20*unemp, Errorvar.= 0.92 , R^2 = 0.68
(24.27) (4.68) (0.10) (0.46)
4.69 6.69 -1.96 2.02

Table 3: Total effects of model 9

Standardized total effects of X on ETA

	arf	t	unemp
SMUG	0.528	0.758	-0.210

Standardized total effects of ETA on Y

	SMUG
lnim	-0.98
lnrg	-0.57
gpconsum	0.50

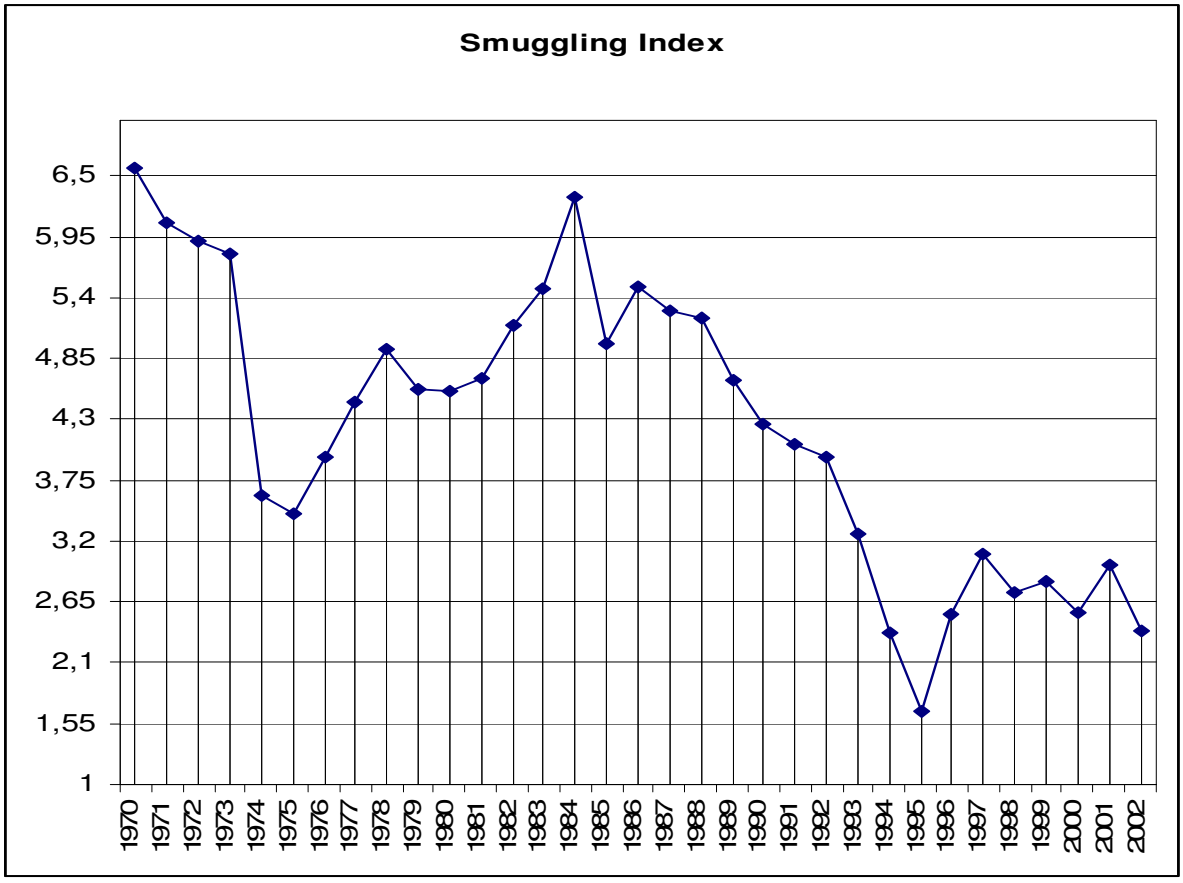

Fig.3 Ordinal Index of smuggling in Iran (1970-2002)

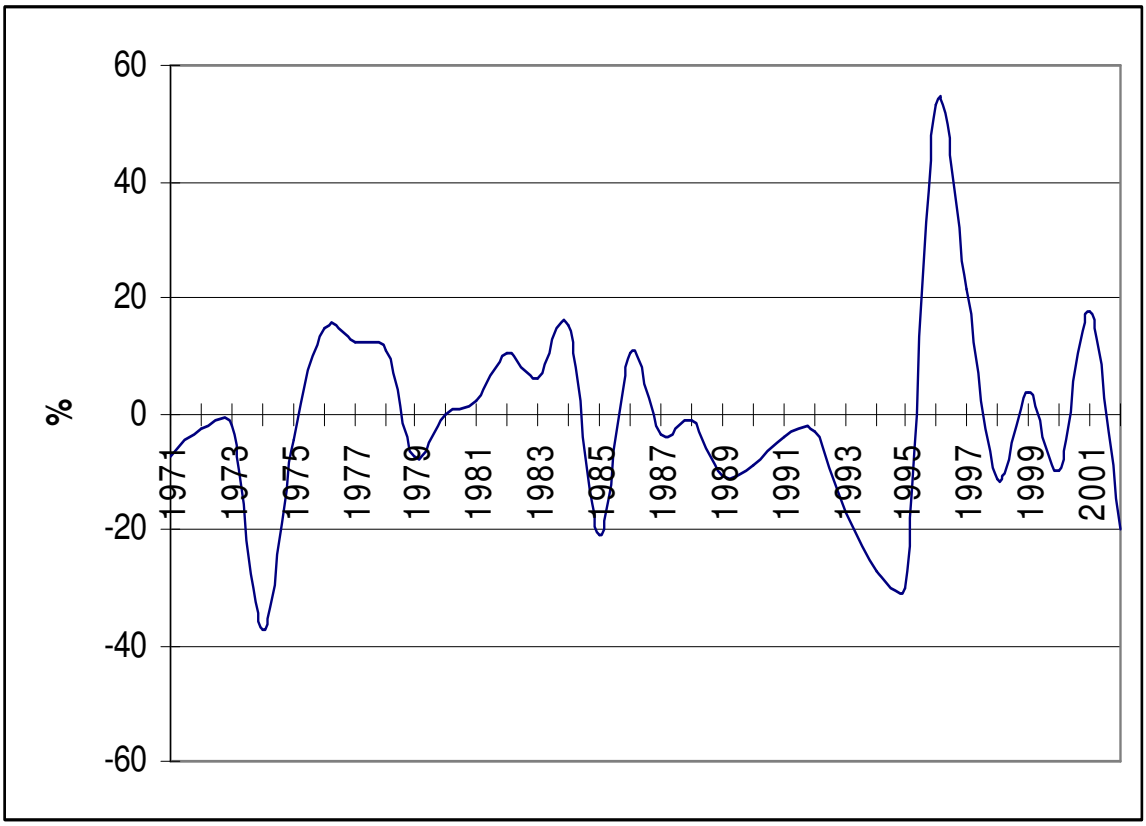

Fig.4 Growth rates of ordinal smuggling index in Iran (1971-2002)

References

Aigner Dennis J., Schneider Friedrich, Ghosh Damayanti (1988). Me and my shadow: estimating the size of the U.S. hidden economy from time series data. *Dynamic Econometric modelling. Proceedings of the Third International Symposium in Economic Theory and Econometrics. Edited by Barnett W. Berndt E. White H. Cambridge University Press, pp. 297- 334.*

Alona, B., (1984), "Import Smuggling in the Philippines: An Economic Analysis", Journal of Philippine Development, Vol.XI, No: 2, pp.157-189.

Barnett, R.,(2003), "Smuggling, Non-Fundamental Uncertainty, and Parallel Market Exchange Rate Volatility", The Canadian Journal of Economics, Vol.36, No:3, pp.701-727.

Bentler P. M. (1986). Structural Equation Modelling and Psycometrika: An historical perspective on growth and achievements. *Psycometrika, 51, pp. 35-51.*

Bhagwati, J., (1964), "On the under invoicing of imports", Bulletin of the Oxford University Institute of Statistics, November 1964.

Bhagwati and Hansen (1973), A Theoretical Analysis of Smuggling, *The Quarterly Journal of Economics* , Vol. 87, No. 2, pp. 172-187.

Bielby W.T., Hauser M. (1977). „Structural equation models". *Annual Review of Sociology, 3, pp. 137-161.*

Bollen K. A. (1989). "Structural equations with latent variables". New York: John Wiley & Sons.

Breusch, Trevor (2005). ''Estimating the underground economy using MIMIC models", The Australian National University, Available at: http://129.3.20.41/eps/em/papers/0507/0507003.pdf

Byrne Barbara M. (1998). "Structural equation modelling with LISREL, PRELIS, and SIMPLIS", Mahwah, N.J.: Lawrence Erlbaum Associates. Multivariate applications book series

Deflem, M., Henry-Turner, K. (2001), "Smuggling, The Encyclopedia of Criminology and Deviant Behaviour", Clifton D. Bryant, Editor-in-Chief. Volume 2, Crime and Juvenile Delinquency, pp. 473-475.

Diamantopoulos, Adamantios and Siguaw, Judy A. 2000. "Introducing LISREL: A Guide for the Uninitiated". Sage Publications, London.

Dominguez, Jorge I.(1975). Smuggling**.** *Foreign Policy*, No. 20, pp. 87-96+161-164

Giles David E.A., Tedds Lindsay M. (2002). "Taxes and the Canadian Underground Economy", *Canadian Tax paper n.106. Canadian Tax Foundation*. Toronto.

Goldberger A. S. (1972). "Structural Equation Methods in the Social Sciences". *Econometrica, Vol.40, pp. 979-1001.*

Hayduk L. A. (1987). Structural equation modelling with LISREL. Essential and advances. The Johns Hopkins University Press. London.

Hoyle R. H. (ed.) (1995). "Structural Equation Modeling: Concepts, Issues, and Applications". Thousand Oaks, CA: Sage.

--------- (2004). "A Study on Economic Causes of Smuggling", Lithuanian Free Market Institute, URL: http://www.freema.org/Projects/Smuggling.pdf

Kaufmann, Daniel and Kaliberda, Aleksander (1996), "Integrating the unofficial economy into the dynamics of post socialist economies: A framework of analyses and evidence", Washington, D.C., the World Bank, Policy research working paper 1691.

Macedo, J.B.D (1987), "Currency Incontrovertibility, Trade Taxes and Smuggling", NBER Working Paper No. W2177

Martin and Panagariya (1983), "Smuggling, Trade and Price Disparity: A Crime Theoretic Approach", Journal of International Economics, November 1984, 201-217.

Maruyama Geoffrey M. (1997). "Basic of Structural Equation Modelling", SAGE Publications.

Merriman, D., (2002), "Understanding, Measure, and Combat Tobacco Smuggling", WORLD BANK ECONOMICS OF TOBACCO TOOLKIT, Tool 7. Available at: http://www1.worldbank.org/tobacco/pdf/Smuggling.pdf

Morgenstern, O., (1950), "On the accuracy of economic observations: Foreign trade statistics", in: The Accuracy of Economic Observations, Chapter IX, Princeton University Press, 1950.

Naya, S., Morgan, T., (1969), 'The accuracy of international trade data: The case of South East Asian countries", Journal of the American Statistical Association, June 1969.

Norton, D. (1988), "On the Economic Theory of Smuggling", *Economica*, New Series, Vol. 55, No. 217, pp. 107-118

Oskoee, B, Goswami, G. (2003), "Smuggling and the Black Market Premium", Scientific Journal of Administrative Development, Vol 1, No.1, pp.95-111

Pajoyan, J., Madah, M. (2005), "Economic Review of Smuggling in Iran", Pajoheshnameh Eghtesadi, No: 20, pp.43-70 (Farsi).

Pitt, Mark M., 1981. "Smuggling and price disparity", Journal of International Economics, Elsevier, vol. 11(4), pp. 447-458.

Phylaktis, K., (1992), "The Black Market for Dollars in Chile", Journal of Development Economy, No: 37, pp.155-172.

Thursby, M., Jensen, R., Thursby J. (1991), "Smuggling, Camouflaging, and Market Structure", *The Quarterly Journal of Economics*, Vol. 106, No. 3, pp. 789-814.

Tanzi Vito (1999). "Uses and Abuses of Estimates of the Underground Economy", *The Economic Journal, 109 (June), pp. 338-347.*

Winston, G.C. (1969), "Over-invoicing, underutilization and distorted industrial growth", Pakistan Development Review.

Yavari,K (2000), "Estimation of smuggling and over-invoicing in import section : the case of Iran", The 3rd national forum on smuggling , University of Modarees, Faculty of Economics, Tehran, IRAN

Appendices:

- **Appendix A** – **Table 4:** Sources of Data- Annually data for 1970-2002
- **Appendix B - Table 5:** Analysis of normality
- **Appendix C – Table 6 and 7:** Unit Root and Cointegration Tests
- **Appendix D – Table 8 and Fig.5:** Analysis of residuals
- **Appendix E** – Average variance extracted

Appendix A (Table 4): Data explanation

Var.	CAUSES	Sources	Transf. Used[1]	Annotations
X_1	Rate of Fine on Smuggling (arf)	Pajoyan & Madah (2005)	Inverse	(arf=1/rf) That is the the rate of fine in rial per each US$ smuggled goods on the constant prices of 1990
X_2	Unemployment rate (unemp)	Central Bank of Iran	-	percentage
X_3	Foreign Exchange rate in black market	Central Bank of Iran	LN	-That is the informal exchange rate of US$ per rials.
X_4	Official Exchange rate	Central Bank of Iran	LN	-That is the official exchange rate for US$ in Iran
X_5	Tariff Burden	Central Bank of Iran	-	- TAX on Imports / Total Imports
	INDICATORS		-	
Y_1	Real Government Revenues	Central Bank of Iran	LN	(Government General Revenues market price value /deflator of CPI1990)
Y_2	Import Price Index	Central Bank of Iran	LN	
Y_3	Petrolume Products Consumption	Ministry of Energy , Energy Planning Department- Energy Balances of Islamic Republic of Iran	Growth rate	Growth rate of total final consumption of petroleum products includes: Residential & Commercial Industrial Transport Agricultural Non - energy uses
Y4	Black Market Perimium	Central Bank of IRAN	-	(Black foreign exchange rate- Official rate)/Official rate

Note: **"LN" means natural logarithm.**

Appendix B: Analysis of normality

The following table 5 presentes the tests of normality (univariate) of the variables used in MIMIC models. This test has performed by Eviews 5 software and presentes the p-value of the Jarque-Bera Test. The p-values larger than 5% confirm the acceptance of null hypothesis, indicating normal distribution of respected variables.

Table 5: J-Bera test (p-value) of univariate normality

Causes	J-Bera test (p-value)
Arf (reverse of fine rates)	0.109818
Lnef (natural logarithm of official exchange rate)	0.194410
Lnei (natural logarithm of black exchange rate)	0.284913
Tariff burden(t)	0.120557
Unemp (Unemployment rate)	0.294020
Indicators	
Lnim (natural logarithm of import price index)	0.195895
Lnrg (natural logarithm of real government revenues)	0.514966
BMP (black market perimium)	0.331927
Gpconsum(growth rate of petrolume goods consumption)	0.907181

Appendix C: unit-root and cointegeration tests

Following guidlines of Breusch(2005) which asserts that with integerated or tending data, the levels of variables are strongly informative. If there is cointegeration , the strategy of estimating on the diffrences throw such information away.

The Econometric software Eviews 5 was used for this purpose.

Table 6 : **Unit-root test**

Causual Variables	Included In equation	level		1st diff.		2nd diff.	
		ADF	PP	ADF	PP	ADF	PP
ARF	C	0.29	0.29	0.00*	0.00*	-	-
Lnef	C & T	0.77	0.83	0.11	0.18	0.00*	0.00*
Lnei	C & T	0.26	0.22	0.00*	0.00*	-	-
T	C & T	0.15	0.16	0.00*	0.00*	-	-
Unemp.	C & T	0.00*	0.49	0.02*	0.02*	-	-
Indicators							
Lnim	C & T	0.55	0.65	0.37	0.43	0.00*	0.00*
Lnrg	C & T	0.66	0.55	0.00*	0.00*	-	-
BMP	C & T	0.64	0.63	0.00*	0.00*	-	-
Gpconsum.	C & T	0.00*	0.00*	-	-	-	-

Note: For ADF and PP show the MacKinnon(1996) one sided p values; * means stationary at 0.05 level.

Table 7: **Johansen Cointegration test**

Variables (n)	L_{trace} value	no.Cointegrated Eq.	H0:rank=0 vs. H1: rank>0
Arf, lnei,t, and unemp.(4)	65.99	2	Reject H0: no cointegration at 5%
lnrg and bmp (2)	4.29	1	Rejection of H0: no cointegration at 5%
arf, t, unemp, lnim,lnrg(5)	81.86	2	Rejection of H0: no cointegration at 5%
arf, t, unemp, lnim (4)	60.20	1	Rjection of H0: no cointegration at 5%
arf, t, lnei, unemp, and lnrg(5)	88.69	2	Rejection of H0: no cointegration at 5%

Appendix D: Analysis of residuals

The analysis of residuals which is presented in table 8 and figure 5 allows the validity of the model to be accepted. Nomal probability or Q plot which has demonstrated in figure 5 plots the standardized residuals (horizontal axis) agansit the quantiles of the normal distribution. The best possible fit would be indicated if all resdiuals were lying in a straight vertical line, whereas the worst possible fit would be indicated if all residuals were lying in a horizontal line. An acceptable fit is indicated when the residuals lie approximately along the diagonal,with steeper plots showing the better fits (Diamantopoulos,et.al,2000). For the selected model in this study (figure7) the Q-plot of standardized residuals is around diagonal and greater than 45 degrees.That is acceptable indicator of the fitness of model with empirical data.Furthermore, as it is clear from table 8, the residuals obtained are small and lower than 2. The residuals are clustered symmetrically around the zero point, with most residuals lying in the middle of distibution and fewer in the tails, following an almost symmetrical positive-negative pattern.

Table 8: Analysis of residuals of the model 9

Standatdized residuals

	lnim	lnrg	gpconsum	arf	t	unemp
lnim	0.000					
lnrg	-0.056	0.000				
gpconsum	-0.136	1.011	0.000			
arf	0.044	-1.780	-0.721	- -		
t	-0.012	0.315	-0.154	- -	- -	
unemp	0.029	-1.341	-0.661	- -	- -	- -

Summary Statistics for Standardized Residuals

Smallest Standardized Residual = -1.780
Median Standardized Residual = 0.000
Largest Standardized Residual = 1.011

Stemleaf Plot

- 1|83
- 0|772110000000000000
0|3

1|0

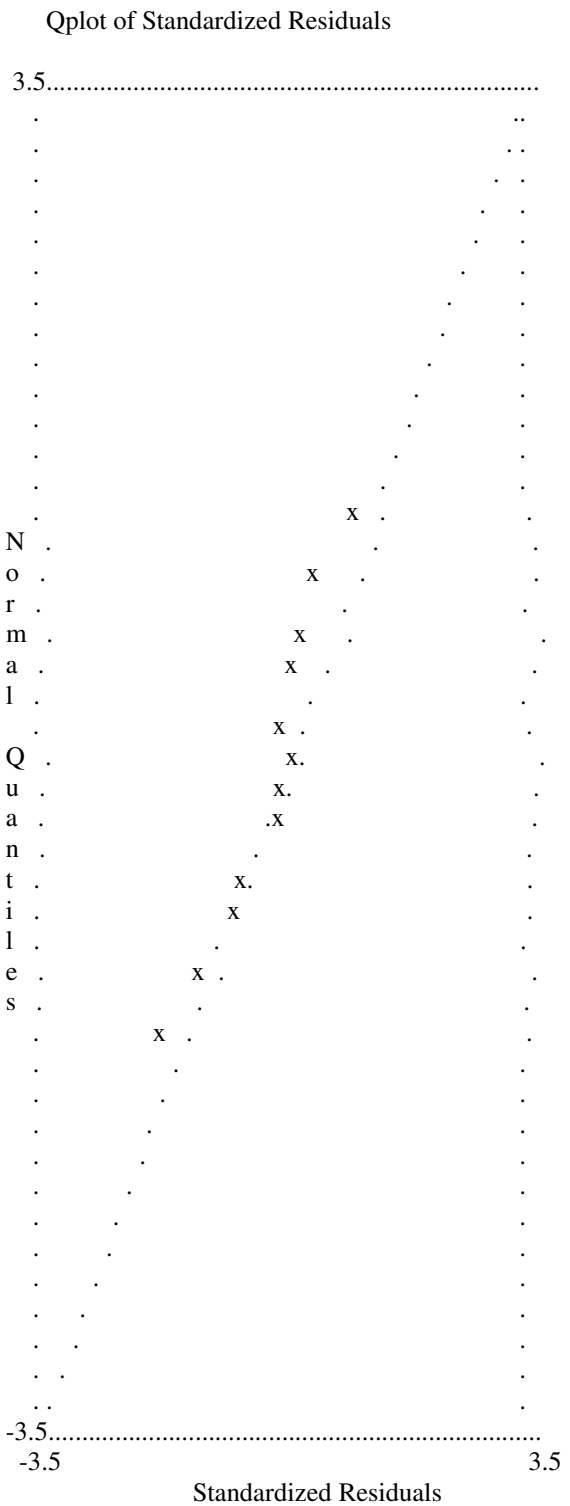

Figure 5: Q-plot diagram of standardized residuals

Appendix E: Average variance extracted (p_v) and further assessment of measurement model

This index shows directly the " amount of variance that is captured by the construct in relation to the amount of variance due to measurement errors" (Diamantopoulos,et.al,2000).Pv less than 0.50 indicate that measurement errors acounts for a greater amount of varaince in the indicators than doese the underlying latent variable. In such a situation, one can doubt about the soundness of the indicators and/or the latent variable itself. The LISREL program does not calculate this index.However, by using the *Cmpeletly Standardized Solutions* estimated by the model and following formula , we can estimate this index:

$$\rho_v \equiv \left(\sum \lambda^2\right) / \left[\sum \lambda^2 + \sum (\theta)\right]$$

where pv is the average variance extracted , λ is the indicator loadings, θ is the indicator error variances, and Σ is summation over the indicators of the latent variable.

$$\rho_v = \left[(-0.981)^2 + (-0.574)^2 + (0.498)^2\right] / \begin{bmatrix} (-0.981)^2 + (-0.574)^2 + (0.498)^2 + \\ (0.039 + 0.671 + 0.752) \end{bmatrix} = 0.512$$

Since Pv>0.50, we can conclude that substantially higher amount of variance in the indicators is captured by the construct compared to that accounted for measurement error. This index provides more confidence in operationaliazation and reliablity of smuggling and its indicators.