Black Markets and Economic Sanctions

Ioana M. Petrescu[1]

University of Maryland

July 2011

PRELIMINARY AND INCOMPLETE

PLEASE DO NOT CITE!

[1]Contact information: petrescu@umd.edu. I am very grateful to Kevin Hassett, Gary Hufbauer, Peter Reuter, the CISSM Forum audience at the Unviersity of Maryland and the WEAI conference audience for very helpful advice. I am also grateful to Ly Nguyen and Sean Lowry for excellent research assistance. Data on economic sanctions used with permission of the Peterson Institute for International Economics.

Abstract

Countries often use economic sanctions to coerce other countries to change certain policies of which they don't approve. However, the impact of sanctions fades shortly after the sanction is imposed and countries have little incentive to modify their behavior. This paper shows that this decrease in the impact of sanctions can be explained in part by an increase in black markets activity after the sanctions are imposed. First, I compile a dataset of estimates of black market magnitudes from various studies that use the DYMIMIC method. Second, I estimate the magnitude of black markets at aggregate level using the electricity and currency methods. And third, I use these estimates of black markets together with data on economic sanctions from Hufbauer et al (2007) to analyze the relationship between black markets and economic sanctions. I find that under certain circumstances black markets increase when countries are sanctioned using cuts in imports to the sanctioned country, cuts in development aid or freezing of financial assets.

JEL codes: F51, E26, H56

Keywords: Economic sanctions, black markets

1 Introduction

In October 2000, the United Nations issued a report according to which international diamond dealers still traded with Angolan rebels despite an UN sanction on diamond trade. UNITA (The National Union for the Total Independence of Angola) was sanctioned eight years earlier by UN because of civil war, however according to the report: "implementation of the reform programme, which includes registration of independent miners and dealers and a requirement that all uncut gems exported from the country be certified, has failed to halt UNITA's use of diamonds to finance the war. Last year the Angolan government estimated that the rebels still earned between $90 mn and $125 mn from the stones, known as 'conflict diamonds'" (Felshman 2001). This report attracted attention to the emergence of black markets, an issue that very common in sanctioned countries.

Despite such reports and plenty anecdotal evidence, there is no empirical papers that estimate the size of black markets in sanctioned countries. This paper estimates the black market size using the electricity and currency methods for a large panel of 160 countries over 50 years. It uses these measures to analyze the evolution of black markets in countries that are sanctioned.

In the past few decades, the use of economic sanctions has increased substantially and sanctions have become the foreign policy tool of choice for many countries. In theory, the way sanctions work is simple; sanctioned countries (called targets) suffer costs resulting from actions taken by the sanctioning countries (called senders). In order to avoid the costs, targets modify their behavior in the direction desired by the senders. Very often, the behavior of targets does not seem to change in the direction desired by the senders. It is likely that once the sanc-

tions are imposed, the black market activity intensifies and diminishes the effects of the economic sanction. Black markets can develop when sanctioned goods are being smuggled over the border, when sanctioned goods are being illegally produced in the target country (there is anecdotal evidence of increased production of counterfeited drugs in sanctioned countries) and the underground financial transactions increase as transactions through international financial intermediaries are not possible once financial sanctions are in place.

This paper finds that black market size increases with government expenditures and decreases with GDP/capita. It also finds that export sanctions lead to higher level of currency-based black markets (black markets where cash is being used in transactions) and financial sanctions lead to higher levels of currency-based black markets, but lower levels of electricity-based black markets (markets that need electricity to operate).

This study builds mostly on previous literature on black markets that use the electricity and currency methods. Bhattacharyya (1990), Bhattacharyya and Ghose (1998), Feige (1979), Mirus et al (1994) and Tanzi (1983) are studies that estimate the size of black markets using the currency method. The core idea of this method is that black market transactions use only currency. The authors estimate the amount of currency used in these transactions and then infer the amount of black market activity that requires this much currency. This study modifies a currency method described in Feige 1979 and estimates the size of black market size as share of official GDP for 57 countries and 15 years. I use these estimates to analyze the relationship between economic sanctions and black markets.

Hanousek and Palda (2004), Kaufmann and Kaliberda (1996), Lacko (1999) and Lacko (2000) estimate the size of black markets using the electricity method.

This method is based on the assumption that black market activity uses electricity and the whole electricity consumption is the sum of the electricity used for official activities and the electricity used for black markets activities. This study builds mostly on Kaufmann and Kaliberda (1996) that use the known elasticity of electricity consumption with respect to the overall income (official and black market income) to estimate the changes in black market activity. I estimate the size of black market using the elasticity of electricity with respect to overall income for 146 countries and 49 years and use these measures of black market activity to look at the relationship between sanctions and black markets.

Arvate et al 2005, Bajada and Schneider 2003, Chattopadhyay et al 2005, Dell'anno and Schneider 2003, Mummert and Schneider 2002, Schneider 2000, Schneider 2002, Schneider 2002b, Schneider 2003, Schneider 2004a, Schneider 2004b, Schneider 2005, Schneider and Enste 2000 and Schneider et Savasan 2005 are some of the studies that use the DYMIMIC method. I use the values from these papers as baseline measures in the electricity estimation. These estimate black market size as share of official GDP for various countries and parts of the world. This method uses the variation in the factors that determine the unknown variable (black market size) and the variation in the effects of the unknown variable (black market size) to estimate the change in black market size. This study compiles all the estimates of these 14 studies in one single dataset of 148 countries and uses this dataset to investigate the effects of sanctions on black market size.

The paper is organized as follows: Chapter 2 summarizes the data used in the analysis and the methods used to create the two black market variables, Chapter 3 presents results using the newly constructed black market estimates and finally, Chapter 4 concludes.

2 Data and methodology

This study uses three types of data: black markets data, sanctions data, and other data. The black market measures are of two types: electricity method estimates and currency method estimates. The electricity method estimates are calculated using an electricity consumption approach using data from World Development Indicators, WDI. The currency method estimates of black market activity are estimated using the currency method and data from International Finance Statistics, IFS and WDI. The sanctions data comes from a dataset of 178 economic sanctions imposed between 1914 and 2007 from Hufbauer et (2007). Finally, the other data used to analyze the black markets is taken from International Country Risk Guide, ICSR and WDI. Table 1 shows the definitions of all variables used in the analysis, their units of measurement and the source of the data. Table 2 presents summary statistics for all variables.

2.1 Black market data

The currency method is based on the idea that black markets use currency only. Thus, it measures only monetary transactions such as trade of stolen goods, smuggling, or wages from unreported work.

The method assume that the currency in circulation is a sum of the currency used for official activities and for black market activities. The method derives the currency used in black market activities and then uses it to estimate the black market activity that would require that amount of currency. The method uses a baseline period when there is no black market activity to estimate the correct currency to demand deposits ratio. It also assumes that this ratio remains constant

over time and also that the amount of income produced by $1 in cash in the black market is the same as the income produced by $1 in cash and demand deposits in the official economy.

The black market variable is derived as follows: First, I calculate the "correct" currency to demand deposit ratio. Previous studies estimate this ratio as .217. In my data, the currency to demand deposit ratio calculated from the reported currency and demand deposits data is close to .2 for countries with very low black market size such as the United States. It is reasonable to assume that .2 is the ratio that one would see in a case of 0 black market activity. Thus,

$$ratio = \frac{currency}{demand\ deposits} = .2. \tag{1}$$

I use (1) and the value reported of demand deposits to estimate the currency we expect to see being exchanged in official transactions only, estimated currency. Thus, the difference between the reported currency and this estimated currency is the currency used in black market activities, black currency:

$$black\ currency = reported\ currency - ratio * reported\ demand\ deposits \tag{2}$$

Next, I used the value of the black currency to derive the amount of black market activity that needed that amount of black currency. I use the assumption that if the estimated currency (used for legal transactions) and demand deposits produce an amount of legal activity equal to the GNP, then the amount of black currency produce the following black market activity:

$$black\ market\ activity = \frac{black\ currency * GNP}{ratio * reported\ demand\ deposits + demand\ deposits} \tag{3}$$

The value of the black markets as share of official GDP is the value from (3) adjusted by overall GDP, the sum between black market activity and official GDP:

$$black\ market = 100 * \frac{black\ market\ activity}{overall\ GDP} \tag{4}$$

For example, the demand deposits in the Czech Republic in 2002 were CSK 617.3 trillion. According to (1), the estimated currency (the currency used for official transactions) was .2*617.3=CSK 123 trillion. The reported currency was CSK 224 trillion, thus the black currency (the currency used for black market activities) was 224-123=CSK 101 trillion according to (2). The GNP was CSK 2,352.13 trillion, thus the amount of black market activity that would require 101 CSK trillion in currency is 101*2352.13/(123+617.3)=CSK 320.90 trillion according to (3). The official GDP was CSK 2,460 trillion, thus, the black market size as share of official GDP was 100*320.90/(2460+320.90)=11.53%.

The black market measures using the electricity approach are based on the idea that black market producers are using electricity and that the overall market activity (official markets and black markets) can be derived from the electricity consumption. This estimate measures black market activity that require electricity for production. The method I use is derived from Kaufmann and Kaliberda 1996 who assume that the elasticity of electricity consumption with respect to overall income is 1. Thus, using the electricity consumption for a country, I can derive

the overall GDP growth (official and black market activity growth):

$$\frac{\%\Delta electricity}{electricity_t} = \frac{\%\Delta overall\ GDP}{overall\ GDP_t} \tag{5}$$

In order to calculate the black market, I need a baseline black market size for at least one year for each country. I use the DYMIMIC values as baseline. The DYMIMIC method estimates are taken from 14 studies[1] that use similar techniques to calculate black markets as share of official GDP for various countries[2]. I rescale the DYMIMIC values such that black markets are expressed as black markets as share of the overall GDP. I choose 2000 as baseline year because this is the year with most black market values in the DYMIMIC dataset.

Thus, for year 2000, the overall GDP is scaled to 100, the black market value is the DYMIMIC value and the official GDP value is 100-DYMIMIC value. I use the overall GDP growth to estimate overall GDP values for year 2001. From the official GDP growth, I estimate the official GDP for year 2001, and the difference between the overall GDP and the official GDP is black market size. Finally, this value is adjusted by the overall GDP. This is the black market as share of overall

[1] Arvate et al 2005, Bajada and Schneider 2003, Chattopadhyay et al 2005, Dell'anno and Schneider 2003, Mummert and Schneider 2002, Schneider 2000, Schneider 2002, Schneider 2002b, Schneider 2003, Schneider 2004a, Schneider 2004b, Schneider 2005, Schneider and Enste 2000 and Schneider and Savasan 2005

[2] For the estimation, a factor-analytic approach is used to measure black markets as an unobserved variable over time. The unknown coefficients are estimated in a set of structural equations within which the black markets variable cannot be measured directly. The DYMIMIC method links the unobserved variables to observed indicators. A set of variables such as taxation, regulation and tax morality determine the size of the black markets. Another set of variables such as monetary transactions, labor market changes and growth in the official economy are affected by the changes in the black markets. Observing the changes in the observed variables (determinants of black markets and outcomes of black markets) leads to estimating the changes in the unobserved variable (black market size). The actual size of the black market is estimated by using a baseline value for the black market and then estimate the rest of the values from changes in black markets calculated above.

GDP calculated using electricity approach. For example, in the Czech Republic in 2000, the overall GDP for the baseline year of 2000 is 100. The black market size according to the DYMIMIC approach is 15.78% in year 2000. Thus, the official GDP is 100-15.78=84.22. Electricity consumption growth was 2.86% in 2001 in the Czech Republic, thus the overall GDP growth was 2.86% (according to (5)). Thus, the overall GDP in 2001 is 100*(1+.0286)=102.86 The official GDP growth was 2.28%, thus the official GDP for year 2001 is 84.22*1.0228=86.14. The black market size is the difference between the overall GDP and official GDP=102.86-86.14= 16. 72 This value is adjusted by the official GDP, and the black market value as share of official GDP is 100*16.72/102.86= 16. 25%. The values for the rest of the years are similarly estimated.

Figure 1 shows the average black market calculated using both approaches for three countries characteristics of the lower end of the black market distribution, middle of the distribution and higher end. The Czech Republic is a country with low black market size. Black markets using currency approach are 8.24% of overall GDP and black markets using electricity approach are 17.16% of the overall GDP. Kenya is a country with mean sized black markets. Black markets using currency approach are 20.86% of overall GDP and black markets using electricity approach are 25.53% of the overall GDP. Kazakhstan has very large black markets averaging 45.87% of overall GDP for currency approach and 34.07% of overall GDP for electricity approach.

Figure 2 presents the mean black markets for both approaches by quintiles. Countries in the lowest quintile average 11.52% of overall GDP in black markets based on currency and 6.97% of overall GDP in black markets based on electricity. The countries at the top of the distribution average 56.92% of overall GDP in black

markets using the currency method and 34.53% in black markets using electricity method. In general, the values for currency method are higher than the ones for electricity method. The currency method measures a wider range of black markets than the electricity based and it also encompasses probably most of the electricity based black markets with the exception of the black markets that need electricity to operate, but use bartering rather than cash for transactions.

Figure 3 shows the relationship between unemployment and black markets. The blue dots represent the black markets using the currency approach and the green dots represent the black markets using the electricity approach. Unemployment and black markets seem to be positively related regardless of the method of calculation. It seems that black markets are an alternative to official markets/employment, and when official employment is sparse, people get jobs in the black markets.

Figure 4 shows the relationship between GDP per capita and black markets. The blue dots represent the black markets using the currency approach and the green dots represent the black markets using the electricity approach. GDP per capita and black markets seem to be negatively related regardless of the method of calculation. It seems that the better off a country becomes, the less likely people are to be involved in black market activities. Countries with low GDP per capita might not have official employment opportunities available for their population and most people are forced to work in the black markets or not at all. Countries with higher GDP/capita might create more official market opportunities for their people. These countries are also less likely to deal with high levels of corruption that are also contributing to black market creation.

2.2 Sanctions data

Economic sanctions are "deliberate, government withdrawal, or threat of withdrawal, of customary trade or financial relations" according to Hufbauer et al (2007). Economic sanctions are imposed to change a policy of one country of which the sender does not approve. Alternatively, the sender can do nothing, engage in diplomatic talks with the target, or go to war. Economic sanctions are imposed for reasons ranging from stopping nuclear proliferation to preventing human right violations. The senders in my sample are mostly large countries or coalitions of countries such as the League of Nations, United States, China, and the European Union. The targets vary from very large such as India and Pakistan to small such as Greece, Egypt, and Liberia. Economic sanctions can involve cuts in imports from the target (import sanctions), cuts in exports to the target (export sanctions), and cuts in financial aid and/or freezing financial assets (financial sanctions). These kind of sanctions are usually imposed in combination of two or three. Economic sanctions are lifted when the goals of the sanctions have been met or when the sender changed its mind.

Sanction variables are constructed using the sanctions in Hufbauer et al. (2007) data set. This data set provides information on economic sanctions imposed on various countries between 1914 and 2007. The dataset for this study is a country year level dataset in where a country k in year t. The sanction variable equals 1 if country k was sanctioned in year t by another country or alliance of countries and 0 if it was not sanctioned at all. 127 distinct countries were sanctioned 178 times over the period 1914-2007.

Other sanction variables are export, import, and financial. Export is a dummy

variable that takes value 1 if an export sanction was imposed on country k in year t, and 0 if no export sanction was imposed, import is a dummy taking value 1 if an import sanction was imposed on k in year t and 0 if no import sanction was imposed and financial is a dummy that takes value 1 if the a financial sanction was imposed on country k in year t and 0 if no financial sanctions were imposed. Export sanctions were imposed on 11% of the sample, import sanctions on only 4% of the sample, and financial sanctions on 10% of the sample.

2.3 Other data

Government expenditures, unemployment, inflation, corruption, highest corporate income tax rate, highest personal income tax rate and GDP per capita are other variables used in the analysis. Government expenditures as share of GDP, G/GDP are taken from WDI. They measure the final expenditures of the government, and they average 28.08% of GDP. Unemployment comes also from WDI and measures the people without work, seeking employment out of the labor force. Unemployment averages 8.92% and varies between .2% and 57%. Inflation also comes from WDI, measures the percentage change of GDP deflator and averages 38.88%. The original corruption variable from the ICRG dataset varies from 0 to 6 where 0 means high corruption and 6 means low corruption. The variable is rescaled for the analysis such that higher numbers correspond to higher corruption levels. The dataset contains corruption values for 145 countries over 27 years between 1985 and 2011. Corruption values range from 0 in countries like in Belgium and Canada to 6 in countries like Liberia, Niger or Paraguay. The mean corruption value for this dataset is 3.01. The highest corporate income tax rate and the highest income

tax rates are taken from Petrescu 2011 and they range from 0% and 75% for corporate rate and from 0% and 95% for personal rate. The GDP/capita variable is expressed in constant US dollars. The variable ranges between $62.23 in Liberia to $116,772.7 in Monaco. The mean for 198 countries and 50 years is $6,445.32.

2.4 Model

This paper estimates the effects of economic sanctions on black market size measured as percent of overall GDP. For the first estimation, I use black market size as percent of overall GDP as dependent variable and the sanction dummy for independent variable. I also control for other country characteristics X and include country and year fixed effects. Equation (6) summarizes this approach:

$$black_{it} = \alpha_0 + \alpha_1 sanction_{it} + \alpha_2 X_{it} + \delta_i + \tau_t + \epsilon_{it}, \tag{6}$$

where i is country i, t is year t, δ_i is the country fixed effect, τ_t is the time fixed effect and X_{it} are country characteristics such as: G/GDP, unemployment, inflation, corruption, corporate rate, personal rate and GDP/cap. I expect that sanction will have a positive effect on black markets, G/GDP and unemployment will increase black market size, inflation will decrease black markets, corruption, corporate rate, personal rate will increase black markets and GDP/cap will decrease black market size.

The second specification is similar to (6), but I control for a specific type of sanction instead of sanction in general. The new estimation is:

$$black_{it} = \beta_0 + \beta_1 type\ sanction_{it} + \beta_2 X_{it} + \delta_i + \tau_t + \varepsilon_{it}, \tag{7}$$

where type sanction$_{it}$ is financial sanction dummy, import sanction dummy or export sanction dummy. Financial sanctions could increase the size of black markets if people cannot use international banks and need to rely on cash and informal financial transactions to do business. They can also decrease the size of black markets if the cut in development aid affect negatively the people working in black markets. Overall, the financial sanction sign is ambiguous. Export sanctions are likely to increase black markets because the target will resort to smuggling sanctioned goods over the border if they are not available anymore from the sender. Import sanction can have a positive effect on the black market size if black markets develop in the target to export illegally the sanctioned goods over the border.

3 Results

Tables 3 and 4 present the results of specifications (6) and (7). The specifications are OLS with fixed effects for countries and years. The standard errors are clustered at country level. Each table presents the effects of sanctions in general, and for specific sanctions such as financial, export, and import on the size of black markets. The dependent variable in Table 3 is black markets as percent of overall GDP calculated using the currency method. All four specifications presented in this table control for G/GDP, unemployment, inflation, corruption, corporate rate, personal rate and GDP/cap. Column (1) shows the effects of economic sanctions on the level of black markets. The coefficient is positive and significant at 1% level. Economic sanctions lead to an increase of 5.72% in black markets as percent of overall GDP. Economic sanctions seem to increase underground activities that require cash.

Government expenditures also have a positive effect on black markets: An increase on 1% in government expenditures as percent of GDP leads to an increase of 1.12% in black markets as percent of overall GDP. Unemployment has a positive, but smaller effect. An increase of 1% in unemployment leads to .67% increase in black markets as percent of overall GDP. Inflation has a negative effect, but it is not statistically different from zero. Corruption is not statistically significant either. The highest corporate tax rate is negative and statistically significant at 10% level. An increase of 10% in the highest corporate rate will decrease black markets by 19% of overall GDP. The highest personal income tax rate is positive, but not statistically significant, probably because people modify their incomes in order to pay the lowest income tax rate and only the smallest of the two rates is important in the economic decisions. Finally, GDP per capita is negative and statistically significant at 5% level confirming that the better off a society gets, the less likely it is for its people to engage in black market activities. The model explains 97% of the variation of black market as percent of overall GDP.

Column (2) shows the results of imposing financial sanctions on the size of black markets in the target. Financial sanctions increase black markets by 5.72%, the same magnitude as for sanctions in general. For this sample, all the sanctioned countries were financially sanctioned, thus the regression in (2) is the same as the one in (1). The fact that financial sanctions increase currency-based black markets means that people start using cash and underground financial transactions when access to international financial intermediaries is restricted by sanctions.

Column (3) presents the results of export sanctions on black markets. The effect is positive and significant at 5% level. The magnitude of the export sanctions is smaller than the magnitude of financial sanctions. Export sanctions increase black

markets because imports from sender are cut, thus the target substitutes those imports for smuggled goods. The markets for smuggled goods is visible in the higher currency-based black markets levels since cash is most likely used to buy and sell smuggled goods. Finally, column (4) shows the effects of import sanctions. Import sanctions are less common than financial or export sanctions, and in this sample, there are not import sanctions, so the variable is dropped.

The dependent variable in Table 4 is black markets as percent of overall GDP calculated using the electricity approach. Column (1) controls for the sanction dummy and shows that sanctions have no significant effect on black markets. It is possible that different types of sanctions have different effects on black markets and the two effects cancel out. Thus, I test for the effects of each of the three types of sanctions in columns (2)-(4). Column (2) shows the effects of financial sanctions on black markets. Imposing financial sanctions on a country decreases black markets by 10.31%. Financial sanctions include cuts in development aid and if that development aid used to make it to black market production that needs electricity, then financial sanctions will lead to a decrease in this type of black market activity. Also, as access to banks is restricted, underground businesses try to switch to cash only transactions, but they cannot keep the production at the same levels as before and electricity-based activities decline. Column (3) and column (4) show the effects of export and import sanctions on black markets. Export sanctions affect black markets negatively and import sanctions affect them positively though none of these coefficients are statistically significant at 10% level. Export sanctions might affect black markets negatively if sanctioned items are needed to produce the goods produced in these electricity-based black markets. Export sanctions might affect black markets positively if the sanctioned items are

goods that can be produced in the black markets (e.g. counterfeited drugs, but not refined gasoline). These two effects can cancel out and lead to a zero effect. It is possible that import sanctions (cut of exports from target to sender) might have no effect on the black markets. If the number of senders is small, the target can find another official trade partner and this does not require an increase in underground activity.

Similar to results in Table 3, G/GDP in Table 4 is positive and significant. The magnitude of the effect is similar to the ones described in Table 3. Unemployment is again positive, but this time, not statistically significant. Corruption and inflation are not statistically different from zero just as in the specifications from Table 3. Corporate rate is positive and significant unlike the results in the currency method regressions. An increase of 10% in top corporate income leads to an increase on 45% in black market as percent of overall GDP. The electricity method might capture activities that can be done also in the formal markets and taxation is a decisive factor in choosing whether to operate in the formal or black market. Thus, high corporate taxes make entrepreneurs more likely to start businesses in the black market rather than in the formal market to avoid paying taxes. Similar to the results in Table 3, personal rate is not statistically significant and GDP/cap is negative and statistically significant. The sample is larger than before because I am able to create more black markets observations using electricity method than currency method.

4 Conclusion

This paper estimates the magnitude of black markets for 160 countries and 50 years. The study constructs two measures of black markets: First, a measure of underground activities that require the exchange of currency and second, a measure of hidden activities that require electric power for production. Findings show that high government expenditures and low GDP per capita lead to higher levels of black markets.

The study also looks at black market activities in sanctioned countries. Preliminary analysis finds that black market size sometimes increases when countries are sanctioned. Export sanctions have a positive effect on currency-based black markets and financial sanctions increase currency-based black market activity and decrease electricity-based black market activity.

Both methods used in this paper have some drawbacks that might affect the magnitude of the black markets. The currency method might lead to incorrect estimations because it relies on several assumptions that might not be correct: The black market might not use cash exclusively for their transactions. The rise of financial innovations reduces the demand for hard currency even in black markets settings (Mirus et al 1994). Ideally, we would know the correct currency to demand deposits ratio for a country/period with no black markets, but there is no such example, so instead we use a reasonable estimation of such a ratio. The currency to demand deposits ratio might not be constant over time and across black and official markets (Hanousek and Palda 2004). Another assumption is that a dollar in the official economy produces the same amount of economic activity as a dollar in the black markets. The money multiplier can be higher in the black markets

because there are no taxes or perhaps lower because there is higher risk premium or markups on black market goods (Feige 1979). Finally, the method uses the measured GNP and GDP to estimate the size of the black markets and both of these variables suffer from measurement errors due to tax evasion and smuggling (Bhattacharyya 1990).

The electricity measure can be biased because it ignores price deregulation and introduction of new technologies that might affect electricity demand especially in transitional economies (Hanousek and Palda 2004). It is also unlikely the unit elasticity holds across all countries and across the time (Kaufman and Kaliberda 1996). The electricity method accuracy also depends on the quality of the baseline values from the DYMIMIC data set. This approach is not perfect either since it does not estimate the size of the black markets, but the relative change from one year to another and the size is estimated using a baseline value (Dell'Anno 2006). This means that all values of black markets are estimated based on an initial value for which we do not have any empirical base. Also, the DYMIMIC method is not based on a theory, but only on statistics and this makes it hard to interpret and assess whether the results are reasonable (Smith 2002 and Hill 2002).

Future work should address these limitations of these methods, construct a more accurate measure of black markets, and use this new measure to estimate the effects of sanctions on black markets controlling for other factors that affect the size of black markets.

References

[1] Alm, James, Jorge Martinez-Vazquez, and Friedrich Schneider. 2003. "'Sizing' the Problem of the Hard-To-Tax." Paper presented at the Andrew Young School of Policy Studies Conference, Georgia State University.

[2] Arvate, Paulo, Claudio Ribeiro de Lucinda, and Friedrich Schneider. 2005. "The Brazilian Shadow Economy." Johannes Kepler University of Linz Economics.

[3] Bajada, Christopher, and Friedrich Schneider. 2004."The Size and Development of the Shadow Economies in the Asia-Pacific." Johannes Kepler University of Linz Economics.

[4] Berger, Helge and Volker Nitsch. 2008. "Gotcha! A Profile of Smuggling in International Trade." CESifo Working Paper 2475.

[5] Bhattacharyya, D.K. 1990. "An Econometric Method of Estimating the 'Hidden Economy', United Kingdom (1960-1984): Estimates and Tests." The Economic Journal, 100(402): 703-17.

[6] Bhattacharyya, D.K. and Susmita Ghose. 1998. "Corruption in India and the Hidden Economy." Economic and Political Weekly, 33(44): 2795-99.

[7] Bhattacharyya, D.K. 1999. "On the Economic Rationale of Estimating the Hidden Economy." The Economic Journal, 109(456): F348-F359.

[8] Breusch, Trevor. 2005. "Estimating the Underground Economy using MIMIC Models." The Australian National University Working Paper.

[9] Breusch, Trevor. 2005. "The Canadian Underground Economy: An Examination of Giles and Tedds." Canadian Tax Journal / Revue Fiscale Canadienne, 53(2): 367-91.

[10] Chattopadhyay, Sumana, Kausik Chaudhuri, and Friedrich Schneider. 2006. "The Size and Development of Shadow Economy in India – A First Attempt of a Public Choice Explanation." Johannes Kepler University of Linz Economics.

[11] Contini, Bruno. 1981. "Labor Market Segmentation and the Development of the Parallel Economy - The Italian Experience." Oxford Economic Papers, 33(3): 401-12.

[12] Dell'Anno, Roberto and Friedrich Schneider. 2003. "The Shadow Economy of Italy and other OECD Countries: What do we know?" Journal of Public Finance and Public Choice, 21(2-3): 97-120.

[13] Dell'Anno, Roberto, and Friedrich Schneider. 2006. "Estimating the Underground Economy by Using MIMIC Models: A Response to T. Breusch's Critique." Johannes Kepler University of Linz Economics Working Paper 0607.

[14] Dell'Anno, Roberto. 2007. "The Shadow Economy in Portugal: An Analysis with the Mimic Approach." Journal of Applied Economics, X(2): 253-77.

[15] Dreher, Axel and Friedrich Schneider. 2006. "Corruption and the Shadow Economy: An Empirical Analysis." Paper submitted to the Annual Meeting of the Public Choice Society, New Orleans, LA.

[16] Feige, Edgar L. 1979. "How Big is the Irregular Economy?" Challenge, 22: 5-13.

[17] Fisman and Wei. 2007. "The Smuggling of Art, and the Art of Smuggling: Uncovering the Illicit Trade in Cultural Property and Antiques." National Bureau of Economic Research Working Paper 13446.

[18] Fleshman, Michael. 2001 "'Conflict diamonds' evade UN sanctions." Africa Recovery, 15(4):15.

[19] Frey, Bruno S., and Friedrich Schneider. 2000. "Informal and Underground Economy." International Encyclopedia of Social and Behavioral Science.

[20] Giles, David E. A. 1999a. "Measuring the Hidden Economy: Implications for Econometric Modeling." The Economic Journal, 109(456): F370-80.

[21] Giles, David E.A. 1999b. "Modelling the Hidden Economy and the Tax-Gap in New Zealand." Empirical Economics, 24(4): 621-40.

[22] Giles, David E.A. 1999c. "The Rise and Fall of the New Zealand Underground Economy: Are the Responses Symmetric?" Applied Economics Letters, 6(3): 185-9.

[23] Hanousek, Jan and Filip Palda. 2004. "Mission Implausible III: Measuring the Informal Sector in a Transition Economy using Macro Methods." William Davidson Institute Working Paper Number 683.

[24] Hill, Roderick. 2002. "The Underground Economy in Canada: Boom or Bust?" Canadian Tax Journal / Revue Fiscale Canadienne, 50(5): 1641-54.

[25] Hufbauer, Gary, Jeffrey Schott, Kimberly Elliott and Barbara Oegg. 2007. "Economic Sanctions Reconsidered." Peterson Institute for International Economics, Washington, DC.

[26] Kaufmann, Daniel and Aleksander Kaliberda. 1996. "Integrating the Unofficial Economy Into the Dynamics of Post-Socialist Economies: A Framework of Analysis and Evidence." World Bank Policy Research Working Paper No. 1691.

[27] Kanniainen, Vesa, Jenni Pääkkönen, and Friedrich Schneider. 2004. "Fiscal and Ethical Determinants of Shadow Economy: Theory and Evidence." Helsinki Center of Economic Research Discussion Paper 30.

[28] Mária Lackó. 1999. "Do Power Consumption Data Tell the Story? – Electricity Intensity and Hidden Economy in Post-Socialist Countries." Budapest Working Papers on the Labour Market 1999/2.

[29] Mária Lackó. 2000. "Hidden Economy – an Unknown Quantity? Comparative Analysis of Hidden Economies in Transition Countries, 1989-95." Economic of Transition, 8(1):117-49.

[30] Mirus, Rolf, Roger S. Smith, and Vladimir Karoleff. 1994. "Canada's Underground Economy Revisited: Update and Critique." Canadian Public Policy / Analyse de Politiques, 20(3): 235-52.

[31] Mummert, Annette, and Friedrich Schneider. 2002. "The German Shadow Economy: Parted in a United Germany?" Finanzarchiv, 86(3).

[32] Petersen, Hans-Georg. 1982. "Size of the Public Sector, Economic Growth and the Informal Economy: Development Trends in the Federal Republic of Germany." Review of Incomeand Wealth, 28(2): 191-215.

[33] Petrescu, Ioana. 2011. "Financial Sector Quality and Tax Revenue: Panel Evidence." Working Paper.

[34] Schneider, Friedrich and Dominik H. Enste. 2000. "Shadow Economy: Size, Causes, and Consequences." Journal of Economic Literature, 38(March): 77-114.

[35] Schneider, Friedrich, Valerie Braithwaite, and Monika Reinhart. 2001. "Individual Behavior in the Cash/Shadow Economy in Australia: Facts, Empirical Findings and some Mysteries." Unpublished.

[36] Schneider, Friedrich. 2002a. "The Size and Development of the Shadow Economies and Shadow Economy Labor Force of 16 Central and South American and 21 OECD Countries: First Results for the 90s." http://www.econ.jku.at/members/Schneider/files/publications/SouthAmerica.PDF

[37] Schneider, Friedrich. 2002b. "The Value Added of Underground Activities: Size and Measurement of the Shadow Economies and Shadow Economy Labor Force all over the World." World Bank Discussion Paper.

[38] Schneider, Friedrich. 2002c. "The Value Added of Underground Activities: Size and Measurement of the Shadow Economies of 110 Countries all over the World." Paper presented at the Workshop of Australian National Tax Centre, ANU, Canberra, Australia.

[39] Schneider, Friedrich. 2003. "The Development of the Shadow Economies and Shadow Labor Force of 22 Transition and 21 OECD Countries." The Informal Economy in the EU - Accession Countries: Size, Scope, Trends and Challenges to the Process of EU Enlargement, Center for the Study of Democracy, Sofia.

[40] Schneider, Friedrich. 2004a. "Shadow Economy." Encyclopedia of Public Choice.

[41] Schneider, Friedrich. 2004b. "Shadow Economies Around the World: What Do We Really Know?" Johannes Kepler University of Linz Economics Working Paper.

[42] Schneider, Friedrich. 2004c. "The Size and Development of the Shadow Economies of Serbia/Montenegro and of 9 other East European Transformation Countries: A First and Preliminary Attempt." Johannes Kepler University of Linz Economics Working Paper.

[43] Schneider, Friedrich, and Benno Torgler. 2005. "Attitudes Towards Paying Taxes in Austria: An Empirical Analysis." Empirica, 32(2): 231-250.

[44] Schneider, Friedrich, and Fatih Savasan. 2005. "The Size of Shadow Economies of Turkey (and of her Neighbouring Countries) Including an Informal Hiring and Sectoral Analysis of the Turkish Shadow Economy." Johannes Kepler University of Linz Economics.

[45] Schneider, Friedrich. 2005a. "Shadow Economy around the World: What do We Really Know?" European Journal of Political Economy, 21(3): 598-642.

[46] Schneider, Friedrich. 2005b. "Shadow Economies of 145 Countries all over the World: What do we really know?" Johannes Kepler University of Linz Economics.

[47] Schneider, Friedrich. 2005c. "The Size of Shadow Economies in 145 Countries from 1999 to 2003." The Brown Journal of World Affairs, 11(3): 112-129.

[48] Shafey, O., V. Cokkinides, T. M. Cavalcante, M. Teixeira, C. Vianna, and M. Thun. 2002. "Case Studies in International Tobacco Surveillance: Cigarette Smuggling in Brazil." Tobacco Control, 11(3): 215-19.

[49] Smith, Roger. 2002. "The Underground Economy: Guidance for Policy Makers?" Canadian Tax Journal / Revue Fiscale Canadienne, 50(5): 1655-61.

[50] Tanzi, Vito. 1983. "The Underground Economy in the United States: Annual Estimates, 1930-80." Staff Papers - International Monetary Fund, 30(2): 283-305.

[51] Tanzi, Vito. 1999. "Uses and Abuses of Estimates of the Underground Economy." The Economic Journal, 109(456): F338-47.

[52] Tedds, Lindsay. 2004. "Revisiting the Latent Variable/MIMIC Model Approach to Measuring the Size of the Canadian Underground Economy." Munich Personal RePEc Archive Paper 4229.

[53] Thomas, Jim. 1999. "Quantifying the Black Economy: 'Measurement without Theory' Yet Again?" The Economic Journal, 109(456): F381-F389.

Appendix

Table 1 –Definitions

Category	Variable	Definition	Units	Source
Currency	Currency in circulation	Total currency in circulation (M0)	Local currency unit	IFS
	GDP	Gross domestic product	Local currency unit	IFS
	GNP	Gross national product	Local currency unit	IFS
	M1	Money=currency and deposits	Local currency unit	WDI
	Black markets (currency)	All market-based production of goods and services that are deliberately concealed from public authorities as a share of GDP that involved with cash exchange	%	Author's calculations
Electricity	Electric power consumption	Production of power plants and combined heat and power plants, less distribution losses, and own use by heat and power plants	kWh	WDI
	Growth	Annual GDP growth	%	WDI
	Black markets (electricity)	All market-based production of goods and services that are deliberately concealed from public authorities as a share of GDP and created with use of electric energy	%	Author's calculations
Dymimic	Black markets (Dymimic)	All market-based production of goods and services that are deliberately concealed from public authorities as a share of GDP	%	Various

Table 1 cont'd - Definitions

Category	Variable	Definition	Units	Source
Sanctions	Sanction	Equals 1 if the country was sanctioned by a third party (country or group of countries) and 0 if not sanctioned		Hufbauer et al 2007
	Export	Equals 1 if the country is the target in export sanctions =the sender eliminates or reduces exports to the target		Hufbauer et al 2007
	Import	Equals 1 if the country is the target in import sanctions= the sender eliminates or reduces imports from the target		Hufbauer et al 2007
	Financial	Equals 1 if the country is the target in financial sanctions= the sender eliminates or reduces loans or financial aid to the target		Hufbauer et al 2007
Other	G/GDP	General government final consumption expenditure (formerly general government consumption) includes all government current expenditures for purchases of goods and services (including compensation of employees). It also includes most expenditures on national defense and security, but excludes government military expenditures that are part of government capital formation. Expressed as share of GDP.	%	WDI
	Unemployment	Unemployment refers to the share of the labor force that is without work but available for and seeking employment as share of labor force.	%	WDI

Table 1 cont'd - Definitions

Category	Variable	Definition	Units	Source
Other	Inflation	Percentage change in GDP deflator.	%	WDI
	Corruption	Corruption of the political system. The least corrupt system has a score of 0 and the most corrupt has a score of 6.		ICRG & author's calculations
	Corporate rate	Highest corporate tax rate	%	Petrescu 2011
	Personal rate	Highest personal income tax rate	%	Petrescu 2011
	GDP/capita	GDP divided by population	2000 US $	WDI

Table 2 –Summary statistics

Category	Variable	Observations	Mean	Standard deviation
Currency	Currency in circulation	1179	2710000000000	19700000000000
	GDP	6683	14300000000000	171000000000000
	GNP	4660	18600000000000	196000000000000
	M1	1043	8430000000000	57600000000000
	Black markets (currency)	373	32.89	17.04
Electricity	Electric power consumption	4974	81800000000	305000000000
	Growth	7610	3.85	6.37
	Black markets (electricity)	910	20.62	10.57
Dymimic	Black markets (Dymimic)	1349	21.35	8.12
Sanctions	Sanction	14630	0.14	0.35
	Export	14302	.11	.31
	Import	13354	.04	.21
	Financial	14119	.10	.30
Other	G/GDP	6880	15.94	6.96
	Unemployment	2236	8.92	6.57
	Inflation	7585	38.88	466.58
	Corruption	3627	2.98	1.36
	Corporate rate	3469	31.65	13.04
	Personal rate	2987	36.56	17.86
	GDP/capita	7497	6460.83	10780.72

Table 3 –The effects of economic sanctions on the underground economy (currency approach)

	Black markets (currency approach)			
	(1)	(2)	(3)	(4)
Sanction	5.72 (1.99)***			
Financial sanction		5.72 (1.99)***		
Export sanction			5.13 (2.38)**	
Import sanction				-
G/GDP	1.12 (.66)*	1.12 (.66)*	1.09 (.71)	1.10 (.71)
Unemployment	.67 (.40)*	.67 (.40)*	.67 (.42)	.69 (.42)
Inflation	-.15 (.13)	-.15 (.13)	-.14 (.15)	-.17 (.15)
Corruption	-.77 (.90)	-.77 (.90)	-.68 (1.13)	-.74 (1.10)
Corporate rate	-.19 (.10)*	-.19 (.10)*	-.26 (.20)	-.26 (.20)
Personal rate	.03 (.10)	.03 (.10)	.04 (.10)	.03 (.10)
GDP/cap	-.005 (.002)**	-.005 (.002)**	-.006 (.003)**	-.005 (.003)**
Country dummies	Yes	Yes	Yes	Yes
Year dummies	Yes	Yes	Yes	Yes
Observations	114	114	111	109
R^2	.97	.97	.97	.97

Notes: Robust standard errors in parentheses. * denotes significant at 10% level, ** significant at 5% level and *** significant at 1% level.

Table 4 –The effects of economic sanctions on the underground economy (electricity approach)

	Black markets (electricity approach)			
	(1)	(2)	(3)	(4)
Sanction	-4.00 (2.86)			
Financial sanction		-10.31 (2.60)***		
Export sanction			-5.51 (4.65)	
Import sanction				.19 (3.99)
G/GDP	1.12 (.55)**	1.09 (.56)*	1.10 (.55)**	1.12 (.61)*
Unemployment	.06 (.34)	.02 (.35)	.07 (.33)	.07 (.35)
Inflation	.002 (.002)	.003 (.002)	.003 (.002)	.003 (.002)
Corruption	-.80 (1.07)	-.28 (1.06)	-.67 (1.18)	-.54 (1.10)
Corporate rate	.45 (.16)***	.40 (.14)***	.43 (.16)***	.44 (.17)**
Personal rate	-.06 (.16)	.10 (.15)	.08 (.16)	.12 (.19)
GDP/cap	-.003 (.0006)**	-.003 (.0006)**	-.003 (.0006)**	-.003 (.0006)***
Country dummies	Yes	Yes	Yes	Yes
Year dummies	Yes	Yes	Yes	Yes
Observations	547	537	532	513
R^2	.65	.68	.65	.68

Notes: Robust standard errors in parentheses. * denotes significant at 10% level, ** significant at 5% level and *** significant at 1% level.

Figure 1

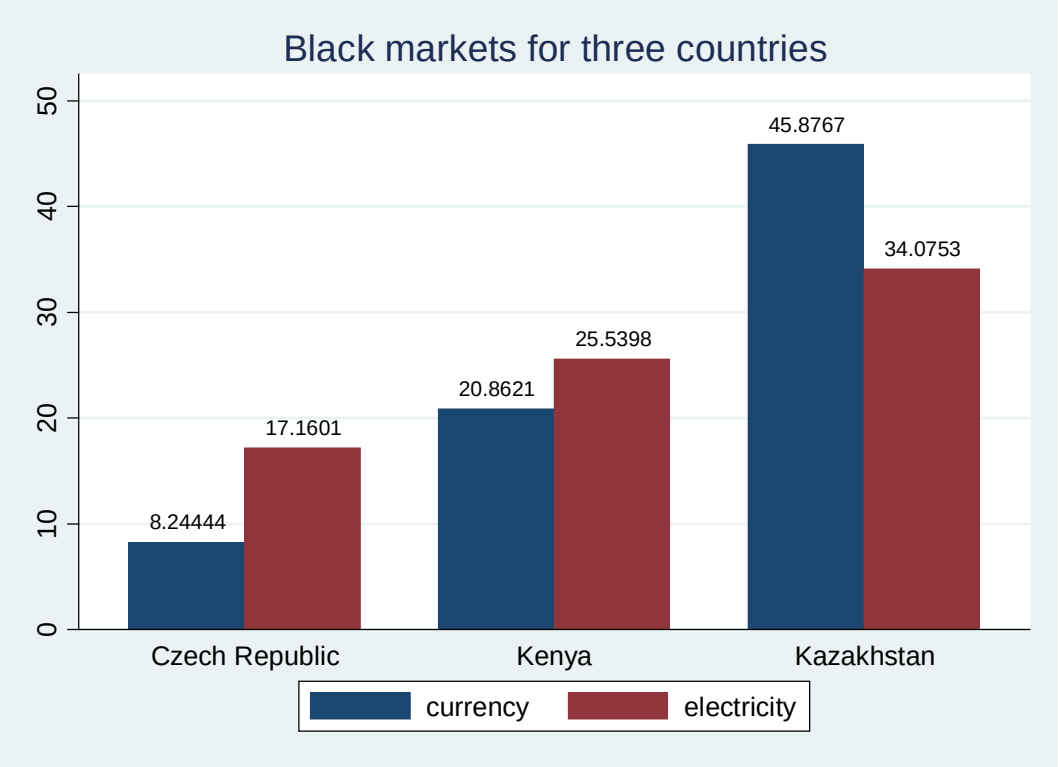

Figure 2

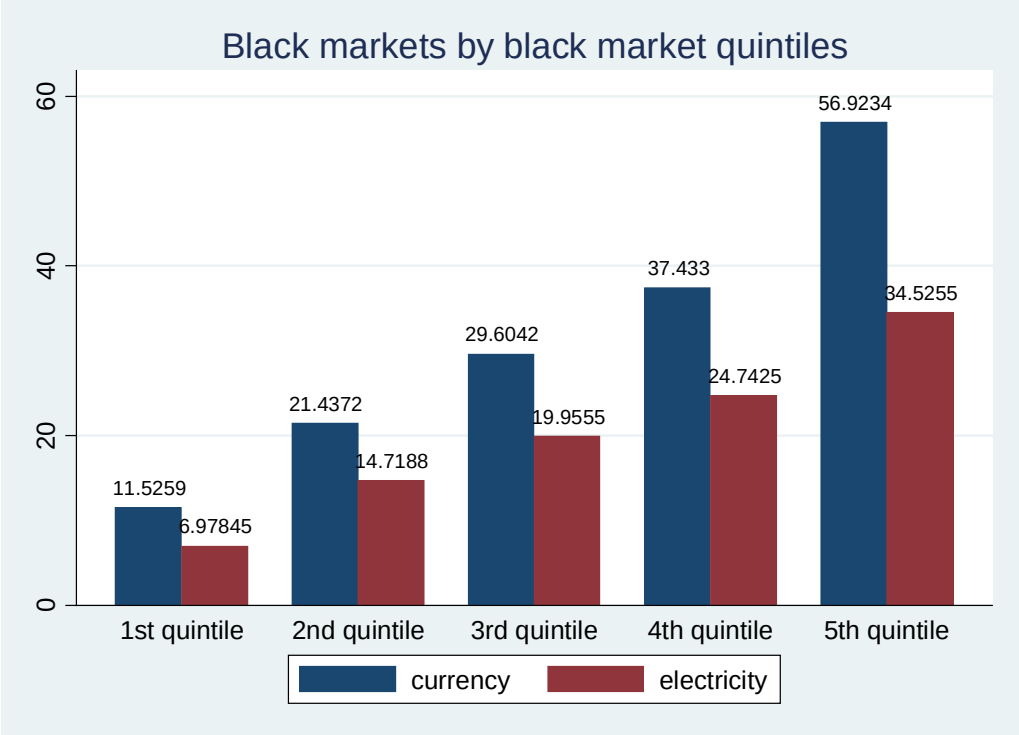

Figure 3

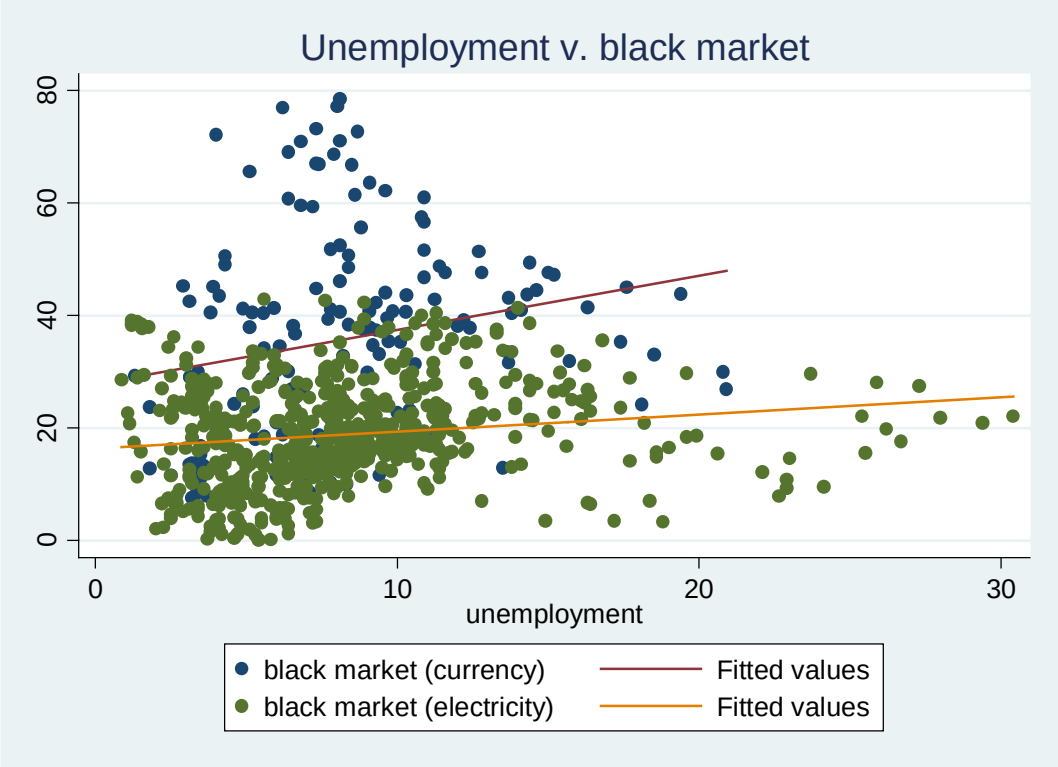

Figure 4