The shadow economy Kuznets's curve panel data analysis

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Abstract

The review of recent literature shows the relationship between shadow economy and economic growth is ambiguous. This paper attempts to answer whether the relationship between shadow economy and economic growth depends on the level of development or not? In this way, the Shadow Economy Kuznets's Curve (SEKC) is estimated in two quadratic -Inverted U- and cubic -N shape- functional form by using shadow economies data of 21 selected OECD countries for time period of 1995-2006. The panel data analyses results show that cubic functional form justifies the relationship between shadow economy and economic growth better, this relationship depends on the level of development and the shadow economy has a positive effect on the official economy.

JEL Classification: O17, O4, C23

Keywords: Shadow economy, economic growth, Kuznets's curve, panel data analysis, OECD.

Introduction

Economic activities may be classified under a structural approach into two major group namely formal economy and shadow economy. It is stated that the main stimulus behind the actions of economic agents in their inclinations toward shadow economy is the creation of a non-transparent setting of activities in order to escape legal frameworks. Such as issue i.e., regulation evasion, may in its turn be the result of numerous stimulating factors some of which are related with the way of government intervention, some other arise from the structure of macro-economy and some further stimulating factors arise from the nature of a certain economic activity. Among such factors are the system for granting economic privileges, implementation of different rationing

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systems, tax burden, social security burden, the specifications of taxation system and totally the factors interfering with competitive environment in economy.

Although in recent years, the shadow economy literature especially on definition, methods to estimate and main causes has improved well, the effects on official economic growth are yet ambiguous. Summarizing the literature, every in this field focused on a case study for a particular country. Thus, the subject needs to be approached on the basis of empirical work across the countries to prove the relationship between shadow economy and economic growth.

Objectives of the study

This study has the following specific objectives:

- To explain the basic concepts of shadow economy and economic growth through extensively review of literatures.
- Investigate the relationship between shadow economy and economic growth based on the Kuznets's law from 21 OECD countries.
- To suggest recommendations based on the findings.

This paper tends to analyze the relationship between shadow economy and economic growth by using Kuznets's curve. In the other words, this paper attempts to answer whether the relationship between shadow economy and economic growth depends on the level of development or not?

Theoretical and empirical view of shadow and official economy

According to Chen (2007), there are at least three schools of thought on link between shadow and formal economies: *dualism, structuralism*, and *legalism*. The "dualists" argue that shadow activities have few linkages to the official economy but, rather, operate as a separate sector. This approach is based on the neoclassical hypothesis that rigidities in the official sector, introduced through legislation or negotiation, segment the market (Harris and Todaro, 1970). The dualist hypothesis asserts that these two sectors are subsidiaries through common factors that lead to the flow of workers and activities from formal to the shadow economy.

The "structuralists" consider the shadow and formal sectors as intrinsically linked. Formal enterprises promote informal production and employment relationships with subordinated economic units and workers to reduce their input costs (Chen, 2007). According to this approach, both informal enterprises and informal wage workers are inclined to meet the interests of increasing the competitiveness of regular firms, providing cheap goods and services. Consequently, growing official economy boosts unofficial production.

The "legalists" direct their interest on the relationship between shadow activities and the formal regulatory environment, not formal firms (Chen, 2007), which is attributed to the fact that the capitalist interests collude with government to set the formal "rules of the game" (de Soto, 1989).

Another viewpoint to examine the economic consequences of shadow economy on official economy is based on the analysis of the nature of this relationship. It means that the interest of economist is to know if substitution effects prevail on complementary ones. When the complementarities between unofficial and official economy overcome the substitution effects, larger shadow economy should stimulate the official growth.

It fits the structuralist hypothesis. The economic explanation is that the value-added created in the shadow economy is spent (also) in the official sector. At the same time, more official production increases the demand of unofficial goods and services.

The alternative hypothesis that substitution effects between unofficial and official GDP prevail on complementarities, is basically based on the idea that unofficial activities, creating unfair competition, interferes negatively with the market allocation.

From the demand side, a lack of transparency may distort the information flows, thus making difficult market competition and an efficient comparison of goods and services. From production side, the untaxed return of investment of the unofficial business activities may attract resources from official firms. It is due to the fact that more productive investments of official activities may have lower taxed returns than unofficial ones. Then the misallocation slows down economic growth.

So there are two views about the relationship between these two variables. One of these argues the relationship between shadow and official economy is negative and the other one emphasizes is positive.

The negative relationship between shadow and official economy

One hypothesis is that a substantial reduction of the shadow economy leads to a significant increase in tax revenues and therefore to a greater quantity and quality of public goods and services, which ultimately can stimulate economic growth. Some authors found evidence for this hypothesis.

Since many Latin American countries had or still have a tradition of excessive regulations and weak government institutions, Loayza (1996) finds some evidence of the implications of his growth model in the early 1990s in these countries: the increase in the size of the shadow economy negatively affects growth (1) by reducing the availability of public services for everyone

in the economy, and (2) by using the existing public services less efficiently, or not at all.

Knack and Keefer (1997) find, in a cross sectional analysis, a strong and significantly positive relationship between social capital variable and economic growth. Since the social capital is measured as willingness to pay taxes voluntarily, the higher is the level of social capital; the lower is the incentive to get involved in informal sector. Hence one may conclude that there is a negative relationship between the growth of the shadow economy and the official one.

A recent study by Loayza (1996) presents a simple macroeconomic endogenous growth model whose production technology depends on congest able public services. The determinants and effects of the informal sector are studied, where excessive taxes and regulations are imposed by governments and where the capability to enforce compliance is low.

The model concludes that in economies where (1) the statutory tax burden is larger than the optimal tax burden, and where (2) the enforcement of compliance is too weak, the increase of the relative size of the informal economy generates a reduction of economic growth. The reason for this correlation is the strongly negative correlation between the informal sector and public infrastructure indices, while public infrastructure is the key element for economic growth. For example, Loayza finds empirical evidence for Latin America countries that if the shadow economy increases by one percentage point of GDP ceteris paribus, the growth rate of official real GDP per capita decreases by 1.22 percentage points of GDP.

This negative impact of informal sector activities on economic growth is not broadly accepted. For example, the key feature of the model has been criticized, because the model is based on the assumption that the production technology essentially depends on tax-financed public services, which are subject to congestion. In addition, the informal sector is not paying any taxes but must pay penalties which are not used to finance public services. Based on these assumptions the negative correlation between the size of the informal sector and economic growth is therefore not very surprising.

The positive relationship between shadow and official economy

In the neoclassical view, the shadow economy is optimal in the sense that it responds to the economic environment's demand for urban services and small-scale manufacturing. From this point of view, the informal sector provides the economy with a dynamic and entrepreneurial spirit and can lead to more competition, higher efficiency and strong boundaries and limits for government activities. The informal sector may offer great contributions “to the creation of markets, increase financial resources, enhance entrepreneurship, and transform

the legal, social, and economic institutions necessary for accumulation" (Asea, 1996). The voluntary self-selection between the formal and informal sectors, as described above in microeconomic models, may provide a higher potential for economic growth and, hence, a positive correlation between an increase of the informal sector and economic growth.

Empirical findings of Schneider (1998) also show clearly that over 66 percent of the earnings in the shadow economy are rather immediately spent in the official sector. The positive effects of this expenditure for economic growth and for the (indirect) tax revenues must be taken into account as well. Bhattacharyya (1993, 1999) found clear evidence for the United Kingdom (1960–84) that the hidden economy has a significant effect on consumer expenditures. He points out that the hidden economy has a positive effect on consumer expenditures of nondurable goods and services, but an even stronger positive effect on consumer expenditures of durable goods and services.

Adam and Ginsburgh (1985) also focus on the implications of the shadow economy on "official" growth in their study concerning Belgium. They find a positive relationship between the growth of the shadow economy and the "official" one and, under certain assumptions (i.e., very low entry costs into the shadow economy due to a low probability of enforcement), they conclude that an expansionary fiscal policy has a positive stimulus for both the formal and informal economies. A study of the United States by Fichtenbaum (1989) argues that the United States productivity slowdown over the period 1970-89 was vastly overstated, as the underreporting of income due to the more rapid growth of the United States shadow economy during this period was not taken into account.

Snodgrass and Winkler (2004) point out that enterprise growth is an element of economic growth, for its favorable impact on the income and employment levels of targeted population and as an engine of economic development. Using a cross country micro and small enterprise (MSE) data set of to assess whether the presumed comparative advantages of MSEs hold true in practice, they find that there is a robust, positive relationship between the relative size of the MSE sector and economic growth. While informality is often associated with small, unregistered enterprises, one may conclude that there is a positive relationship between the growth of shadow economy and the formal one.

Gillman and Cziraky (2004) use a MIMIC model for latent underground economy for Bulgaria, Croatia and Romania. Furthermore they estimate a dynamic structural equation model and investigate short-run effects of the underground economy on output growth and test for Granger causality and long-run co integrating relationships using bivariate Granger causality tests and Johansen,s maximum likelihood technique. The results indicate different shares

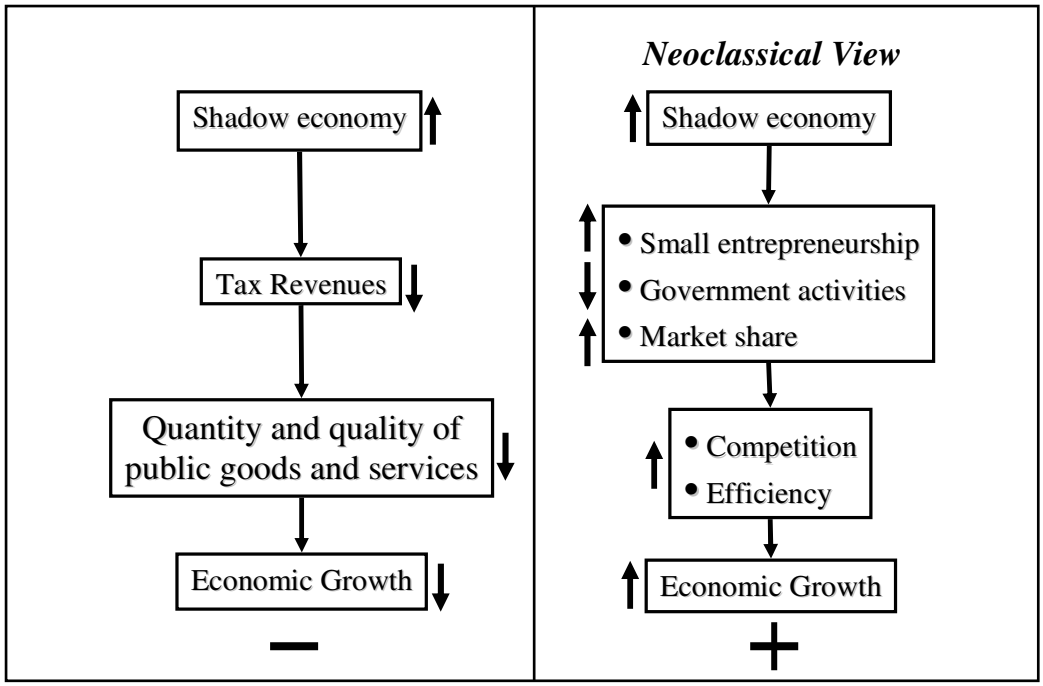
of underground economies across the three countries and a positive long-run effect of underground economy on output growth.

Schneider and Hametner (2007) analyze the interaction between Colombian shadow and official economy. They find the shadow economy has a positive effect on the official one. Average growth rate of real per capita GDP is 1.11% between 1976 and 2002 and the shadow economy "explains" on average between 0.09 and 0.27 of this growth.

Schneider (2004) by estimating a basic equation for a sample of 110 developing and developed countries with further estimates for two separate sub samples of 21 OECD countries and 89 developing and transition countries, point out all three sets of regression clearly indicate that the shadow economy has a statistically significant influence on official economic growth. For transition countries and highly industrialized (OECD) countries this influence is positive while for developing countries the shadow economy has a negative influence on official growth.

Giles (1997a, b, 1999) and Giles et al. (2002) investigate the relationship between the shadow and official economies for New Zealand and Canada, and find clear evidence of Granger Causality from official GDP to the shadow economy and only very mild evidence of Granger Causality in the reverse direction. This is supported by similar evidence for New Zealand reported by Giles. Considering both lines of theoretical and empirical argument, the relationship between the shadow economy and "official" economic growth is ambiguous.

Figurer 1: Theoretical Reasoning about the Interaction between the Shadow and the Economic Growth



Kuznets's Law

To investigate whether the relationship between shadow economy and economic growth is dependent on level of development, we use the Kuznets's law. Simon Kuznets's "inverted U-curve hypothesis" is one of the most enduring and remarkable argument in the history of the social sciences. In the 5 years prior to 2000, nearly 500 articles from a wide cross-section of social science inquiry referenced the U-curve article (Moran, 2005). Srinivasan (1977) call the hypothesis "some sort of iron law of development."

Kuznets (1955) argued that the income distribution within a country was likely to vary over time with its progress from a poor agricultural society to a rich industrial society. The average per capita income of the rural population is usually lower than that of the urban population, whereas income distribution within the urban population is more unequal. In the urban population, savings are concentrated in the upper-income groups and the cumulative effects of such savings would be the concentration of an increasing proportion of income yielding assets in the upper-income groups. Thus, as the weight of the urban sector in the economy increases with industrialization, the country's overall income distribution will tend to deteriorate until such time as the urban sector dominates. Thereafter, the income distribution will tend to stabilize because of three factors: (i) the slower growth in the population of the wealthier classes; (ii) the exploitation of the opportunities for wealth creation offered by technology undertaken by those whose assets are not in established industries; and (iii) the shift of workers away from lower-income to higher-income industries.

The literature in the 1960 and 1970s in general supported the hypothesis that income inequality is related to the level of per capita income (Ahluwalia 1976).

According to Kuznets' law, the relationship between income inequality and per capita income may be described by a curve in the shape of an inverted U, with an upward phase in which income inequality increases with rising per capita income, and a downward phase in which inequality declines with increases in per capita income.

In the modern setting, economists have found a systematic relationship between income changes and environmental quality/pollution, and thus the Environmental Kuznets's Curve (EKC) also as the other type of Kuznets Curve has become the backbone of environmental policy and reform (Selden and others, 1994).

But during the past three decades, diverse patterns have emerged with respect to income distribution. Most South and East Asian economies grew at high per capita rates since the early 1970s while maintaining moderate levels of

inequality, although increasing over time, in particular in China. In contrast, Latin American countries grew by less than half of the average growth rate in South and East Asia while maintaining high inequality. The differences in inequality at a given rate of growth could reflect a different combination of policies and institutions across countries and that these differences in policies matter for income distribution (De Ferranti and others 2004).

So some of the recent literature challenged this hypothesis and several empirical studies found no significant relationship between inequality and per capita income, see Anand and Kanbur (1992). Li, Squire, and Zou (1998) argue that the Kuznets's curve works better for a cross section of countries at a point in time than for the evolution of inequality over the time within countries.

Empirical Model Estimation Procedures

Data that have both time series and cross sections, usually referred to as panel data, are common in economics. Many recent studies of the Kuznets curve have used panel data because it provides a rich source of information about the economy and allows researchers great flexibility in modeling differences in behavior across individuals. In our study, we used panel data covering the shadow economy in 21selected OECD countries over a 12-years period (1995-2006).

The shadow economy Kuznets curve models have been estimated in quadratic specifications between shadow economy and per capita income. We adopt of this specification in our analysis. The general form of the panel data model used to describe the relationship between shadow economy and income in this study is given in equations (1);

$$\ln(shadow) = \alpha + \sum_{k=1}^{m} \beta_k \left(\ln(y_{it})\right)^k + \sum_{n=1} \beta_{m+n} \ln(Z_{it}) + u_{it} \qquad (1)$$

Here, $shadow$ is the size of shadow economy based on Purchasing-Power-Parity (PPP), y is per capita GDP based on Purchasing-Power-Parity (PPP), Z is a vector of other factors -control variables- that influence $shadow$, α is the intercept term, u is the error term and i , t represent indices of country and time, respectively. We estimated the model whit quadratic -inverted U-specification, that is $m = 2$.

Panel data models examine fixed and/or random effects, one or two way of group of time. The core difference between fixed and random effect one or two way models lies in the role of the error components u_{it} that can take different structures. The specification of error components can depend solely on the cross section to which the observation belongs or both on the cross section and time series. If the specification depends on the cross section, then we have, $u_{it} = v_i + \varepsilon_{it}$ -one way- ; and if the specification is assumed to be dependent on

both cross section and time series, then the error components follow $u_{it} = v_i + e_t + \varepsilon_{it}$ -two way-. The term v_i is intended to capture the heterogeneity across individuals and the term e_t is to represent the heterogeneity over time. Furthermore, v_i and e_t can either be random or nonrandom –random or fixed effects-, and ε_{it} is the classical error term with zero mean and homoscedastic covariance matrix. The nature of the error structures leads to different estimation procedures depending on the specification.

For this study, we estimated the models using one-way and two-way fixed and random effects models with F tests, Hausman tests - compares fixed effect and random effect models- and Chow test -compares one-way and two-way models- used to evaluate the appropriateness of the model specifications.

A more significant problem with the original "inverted U" shaped model is the troubling concern that a shadow economy reduction may not actually be occurring on global scales. The recent wave of multinational enterprises (MNEs) has been directed towards countries with high human capital. Most of these countries offering a suit of incentives through tax competition to attract foreign direct investment (FDI) are categorized as tax havens. Although tax havens offer low or zero tax rates to MNEs, they adjust their tax regimes to place a grater burden on other factors of production especially labor and profits of local companies and induce them towards shadow activities. In the other hand, MNEs tend to take more advantages through tax havens by managing earning and transfer pricing so shadow economy increases in these countries.

So in high level of development, the relationship between shadow economy and economic growth returns and actually the “inverted U curve” is an "N" shape. Therefore we should estimate the model whit cubic specification, that is $m = 3$.

To calculate the cubic model, we use the correlated panel-corrected, standard errors (PCSE) model recommended by Beck and Katz (1995). With unbalanced panels, this is a Prais-Winsten estimator. Use of PCSE is consistent with the assumption that the disturbances across panels are heteroskedastic (each country has its own variance) and contemporaneously correlated across countries (each pair of countries has their own covariance). The estimator is a conservative alternative to feasible generalized least squares (FGLS).

The expected signs of coefficients when the shadow economy kuznets’s curve is in quadratic form are $\beta_1 \succ 0$, $\beta_2 \prec 0$ and in cubic form are $\beta_1 \succ 0$, $\beta_2 \prec 0$ and $\beta_3 \succ 0$. If the shadow economy kuznets’s curve exists,

the return point is calculated at $\tau = \left(-\beta_1 / 2\beta_2 \right)$ for quadratic form and $\tau = \left(-2\beta_2 \pm \sqrt{4\beta_2^2 - 12\beta_1\beta_3} / 6\beta_3 \right)$ for cubic form.

Data

In this paper we have studied data of 21 selected OECD countries; Australia, Austria, Belgium, Canada, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Japan, Netherlands, New Zealand, Norway, Portugal, Spain, Sweden, Switzerland, United Kingdom and United States, and for time period of 1995-2006 at annual frequency.

Richness of a Country

Per capita GDP measures the relationship between economic growth and shadow economy[1]. It also directly measures the endogenous characteristics of growth such that it accounts for industrialization, urbanization and other development factors (Shafik 1994). The data source of Per capita GDP base on PPP is International Monetary Found (IMF).

Shadow Economy

The shadow economy includes all market-based legal production of goods and services that are deliberately concealed from public authorities for the following reasons (Schneider 2005):

(1) To avoid or evasion payment of income, value added or other taxes,

(2) To avoid payment of social security contributions,

(3) To avoid having to meet certain legal labor market standards, such as minimum wages, maximum working hours, safety standards, etc., and

(4) To avoid complying with certain administrative procedures, such as completing statistical questionnaires or other administrative forms.

Hence, in this paper, we will not deal with typical underground economic activities, which are all illegal actions with the characteristics of classical crimes like burglary, robbery, drug dealing, etc. We also do not include the informal household economy which consists of all household services and production. In this paper we use the shadow economies data constructed by Schneider (2007) based on the DYMIMIC and currency demand method.

[1] - Taking per capita GDP as a measure of development remains a shadow of doubt in economic development literature; however it still remains an important measure used beside the other measures and indicators.

Tax and social security contribution burdens

Studies point to tax and social security burdens are one of the main causes of the existence of the shadow economy. Since taxes affect labor–leisure choices, and also increase labor supply in the shadow economy, the distortion of the overall tax burden is a major concern. The greater the difference between the total cost of labor in the official economy and after-tax earnings from work, the greater is the incentive to work in the shadow economy. However, even major tax reforms with major tax rate deductions may not lead to a substantial decrease of the shadow economy. Such reforms may stabilize the size of the shadow economy and avoid a further increase. Social networks and personal relationships, high profits from irregular activities, and associated investments in real and human capital prevent people from transferring to the official economy (Schneider, 2006).

The data of tax revnue (direct, indirect tax and social security payment) percent of GDP -tax burden- are used from OECD fact book 2008.

Demographic and labor characteristics

Demographic and labor characteristics such as population size or the labor force may also affect the shadow economy. As Bahl (2003, p. 13) points out, in countries with faster growing populations tax systems may lag behind in the ability to capture new taxpayers. This may increase the incentive to be active in the underground economy. Moreover the higher density of population in urban areas may further anonymity and thus reduce loyalty towards the state; this may lead to a higher level of shadow economy. As many sectors are city-based, it is expected that there the incentives to act in the underground economy are higher, especially when government activities and services are below individuals' expectations and preferences. Thus, the higher the urbanization and the population size, the higher ceteris paribus the shadow economy (Torgler and Schneider, 2007). The data source of population is International Monetary Found (IMF).

The labor force variable measures the potential pool that has the best preconditions to work in the shadow economy. On the other hand, individuals with an occupation have less leisure time at their disposal. Thus, time acts as a restriction to being active in the shadow economy. Unemployed people have an incentive not to report their additional work hours as otherwise they would lose their financial support. If the wage of illicit work and the financial aid together yield more income than regular and overtime work, taking also into account the costs of detection and punishment and assuming risk neutrality, full-time illicit work as an unemployed person yields ceteris paribus a higher utility. In such a situation, the danger that a person remains in the shadow economy and turns down job offers increases (Schneider and Enste, 2002). In sum, the higher the

labor force, the lower ceteris paribus the shadow economy. The labor force participation rate derived from OECD fact book 2008.

Openness

We also measure openness focusing on trade. Trade is transparent and easier to tax and therefore more difficult to hide in the underground economy. Thus, a higher trade volume in relation to countries' GDP may lead ceteris paribus to a lower shadow economy (Torgler and Schneider, 2007). The data of this variable (trade percent of GDP) is collected from OECD fact book 2008.

Economic freedoms

Using different restrictions on economic activities by government, financial, labor, trade and investment markets and also property rights causes economic freedom decreasing and going people and firms towards shadow economy activities. The Heritage Foundation has provided economic freedom index since 1995.

The definition of economic freedom encompasses all liberties and rights of production, distribution, or consumption of goods and services. The highest form of economic freedom provides an absolute right of property ownership; fully realized freedoms of movement for labor, capital, and goods; and an absolute absence of coercion or constraint of economic liberty beyond the extent necessary for citizens to protect and maintain liberty itself. In other words, individuals are free to work, produce, consume, and invest in any way they please, and that freedom is both protected by the state and unconstrained by the state (Beach and Kane, 2008).

Overall economic freedom, defined by multiple rights and liberties, can be quantified as an index of less abstract components. The index we conceive uses 10 specific freedoms, some as composites of even further detailed and quantifiable components. A detailed discussion of each of these factors and their component variables follows this overview.

• *Business freedom* is the ability to create, operate, and close an enterprise quickly and easily. Burdensome, redundant regulatory rules are the most harmful barriers to business freedom.

• *Trade freedom* is a composite measure of the absence of tariff and non-tariff barriers that affect imports and exports of goods and services.

• *Fiscal freedom* is a measure of the burden of government from the revenue side. It includes both the tax burden in terms of the top tax rate on income (individual and corporate separately) and the overall amount of tax revenue as a portion of gross domestic product (GDP).

• *Government size* is defined to include all government expenditures, including consumption and transfers. Ideally, the state will provide only true public goods, with an absolute minimum of expenditure.

• *Monetary freedom* combines a measure of price stability with an assessment of price controls. Both inflation and price controls distort market activity. Price stability without microeconomic intervention is the ideal state for the free market.

• *Investment freedom* is an assessment of the free flow of capital, especially foreign capital.

• *Financial freedom* is a measure of banking security as well as independence from government control. State ownership of banks and other financial institutions such as insurer and capital markets is an inefficient burden, and political favoritism has no place in a free capital market.

• *Property rights* is an assessment of the ability of individuals to accumulate private property, secured by clear laws that are fully enforced by the state.

• *Freedom from corruption* is based on quantitative data that assess the perception of corruption in the business environment, including levels of governmental legal, judicial, and administrative corruption.

• *Labor freedom* is a composite measure of the ability of workers and businesses to interact without restriction by the state.

Labor freedom is available only for recent years and not for the time period of this paper. It is expected that shadow economy activities decrease by increasing economic freedom.

Table 1: Characteristics of sample data

	Mean	***Standard deviation***	***Minimum***	***Maximum***
GDP per capita ($)	27336.05	5786.1	14936.9	44674.8
Shadow economy ($,000)	150.9	194.9	6.97	1001.04
Tax burden (tax revenues % of GDP)	37.89	7.03	25.3	53.9
Labor force precipitation rate	72.48	5.77	58.06	83.1
Population (persons,000)	40.67	62.91	3.6	299.72
Openness (trade % of GDP)	36.54	17.76	8.5	92.2
Economic freedom	69.86	6.49	57.36	82.07
Number of Observations	252			

Results and discussions

The regression results for the one-way and two-way, fixed and random effects quadratic specification are presented in table 2. The Hausman test statistics is equaled to 15.44 and significant so the null hypothesis -model is random- is rejected,suggesting the fixed effects model is better than the random effects one. We use Chow test to compare one-way and two-way models. The F ratio

for this test is: $F(n-1, nT-n-K) = \dfrac{(RSS_1 - RSS_2)/(n-1)}{(1-RSS_1)/(nT-n-K)}$, which T is the number of time period, n is the number of cross sections and K is number of regressors in the model. The Chow test equal to 3.123 is higher than the critical value at the 5 percent significant level, 1.57, suggesting that the one-way fixed effects model is better than a two-way fixed effects model. As shown in table 2, the signs of the estimated coefficients for one-way fixed effects model is in line with shadow economy Kuznets's curve (SEKC). So the shadow economy Kuznets's curve is existed and significant. In the other word, the size of shadow economy is related to the level of per capita income. To estimate quadratic specification of SEKC, we use three control variables labor force participation rate, population and economic freedom. The results show that all estimated coefficients are significant at the 1 percent level. The F- statistics indicates the model is significant. With R^2 equal to 0.948, the estimated shadow economy function also performs extremely well in terms of goodness-of-fit statistics.

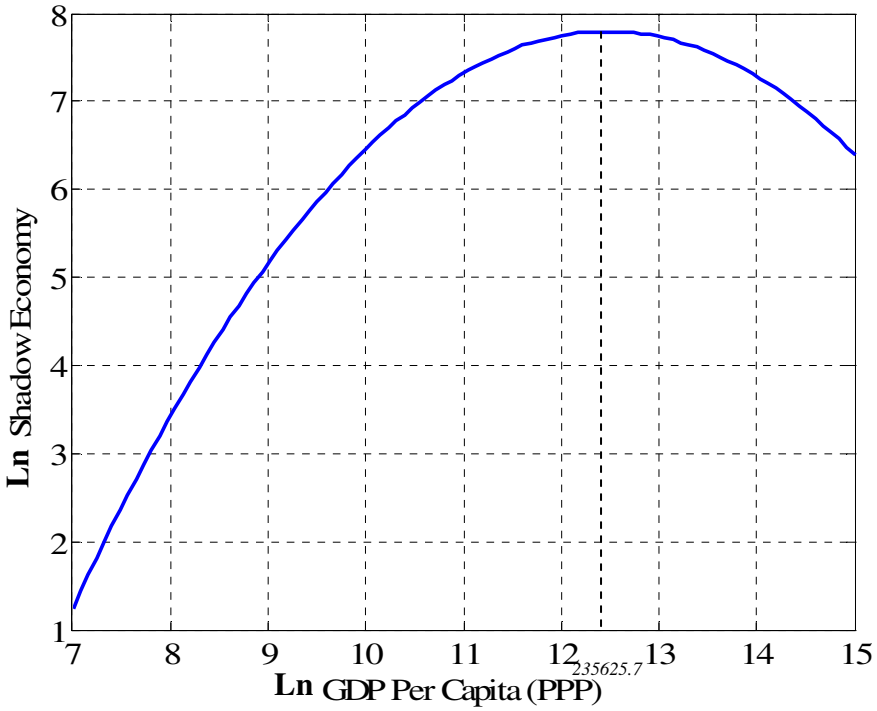
Table 2: Determinants of SEKC (quadratic form)

Regression ***Dependent variable:***	***Fixed effects***		***Random effects***	
$\ln(shadow-economy)$***, 1995-2006***	***One Way***	***Two Way***	***One Way***	***Two Way***
$\ln(GDP_{per})$	5.477 (4.48)*	0.409 (0.34)	5.645 (4.64)*	3.768 (3.09)*
$(\ln(GDP_{per}))^2$	−0.220 (−3.68)*	0.025 (0.43)	−0.229 (−3.85)*	−0.138 (−2.32)**
$\ln(labor-force-Participation-rate)$	−0.726 (−3.56)*	−0.177 (−0.92)	−0.866 (−4.46)*	−0.652 (−3.38)*
$\ln(Population)$	0.712 (3.03)*	0.654 (3.25)*	0.923 (23.26)*	0.923 (20.91)*
$\ln(economic-freedom)$	−0.288 (−3.02)*	−0.238 (−2.76)*	−0.338 (−3.59)*	−0.309 (−3.38)*
$Cons\tan$	−26.313 (−4.26)*	−2.583 (−0.43)	−26.930 (−4.40)*	−18.267 (−3.00)*
Observations	*252*	*252*	*252*	*252*
Groups	*21*	*21*	*21*	*21*
R^2	*0.948*	*.999*	*0.924*	*0.894*
F-statistic, wald chi2	*7039.78*	*6806.1*	*601.74*	*416.05*
Sum square residual	*0.467*	*0.319*	*0.530*	*0.458*
Hausman test			*15.44 (0.00)*	
Turning point	*12.37* *($235625.7)*	*-8.18* *($0.000280)*	*12.32* *($224134.1)*	*13.65* *($847460.9)*

* Significant at the 1 percent level, ** Significant at the 5 percent level, *** Significant at the 10 percent level

The SEKC associated with quadratic functional form of the one-way fixed effects model is shown graphically in Figure 2.

Figure 2: The shadow economy Kuznets's curve 21 OECD countries (Quadratic form)



Using the quadratic specification, we obtained a turning point of $235625.7 GDP per capita and this is very outlying and by this way, all 21 OECD countries are in upward phase of the inverted U curve. In other words, the relationship between shadow economy and economic growth is positive for all mentioned countries.

The regression results for cubic specification are shown in table 3. To estimate shadow economy Kuznets's curve in cubic specification, we use 11 control variables that most of them are components of economic freedom index. The results show that the signs of estimated coefficients are in line with theoretical view.

Tax burden, labor force participation rate, openness, population, monetary freedom, financial freedom, government size and property rights variables are significant at the 1 percent level. Freedom from corruption variable is significant at the 5 percent where business freedom and investment freedom are not significant. Other variables are also significant at the 10 percent level. R^2 equal to 0.976, indicates the estimated shadow economy function performs extremely well in terms of goodness-of-fit statistics.

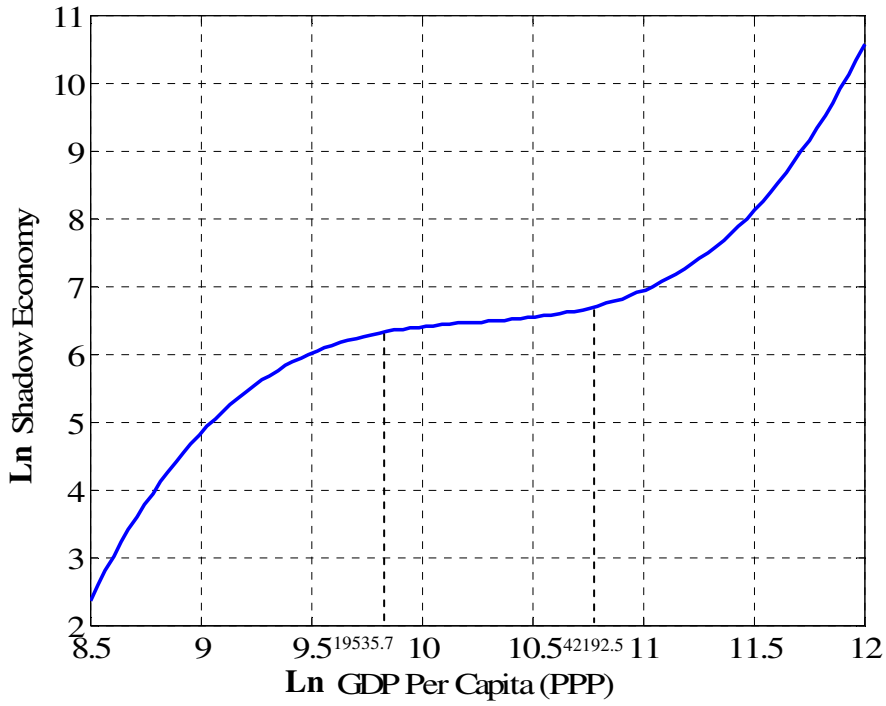
Table 3: Determinants of SEKC (cubic form)

Regression	
Dependent variable: $\ln(shadow-economy)$ ***, 1995-2006***	***Liner regression, correlated panels corrected standard error (PCSEs)***
$\ln(GDP_{per})$	$218.08 \quad (1.89)^{***}$
$(\ln(GDP_{per}))^2$	$-21.251 \quad (-1.88)^{***}$
$(\ln(GDP_{per}))^3$	$0.691 \quad (1.87)^{***}$
$\ln(Tax-burden)$	$0.841 \quad (8.85)^{*}$
$\ln(labor-force-Participation-rate)$	$-0.705 \quad (-3.68)^{*}$
$\ln(Openness)$	$0.073 \quad (3.86)^{*}$
$\ln(Population)$	$0.969 \quad (147.2)^{*}$
$\ln(Bu\sin ess-freedom)$	$0.114 \quad (1.21)$
$\ln(Investment-freedom)$	$0.047 \quad (0.93)$
$\ln(Monetary-freedom)$	$-1.045 \quad (-4.07)^{*}$
$\ln(Financial-freedom)$	$-0.225 \quad (-5.44)^{*}$
$\ln(freedom-from-corruption)$	$-0.179 \quad (-2.10)^{**}$
$\ln(Government-size)$	$0.058 \quad (3.01)^{*}$
$\ln(\Pr operty-rights)$	$-0.615 \quad (-6.14)^{*}$
$Cons\tan$	$-740.30 \quad (-1.89)^{***}$
Observations	*512*
Groups	*21*
R^2	*0.976*
wald chi2	*297546.5 (0.00)*
Turning point	*9.88 ($19535.7)* *10.65 ($42192.6)*

* Significant at the 1 percent level, ** Significant at the 5 percent level, *** Significant at the 10 percent level

So the N shape shadow economy Kuznet's curve is existed and significant. In the other words, the size of shadow economy is related to the level of per capita income. Figure 3 shows the SEKC in cubic functional form.

Figure 3: The shadow economy Kuznets's curve 21 OECD countries (Cubic form)



Using the cubic specification, we obtained turning points within the range of $19535.7- $42192.5 GDP per capita.

As this figure shows in high level of development the relationship between shadow economy and economic growth returns and is again positive. For example in year 2006, Ireland[1], Norway and USA are countries in this part of N-shape Kuznet's curve and other ones in down ward part of it.

Conclusion

Several studies have been conducted to investigate the relationship between shadow economy and the official one. There are two views about this issue. One of them argues the relationship between shadow and official economy is negative and the other one emphasizes that is positive. So the relationship between these two variables is ambiguous. This paper attempts to analyze the relationship between the shadow and formal economic growth by using Kuznets's curve (Inverted U-Curve). In the other word, this paper attempts to answer whether the relationship between shadow economy and economic growth depends on the level of development or not?

[1] - Ireland has the second highest per capita income of any country in the EU next to Luxembourg and fourth highest in the world based on measurements of Gross Domestic Product (GDP) per capita. The Gross National Income is the seventh highest in the world. The unusually large divergance between GDP and GNI is due to the repatriation of profits by multinational companies (http://en.wikipedia.org/wiki/Economy_of_the_Republic_of_Ireland).

In this way, the Shadow Economy Kuznets's Curve (SEKC) is estimated in two quadratic and cubic functional forms by using shadow economies data of 21 selected OECD countries for time period of 1995-2006. The panel data fixed and random effects analyses for quadratic form show the shadow economy Kuznets's curve (SEKC) is existed and valid. So the size of shadow economy is related to the level of per capita income. In other words, the shadow economy growth has positive effect on the formal economic growth in the first stages of development and has negative effect on the formal economic growth in the later stages of development. But using the quadratic specification, we obtained a turning point of $235625.7 GDP per capita which is very outlying in a way that all 21 OECD countries are in upward phase of the inverted U curve. Therefore, the relationship between shadow economy and economic growth will be positive for all mentioned countries.

A more significant problem with the original "inverted U" shaped model is the troubling concern that a shadow economy reduction may not actually be occurring on global scales. Then in high level of development, the relationship between shadow economy and economic growth may returns and actually the "inverted U curve" is an "N" shape. So we estimate the shadow economy Kuznets's curve in cubic functional form. To calculate the cubic model, we use the correlated panel-corrected, standard errors (PCSE) method. The results show the N shape shadow economy Kuznet's curve is existed and significant, the size of shadow economy is related to the level of per capita income and in high level of development the relationship between shadow economy and economic growth returns and is again positive. The cubic functional form indicates turning points within the range of $19535.7- $42192.5 GDP per capita.

We draw the following conclusions. The shadow economy has a positive effect on the official economy and vice versa. It supports the hypothesis that these two sectors are rather complements than substitutes. The shadow economy in OECD countries sustains the growth of official GDP because it mainly creates additional resources to reinvest in the economy.

However, the shadow activity is a "second best" alternative that contributes to the production of consumer and producer goods and to economic growth. Compared to a Pareto optimal economy, shadow economy activity would appear to reduce the rate of growth, but in the real world the economy is not at an optimum. Given the real world with poorly defined and enforce property rights, poorly designed and often excessive regulation, corruption, and poor tax administration, the shadow economy may contribute to economic growth.

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