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Size and Effects on Economic Growth**

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**THE SHADOW ECONOMY IN COLOMBIA:
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Abstract:

Using the currency demand approach size and development of the Colombian shadow economy are estimated over the period from 1976 to 2002. In the 70s the size fluctuated around 20% of official GDP and rose to 50% in the 90s. The most important factors driving the shadow economy are unemployment and taxation. Analyzing the interaction between shadow and official economy, 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.

JEL-Code: 017, 05, D78, H2, H11, H26

Key-words: Colombian shadow economy, currency demand method, taxation, unemployment, interaction between the shadow and official economy.

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1. Introduction

Colombia is a developing country which unfortunately made the headlines in the media because of her drug crime business which negatively influenced Colombia's image by her large-scale cocaine production and trade especially since the 80s. Our paper, however, does not deal with drug trafficking or other illegal (i.e. classical crime) economic activities in Colombia, because the focus of our study is the estimation of the size and the development of the shadow economy over time and its influence on the "official" economic growth of Colombia. To our knowledge these two aspects have not been investigated so far, especially the interaction of the shadow economy with the official one and here the question whether the shadow economy has a positive or negative effect!

Our paper is divided in five parts. After this short introduction, in part 2 some theoretical considerations about this topic are given, explaining different ways of defining a shadow economy, analyzing the main causes that support underground activity and discussing interactions between formal (official) and informal (shadow) economy. In part 3, the econometric results of regression models based on the currency-demand approach (to calculate the size of the shadow economy in Colombia) are presented. Based on these results, in part 4 econometric estimations are shown which demonstrate the influence of the shadow economy on the official one, here on "official" economic growth. In part 5, the study concludes with a summary of the main findings and a brief outlook on possible policies to tackle the problem of underground activities.

2. Theoretical background

2.1. Defining the shadow economy

Researchers attempting to estimate the size of shadow economy face the problem of defining a shadow economy. One commonly used (working) definition is: All currently unregistered economic activities are counted that contribute to the officially calculated (or observed) Gross National Product.¹ Smith (1994, p. 18) uses the definition "market-based production of goods and services, whether legal or illegal, that escapes detection in the official estimates of GDP." One of the broadest definitions includes "those economic activities and the income derived from them that circumvent or other wise

¹ This definition is used, for example, by Feige (1989, 1994), Schneider (1994a, 2003b, 2005), and Frey and Pommerehne (1984). Do-it-yourself activities are not included.

government regulation, taxation or observation".² As these just mentioned definitions still leave open a lot of questions, Table 2.1 summarizes what could be a reasonable consensus about the definition of the underground (or shadow) economy. From Table 2.1, it is clear that a broad definition of the shadow economy includes unreported income from the production of legal goods and services, either from monetary or barter transactions – and so includes all economic activities that would generally be taxable were they reported to the tax authorities.

Table 2.1: A taxonomy of types of underground economic activities

monetary transactions		non-monetary transactions	
illegal activities			
<ul style="list-style-type: none"> • trade with stolen goods • drug dealing and manufacturing • prostitution • gambling • smuggling • fraud • etc. 		<ul style="list-style-type: none"> • barter of drugs, stolen goods, smuggling, etc. • producing or growing drugs for own use • theft for own use 	
legal activities			
tax evasion	tax avoidance	tax evasion	tax avoidance
<ul style="list-style-type: none"> • unreported income from self-employment • wages, salaries and assets from unreported work related to legal services and goods 	<ul style="list-style-type: none"> • employee discounts, fringe benefits 	<ul style="list-style-type: none"> • barter of legal services and goods 	<ul style="list-style-type: none"> • all do-it-yourself work and neighbour help

Source: Structure of the table is taken from Lippert and Walker (1997, p. 5) with additional own remarks.

Our paper uses a more narrow definition of the shadow economy³: The shadow economy includes all market-based legal production of goods and services that are deliberately concealed from public authorities for the following reasons:

- (1) tax evasion or tax avoidance,
- (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/or

² This definition is taken from Del'Anno (2003), Del'Anno and Schneider (2004) and Feige (1989). See also Thomas (1999) and Fleming et al. (2000).

³ Compare also the excellent discussion of the definition of the shadow economy in Pedersen (2003, pp. 13-19), who uses a similar definition.

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

Hence, this paper does not deal with typical economic activities that are illegal and fit the characteristics of classical crimes like burglary, robbery, drug dealing, etc. The definition used also excludes all non-market based economic activities like neighbour help, household and do-it-yourself work.

2.2. Theoretical considerations about the main causes for the existence of the shadow economy

(1) Tax and social security burdens

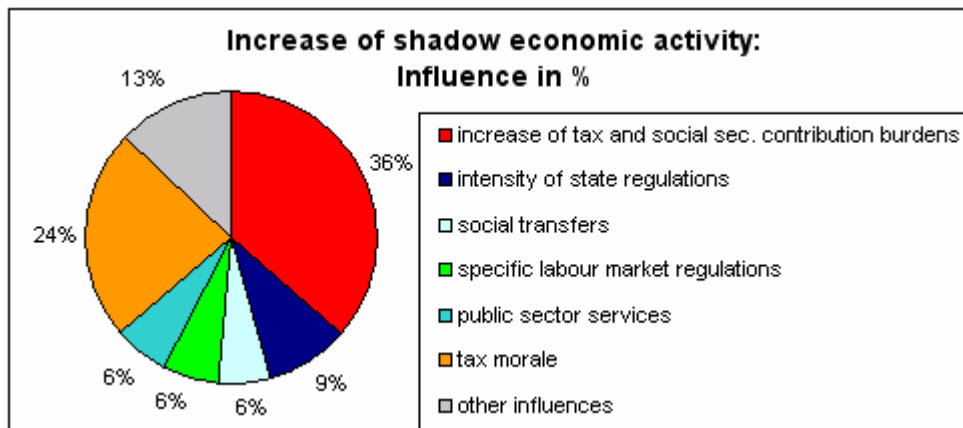
Numerous studies demonstrate, that an increasing burden of taxes and social security contributions is one of the main causes for the development and increase of shadow economic activities.⁴ The reason is that this form of fiscal intervention has a strong influence on individuals' cost-benefit and/or labour-leisure choices because it heavily increases the opportunity cost for legal economic activities and finally reduces the profitability of legal (official) work. The greater the difference between total cost of labour 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.⁵ 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 going back to the official economy.⁶

Figure. 2.1: Main causes for the increase of shadow economic activities.

⁴ See Enste in Bajada/ Schneider (2005), Schneider (2005, 2006), Alm (1996)

⁵ See Schneider (1994b, 1998b) for a similar result of the effects of a major tax reform in Austria on the shadow economy.

⁶ For Canada, Spiro (1993) found such reactions of people facing an increase in indirect taxes (VAT, GST).



Source: Schneider (2006).

Figure 2.1 illustrates the great importance of tax and social security contribution burdens on the size and the development of the shadow economy. Further empirical studies of the influence of the tax burden on the shadow economy by Schneider (1994b, 2000) and Johnson et al. (1998a,b) also show statistically significant evidence for the influence of taxation on the shadow economy. A strong influence of indirect and direct taxation on the shadow economy is additionally demonstrated by empirical results for Austria and Scandinavian countries from Schneider (2005).

(2) Intensity of regulation

The original objectives of regulations were to avoid market failures, hence the goal was to increase welfare, reducing external effects and redistribution of wealth for higher justice within the population. Labour market regulation mostly for employees' and workers' protection mainly show, at least in the long term, positive effects. However, regulations also lead to the fact that people often consider such interventions of the government as a limitation of their personal freedom. In addition, fulfilling laws normally causes supplementary cost and may therefore have a negative influence on production possibilities and competitiveness of individuals and firms. A higher scope of regulation leads in most cases to higher bureaucratic expenditures for individuals and firms as well as for public authorities (Schneider (2000)) and may be a "hotbed" for corruption, particularly in developing countries. To sum up, individuals often consider increasing intensity of state regulation as cost-rising and freedom-limiting. Therefore, increasing intensity of regulation supports the switch to shadow economic activities. These theoretical considerations are supported by empirical studies, which show, that increasing intensity of regulation leads to a growing shadow economy.⁷ At this point it is should be mentioned, that a higher possibility of detection and/or higher expected

⁷ Compare Schneider (2005), Wagner (1984), Enste (2005) and especially the survey of Schneider and Enste (2002).

punishment also influence the growth of the shadow economy negatively (Wagner (1984)).

(3) Changes in labour market conditions and the employment system

A rationing (i.e. strong policy intervention) on the official labour market, e.g. reduction of maximum working hours per week, or a decrease of the age for retirement have the effect that people have available much more time which can be used for shadow economic activities. Another argument could be that after such changes people find themselves confronted with circumstances where their desired total working time no longer corresponds to their actual one, so that they have a strong incentive to engage in shadow economic activities. An economic crisis may also lead to a reduction of the work force needed in the official labour market; hence it is common that during recessions the official demand for labour decreases and unemployment rises. Thus, it is not surprising that during the worldwide recession in the 70s a general increase in the extent of shadow economic activity was observed (Gijssels (1984)).

An increase in transfers (e.g. unemployment benefits, pensions, etc.) reduces the incentives to work in the official economy, too. As a consequence, people choose to work less in the official economy and as a result may increase their shadow economic activities.

Another incentive for working in the shadow economy is a rise in the wage rate in the informal sector (e.g. caused by higher demand for illicit work) as this increases the rentability of illicit work relative to employment in the official sector. In a similar way, a reduction in the net wage rate in the official economy (e.g. due to an increase in payroll tax) decreases the rentability of work in the official economy or the marginal utility of the extension of official working time which may also lead to an increase of shadow economic activity. However, this argumentation is only valid for considerations on a microeconomic basis. According to macroeconomic theory, lower wages lead to higher employment as demand for labour increases and lower unemployment implicates, ceteris paribus, lower activity in the shadow economy.⁸

(4) Changes in individual values and general attitude towards shadow economic activity

In all „civilized“ societies politicians interfere in the economy in order to “fix” the limits between legality and illegality and to regulate the functioning of economic life. These interventions, however, may not be according to everybody's idea of morality and

⁸ Schneider/ Enste (2002), Wagner (1984), Enste (2005) and Kirchgässner (2006).

understanding of justice (Besozzi (2001)). This means that people have no bad feelings towards „normal“ shadow economic activities; people often may find it easy to justify their unofficial supply or demand for goods and services because friends and family members just “do the same” (Schneider (2000, p.8)).

The term „changes in individual values“ generally consists of all possible changes in morality of a certain group or a whole country’s population relating to their willingness to accept state regulations. They may also change their view of the competence of public authorities, tax morale and the common attitude towards shadow economic activities. In general, if trust of the public authorities is high handling their affairs and if the population shows a positive attitude towards fiscal interventions, one normally expects lower shadow economic activities (Haslinger (1984) and Kirchgässner (2006)). For instance a change in individual values may happen, when taxpayers suddenly believe that they no longer receive adequate social services or benefits for the revenues paid to the government. Another example is the increase in overall tax burdens which is not accompanied by immediate and visible increases in (social) state services. Such events lower the acceptance and the trust in public authorities and increase the incentive to engage in the shadow economy, partly because in such situations people may feel the need to balance subjectively felt individual welfare losses out themselves.⁹

2.3. Theoretical reasoning about the interaction between official and unofficial economies

Obviously there are many interactions between the official and unofficial (shadow) economies in a country, hence a strict separation of these two parts of the economy is not possible.¹⁰ Therefore it is not surprising that there is a continuous interaction between official and unofficial economy. Naylor (1996) emphasizes that the official part of the economy could never work efficiently if it were totally separated from the unofficial part. A study carried out by the OECD confirms further, that the shadow economy permanently competes with the official economy, on the other hand Lubell (1991) states that the formal and informal economies also complement each other. Other studies (Lubell (1991), Besozzi (2001) and Schneider (2005)) show, that a certain influence of the shadow economy on the efficient functioning and development of the official economy can not be denied.

⁹ Schneider (2000) and Gretschnann (1984).

¹⁰ Compare Besozzi (2001), Naylor (1996) cited in Besozzi (2001, p.12), Lubell (1991) and Schneider (2005).

One of the shadow economy's main influences is the one on the tax system. As a consequence, redistribution policies based on tax revenues and the overall financing of the public sector are affected. For instance, one hypothesis is that a reduction in the size of the shadow economy leads to higher tax revenues, if and only if this leads to an increase in economic activities in the official sector, which happens only to a very limited extent. These additional resources can then be invested in a qualitative and quantitative improvement of public goods and services which in turn induces economic growth (Schneider (2005)). On the other hand, Schneider (2005) argues that shadow economic activity even generates additional tax revenues if these shadow activities are complementary to the official economy and if the earned extra income is spent in the official economy for goods and services.

Frey (1989) mentions that especially in developing countries parts of the raw materials and semi-produced goods used in the official economy originate from shadow economic sources. Particularly in developing countries, the actors of the informal economy established themselves as important customers, suppliers and business partners of firms working in the official economy (Besozzi (2001)). This again underlines the strong interdependence between formal and informal economy (Witte (1996) and Lubell (1991)).

Applying the allocation theory, the shadow economy has positive effects on the overall functioning of an economy: more efficient use of scarce resources, stimulation of markets and competition, incentives for firms and individuals, enlargement of market supply with additional goods and services, generation of additional income, more creativity and more innovation, etc. However, the allocation effects of the shadow economy are not exclusively positive. Unfair ruinous competition due to cost advantages of suppliers in the informal economy may cause official suppliers to be pushed out of the market as they are no longer competitive. In addition, a lack of transparency and a lacking structure of the unofficial sector may lead to problems in information flows and consequently will lead to a higher intransparency of the markets which means that conditions for both, suppliers and consumers, become harder for efficient comparisons of quality and prices. On the other hand, unofficial suppliers often work under perfect competition, so that the condition of setting prices equal to marginal cost holds. Higher competition creates incentives, which lead to more efficient resource allocation on both sides, the official and the shadow economy (Schneider (2003a)).

Another problem caused by the shadow economy is the bias in the officially published data of economic figures which are used for economic policy decisions, too. As the informal part of the economy does not appear in official statistics, it can only be taken into consideration with rough approximations or in the extreme case, not at all. Hence, all stabilizing, redistributive and fiscal policies are based on inaccurate or even false indicators. A study by Feige and McGee (1989) shows, for instance, that traditional anticyclical monetary and fiscal policy measures do not have the desired stabilizing but destabilizing effects if shadow economic activity is not taken into consideration. McGee (1989) describes a very impressive model in which monetary policy, aiming at full employment and only based on indicators of the official economy, disregarding the shadow economy, does not lead to the required positive labour market effects but causes stagflation.

Whether economic efficiency or justice should be the primary interest for politics is a controversial issue, however, governments usually implement redistribution policies to some extent, where efficiency is strongly influenced by the shadow economy. As the size of the informal sector can only be estimated and also the individuals acting in the underground can not be identified precisely, it is possible that those benefiting from public services and allowances intended to support the underprivileged part of the population identified by official statistics, are not the real "needy". The easier it is for individuals to cheat and the more are doing it, the higher are the official expenditures in these categories leading to an even higher light budget situation. This either leads to an increase in overall taxation, or to a reduction in social services and allowances. Regardless of how a government finances this discrepancy, there will always be many citizens feeling cheated (those who are forced to pay more and more taxes, those who receive too little social benefits despite their neediness, etc.). This may easily end in a vicious circle, as individuals, who feel unfairly treated rapidly begin establishing "justice" themselves, doing their own redistribution policies by migrating into the shadow economy which causes the official redistribution policies to fail their objectives even more (Schneider and Enste (2002)). In this respect, Fleming, Roman and Farrell (2000) claim that the size of the shadow economy may even serve as an indicator of how efficient or inefficient political strategies are, as inappropriate policies are incentives for individuals to begin acting in the underground.

Various studies (e.g. Schneider (2005 and 2006)) demonstrate the interaction between the official and the shadow economy, still, but their results are discussed controversially, especially, whether positive effects predominant negative ones or vice

versa. As these effects among others always depend on the concrete size of the shadow economy, the intensity of interaction between formal and informal sector and the specific economic situation of a country, an answer can only be given after an empirical analysis is undertaken for concrete countries, which we will do for the case of a developing country, namely Colombia.

3. Empirical estimates of the size of the shadow economy in Colombia

3.1. Estimation method and variables

One possibility to estimate the size and development of the shadow economy is to use the currency demand approach¹¹. We have chosen this approach for Colombia and have applied two variations of the currency demand model, which also have been estimated: The first uses as dependent variable, the ratio of cash holdings to checkable deposits (*CD*), the second uses as dependent variable, currency demand per capita (*CDC*). Using these two different specifications of the dependent variable, robustness and reliability of the estimation results can be examined. The independent variables used to explain the official currency demand are:

- (1) the real Gross Domestic Product (GDP) per capita (*GDPPC*),
- (2) the yearly average interest rate on deposits of 90 days (*IRD*),
- (3) the cumulative real value of imported cash dispensers (depreciations of 20 % per year deducted) as a proxy variable for cash substitutes describing changes in cash demand over time (*ICD*).

The variables included in the model for explaining the currency demand induced by shadow economic activities are

- (4) the average real direct (*TY*) and indirect (*TC*) net tax rates (tax on income and VAT),
- (5) the unemployment rate (*UNEMP*), and
- (6) the real expenditures for public employees in % of GDP (as a proxy for the intensity of regulation and control) (*EPE*).¹²

Estimation equation for model 1 based on the ratio of cash holdings to checkable

deposits:

$$CD_t = \beta_0 + \beta_1 \times \ln GDPPC_t + \beta_2 \times IRD_t + \beta_3 \times \ln ICD_t + \beta_4 \times \ln TY_t + \beta_5 \times TC_t + \beta_6 \times UNEMP_t + \beta_7 \times EPE_t + u_t \quad (1)$$

Estimation equation for model 2 based on currency demand per capita:

$$\ln CDC_t = \beta_0 + \beta_1 \times \ln GDPPC_t + \beta_2 \times IRD_t + \beta_3 \times \ln ICD_t + \beta_4 \times \ln TY_t + \beta_5 \times TC_t + \beta_6 \times UNEMP_t + \beta_7 \times EPE_t + u_t \quad (2)$$

¹¹ For a detailed description and criticism on the currency-demand method see appendix A.

¹² For a detailed description of the variables used see appendix B., Table 1.1.

Based on monetary theory, the real GDP per capita is expected to have a positive effect on the dependent variable in both equations, whereas the interest rate should have a negative impact. Also the proxy variable for cash substitutes should influence the dependent variables positively, as it facilitates withdrawals. From the above theoretical considerations on the factors influencing the size and development of shadow economic activity, the coefficients of direct and indirect taxation, the unemployment rate and the proxy variable for the intensity of regulation are expected to have positive signs. To summarize, for both equations we derive for the independent variables the following signs:

$$\beta_1 > 0, \beta_2 < 0, \beta_3 > 0, \beta_4, \beta_5, \beta_6 \text{ and } \beta_7 > 0$$

3.2. **Estimation results**

Table 3.1 shows the regression results for the two estimations based on the currency demand method. The detailed results including all statistics are shown in Appendix B, Tables 2.1 and 2.2. According to the theoretical considerations, one of the most important causes for shadow economic activity is the (total) tax burden, but the two tax variables included in the currency demand equations are not statistically significant at a 5 % level¹³ - with the exception of the indirect tax burden (*TC*) in model 1. One reason for this may be multicollinearity between the two tax variables and in order to avoid this, we also tried an overall tax burden (direct and indirect tax burden), which showed up statistically significant in both equations. In our regressions we use yearly data for the period from 1976 to 2002. For model 2, we use the natural logarithm of currency demand per capita; in both variants of model 2, an ARIMA model has been specified to correct for first order autocorrelation. For model 1, a standard OLS regression has been run for the original model (var. 1a with both tax variables included) as well as for the variation (var. 1b with only one total tax variable) as test statistics here do not indicate time series problems.

¹³ In this paper we follow the usual procedure to declare coefficients as “statistically significant”, if their statistical significance is given on a 5 % or better significance level.

Table. 3.1: Regression results using the currency demand method.

regression results					
		model 1		model 2	
endogenous variables		ratio cash holdings to checkable deposits		currency demand per capita (ln)	
exogenous variables		estim. coefficients		estim. coefficients	
		Var. 1a	Var. 1b	Var. 2a	Var. 2b
GDPPC:	real GDP per capita (ln)	0.2590352	0.3618224*	5.298498*	5.33385*
IRD:	interest rate on bank deposits (yearly average)	-0.1580274	-0.1909795	-0.544635	-0.5517756
ICD:	cumulative value of cash dispensers (ln)	-0.0021550	-0.0106367	0.008891	0.008133
TY:	average net tax rate on income	0.5357451		2.356146	
TC:	average net tax rate on consumption	2.3821260*		3.080567	
T	overall taxation on income and consumption (ty+tc)		1.195981*		2.608898 (*)
UNEMP:	unemployment rate	2.7227350*	2.432499*	5.130958*	5.172192*
EPE:	real expenditures for public employees (% of real GDP)	-0.0370014	0.4260926	-2.597696	-2.713188
constant term		3.8371500	-5.246178*	-67.401480*	-67.8917*

* significant on 5 % level (*) significant on the 10% level

Source: Own calculations. For more detailed tables of the regression results see appendix B.2.

The coefficients of the independent variables of both regression models show the theoretically expected signs. Only the sign of the proxy variable for cash substitutes (ICD) is ambiguous, but considering that it is not statistically significant in none of the four estimations, this is not too worrying.¹⁴ It may be that this variable is not a good proxy for explaining changes in currency demand via cash substitutes. Another explanation could be that the increasing availability of cash dispensers generally has an ambivalent influence on currency demand: A higher number of cash dispensers may contribute to the attractiveness of using plastic money (higher circulation of credit and debit cards), while they simultaneously increase currency demand making withdrawals considerably more convenient. Hence, it is highly likely that the effects cancel out each other.

Regarding the other independent variables explaining the currency demand, real GDP per capita (GDPPC) has a statistically significant and quantitatively large influence on the dependent variable in all models. If real GDP per capita rises by 1 %, the ratio of cash holdings to checkable deposits increases by 0.003 and 0.004 in estimation 1a and 1b respectively and the currency demand per capita increases by 5.3 %, ceteris

¹⁴ Also the low beta-coefficients of the variable underline that it is relatively unimportant (see appendix B.2).

paribus. Standardized beta-coefficients also show the important impact of GDP per capita on the endogenous variables, particularly in model 2a, where the beta-coefficient for real GDP per capita is 0.38 which is by far the greatest value compared to the beta-coefficients of the other variables. The coefficient on the average interest rate on bank deposits (*IRD*) has a negative sign in all regressions presented, which indicates the expected decrease in cash holdings with rising interest rates. However, the coefficient is not statistically significant (p-values between 0.24 and 0.38) in all four equations.

The variables explaining currency demand induced by shadow economic activities (direct and indirect tax rates: *TY*, *TC* and unemployment rate: *UNEMP*) also show the expected signs: The positive relation between rising unemployment, as well as increasing direct and indirect tax rates and the dependent variables are in line with our hypothesis that these factors support the growth of underground activities and hence have a positive impact on currency demand. Personnel cost for public sector employees (*EPE*) as a proxy variable for the intensity of regulation and control shows a negative effect on currency demand in three of the four regressions presented. According to our theoretical argumentation this is the wrong sign for this variable, as higher intervention in the market should increase the size of the shadow economy and consequently the demand for cash. One explanation for the negative relation detected could be that higher personnel cost were due to a widening of the staff in the executive areas which means higher possibility of detection of informal activities and therefore a decrease in the attractiveness of illicit work and other underground activities. However, as this variable is not statistically significant in both models and their variants, a detailed interpretation of this variable is not necessary.

With respect to the statistical significance of the independent variable unemployment rate (*UNEMP*), this variable is highly statistically significant in all models and also has a great quantitative effect on the endogenous variables. This can be shown by a comparison of the regression coefficients as well as by the standardized beta-coefficients. In our regression results, a rise in the unemployment rate by one percentage point increases the ratio of cash holdings to checkable deposits by 0.027 and 0.024 for variant 1a and 1b respectively and money per capita in circulation by 0.05 %, ceteris paribus.

The tax variables, which are considered as one of the main causes for shadow economic activities, have an important effect on the demand for money: An increase by one percentage point of the indirect average net tax rate (*TC*), whose statistical

significance is satisfactory in both of the main equations, increases the ratio of cash holdings to checkable deposits by 0.02 and the currency demand per capita by 0.038 %, *ceteris paribus*. The direct average net tax rate (*TY*), too, has a great influence on demand for cash: If the average net tax rate on income rises by one percentage point, currency demand per capita increases by 0.023 % and the ratio of cash holdings to checkable deposits increases by 0.005. However, the impact of the tax rate on income is smaller than that of the tax rate on consumption and is not statistically significant. The reason for that may be that the tax variables are highly correlated (correlation coefficient ($Cor[TY, TC] = 0.8145$) and thus there might be a problem of multicollinearity. Nevertheless, standard F-tests show a high joint statistical significance of the tax variables. To avoid the problem of multicollinearity, a total tax burden variable is used and variations 1b and 2b of the main equation models have been estimated. The results show a large quantitative impact of overall taxation as well as statistical significance on a high level (p-values are 0.002 and 0.057 for variant 1b and 2b respectively).

Further statistical tests show a high joint significance of the variables (*TY*, *TC*, *UNEMP*, *EPE*) used for describing demand for money induced by shadow economic activities in both models: The four variables are jointly statistically significant on a 15 % level and the three variables *TY*, *TC* and *UNEMP* even on a 1 % level in both of the main equation models¹⁵.

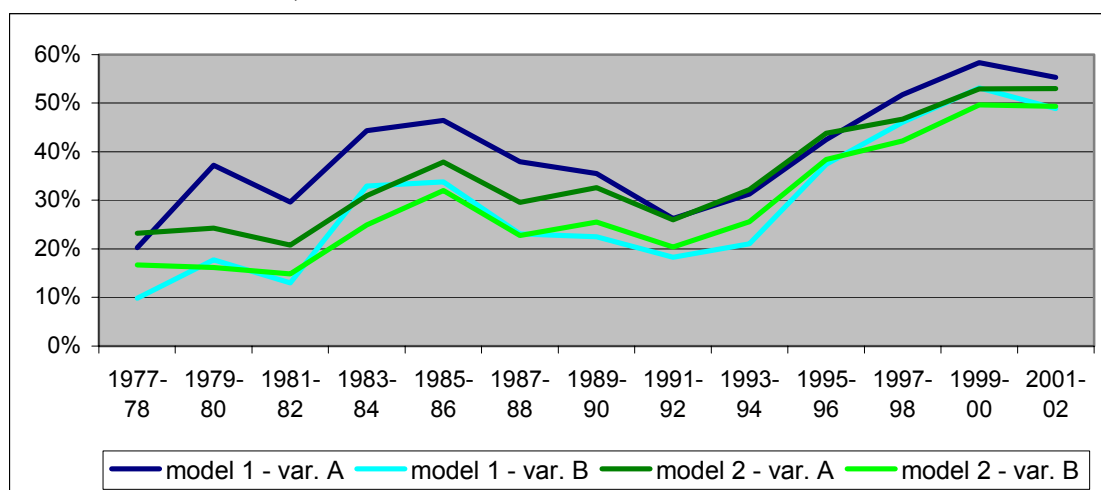
In the next step we undertake simulations, where the values of the variables used to explain the currency demand induced by shadow economic activities (*TY*, *TC*, *UNEMP*, *EPE*) were held on their lowest levels, in order to calculate the theoretical („official“) currency demand per capita. The difference between the real observed and the calculated theoretical demand for money gives the estimated currency demand per capita induced by shadow economic activities. These results multiplied by the velocity of money in the official economy provide value added figures of the estimated size of the shadow economy which can be shown as a percentage of GDP.

The simulation results of the different models for the size of the shadow economy in Colombia lie relatively closely together, especially the simulations derived from the two regressions with only one cumulative tax variable (variants 1b and 2b). The results are presented in Figure 3.1 which also shows the robustness of the models presented in this paper. Even if the simulation results generally show higher divergences in earlier

¹⁵ See appendix B.2 for details.

years, the estimates present the same trend: The size of the shadow economy in Colombia increases rapidly until the mid 80s, followed by a slight decrease until the mid 90s. From the mid 90s on, the size of the Colombian shadow economy experiences another drastic increase. Only at the end of the period under consideration this trend comes to an end and a new slight decrease can be noticed.

Figure 3.1: Four simulations of the estimated size of the shadow economy in % of nominal GDP for Colombia, 1977-2002.



Source: Model 1 – var. A and model 1 – var. B are based on the regression results of model 1, variants a and b respectively, using the ratio of cash holdings to checkable deposits as endogenous variables whereas model 2 – var. A and model 2 – var. B use the results of the second regression’s variants using currency demand per capita as endogenous variable.

The trends in the development of the shadow economy in Colombia resulting from the above simulations correspond to the general expectations: The increase until 1985 can be explained by the generally poor “official” economic situation in the country during that period (decreasing growth rates of GDP, rapid increase of the unemployment rate). During that time, underground activity was the only possibility for many people to generate income, especially for those from the poorer part of the population. The following decrease in the size of the shadow economy reflects the beginning stabilization of the economic situation. The drastic increase in the shadow economy over the last decade (1992-2000) is plausible due to another slowdown in “official” economic growth beginning in the mid 90s; it resulted in the worst recession the country experienced in the last century in 1999.

4. The interaction of the shadow economy with the official one in Colombia

4.1. The estimations of a growth model

To estimate the influence of the shadow economy on the “official” one, a growth model has to be specified, explaining the growth of real “official” GDP per capita (*GGDPPC*) by the independent factors influencing economic growth given using general economic theory. The most important factors are: inflation rate [*IR*], domestic and foreign direct investments [*DI*, *FDI*], size of the population [*POP*], human capital, measured as average schooling years per capita [*SPC*], participation rate on labour market [*LPA*], public spending on consumption [*PCGDP*] as well as the size of the shadow economy [*SE*]. Applying this we get the following regression equation:

Regression model:

$$\ln GGDPPC_t = \beta_0 + \beta_1 \times \ln GGDPPC_{t-1} + \beta_2 \times IR_t + \beta_3 \times \ln DI_t + \beta_4 \times \ln FDI_t + \beta_5 \times \ln POP_t + \beta_6 \times SPC_t + \beta_7 \times LPA_t + \beta_8 \times PCGDP_t + \beta_9 \times SE_t + u_t \quad (3)$$

According to general economic growth theory, the expected signs of the regression coefficients of the independent variables are positive for the lagged endogenous variable (*GGDPPC*), domestic and foreign direct investments (*DI*, *FDI*), total population (*POP*), average schooling per capita (*SPC*) and the participation rate on the labour market (*LPA*), whereas the signs of the coefficients for inflation rate (*IR*) and government consumption (*PCGDP*) are negative.

Equation (3) has been estimated using several variations of the independent variable shadow economy: The first one uses the simulations on the size of the shadow economy calculated from the regression results of the first model, variants 1a and 1b (variable: ratio of cash holdings to checkable deposits) and the second variation uses the estimations from model 2, variants 2a and 2b, based on the currency demand per capita. Therefore, in total, four regressions have been run to estimate the influence of the shadow economy on official economic growth.

4.2. Econometric results

The results are shown in Table 4.1, detailed ones (including test-statistics) are presented in appendix B.3. The estimated coefficients, in general, show the expected signs. Capital investments and total population have a positive and statistically significant effect on economic growth which is in line with economic growth theory. Foreign direct investment, the participation rate on the labour market and average years of schooling per capita also influence growth positively, although they do not show high statistical significance in all model variations. The price level and governmental consumption spending have the expected negative effect on economic growth and are highly statistically significant in all cases.

Table 4.1: Empirical results estimating the effect of the shadow economy on economic growth in Colombia, 1983-2002.

	regressions based on size of the shadow economy calculated from estimation results of			
	model 1		model 2	
	var. A	var. B	var. A	var. B
Growth of real GDP per capita (yearly, %)				
Growth of real GDP per capita %, lagged 1 year	-0.121725	-0.268726	-0.027391	-0.059163
Consumer price index	-0.000856 *	-0.000688 *	-0.000586 *	-0.000614 *
Domestic investments (ln)	0.035806 *	0.042470 *	0.030552 *	0.034698 *
Foreign direct investments (ln)	0.011613 *	0.002667	0.001436	0.000698
Total population (ln)	0.330641 *	0.417668	0.097455 *	0.134956 *
Participation rate on the labour market	0.427518	0.114300	0.318017 *	0.274949
Average schooling per capita	0.010578	0.010302	0.017800 *	0.015583
Public spending on consumption (% of GDP)	-1.269864 *	-1.679029 *	-0.867282 *	-0.964133 *
Constant	-6.463802 *	-7.751374	-2.302499 *	-2.935943
Size of shadow economy (% of GDP) - based on estimations model 1	0.203905 *	0.217251 *		
Size of shadow economy (% of GDP) - based on estimations model 2			0.203316 *	0.205652 *

* significant on 5 % level

Source: Own calculations. See appendix B.3 for a more detailed listing of the regression results.

For the most interesting independent variable, the shadow economy, the regression results show a quantitatively substantial and statistically highly significant positive influence on GDP growth: An increase in the size of the shadow economy by one percentage point (measured in percent of GDP), leads to a rise of the growth rate of real GDP per capita by between 0.20 and 0.22 percentage points, ceteris paribus. The (standardized) beta-coefficients¹⁶ also point out the relatively large influence of shadow economic activity on economic growth. As beta-coefficients allow for a direct comparison of the importance of the various estimated coefficients of the independent variables, we got the result that the shadow economy has a quantitatively larger effect on economic growth than investments, participation rate and the average educational level.

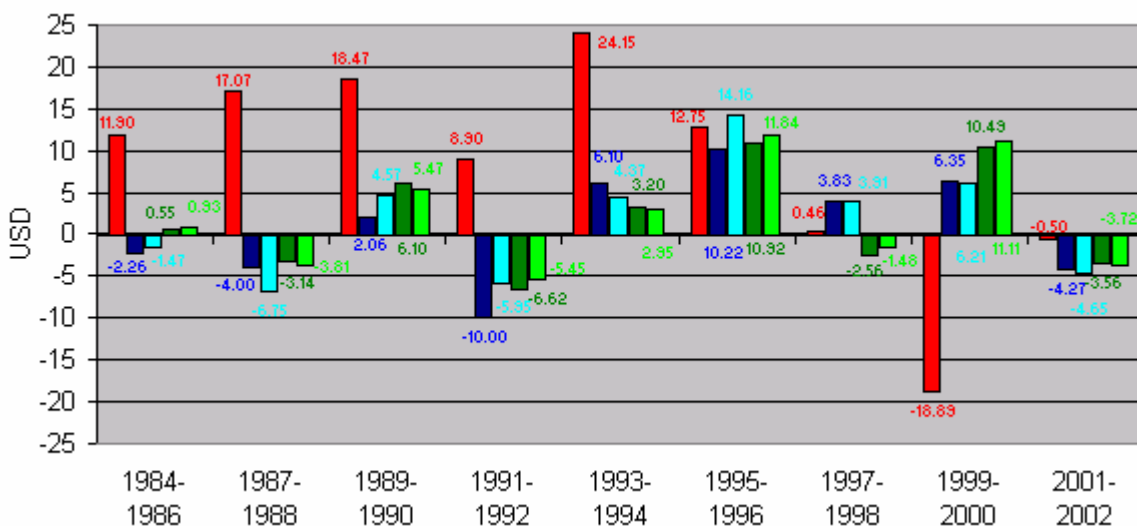
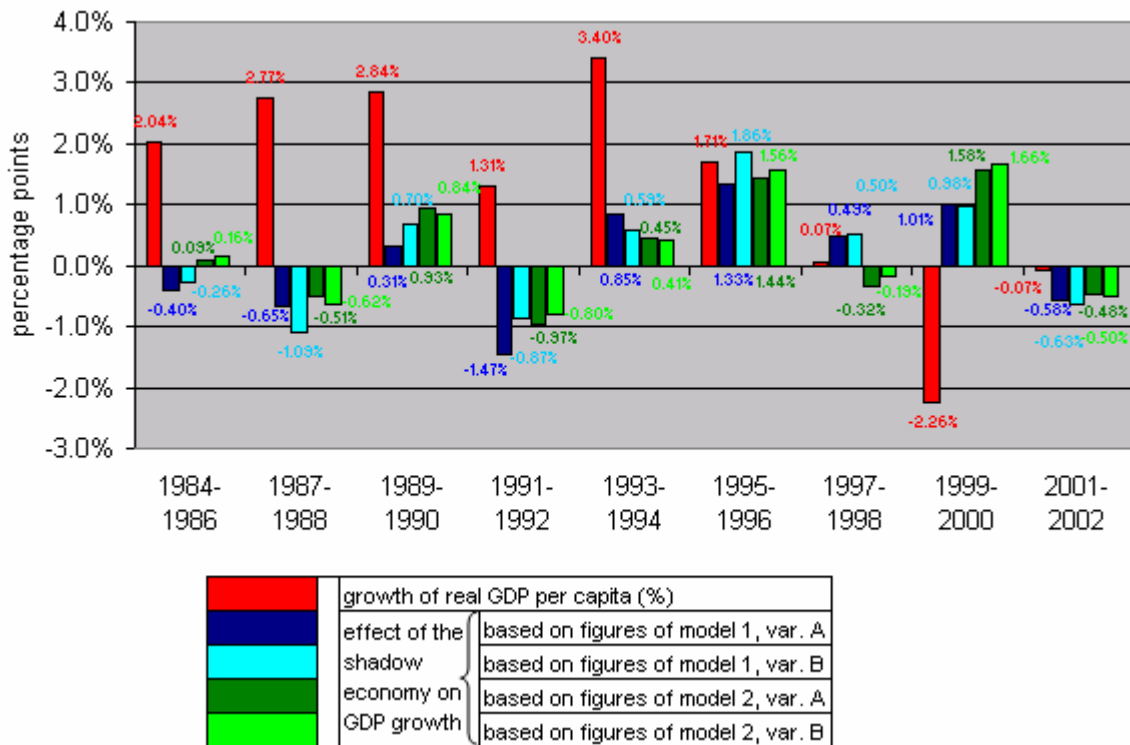
4.3. Simulations on the relative and absolute influence of the shadow economy on economic growth

Finally, we empirically determine the relative and absolute influence of the shadow economy for each year of our investigation; i.e. from 1983 to 2002. Applying a dynamic simulation, the difference between the official and the theoretical growth of real GDP per capita (the theoretical growth rate is corrected for the influence of the shadow economy) can be calculated: Multiplying the yearly variation of the estimated size of the shadow economy with its regression coefficient provides the concrete influence of the

¹⁶ See appendix B.3 for details.

shadow economy on GDP growth for each year in percentage points. Taking these values one can easily calculate the absolute effects of the informal economy on economic growth. The corresponding simulation results are shown in Figure 4.1.

Figure 4.1: Absolute and relative influence of the shadow economy on economic growth (of real GDP per capita) in Colombia, 1984-2002, 2-years-averages, in USD and percentage points.



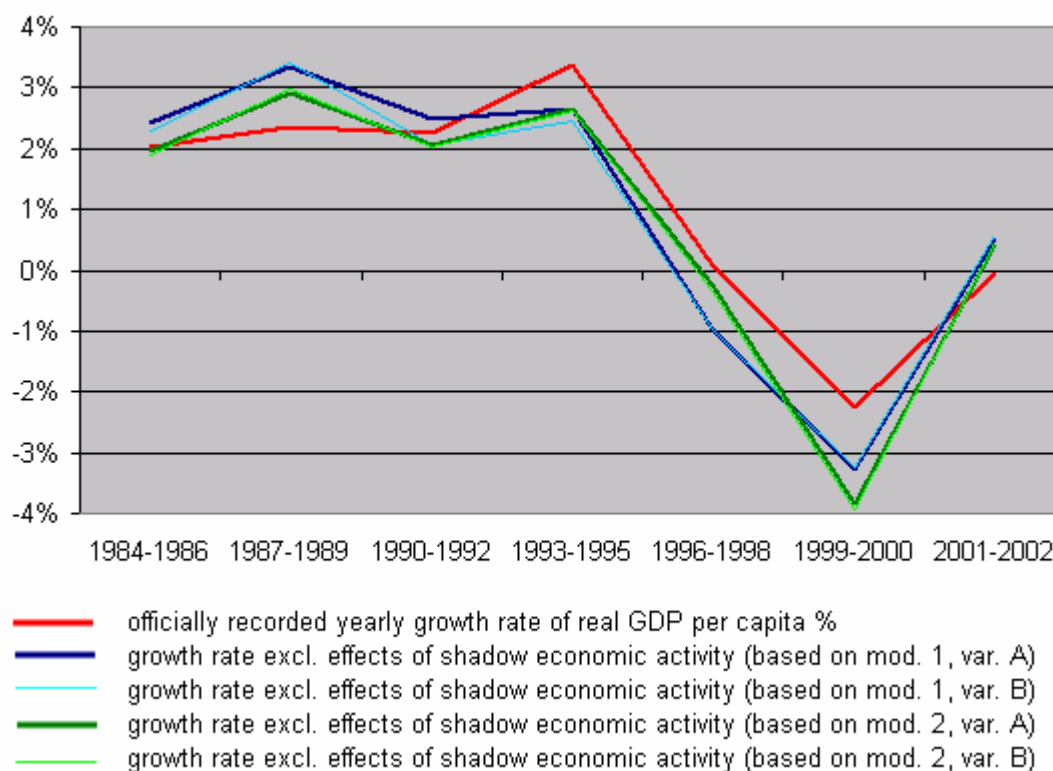
Source: Own calculations.

While average values of the growth of real GDP per capita vary between -2.3 and +3.4 % or -19 and +24 USD two periods, the average values of the relative and

absolute influences on growth by shadow economic activity lie between -1.47 and +1.86 percentage points and -10 and +14 USD respectively, which again shows the substantial effect of underground activity on economic growth. Due to the slight decrease of the size of the shadow economy in the 80s, there is a predominately negative contribution of the informal economy on growth in this period which changes into a positive one at the beginning of the 90s. Especially in the years 1999 and 2000 when the Colombian economy experienced its biggest recession of the 20th century the positive contribution of the shadow economy on economic growth seems to be particularly important. These results clearly demonstrate that especially during an economic crisis, shadow economy contributed to (partly) equalize the negative growth rates.

A simulation of the theoretical development of economic growth under exclusion of shadow economic effects makes it clear that the theoretical growth rates (except during the second half of the 80s) continuously lie below the officially recorded economic growth rates which include the influence of the shadow economy. The results are shown in Figure 4.2.

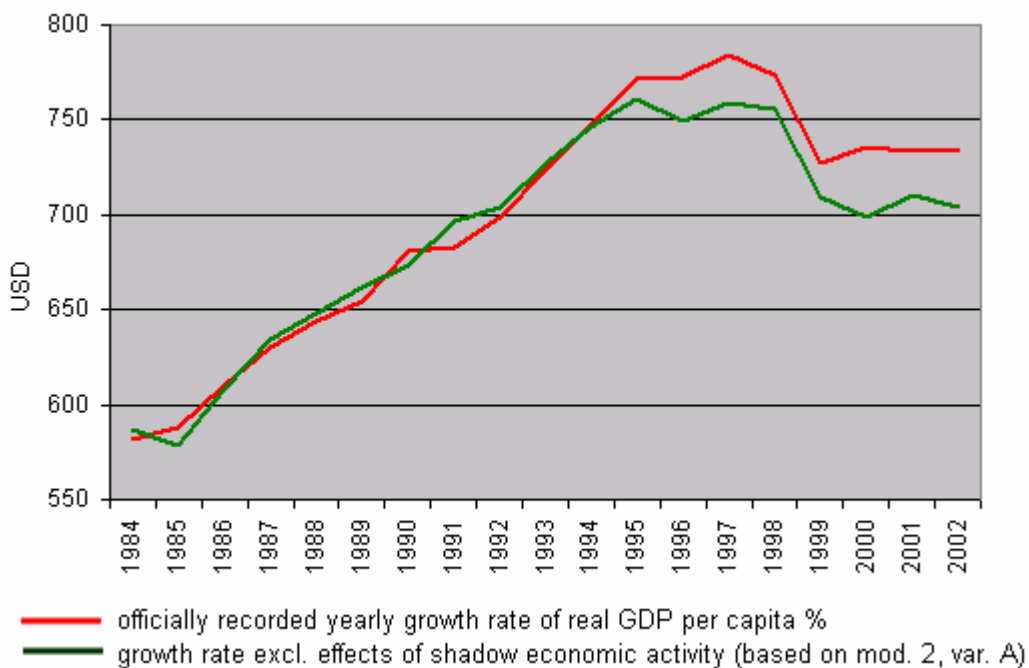
Figure..4.2.: Comparison of officially registered yearly growth rates of real GDP per capita in Colombia and simulated theoretical growth rates excluding the effects of shadow economic activity on growth, 1984-2002.



Source: Own calculations.

To underline this substantial influence on “official” economic growth caused by the informal economy, another simulation has been carried out which compares the development of the officially registered real GDP per capita and a simulated theoretical development of the GDP per capita corrected for the influence of the shadow economy. The results are shown in Figure 4.3. The basis for this simulation is the officially registered real GDP per capita in 1983. For the calculation of the theoretical development of real GDP per capita for the years until 2002, yearly growth rates were corrected for the effects of the shadow economy. They again demonstrate the great impact of the shadow economy by which the officially registered GDP per capita is influenced. The difference between the theoretical and the officially registered value is biggest in the period 1999 to 2000 when the Colombian economy experienced its major crisis of the 20th century. For the year 2000, the simulated real GDP per capita corrected for the effect of the shadow economy lies 37 USD below the officially registered one.

Figure 4.3: Comparison of the development of the officially registered real GDP per capita and the simulated real GDP per capita corrected for shadow economic influences, Colombia, 1984-2002.



Source: Own calculations.

To sum up, all variations of the different simulations illustrate a significant positive impact of the shadow economy on economic growth in Colombia. Furthermore, the simulations on the absolute and relative effects demonstrate that the shadow economy

considerably contributes to (at least partially) offset negative growth rates in economic crises.

5. Summary and conclusion

Applying the currency demand approach, the first major finding of our paper is the large size of the shadow economy in Colombia, over the period from 1976 to 2002. After a slight decrease in the second half of the 80s, shadow economic activities have increased again in the last years (1995 to 2002) so that the shadow economy presently has reached a level of more than 50 % of real “official” GDP in Colombia. Our empirical analysis of the main causes for underground activities shows that on the one side rising unemployment has a great effect on the growth of the shadow economy, and on the other side we find a considerable influence caused by increases of direct and indirect taxation.

Our second major finding is the positive effect of the shadow economy on economic growth in Colombia. Our results demonstrate a clear positive relation between the size of the shadow economy and the growth rates of real GDP per capita: The average growth rate of real GDP per capita between 1977 and 2002 is 1.11 %, and an average between 0.07 and 0.27 percentage points of the growth is explained by shadow economic activities. The simulations also demonstrate that particularly during recessions, the shadow economy at least partly offsets the negative growth rates of the official economy.

Considering these two major findings we draw the following two conclusions:

(1) Even if our econometric estimates provide the clear result of a positive (i.e. stimulating) effect of the shadow economy on “official” economic growth, we are aware that there are still great latent potentials and productivities in the shadow economy which can not be (fully) used due to the generally low productivity of the shadow economic activities and restrictions on human and financial capital resources. This may be one of the reasons why Colombia keeps being classified as a developing country and why its economic standard is still relatively low compared to western industrialized OECD nations. Colombia’s government is aware about these lost potentials by not using these underground productivities and has already implemented various programs to integrate the shadow economy in the official economy. We think it is reasonable to follow this strategy to benefit more from the shadow economic potentials.¹⁷

¹⁷ For a further discussion of integration strategies see Tokman (2006) and Lubell (1991).

(2) Moreover, Colombia was one of the first countries, where the government actively began dealing with the problems and potentials of shadow economic activities. Already from the beginning of the 70s, Colombia's government has not only implemented strategies to integrate the shadow economy but also programs were set up to aim at the reduction of shadow economic activities. Unfortunately, these programs have not been of great success, mainly due to a lack of a long-term strategy and too little coordination of different programs.¹⁸ One suggestion for a better coordination of the various programs dealing with the shadow economy could be the so-called "two-pillar strategy" which is an all-embracing approach on a macroeconomic basis aiming at a slow-down or reduction in shadow economic activities.¹⁹

¹⁸ See for example O'Grady (2006) for a discussion of continuous drawbacks in taxation policy and Gracia/ Urdinola (2000) for a debate on changes in labour market regulations.

¹⁹ For a detailed explanation of the two-pillar strategy consult Schneider/Enste (2002).

Appendix A: Currency demand approach

The currency demand approach was first used by Cagan (1958), who considered the correlation between the demand of currency and tax pressure (as one cause of the shadow economy) for the United States over the period 1919-1955. Twenty years later, Gutmann (1977) used the same approach but without any statistical procedures. Cagan's approach was further developed by Tanzi (1980, 1983), who econometrically estimated a currency demand function for the United States over the period 1929 to 1980 in order to calculate the size of the shadow economy. His approach assumes that shadow (or hidden) transactions are undertaken in the form of cash payments, so as to leave no observable traces for the authorities. An increase in the size of the shadow economy will therefore increase the demand for currency. To isolate the resulting excess demand for currency, an equation for currency demand is econometrically estimated over time. All conventional possible factors, such as the development of income, payment habits, interest rates, and so on, are controlled for. Additionally, such variables as the direct and indirect tax burden and government regulation, which are assumed to be the major factors causing people to work in the shadow economy, are included in the estimation equation. The basic regression equation for the currency demand, proposed by Tanzi (1983), is the following:

$$\ln(C / M_2)_t = \beta_0 + \beta_1 \ln(1 + TW)_t + \beta_2 \ln(WS / Y)_t + \beta_3 \ln R_t + \beta_4 \ln(Y / N)_t + u_t$$

with $\beta_1 > 0$, $\beta_2 > 0$, $\beta_3 < 0$, $\beta_4 > 0$ where \ln denotes natural logarithms. C/M_2 is the ratio of cash holdings to current and deposit accounts, TW is a weighted average tax rate (to proxy changes in the size of the shadow economy), WS/Y is a proportion of wages and salaries in national income (to capture changing payment and money holding patterns), R is the interest paid on savings deposits (to capture the opportunity cost of holding cash) and Y/N is the per capita income.²⁰ Any "excess" increase in currency, or the amount unexplained by the conventional or normal factors is then attributed to the rising tax burden and the other reasons leading people to work in the shadow economy. Figures for the size and development of the shadow economy can be calculated in a first step by comparing the difference between the development of currency when the direct and indirect tax burden and government regulation are held at lowest values, and the development of currency with the current (higher) burden of taxation and government regulation. Assuming in a second step the same income velocity for currency used in the shadow economy as for legal M1 in the official economy, the size of the shadow can be computed and compared to the official GDP. This is one of the most commonly used approaches. It has been applied to many OECD

²⁰ The estimation of such a currency demand equation has been criticized by Thomas (1999) but part of this criticism has been considered by the work of Giles (1999a,b) and Bhattacharyya (1999), who both use the latest economic techniques.

countries²¹ but has nevertheless been criticized on various grounds.²² The most commonly raised objections to this method are: (1) Not all transactions in the shadow economy are paid in cash. Isachsen and Strom (1985) used the survey method to find out that in Norway, in 1980, roughly 80 % of all transactions in the hidden sector were paid in cash. The size of the total shadow economy (including barter) may thus be even larger than previously estimated. (2) Most studies consider only one particular factor, the tax burden, as a cause of the shadow economy. But others (such as the impact of regulation, taxpayers' attitudes toward the state, tax morality and so on) are not considered, because reliable data for most countries is not available. If, as seems likely, these other factors also have an impact on the extent of the hidden economy, it might again be higher than reported in most studies.²³ (3) As discussed by Garcia (1978), Park (1979) and Feige (1996), increases in currency demand deposits are due largely to a slowdown in demand deposits rather than to an increase in currency caused by activities in the shadow economy, at least in the case of the United States. (4) Blades (1982) and Feige (1986, 1996) criticize Tanzi's studies on the grounds that the US dollar is used as an international currency so that Tanzi should have considered (and controlled for) the presence of US dollars, which are used as an international currency and held in cash abroad.²⁴ Frey and Pommerehne (1984) and Thomas (1986, 1992, 1999) claim that Tanzi's parameter estimates are not very stable.²⁵ (5) Most studies assume the same velocity of money in official and shadow economies. As argued by Hill and Kabir (1996) for Canada and by Klovland (1984) for the Scandinavian countries, there is considerable uncertainty about the velocity of money in the official economy, and the velocity of money in the hidden sector is even more difficult to estimate. Without knowledge about the velocity of currency in the shadow economy, one has to accept the assumption of an equal money

²¹ See Karmann (1986, 1990), Schneider (1997, 1998a), Johnson et al. (1998a), and Williams and Windebank (1995).

²² See Thomas (1992, 1999), Feige (1986), Pozo (1996), Pedersen (2003) and Ahumada et al. (2004).

²³ One (weak) justification for the only use of the tax variable is that this variable has by far the strongest impact on the size of the shadow economy in the studies known to the authors. The only exception is the study by Frey and Weck-Hannemann (1984) where the variable "tax immorality" has a quantitatively larger and statistically stronger influence than the direct tax share in the model approach. In the study of Pommerehne and Schneider (1985) for the US, besides various tax measures, data for regulation, tax immorality, minimum wage rates are available, the tax variable has a dominating influence and contributes roughly 60-70 % to the size of the shadow economy. See also Zilberfarb (1986).

²⁴ Another study by Tanzi (1982, esp. pp. 110-113) explicitly deals with this criticism. A very careful investigation of the amount of US dollars used abroad and US currency used in the shadow economy and for "classical" crime activities has been undertaken by Rogoff (1998), who concludes that large denomination bills are a major driving force for the growth of the shadow economy and classical crime activities, due largely to reduced transactions costs.

²⁵ However in studies for European countries Kirchgässner (1983, 1984) and Schneider (1986) conclude that the estimation results for Germany, Denmark, Norway and Sweden are quite robust when using the currency demand method. Hill and Kabir (1996) find for Canada that the rise of the shadow economy varies with respect to the tax variable used; they conclude "when the theoretically best tax rates are selected and a range of plausible velocity values is used, this method estimates underground economic growth between 1964 and 1995 at between 3 % and 11 % of GDP." (p. 1553).

velocity in both sectors. (6) Ahumada et al. (2004) show that the currency approach together with the assumption of equal income velocity of money in the reported and the hidden transaction is only correct if the income elasticity is 1. (7) Finally, the assumption of no shadow economy in a base year is open to criticism. Relaxing this assumption would again imply an upward adjustment of the size of the shadow economy.

Appendix B

Table 1.1. Description of the variables used in the discussed regression models

Variable		Obs	Mean	Std. Dev.	Min	Max	source <small>²⁶</small>
name	label						
CDC	currency demand per capita in COP (Colombian Pesos) ²⁷	27	38,122.05	50,830.49	650.3	181,608.1	[2], [5]
CD	ratio of cash holdings to checkable deposits	27	0.5088889	0.158000 3	0.33	0.89	[2], [5], o.c.
GDPPC	real GDP per capita in COP	27	1,577,542	194,672.2	1,267,760	1,871,851	[4]
IRD	yearly average interest rate on deposits at 90 days sight	27	0.2859259	0.083861	0.09	0.40	[5]
TY	average net tax rate on income	27	0.2455556	0.043175	0.19	0.32	[1]
TC	average net tax rate on consumption	27	0.1244444	0.021363	0.09	0.17	[1]
UNEMP	unemployment rate	27	0.1081481	0.027321	0.07	0.17	[3], [4]
ICD	cumulative real value of imported cash dispensers, 20 % depreciation per year deducted	27	181,005.8	233,902	1,233	667,015	[1]
EPE	real expenditures for public employees in % of GDP	27	0.1181481	0.014945	0.09	0.15	[5]
GGDPPC	yearly growth of real GDP per capita in %	27	0.0131667	0.023332	-0.0596	0.0566	[4]
IR	consumer price index, basis: Dec. 1998	27	37.57852	43.89995	0.91	133.53	[2]

²⁶ Sources: see numbers in listing of empirical sources; o. c. = own calculations NUMBERS ARE MISSING!!

²⁷ used exchange rate in this paper: average market rate Jan.-July 2006 = 2,388.50 COP/USD

DI	real capital investment, Mio COP	27	115,250.7	36,346.76	68,039	186,646	[5]
FDI	foreign direct investment, Mio USD	27	1,119.02	1,264.427	25	5,562.22	[6]
SPC	average years of schooling per capita	27	6.164815	0.810362	4.89	7.57	[5]
LPA	participation rate on labour market	27	0.5711111	0.037655	0.50	0.62	[3], [4]
POP	Colombian total population	27	3.45e+07	5,739,490	2.47e+07	4.38e+07	[5]
PCGDP	public spending on consumption in % of nominal GDP	27	0.1092593	0.038323	0.06	0.18	[5]
SE1A	size of shadow economy in % of real GDP (estimation results model 1 - var A)	27	0.39404	0.118398	0.18606	0.62144	o. c.
SE1B	size of shadow economy in % of real GDP (estimation results model 1 - var B)	27	0.28722	0.142058	0.0969	0.5606	o. c.
SE2A	size of shadow economy in % of real GDP (estimation results model 2 - var A)	27	0.34918	0.114905	0.18937	0.6012	o. c.
SE2B	size of shadow economy in % of real GDP (estimation results model 2 - var B)	27	0.29137	0.125021	0.1101	0.56772	o. c.

B.2. Detailed regression results using the currency demand method

Table 2.1: Model 1; endogenous variable – ratio of cash holdings to checkable deposits

>> Variant 1a (separate variables for direct and indirect taxation included)

```
Regression with robust standard errors                                Number of obs =      27
                                                                    F(   7,   19) =    50.98
                                                                    Prob > F      =    0.0000
                                                                    R-squared     =    0.9452
                                                                    Root MSE     =    .04325
```

CD	Coef.	Robust Std. Err.	t	P> t	[95% Conf. Interval]	standard. Beta-Coef.
lnGDPPC	.2590352	.1936412	1.34	0.197	-.1462604 .6643308	0.2036661
IRD	-.1580274	.1518791	-1.04	0.311	-.475914 .1598593	-0.083876
lnICD	-.002155	.0100273	-0.21	0.832	-.0231423 .0188323	-0.035066
TY	.5357451	.5313814	1.01	0.326	-.576449 1.647939	0.146398
TC	2.382126	.8315084	2.86	0.010	.6417592 4.122493	0.3220954
UNEMP	2.722735	.5876241	4.63	0.000	1.492824 3.952647	0.4708088
EPE	-.0370014	.9748965	-0.04	0.970	-2.077483 2.00348	-0.0035
_cons	-3.83715	2.588247	-1.48	0.155	-9.254414 1.580114	-

Durbin-Watson d-statistic (8, 27) = 1.918566

test TY+TC+UNEMP+EPE=0

F (1, 19) = 38.05
Prob > F = 0.0000

test TY+TC+UNEMP=0

F(1, 19) = 51.27
Prob > F = 0.0000

>> Variant 1b (only one overall (additive) tax variable included)

```
Regression with robust standard errors                                Number of obs =      27
                                                                    F(   6,   20) =    41.62
                                                                    Prob > F      =    0.0000
                                                                    R-squared     =    0.9389
                                                                    Root MSE     =    .04454
```

CD	Coef.	Semi-robust Std. Err.	t	P> t	[95% Conf. Interval]	standard. Beta-Coef.
lnGDPPC	.3618224	.1683473	2.15	0.044	.0106561 .7129888	0.2844824
IRD	-.1909795	.1570723	-1.22	0.238	-.5186265 .1366676	-0.1013659
lnICD	-.0106367	.0078271	-1.36	0.189	-.0269638 .0056903	-0.1730783
T	1.195981	.3422261	3.49	0.002	.4821099 1.909852	0.4680292
UNEMP	2.432499	.6088839	4.00	0.001	1.16239 3.702609	0.4206219
EPE	.4260926	.9807576	0.43	0.669	-1.619732 2.471917	0.0403042
_cons	-5.246178	2.248711	-2.33	0.030	-9.936908 -.5554484	-

Table 2.2: *Model 2; endogenous variable – currency demand per capita*

>> *Variant 2a (separate variables for direct and indirect taxation included)*

```
ARIMA regression
Sample: 1976 to 2002                Number of obs    =           27
                                   Wald chi2(8)       = 271238.13
Log pseudo-likelihood = 8.573172    Prob > chi2      =           0.0000
```

lnCDC	Semi-robust				[95% Conf. Interval]		standard. Beta-Coeff.
	Coef.	Std. Err.	z	P> z			
lnCDC							
lnGDPPC	5.298315	1.399603	3.79	0.000	2.555144	8.041486	.3792613
IRD	-.5446494	.6256279	-0.87	0.384	-1.770858	.6815588	-.0262058
lnICD	.0088995	.0346624	0.26	0.797	-.0590376	.0768365	.013079
TY	2.35494	1.824497	1.29	0.197	-1.221008	5.930889	.0583881
TC	3.080664	2.629585	1.17	0.241	-2.073228	8.234556	.0378249
UNEMP	5.130851	2.031338	2.53	0.012	1.149503	9.1122	.0806783
EPE	-2.598264	2.957582	-0.88	0.380	-8.395017	3.19849	-.0223726
_cons	-67.39862	19.66135	-3.43	0.001	-105.9342	-28.86308	

```
ARMA
ar
      L1 | .9940802 .0024803 400.78 0.000 .9892189 .9989416
```

```
/sigma | .1622421 .0194285 8.35 0.000 .1241629 .2003212
```

```
test TY+TC+UNEMP+EPE=0
          chi2( 1) =    2.33
          Prob > chi2 =    0.1271
```

```
test TY+TC+UNEMP=0
          chi2( 1) =    8.86
          Prob > chi2 =    0.0029
```

>> *Variant 2b (only one overall (additive) tax variable included)*

```
ARIMA regression
Sample: 1976 to 2002                Number of obs    =           27
                                   Wald chi2(7)       = 251439.16
Log pseudo-likelihood = 8.554679    Prob > chi2      =           0.0000
```

lnCDC	Semi-robust				[95% Conf. Interval]		standard. Beta-Coeff.
	Coef.	Std. Err.	z	P> z			
lnCDC							
lnGDPPC	5.33385	1.4303	3.73	0.000	2.530513	8.137186	0.3815456
IRD	-.5517756	.6320718	-0.87	0.383	-1.790614	.6870624	-0.0266448
lnICD	.008133	.034998	0.23	0.816	-.0604617	.0767278	0.0120401
T	2.608898	1.368292	1.91	0.057	-.0729057	5.290701	0.0928861
UNEMP	5.172192	2.083354	2.48	0.013	1.088894	9.25549	0.0813690
EPE	-2.713188	2.84284	-0.95	0.340	-8.285052	2.858675	-0.0233492
_cons	-67.8917	20.08801	-3.38	0.001	-107.2635	-28.51991	-

```
ARMA
ar
      L1 | .9940831 .0025212 94.29 0.000 .9891417 .9990245
```

```
/sigma | .1623439 .0191869 8.46 0.000 .1247383 .1999494
```

All models have been tested for structural continuity, as substantial policy changes in 1991 (passing of a new constitution, beginning of a more open economic policy with important changes in legislation regarding the labour market etc.) might have caused a structural break in Colombia. The results of a common Chow test for structural discontinuity are the following:

model	variant	F-value	p-value
1	a	1.3554575	0.29259339
1	b	1.7000926	0.18156576
2	a	1.6145011	0.20611913
2	b	2.2105135	0.09274099

As the p-values are high enough, it is suspected that the events in 1991 do not influence the regression results significantly, therefore the estimations are kept as already presented above.

B.3. Detailed regression results on the effect of the shadow economy on economic growth

Table 3.1: Variant 1:

(i) based on estimation results for the size of the shadow economy of model 1A

Sample: 1983 to 2002	Number of obs	=	20
	Wald chi2(10)	=	5.20e+13
Log pseudo-likelihood = 71.5773	Prob > chi2	=	0.0000

GGDPPC	Coef.	Semi-robust Std. Err.	z	P> z	[95% Conf. Interval]	standard. Beta-Coef.
GGDPPC						
GGDPPC						
L1	-.1217248	.1512111	-0.80	0.421	-.4180932 .1746436	-0.1306
IR	-.0008558	.0002551	-3.35	0.001	-.0013558 -.0003558	-1.6504
lnDI	.0358059	.0109654	3.27	0.001	.0143141 .0572978	0.3878
lnFDI	.0116132	.005427	2.14	0.032	.0009765 .0222499	0.4261
lnPOP	.3306413	.0276261	11.97	0.000	.2764952 .3847874	1.5625
SPC	.0105779	.0079799	1.33	0.185	-.0050624 .0262183	0.2786
LPA	.4275179	.2270066	1.88	0.060	-.0174069 .8724426	0.4301
PCGDP	-1.269864	.2072349	-6.13	0.000	-1.676037 -.8636913	-2.1132
SE1A	.2085536	.0472784	4.41	0.000	.1158897 .3012176	0.9666
_cons	-6.463802	.5572105	-11.60	0.000	-7.555914 -5.371689	-

ARMA						
ma						
L1	-1	.0001245	-8031.45	0.000	-1.000244 -.9997562	

/sigma	.0062579	.000727	8.61	0.000	.004833 .0076827	
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Chow test for structural discontinuity in 1991 (H0: no discontinuity):

F-value=0.88371126, p-value=0.63556824

(ii) based on estimation results for the size of the shadow economy of model 1B

Sample: 1983 to 2002	Number of obs	=	20
	Wald chi2(10)	=	4.41e+11
Log pseudo-likelihood = 69.30319	Prob > chi2	=	0.0000

GGDPPC	Coef.	Semi-robust Std. Err.	z	P> z	[95% Conf. Interval]	standard. Beta-Coef.
GGDPPC						
GGDPPC						
L1	-.2687259	.280635	-0.96	0.338	-.8187604 .2813087	-0.28826
IR	-.0006876	.000296	-2.32	0.020	-.0012678 -.0001075	-1.32602
lnDI	.0424703	.0156743	2.71	0.007	.0117492 .0731914	0.460033
lnFDI	.0026674	.0046657	0.57	0.568	-.0064772 .011812	0.097866
lnPOP	.4176676	.2418146	1.73	0.084	-.0562803 .8916155	1.973702
SPC	.0103017	.0130017	0.79	0.428	-.0151812 .0357846	0.271373
LPA	.1142996	.2766075	0.41	0.679	-.4278411 .6564403	0.114994
PCGDP	-1.679029	.6307075	-2.66	0.008	-2.915193 -.4428646	-2.79415
SE1B	.2172506	.091927	2.36	0.018	.037077 .3974242	1.177838
_cons	-7.751374	4.131298	-1.88	0.061	-15.84857 .3458222	-

ARMA						
ma						
L1	-1.000004	.0006324	-1581.40	0.000	-1.001244 -.9987649	

/sigma	.0070114	.0009107	7.70	0.000	.0052264 .0087964	
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Table 3.2: Variant 2:

(i) based on estimation results for the size of the shadow economy of model 2A

Sample: 1983 to 2002	Number of obs	=	
Log pseudo-likelihood = 73.00714	Wald chi2(10)	=	2.00e+
	Prob > chi2	=	0.00

GGDPPC	Coef.	Semi-robust Std. Err.	z	P> z	[95% Conf. Interval]	standard. Beta-Coef.
GGDPPC						
GGDPPC						
L1	-.027391	.1051994	-0.26	0.795	-.233578 .178796	-0.0294
IR	-.0005856	.0001874	-3.12	0.002	-.000953 -.0002183	-1.1293
lnDI	.0305523	.0097423	3.14	0.002	.0114576 .0496469	0.3309
lnFDI	.0014362	.003892	0.37	0.712	-.0061919 .0090643	0.0527
lnPOP	.0974547	.0065177	14.95	0.000	.0846802 .1102292	0.4605
SPC	.0177995	.0086457	2.06	0.040	.0008543 .0347447	0.4689
LPA	.3180173	.133018	2.39	0.017	.0573068 .5787279	0.3199
PCGDP	-.8672816	.1561588	-5.55	0.000	-1.173347 -.561216	-1.4433
SE2A	.2033162	.0467616	4.35	0.000	.1116652 .2949671	0.9089
_cons	-2.302499	.1699759	-13.55	0.000	-2.635645 -1.969352	-

ARMA						
ma						
L1	-1	.0001773	-5640.99	0.000	-1.000348	-.9996527

/sigma	.0058262	.0006829	8.53	0.000	.0044877	.0071647
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Chow test for structural discontinuity in 1991 (H0: no discontinuity):

F-value= 0.99757368, p-value= 0.59546122

(ii) based on estimation results for the size of the shadow economy of model 2B

Sample: 1983 to 2002	Number of obs	=	20
Log pseudo-likelihood = 72.30479	Wald chi2(10)	=	2.10e+14
	Prob > chi2	=	0.0000

GGDPPC	Coef.	Semi-robust Std. Err.	z	P> z	[95% Conf. Interval]	standard. Beta-Coef.
GGDPPC						
GGDPPC						
L1	-.0591626	.1020636	-0.58	0.562	-.2592037 .1408784	-0.0635
IR	-.0006138	.0002065	-2.97	0.003	-.0010186 -.000209	-1.1837
lnDI	.0346977	.0095939	3.62	0.000	.015894 .0535014	0.3758
lnFDI	.0006981	.0040237	0.17	0.862	-.0071881 .0085843	0.0256
lnPOP	.1349563	.0064384	20.96	0.000	.1223372 .1475753	0.6377
SPC	.0155825	.0092332	1.69	0.091	-.0025143 .0336794	0.4105
LPA	.2749487	.153823	1.79	0.074	-.0265388 .5764363	0.2766
PCGDP	-.9641328	.1563503	-6.17	0.000	-1.270574 -.6576918	-1.6045
SE2B	.2056523	.0511161	4.02	0.000	.1054667 .305838	1.0067
_cons	-2.935943					-

ARMA						
ma						
L1	-1	.0000296		0.000	-1.000058	-.9999423

/sigma	.0060343	.0006947	8.69	0.000	.0046727	.007396
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Table 3.3: Comparison of different simulations on the absolute and relative effect of the shadow economy on economic growth

year	relative effect of shadow economy on growth of GDP per capita (percentage points)								min	max	variation
	SE1A	SE1B	SE1A5	SE1B5	SE2A	SE2B	SE2A5	SE2B5			
1984-1986	-0.40%	-0.26%	-0.56%	-0.11%	0.09%	0.16%	-0.25%	-0.06%	-0.56%	0.16%	0.72%
1987-1989	-0.99%	-1.04%	-0.95%	-1.08%	-0.56%	-0.62%	-0.66%	-0.62%	-1.08%	-0.56%	0.52%
1990-1992	-0.22%	0.19%	-0.30%	0.20%	0.19%	0.22%	0.27%	0.19%	-0.30%	0.22%	0.52%
1993-1995	0.72%	0.92%	0.48%	0.91%	0.73%	0.76%	0.06%	0.86%	0.48%	0.92%	0.44%
1996-1998	1.06%	1.05%	0.92%	1.08%	0.31%	0.42%	0.25%	0.60%	0.31%	1.08%	0.77%
1999-2000	1.01%	0.98%	1.12%	1.01%	1.58%	1.66%	1.63%	1.67%	0.98%	1.66%	0.68%
2001-2002	-0.58%	-0.63%	-0.51%	-0.67%	-0.48%	-0.50%	-0.49%	-0.37%	-0.67%	-0.48%	0.19%

year	absolute effect of shadow economy on growth of GDP per capita (USD)								min	max	variation
	SE1A	SE1B	SE1A5	SE1B5	SE2A	SE2B	SE2A5	SE2B5			
1984-1986	-2.26	-1.47	-3.20	-0.63	0.55	0.93	-1.43	-0.32	-3.20	0.93	4.13
1987-1989	-6.22	-6.49	-6.03	-6.72	-3.49	-3.83	-4.13	-3.86	-6.72	-3.49	3.22
1990-1992	-1.74	1.07	-2.23	1.14	1.05	1.31	1.63	1.04	-2.23	1.63	3.85
1993-1995	5.26	6.85	3.50	6.76	5.36	5.64	0.70	6.38	0.70	6.85	6.15
1996-1998	8.17	8.12	7.08	8.37	2.35	3.24	1.95	4.63	1.95	8.37	6.42
1999-2000	6.35	6.21	7.28	6.37	10.49	11.11	11.11	11.24	6.21	11.24	5.03
2001-2002	-4.27	-4.65	-3.76	-4.93	-3.56	-3.72	-3.67	-2.72	-4.93	-2.72	2.21

Estimations based on:

- SE1A: size of the shadow economy calculated from results of regression model 1, var. A considering all variables included in the model for describing the shadow economy
- SE1B: size of the shadow economy calculated from results of regression model 1, var. B considering all variables included in the model for describing the shadow economy
- SE1A5: size of the shadow economy calculated from results of regression model 1, var. A only considering highly significant variables for describing the shadow economy
- SE1B5: size of the shadow economy calculated from results of regression model 1, var. B only considering highly significant variables for describing the shadow economy
- SE2A: size of the shadow economy calculated from results of regression model 2, var. A considering all variables included in the model for describing the shadow economy
- SE2B: size of the shadow economy calculated from results of regression model 2, var. A considering all variables included in the model for describing the shadow economy
- SE2A5: size of the shadow economy calculated from results of regression model 2, var. A only considering highly significant variables for describing the shadow economy
- SE2B5: size of the shadow economy calculated from results of regression model 2, var. B only considering highly significant variables for describing the shadow economy

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