

# The Shadow Economies in Middle and South America and their Influence on the Official Economy: What do we know?

by

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## Abstract:

Using the DYMIMIC and currency demand approach, the size and development of the shadow economies of 21 Middle and South American countries (including Columbia) are estimated. Averaging the figures over all 21 countries the shadow economy increased from 41.1% in 1999/2000 to 43.4% in 2002/03 and since then declined to 42.2% of official GDP in 2004/05. The most important factors driving the shadow economy are indirect taxation, regulation and the unemployment quota. Analyzing the interaction between shadow and official economy in Columbia, the shadow economy has a positive effect on the official one. The Columbian average growth rate of real per capita GDP is 1.11% between 1976 and 2002 and the shadow economy “explains” on average between 0.02 percentage points of this growth.

JEL-class.: O17, O5, D78, H2, H11, H26.

Keywords: shadow economies of Middle and South American countries, currency demand method, DYMIMIC-method, taxation, unemployment, interaction between the shadow and official economy

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# 1 Introduction

As shadow economic activities are a fact of life around Middle and South America, most societies attempt to control these activities through various measures like punishment, prosecution, economic growth or education. To gather information about the extent of the shadow economy and its relationship or who is engaged in corrupt and/or underground activities, the frequency with which these activities are occurring and their magnitude of them, is crucial for making effective and efficient decisions regarding the allocations of a country's resources in this area. Unfortunately, it is very difficult to get accurate information about the shadow economy activities on the goods and labour market, because all individuals engaged in these activities wish not to be identified. Hence, doing research in these two areas can be considered as a scientific passion for knowing the unknown.

The main focus of this study is the estimation of the size and the development of the shadow economies over time in Middle and South American countries and as a case study the influence of the shadow economy on the "official" economy in Colombia. To my knowledge the last aspect has 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!<sup>1</sup>

My paper is divided in six 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 (registered) and informal (shadow) economy. The following part 3 gives a brief overview of the economic structure of Columbia being used as the case study. In part 4, the econometric results of regression models based on the DYMIMIC procedure for 21 countries and on the currency-demand approach (in order to calculate the size of the shadow economy in Colombia over time) are presented. Based on these results, in part 5 econometric estimations are shown which demonstrate the influence of the shadow economy on the official, i.e. registered one, here on "official" economic growth. In part 6, the study concludes with a summary of the main findings and a brief outlook on possible policies to tackle the problem of underground activities.

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<sup>1</sup> Parts of this paper have been taken from Schneider and Hametner (2007).

## 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.<sup>2</sup> 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 government regulation, taxation or observation”.<sup>3</sup> 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	
<i>illegal activities</i>			
<ul style="list-style-type: none"> <li>• trade with stolen goods</li> <li>• drug dealing and manufacturing</li> <li>• prostitution</li> <li>• gambling</li> <li>• smuggling</li> <li>• fraud</li> <li>• etc.</li> </ul>		<ul style="list-style-type: none"> <li>• barter of drugs, stolen goods, smuggling, etc.</li> <li>• producing or growing drugs for own use</li> <li>• theft for own use</li> </ul>	
<i>legal activities</i>			
<i>tax evasion</i>	<i>tax avoidance</i>	<i>tax evasion</i>	<i>tax avoidance</i>
<ul style="list-style-type: none"> <li>• unreported income from self-employment</li> <li>• wages, salaries and assets from unreported work related to legal services and goods</li> </ul>	<ul style="list-style-type: none"> <li>• employee discounts, fringe benefits</li> </ul>	<ul style="list-style-type: none"> <li>• barter of legal services and goods</li> </ul>	<ul style="list-style-type: none"> <li>• all do-it-yourself work and neighbour help</li> </ul>

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

<sup>2</sup> This definition is used, for example, by Feige (1989, 1994), Schneider (1994a, 2003b, 2005, 2007), and Frey and Pommerehne (1984). Do-it-yourself activities are not included.

<sup>3</sup> 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).

My paper uses a more narrow definition of the shadow economy<sup>4</sup>: 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
- (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.<sup>5</sup> 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***

### **2.2.1 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.<sup>6</sup> 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.<sup>7</sup> Figure 2.1 illustrates the great importance of tax and social security contribution burdens on the size and the development of the shadow economy.<sup>8</sup>

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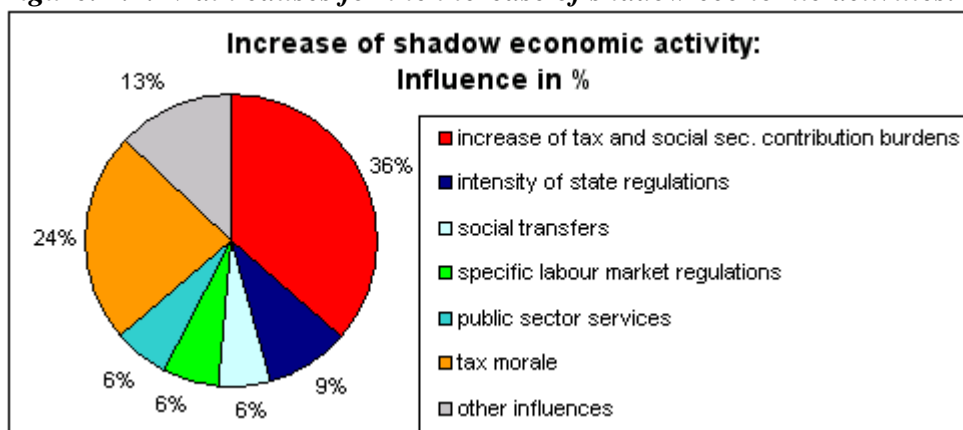
<sup>4</sup> Compare also the excellent discussion of the definition of the shadow economy in Pedersen (2003, pp. 13-19), who uses a similar definition.

<sup>5</sup> It has to be mentioned at this point that especially for the case of Colombia and the other Middle and South American countries it would of course be interesting to include traditional (i.e. classical crime) illegal economic activities in the calculations of the size of the shadow economy. Unfortunately, due to a lack of reliable data in this respect the author needed to refrain from basing their estimations of the size of the shadow economy on this broader definition.

<sup>6</sup> See Enste in Bajada/ Schneider (2005), Schneider (2005, 2006), Alm (1996)

<sup>7</sup> However, even major tax reforms with major tax rate deductions may not lead to a substantial decrease of the

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



Source: Schneider (2006).

### 2.2.2 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 regulations 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.<sup>9</sup>

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shadow economy (see results for Austria in Schneider (1994b, 1998b)) Such reforms may stabilize the size of the shadow economy and avoid a further increase. Social networks and personal relationships, high profits form irregular activities, and associated investments in real and human capital prevent people from going back to the official economy (for Canada, see Spiro 1993)).

<sup>8</sup> The great importance of tax and social security contribution burdens on the size and development of the shadow economy has also been shown in numerous empirical studies, among others by Schneider (1994b, 2000, 2005) and Johnson et al. (1998a, b).

<sup>9</sup> These theoretical considerations are supported by empirical studies, which show, that increasing intensity of regulation leads to a growing shadow economy (see Schneider (2005), Wagner (1984), Enste (2005) and especially the survey of Schneider and Enste (2002).

### **2.2.3 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.<sup>10</sup>

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 profitability 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 returns to 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.<sup>11</sup>

### **2.2.4 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 understanding of justice (Besozzi (2001)). This means that people have no bad feelings

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<sup>10</sup> It is hence not surprising that during the worldwide recession in the 70s a general increase in the extent of shadow economic activity was observed (Gijssels (1984)).

<sup>11</sup> Schneider/ Enste (2002), Wagner (1984), Enste (2005) and Kirchgässner (2006).

towards „normal“ shadow economic activities; people may often 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)). Events like an increase in overall tax burdens which is not accompanied by immediate and visible increases in (social) state services may 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.<sup>12</sup>

### **2.3 Theoretical reasoning about the interaction between official and unofficial economies**

Obviously there are many interactions between the official (registered) and unofficial (shadow) economies in a country, hence a strict separation of these two parts of the economy is not possible.<sup>13</sup> 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.

In principle, these interactions stem from three main topics that are influenced by the shadow economy, namely taxation, general allocations and biased effects of economic policies. The

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<sup>12</sup> Schneider (2000) and Gretschnann (1984).

<sup>13</sup> Compare Besozzi (2001), Naylor (1996) cited in Besozzi (2001, p.12), Lubell (1991) and Schneider (2005).

interactions and their effects originating from these three main sources are summarized in the following table.

**Table 2.2: Interactions between the shadow and the official economy**

The shadow economy influences	through	Effects on the official economy and overall economic performance
<p style="text-align: center;">↓</p> <p><b>tax system</b></p>	<p><i>tax evasion</i> →</p>	<p>Redistribution policies to finance qualitative and quantitative improvement of public goods are impaired, thus economic growth may be negatively affected (Schneider (2005)).</p>
	<p>↙ <i>additional tax revenues</i> →</p>	<p>If the shadow economic activity is complementary to the official economy, extra income is generated via the shadow economy which is then (at least partly) spent in the official economy for goods and services (Schneider (2005)).</p> <p><b><i>Which effect is dominating is open, however, in most developing countries the tax evasion effect dominates!</i></b></p>
<p><b>Allocations</b> →</p>	<p><i>stronger competition and stimulation of markets</i></p>	<p>↗ more efficient use of scarce resources (Schneider 2003a)</p>
		<p>↗ incentives for firms and individuals, stimulation of creativity and innovation</p>
		<p>↗ enlargement of market supply through additional goods and services</p>
		<p>↘ cost advantages of producers acting from the shadow economy may lead to ruinous competition for those in the official economy</p>
<p><b>policy decisions</b> →</p>	<p><i>bias in officially published data</i></p>	<p>↘ stabilizing, redistributive and fiscal policies may fail desired effects<sup>14</sup></p>

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 I will do for the case of a developing country, namely Colombia.

<sup>14</sup> For a more detailed discussion on outcomes of economic policy based on biased data compare Feige and McGee (1998), Mc Gee (1989), Schneider and Enste (2002), Fleming, Roman and Farrell (2000).

### 3 The economic structure of Colombia – an overview

Colombia's economy is traditionally based on agriculture. In the last 30 years this sector contributed on average around 25 % to total GDP, where coffee is its most important good for exports. During the last 10 years, on average 10 % of total exports are attributed to coffee. However, also the production industry (20 % of GDP) and the service sector (25 % of GDP including domestic service) are important parts of the Colombian economy.<sup>15</sup>

The country's economic structure was characterized by a strategy of import substitution until the beginning on the 90s. At the beginning of the 1990s, Colombia's government decided to restructure its economic position and to open, at least slightly, its borders to allow for more international trade. At the same time a completely new constitution was enforced, leading to mayor changes in legislation, especially to liberalizations in the labour market and the banking sector and to an increase in social services. In 1994 the crawling peg of the Colombian peso to the US dollar was changed into a regime of floating exchange rate. To sum up, the 1990s was a decade of complete economic restructuring in Colombia which showed positive effects on the growth rate of GDP at the beginning of the decade. However, from the mid 90s on, the country suffered from stagnating growth rates and slumped into its biggest recession of the last century in 1998 which was mainly due to a heavy crisis in the banking and financial sector. This last point may also be related to a financial crisis in Brazil in the same year, as Colombia's economic performance traditionally has always been dependent on its neighbour countries' developments, especially Brazil's and Venezuela's who are, apart from the US, Colombia's most important trading partners.

Already at the beginning of the 1970s Colombia's government began to actively deal with the issue of shadow economy. The first estimate based on a survey of Bogotá, was done in 1974 and calculated that at least 43 % of the working age population in Bogotá engaged in shadow economic activities.<sup>16</sup> From then on, surveys have been executed regularly, mainly based on personal interviews or other microeconomic data. These investigations continuously gave high estimates of the shadow economy in the cities as well as aggregated for the whole country. The calculations lie on average between 40 and 60 %.<sup>17</sup> Based on these results, the Colombian government lanced lots of programs trying to integrate the "informal workforce"

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<sup>15</sup> Data source: Banco de la República de Colombia (2007)

<sup>16</sup> Oficina de Investigaciones Socio Económicas y Legales Ltda., Bogotá.

<sup>17</sup> Arango, Misas, Lopez (2005). The surveys only deal with "traditional" informal activities, illegal economic activities like drug trafficking are excluded.

into the official economy. These programs have mainly been based on basic social aids and educational trainings.

Finally, when giving an overview of the Colombian economy, one cannot refuse to see the flourishing business of drugs and smuggling. The drug business, which has always been existent to some extent, exploded in the 1980s when the famous Colombian drug cartels came into play and began organizing a whole chain of cultivation, processing and sale of mainly cocaine. The only estimate available to the authors calculates that the extent of drug trafficking in the early 1980s was around 7 % of GDP or 70 % of Colombia's exports with a decreasing trend leading to estimates for the end of the 90s to around 3 % of GDP or 25 % of exports.<sup>18</sup> Somehow related to this important illegal part of Colombia's economy are the guerrillas (the main two groups are FARC and ELN) which have been quite of a problem during the last decades and still keep governing certain areas of the country. It can not be denied that the guerillas contributed to general insecurity and political instability of the country.

## **4 Empirical estimates of the size of the shadow economies**

### **4.1 Econometric Results for 21 Middle and South American Countries**

In tables 4.1 the econometric estimations using the DYMIMIC approach (latent estimation approach) are presented for the 21 Middle and South American countries. For the 21 Middle and South American countries the estimation was done for five different points of time 1999/2000, 2001/02 2002/03, 2003/04 and 2004/05. For these countries I use as cause variables the following: share of direct and indirect taxation (including custom duties in % of GDP) as the two tax burden variables; burden of state regulation (Index of regulation, Heritage Foundation, 2006), unemployment quota and GDP per capita as three cause variables for the status of the "official" economy. As indicator variables I use the employment quota (in % of the population between 18 and 64), annual rate of GDP, and annual rate of local currency per capita<sup>19</sup>).

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<sup>18</sup> Steiner (1998)

<sup>19</sup> Here I have the problem, that in some of these countries the US-\$ is also a widely used currency, which is not considered here, because I got no reliable figures of the amount of US-\$ in these countries.

The estimation result for the 21 countries in Middle and South America is shown in table 4.1. All estimated coefficients of the cause variables are statistically significant and have the theoretically expected signs. If one first considers the two tax burden variables, one realizes that the share of direct taxation is just statistically significant (90% confidence level) and the size of the estimated coefficient has half the size of the value of the share of indirect taxation and custom duties, which is highly significant statistically, and the estimated coefficient has a much larger size. One can interpret this result that direct taxation is a less important for the development of the shadow economy in these countries, compared to indirect taxation and custom duties. If one turns to the burden of state regulation, the Heritage Foundation index, this variable is highly significant statistically, like the two variables, measuring the official economy, unemployment quota and GDP per capita. As a single independent variable, the burden of state regulation has the quantitatively largest impact on the size of the shadow economy, showing that state regulation is the most important factor for the size of the shadow economy in these Middle and South American countries. But also the official labour market is quite important: the unemployment quota has the second largest estimated coefficient and influence on the shadow economy in these 21 countries. If I turn to the indicator variables, one realizes that the employment quota, as well as the change of local currency per capita, have the expected negative and positive influence and are highly statistically significant, respectively.

**Table 4.1: DYMIMIC Estimations of the size of the shadow economy of 21 Middle and South American countries 1999/00, 2001/02, 2002/03, 2003/04 and 2004/05**

<b>Cause Variables</b>	<b>Estimated Coefficients</b>
Share of direct taxation (in % of GDP)	$\lambda_1 = 0.156^{(*)}$ (1.74)
Share of indirect taxation and customs duties (in % of GDP)	$\lambda_2 = 0.259^{**}$ (3.43)
Burden of state regulation (Index, Heritage Foundation: score 1 most economic freedom, 5 least economic freedom)	$\lambda_3 = 0.314^{**}$ (3.02)
Unemployment quota (%)	$\lambda_4 = 0.264^{**}$ (3.27)
GDP per capita (in US-\$)	$\lambda_5 = -0.135^*$ (-2.09)
Lagged endogenous variable	$\lambda_6 = 0.241^{(*)}$ (1.36)
<b>Indicator Variables</b>	
Employment quota (in % of population 18-64)	$\lambda_7 = -0.512^*$ (-2.23)
Annual rate of GDP	$\lambda_8 = -1$ (Residuum)
Change of local currency per capita	$\lambda_9 = 0.394^{**}$ (3.47)
<b>Test-statistics</b>	$RMSE^1 = 0.0070^{(*)}$ (p-value = 0.923) $Chi-square^2 = 9.50$ (p-value = 0.943) $TMNCV^3 = 0.066$ $AGFI^4 = 0.704$ $N = 110$ $D.F.^5 = 36$
<p>Notes:  t-statistics are given in parentheses (*); *, ** means the t-statistics are statistically significant at the 90%, 95%, or 99% confidence level.  1) Steigers Root Mean Square Error of Approximation (RMSEA) for test of close fit; <math>RMSEA &lt; 0.05</math>; the RMSEA-value varies between 0.0 and 1.0.  2) If the structural equation model is asymptotically correct, then the matrix S (sample covariance matrix) will be equal to <math>\Sigma(\theta)</math> (model implied covariance matrix). This test has a statistical validity with a large sample (<math>N \geq 100</math>) and multinomial distributions; both are given for all three equations in tables 3.1-3.3 using a test of multi normal distributions.  3) Test of Multivariate Normality for Continuous Variables (TMNCV); p-values of skewness and kurtosis.  4) Test of Adjusted Goodness of Fit Index (AGFI), varying between 0 and 1; 1 = perfect fit.  5) The degrees of freedom are determined by <math>0.5(p + q)(p + q + 1) - t</math>; with p = number of indicators; q = number of causes; t = the number for free parameters.</p>	

In order to calculate the size and development of the shadow economies of 21 Middle and South American countries, I have to overcome the disadvantage of the DYMIMIC approach, which is that one gets relatively estimated coefficients of the shadow economy and one has to use another approach to get absolute figures. In order to calculate absolute figures of the size of the shadow economies from these DYMIMIC estimation results, I use the already available estimations from the currency demand approach for Columbia, Argentina and Peru.<sup>20</sup> As I have values of the shadow economy (in % of GDP) for various years for the above mentioned countries, I can use a benchmark procedure with the help of the currency demand estimation with figures to transform the index of the shadow economy from the DYMIMIC estimations into cardinal values.<sup>21)</sup>

#### **4.2 The Size of the Shadow Economies for 21 Middle and South American Countries for 1999/2000 to 2004/2005**

Considering the size of the shadow economies over the five periods of time (1999/2000, 2001/2002, 2002/2003, 2003/2004 and 2004/2005) for the 21 countries which are quite different in their developing stage, one should be aware that such country comparisons give only a rough picture of the ranking of the size of the shadow economy in these countries and over time, because the DYMIMIC and the currency demand methods have shortcomings; these are discussed in appendix (chapter 7)<sup>22)</sup>. Due to these shortcomings a detailed discussion of the (relative) ranking of the size of the shadow economies is not done.

In Table 4.2. the sizes of shadow for twenty-one Central and South American countries are shown. Averaging the figures over all twenty-one Central and South American countries, the shadow economy increased from 41.1% in the year 1999/2000 to 43.4% of official GDP in 2002/2003 and since then declined to 42.2% of official GDP in 2004/05. This up and down holds for most of the countries, except for Dominican Republic, Haiti and Paraguay, where the shadow economy is increasing all the time! If I turn to the size of the shadow economy for single countries for 2004/2005, Bolivia has the largest shadow economy with 67.2%, followed by Panama with 62.2% and Peru with 58.2% of official GDP. The median country is Brazil and Columbia with 41.8% and 42.2% and at the lower end are Chile with 19.4%, Costa Rica with 26.3%, and Argentina with 27.2% of official GDP.

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<sup>20</sup> See e.g. Schneider and Hametner (2007) or Schneider (2007).

<sup>21)</sup> This procedure is described in great detail in the paper Del'Anno and Schneider (2005).

<sup>22)</sup> See also Thomas (1992, 1999), Tanzi (1999), Pedersen (2003) and Ahumada, Alveredo, Cavanese A and P.

The sizes of the shadow economies of Central and South American countries are generally similar in their movement. This is partly due to the factors mentioned earlier; for the majority of citizens in many of these countries, the only way to ensure a decent standard of living is to turn to the black market. As income inequality is much more pronounced in some Central and South American countries the rate of increase in shadow economy activity is quite high in some Middle and South American countries.

**Table 4.2.: The Size of the Shadow Economy in Twenty-One Central and South American Countries**

No.	Country	Shadow Economy (in % of official GDP) using the DYMIMIC and Currency Demand Method				
		1999/00	2001/02	2002/03	2003/04	2004/05
1	Argentina	25.4	27.1	28.9	28.6	27.2
2	Bolivia	67.1	68.1	68.3	68.0	67.2
3	Brazil	39.8	40.9	42.3	42.6	41.8
4	Chile	19.8	20.3	20.9	20.3	19.4
5	Colombia	39.1	41.3	43.4	43.0	42.7
6	Costa Rica	26.2	27.0	27.8	27.1	26.3
7	Dominican Republic	32.1	33.4	34.1	34.4	34.8
8	Ecuador	34.4	35.1	36.7	36.1	35.2
9	El Salvador	46.3	47.1	48.3	48.1	47.2
10	Guatemala	51.5	51.9	52.4	51.1	50.3
11	Haiti	55.4	57.1	58.6	59.3	59.6
12	Honduras	49.6	50.8	51.6	50.8	49.3
13	Jamaica	36.4	37.8	38.9	39.2	38.4
14	Mexico	30.1	31.8	33.2	32.6	31.7
15	Nicaragua	45.2	46.9	48.2	48.8	48.1
16	Panama	64.1	65.1	65.3	64.1	62.2
17	Paraguay	27.4	29.2	31.4	32.4	33.1
18	Peru	59.9	60.3	60.9	59.1	58.2
19	Puerto Rico	28.4	29.4	30.7	29.6	28.2
20	Uruguay	51.1	51.4	51.9	50.8	49.2
21	Venezuela, RB	33.6	35.1	36.7	36.1	35.4
<b>Unweighted Average</b>		<b>41.1</b>	<b>42.2</b>	<b>43.4</b>	<b>43.0</b>	<b>42.2</b>

Source: Own calculations.

### 4.3 Results for Columbia

#### 4.3.1 Estimation method and variables

Another possibility to estimate the size and development of the shadow economy is to use the currency demand approach<sup>23</sup>. I have chosen this approach for Columbia because it is the only method to get a shadow economy series for an extended time period (here 1976 to 2002); in my case for 27 years! I have applied two variations of the currency demand model: The first uses as dependent variable, the currency demand per capita (*CDC*), the second uses as dependent variable the ratio of cash holdings to checkable deposits (*CD*). 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 yearly average market exchange rate of the Colombian Peso (COP) to the US dollar (*ER*)
- (4) 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

- (5) the average real direct (*TY*) and indirect (*TC*) net tax rates (tax on income and VAT),
- (6) the unemployment rate (*UNEMP*), and
- (7) the real expenditures for public employees in % of GDP (*EPE*) and the number of new laws issued per year (*LAW*) as proxies for the intensity of regulation and control.<sup>24</sup>

Estimation equation for model 1 based on currency demand per capita:

$$\ln CDC_t = \beta_0 + \beta_1 \times \ln GDPPC_t + \beta_2 \times IRD_t + \beta_3 \times \ln ICD_t + \beta_4 \times \ln ER_t + \beta_5 \times \ln(1 + TY_t) + \beta_6 \times \ln(1 + TC_t) + \beta_7 \times \ln UNEMP_t + \beta_8 \times \ln EPE_t + \beta_9 \times \ln LAW_t + u_t \quad (1)$$

Estimation equation for model 2 based on the ratio of cash holdings to checkable deposits:

<sup>23</sup> For a detailed description and criticism on the currency-demand method see appendix 7A1.

<sup>24</sup> For a detailed description of the variables used see appendix 8B., Table 8.1.1

$$CD_t = \beta_0 + \beta_1 \times \ln GDPPC_t + \beta_2 \times IRD_t + \beta_3 \times \ln ICD_t + \beta_4 \times \ln ER_t + \beta_5 \times \ln(1 + TY_t) + \beta_6 \times \ln(1 + TC_t) + \beta_7 \times \ln UNEMP_t + \beta_8 \times \ln EPE_t + \beta_9 \times \ln LAW_t + u_t \quad (2)$$

Based on monetary theory, the real GDP per capita and the market exchange rate are 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 variables 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:

$$\beta_1 > 0, \beta_2 < 0, \beta_3 > 0, \beta_4 > 0, \beta_5, \beta_6, \beta_7, \beta_8 \text{ and } \beta_9 > 0$$

#### 4.3.2 Estimation results

Table 4.3 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. In my regressions I use yearly data for the period from 1976 to 2002. For model 1, I use the natural logarithm of currency demand per capita. Furthermore, an AR-model has been specified to correct for first order autocorrelation, detected by conventional tests.<sup>25</sup> For model 2, a standard OLS regression has been run as test statistics here do not indicate time series problems.

**Table.4 3: Regression results using the currency demand method.**

<i>regression results</i>		
	<b>model 1</b>	<b>model 2</b>
<b>endogenous variables</b>	<b>currency demand per capita (ln)</b>	<b>ratio cash holdings to checkable deposits</b>
<b>exogenous variables</b>	<b>estim. coefficients</b>	
GDPPC: real GDP per capita	3.15766*	0.955584*
IRD: interest rate on bank deposits (yearly average)	-0.393158*	-0.016046
ICD: cumulative value of cash dispensers	0.0856584*	0.011052
ER: yearly average exchange rate COP/USD	0.454770*	0.103607*
TY: average net tax rate on income	2.734005*	0.638812
TC: average net tax rate on	6.261080*	2.540876*

<sup>25</sup> For test results see Appendix B.2.

	consumption		
UNEMP:	unemployment rate	0.580514*	0.188289*
EPE:	real expenditures for public employees (% of real GDP)	1.039832*	0.141843*
LAW:	number of new laws issued per year	0.108627*	-0.054882*
	constant term	-38.459050*	13.997860*
* significant on 5 % level all variables except CD in logarithmic form			

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

In model 1, based on the currency demand per capita, all coefficients of the independent variables show the theoretically expected signs and are statistically significant.<sup>26</sup> Model 2 in general replicates the outcomes of model 1. However, the results are not that clear as the coefficients of three of the explanatory variables (IRD, ICD and TY) are not statistically significant and one of the proxy variables for intensity of state regulation even enters with the wrong sign.

The variables explaining currency demand induced by shadow economic activities (direct and indirect tax rates: *TY*, *TC* and the unemployment rate: *UNEMP*) 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. Also personnel cost for public sector employees (*EPE*) as a proxy variable for the intensity of regulation and control shows the expected positive effect on currency demand. This finding is supported by our above theoretical argumentation that higher intervention in the market increases the size of the shadow economy and consequently the demand for cash. From the coefficients of the second proxy variable for the intensity of regulation, the number of new laws enforced per year, the effect on the cash demand can not be clearly defined as the coefficients show different signs in the two regression models.

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, especially indirect taxation: A one percent increase of the indirect average net tax rate (*TC*), whose statistical significance is satisfactory in both of the equations presented, increases currency demand per capita by 6.26 % and the ratio of cash holdings to checkable deposits by 2.54 %, ceteris paribus. The direct

<sup>26</sup> 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.

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 percent, currency demand per capita increases by 2.73 % and the ratio of cash holdings to checkable deposits increases by 0.63 %. However, the impact of the tax rate on income is smaller than that of the tax rate on consumption and is not statistically significant in the second model based on the ratio of cash holdings to checkable deposits.

### **4.3.3 Calculation of the size of the Colombian shadow economy**

To calculate the size and development of the Colombian shadow economy I undertake simulations, where the values of the variables used to explain the currency demand induced by shadow economic activities (*TY*, *TC*, *UNEMP*, *EPE*, *LAW*) 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 basically 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.

However, it has to be mentioned that here two main restrictions of the monetary approach come into play: First, the assumption of the same velocity of money in the registered and the shadow economy is only valid when income elasticity is equal to one. If this is not the case, calculations of the size of the shadow economy have to be adjusted by a correction factor which is based on the long-run income elasticity of money. Secondly, estimations of the income elasticity of money are in general based on short-run, i.e. dynamic model specifications, to be concrete, they include the lagged dependent variable. Therefore, such short-run models have to be adjusted for calculating the long-run income elasticity of money.<sup>27</sup> The estimate of the implicit long-run income elasticity for Colombia gives a value of 1.9. The estimations of the size of the shadow economy presented below have been adjusted accordingly.

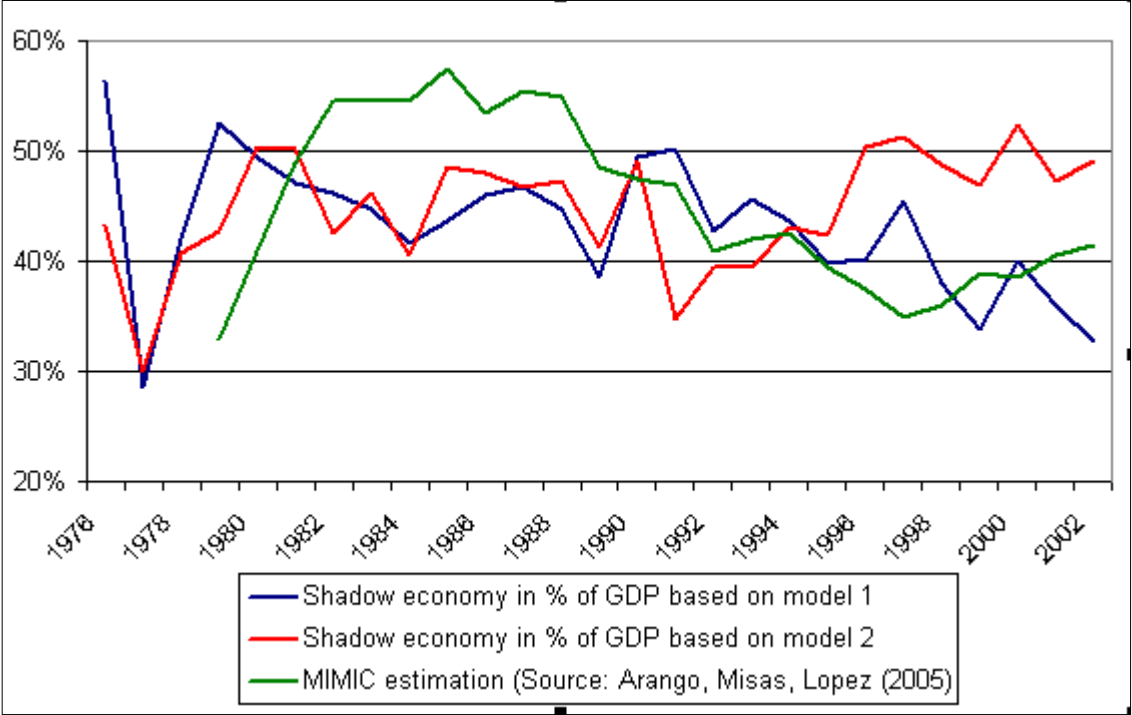
Figure 4.1. shows the simulation results of the two models for the size of the shadow economy in Colombia. Additionally, estimations based on a MIMIC model based on a broader definition of the shadow economy, i.e. including drug trafficking and smuggling,

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<sup>27</sup> For a detailed discussion on possible corrections with respect to the restrictions mentioned see Ahumada, Alvaredo, Canavese (2007)

carried out by the Colombian Central Bank<sup>28</sup> are shown to give a comparison to our estimates based on a narrower definition of the shadow economy.

**Figure 4.1: Simulations of the estimated size of the shadow economy in % of nominal GDP for Colombia, 1977-2002.**



Source: Model 1 is based on the regression results of model 1, using currency demand per capita as endogenous variable whereas model 2 uses the results of the second regression based on the ratio of cash holdings to checkable deposits as endogenous variable. The figures based on the MIMIC estimation by Colombian Central Bank (2005) are in combination with an estimation based on the currency demand approach carried out by Schneider and Enste (2002).

In general, the estimated sizes of the shadow economy based on the two models presented in this paper lie relatively closely together. Only at the end of the period under consideration, the estimates reveal a higher divergence. Basically, the size of the shadow economy in Colombia is relatively stable during the whole decade of the 1980s, always fluctuating between 40 and 50 % of GDP. In the 1990s, however, larger volatility can be observed, where the tendency when comparing the two models based on currency demand approach, can not be clearly identified at the beginning of the decade but shows a consistent decreasing trend from 1997 to 1999 followed by short increase at the end of the century and another decrease for 2001.

<sup>28</sup> Arango, Misas and López who carried out the cited study for the Colombian Central Bank estimated a MIMIC model. As simulations of the size of the shadow economy based on MIMIC models only give index numbers a second, absolute estimation for the size of the shadow economy for at least one point in time is needed to convert the indices in absolute numbers. In this case, the figures fall back on an estimate based on the currency demand method by Schneider (2002) giving a size of the Colombian shadow economy of 39 % of GDP for 1999/2000.

Comparing this development with the estimates by the Colombian Central Bank based on the MIMIC approach and considering a broader definition of the shadow economy, the most obvious deviation is the much high estimates for the decade of the 80s ranging between 50 and 60 % of GDP. This may be due to the organization of drug traffickers in cartels and the beginning of drug trafficking on a large scale during this decade. This tendency is reversed at the beginning of the 90s and the size of the shadow economy keeps decreasing until the end of the 90s to reach a level similar to the one based on the estimates of model 1 presented in this paper. For completeness, it has to be mentioned that only the development of the shadow economy reflects the inclusion of illegal economic activities into the MIMIC estimations. One has to be aware that the conversion of the MIMIC indices in real numbers is based on the estimates of the size of the shadow economy from the outcomes of a currency demand model based on the narrow definition of the shadow economy equal to the one taken for the estimation presented in this paper. Therefore, the relative numbers in % of GDP shown in the chart above do not include illegal economic activity.

The trends in the development of the shadow economy in Colombia resulting from the above simulations correspond to the general expectations: One expects a generally high level of the shadow economy in Colombia given its relatively unstable economic and political situation, the low participation on the labour market, the high level of poverty among the population with mostly low or no professional qualification. The two sharp increases in 1989/1990 and 1997/1998 can be attributed to the announcement of the abolition of the strategy of import substitution followed until then in combination with a new constitution, two events that certainly caused some uncertainty among the population and the fatal recession in 1998, the worst recession the country experienced in the last century, respectively.

Finally it should be emphasized that the results of the size of the Colombian shadow economy coming from the DYMIMIC results in part 4.1 of this paper are quite similar with a range between 40 and 43% of official GDP for the 90s compared with the results using the currency demand approach.

## 5 The interaction of the shadow economy with the official one in Colombia

### 5.1 The estimation 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 [ $IR$ ], the exchange rate [ $ER$ ], 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:

$$GGDPPC_t = \beta_0 + \beta_1 \times GGDPPC_{t-1} + \beta_2 \times \ln IR_t + \beta_3 \times \ln ER_t + \beta_4 \times \ln DI_t + \beta_5 \times \ln FDI_t + \beta_6 \times \ln POP_t + \beta_7 \times \ln SPC_t + \beta_8 \times \ln LPA_t + \beta_9 \times \ln PCGDP + \beta_{10} \times \ln SE_t + u_t \quad (3)$$

According to general economic growth theory, the expected signs of the regression coefficients of the independent variables are positive for the lagged endogenous variable ( $GGDPPC$ ), the exchange rate ( $ER$ ), 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 over the period 1977 to 2002 (26 years) using the two variations of the size 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 (variable: currency demand per capita) and the second uses the estimations from model 2, based on the ratio of cash holdings to checkable deposits.

### 5.2 Econometric results

The results are shown in Table 5.1, detailed ones (including test-statistics) are presented in appendix B.4. The estimated coefficients, in general, show the expected signs. Capital investments, average schooling, the exchange rate and the participation on the labour market have a positive and statistically significant effect on economic growth which is in line with economic growth theory. Foreign direct investment also influences growth positively,

although it does not show high statistical significance in the first model. The price level has the expected negative effect on economic growth and is highly statistically significant in both models whereas governmental consumption spending is not statistically significant in neither case and even shows the wrong sign in the second equation.

**Table 5.1: Empirical results estimating the effect of the shadow economy on economic growth in Colombia, 1977-2002.**

	regressions based on size of the shadow economy calculated from estimation results of	
	model 1	model 2
<b>Growth of real GDP per capita (yearly, %)</b>		
Growth of real GDP per capita %, lagged 1 year	-0.262951	-0.065562
Consumer price index	-0.225484 *	-0.080436 *
Exchange rate (COP/USD)	0.263267 *	0.147100 *
Domestic investments	0.165464 *	0.087980 *
Foreign direct investments	0.008973	0.018283 *
Total population	-0.916131 *	-1.237556 *
Average schooling per capita	0.227228	0.502118
Participation rate on the labour market	0.257386	0.346983 *
Public spending on consumption (% of GDP)	0.084179	-0.069905
Constant	13.095410 *	18.943320 *
Size of shadow economy (% of GDP) - based on estimations model 1	0.121741 *	
Size of shadow economy (% of GDP) - based on estimations model 2		0.103937 *
<i>* significant on 5 % level; all variables in logarithmic form, except growth of real GDP and its lagged value</i>		

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

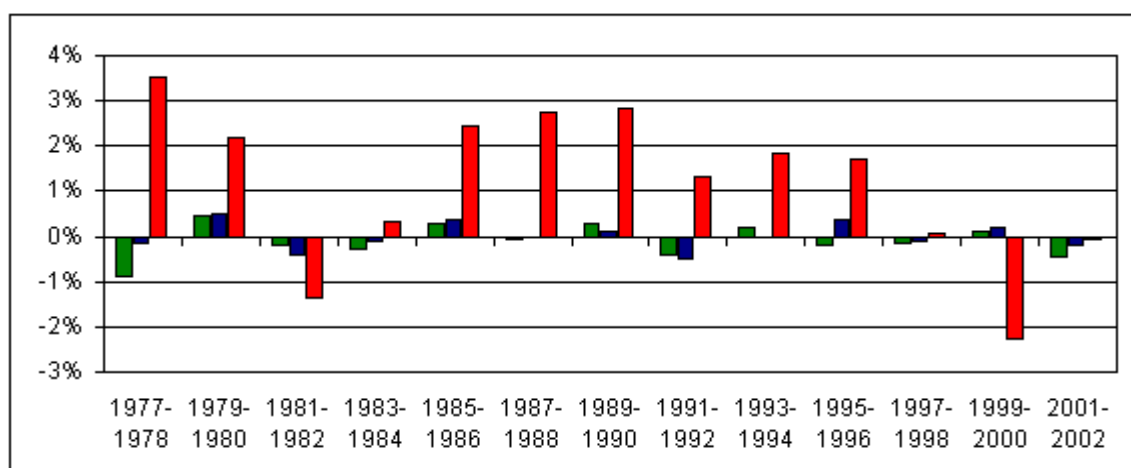
Nearly all coefficients of the explanatory variables show the expected sign and a great number also is statistically significant. Only the coefficient for total population appears twice with the (statistically significant) wrong sign. However, in a country like Colombia, suffering from a very high population growth, even too high for the poor half of the population, it makes sense to assume that population affects growth of GDP per capita negatively.

For the most interesting independent variable, the shadow economy, the regression results show statistically highly significant, although quantitatively moderate, positive influence on GDP growth: A one percent increase in the size of the shadow economy (measured in percent of GDP), leads to a rise of the growth rate of real GDP per capita by around 0.1 percentage points, ceteris paribus.

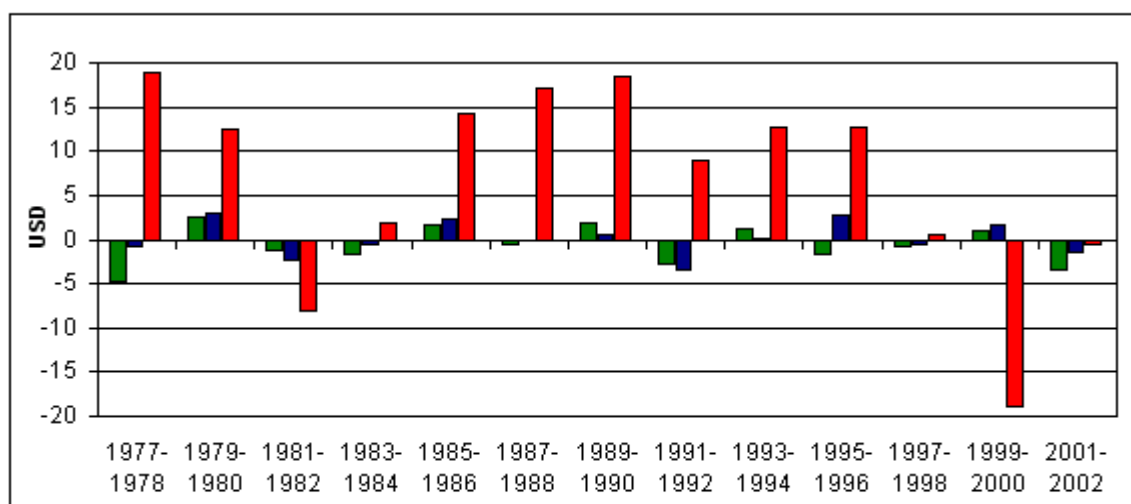
### 5.3 Simulations on the relative and absolute influence of the shadow economy on economic growth

Finally, I empirically determine the relative and absolute influence of the shadow economy for each year of our investigation; i.e. from 1976 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 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 5.1.

**Figure 5.1: Absolute and relative influence of the shadow economy on economic growth (of real GDP per capita) in Colombia, 1976-2002, 2-years-averages, in USD and percentage points.**



	growth of real GDP per capita (%)	
	effect of the shadow economy on GDP growth	based on figures of model 1
		based on figures of model 2



Source: Own calculations.

While average values of the growth of real GDP per capita vary between -2.3 and +3.5 % or -19 and +19 USD for two periods, the average values of the relative and absolute influences on growth by shadow economic activity lie between -0.9 and +0.5 percentage points and -4.7 and +2.9 USD respectively, which shows a moderate but still important effect of underground activity on economic growth. Especially in the years 1999 and 2000 when the Colombian economy experienced its biggest recession of the 20<sup>th</sup> century one can note the positive contribution of the shadow economy on economic growth.

## **6 Summary and conclusion**

Applying the DYMIMIC procedure for 21 Middle and South American countries and the currency demand approach for the case of Colombia, the first major finding of my paper is the large size of the shadow economy in Colombia and most other South American countries (except Chile). The size of the shadow economy in Colombia fluctuated during the whole decade of the 80s between 40 and 50 % of GDP, followed by a period of higher volatility in its size during the 90s. My empirical analysis of the main causes for underground activities shows that on the one side indirect taxation has a great effect on the growth of the shadow economy in these 21 countries, on the other side I also find a considerable influence caused by unemployment and the intensity of regulation.

My second major finding is the positive effect of the shadow economy on economic growth in Colombia. My 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 on average 0.02 percentage points of the growth is explained by shadow economic activities.

Considering the second finding, I draw the following two conclusions:

(1) Even if our econometric estimates provide the clear result of a positive effect of the shadow economy on “official” economic growth, this stimulating influence is only moderate and I’m 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.<sup>29</sup>

(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.<sup>30</sup> 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.<sup>31</sup>

## **7 Appendix A: Methods to estimate the size of the shadow economy**

### **7.1 Appendix A1: 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

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<sup>29</sup> For a further discussion of integration strategies see Tokman (2006) and Lubell (1991).

<sup>30</sup> See for example O'Grady (2006) for a discussion of continuous drawbacks in taxation policy and Gracia/Urduola (2000) for a debate on changes in labour market regulations.

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.<sup>32</sup> 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 countries<sup>33</sup> but has nevertheless been criticized on various grounds.<sup>34</sup> 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

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<sup>31</sup> For a detailed explanation of the two-pillar strategy consult Schneider/Enste (2002).

<sup>32</sup> 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.

<sup>33</sup> See Karmann (1986, 1990), Schneider (1997, 1998a), Johnson et al. (1998a), and Williams and Windebank (1995).

<sup>34</sup> See Thomas (1992, 1999), Feige (1986), Pozo (1996), Pedersen (2003) and Ahumada et al. (2004).

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.<sup>35</sup> (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.<sup>36</sup> Frey and Pommerehne (1984) and Thomas (1986, 1992, 1999) claim that Tanzi's parameter estimates are not very stable.<sup>37</sup> (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 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 and suggest a correction method for that cases where the income elasticity does not equal 1.<sup>38</sup> (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.

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<sup>35</sup> 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).

<sup>36</sup> 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.

<sup>37</sup> 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).

<sup>38</sup> Ahumada, Alvarado, Canavese (2007)

## **7.2 Appendix A2: The Latent (DYMIMIC) Estimation Approach**

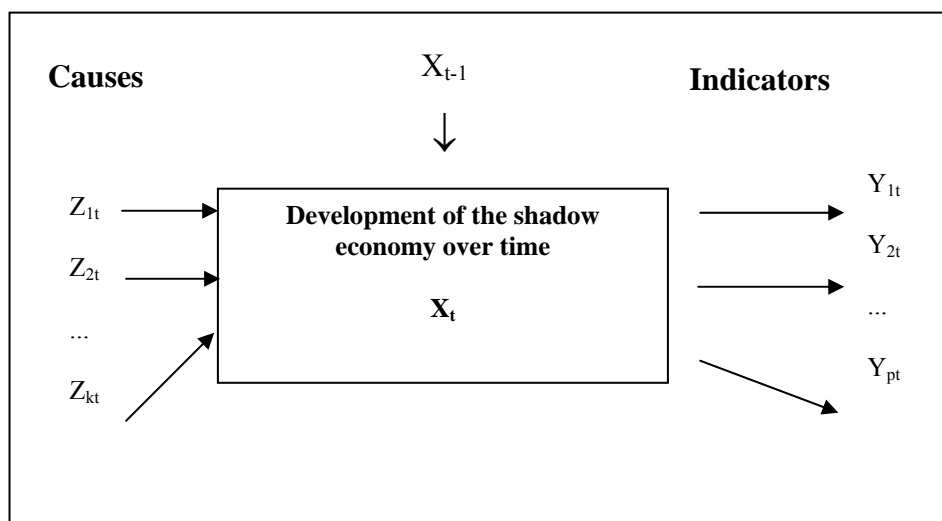
All methods described so far that are designed to estimate the size and development of the shadow economy consider just one indicator that "must" capture all effects of the shadow economy. However, it is obvious that shadow economy effects show up simultaneously in the production, labour, and money markets. An even more important critique is that the causes that determine the size of the shadow economy are taken into account only in some of the monetary approach studies that usually consider one cause, the burden of taxation. The model approach explicitly considers multiple causes leading to the existence and growth of the shadow economy, as well as the multiple effects of the shadow economy over time.

The empirical method used is quite different from those used so far. It is based on the statistical theory of unobserved variables, which considers multiple causes and multiple indicators of the phenomenon to be measured. For the estimation, a factor-analytic approach is used to measure the hidden economy as an unobserved variable over time. The unknown coefficients are estimated in a set of structural equations within which the "unobserved" variable cannot be measured directly. The DYMIMIC (dynamic multiple-indicators multiple-causes) model consists in general of two parts, with the measurement model linking the unobserved variables to observed indicators.<sup>39)</sup> The structural equations model specifies causal relationships among the unobserved variables. In this case, there is one unobserved variable, or the size of the shadow economy; this is assumed to be influenced by a set of indicators for the shadow economy's size, thus capturing the structural dependence of the shadow economy on variables that may be useful in predicting its movement and size in the future. The interaction over time between the causes  $Z_{it}$  ( $i = 1, 2, \dots, k$ ) the size of the shadow economy  $X_t$ , in time  $t$  and the indicators  $Y_{jt}$  ( $j = 1, 2, \dots, p$ ) is shown in Figure 7.1.

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<sup>39)</sup> The latest papers dealing extensively with the DYMIMIC or MIMIC approach, its development and its weaknesses are from Del'Anno (2003) and the excellent study by Giles and Tedds (2002), as well as Breusch (2005a, 2005b), Schneider (2005), and Pickhardt and Sarda-Pous (2006).

**Figure 7.1: Development of the shadow economy over time.**



There is a large body of literature<sup>40)</sup> on the possible causes and indicators of the shadow economy, in which the following three types of causes are distinguished:

### Causes

- (i) The burden of direct and indirect taxation, both actual and perceived. A rising burden of taxation provides a strong incentive to work in the shadow economy.
- (ii) The burden of regulation as proxy for all other state activities. It is assumed that increases in the burden of regulation give a strong incentive to enter the shadow economy.
- (iii) The "tax morality" (citizens' attitudes toward the state), which describes the readiness of individuals (at least partly) to leave their official occupations and enter the shadow economy: it is assumed that a declining tax morality tends to increase the size of the shadow economy.<sup>41)</sup>

### Indicators

A change in the size of the shadow economy may be reflected in the following indicators:

<sup>40)</sup>Thomas (1992); Schneider (1994a, 1997, 2003, 2005); Pozo (1996); Johnson, Kaufmann and Zoido-Lobato (1998a, 1998b); Giles (1997a, 1997b, 1999a, 1999b, 1999c); Giles and Tedds (2002), Giles, Tedds and Werkneh (2002), Del'Anno (2003) and Del'Anno and Schneider (2004).

<sup>41)</sup> When applying this approach for European countries, Frey and Weck-Hannemann (1984) had difficulty in obtaining reliable data for the cause series, besides the ones for the direct and indirect tax burden. Hence, their study was criticized by Helberger and Knepel (1988), who argue that the results were unstable with respect to changing variables in the model and over the years.

- (i) Development of monetary indicators. If activities in the shadow economy rise, additional monetary transactions are required.
- (ii) Development of the labour market. Increasing participation of workers in the hidden sector results in a decrease in participation in the official economy. Similarly, increased activities in the hidden sector may be expected to be reflected in shorter working hours in the official economy.
- (iii) Development of the production market. An increase in the shadow economy means that inputs (especially labour) move out of the official economy (at least partly), and this displacement might have a depressing effect on the official growth rate of the economy.

The latest use of the model approach has been undertaken by Giles (1999a, 1999b, 1999c) and by Giles, Tedds and Werkneh (2002), Giles and Tedds (2002), Chatterjee, Chaudhury and Schneider (2006), Bajada and Schneider (2005), and Pickhardt and Sarda-Pous (2006). They basically estimate a comprehensive (sometime dynamic) MIMIC model to get a time series index of the hidden/measured output of New Zealand, Canada, Germany, India or Australia, and then estimate a separate "cash-demand model" to obtain a benchmark for converting this index into percentage units. Unlike earlier empirical studies of the hidden economy, they paid proper attention to the non-stationary, and possible co-integration of time series data in both models. Again this DYMIMIC model treats hidden output as a latent variable, and uses several (measurable) causal variables and indicator variables. The former include measures of the average and marginal tax rates, inflation, real income and the degree of regulation in the economy. The latter include changes in the (male) labour force participation rate and in the cash/money supply ratio. In their cash-demand equation they allow for different velocities of currency circulation in the hidden and recorded economies. Their cash-demand equation is not used as an input to determine the variation in the hidden economy over time – it is used only to obtain the long-run average value of hidden/measured output, so that the index for this ratio predicted by the DYMIMIC model can be used to calculate a level and the percentage units of the shadow economy. Overall, this latest combination of the currency demand and DYMIMIC approach clearly shows that some progress in the estimation technique of the shadow economy has been achieved and a number of critical points have been overcome.

However, objections can also be raised against the (DY)MIMIC method, like:

- (1) instability in the estimated coefficients with respect to sample size changes,
- (2) instability in the estimated coefficients with respect to alternative specifications,

- (3) difficulty of obtaining reliable data on cause variables other than tax variables, and
- (4) the reliability of the variables grouping into "causes" and "indicators" in explaining the variability of the shadow economy; and
- (5) obtaining only relative values of the size and development of the shadow economy; hence, a second method must be used in order to transform/calibrate these values into absolute ones.

## 8 Appendix B

### 8.1 Appendix B.1. Detailed description of the used variables

**Table 8.1.1. Description of the variables used in the discussed regression models**

Variable		Obs	Mean	Std. Dev.	Min	Max	source <sup>42</sup>
name	label						
CDC	currency demand per capita in COP (Colombian Pesos) <sup>43</sup>	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	0.1580003	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]
ER	yearly average market exchange rate COP/USD	27	684.1716	753.9644	34.84	2534.22	[2]
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]

<sup>42</sup> Sources: see numbers in listing of empirical sources; o. c. = own calculations.

<sup>43</sup> used exchange rate in this paper: average market rate Jan.-July 2006 = 2,388.50 COP/USD

LAW	new laws enforced per year	27	647.037	302.7354	117	1186	[2]
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]
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]
SEDC	size of shadow economy in % of real GDP (estimation results model 1)	27	0.4318296	0.061948	0.285	0.5634	o. c.
SECD	size of shadow economy in % of real GDP (estimation results model 2)	27	0.4809741	0.033111	0.4114	0.545	o. c.

## 8.2 Appendix B.2. Detailed regression results using the currency demand method

Table 8.2.1: Model 1; endogenous variable – currency demand per capita (ln)

ARIMA regression						
Sample: 1976 to 2002			Number of obs	=	27	
Log pseudo-likelihood = 30.48775			Wald chi2(10)	=	57138.53	
			Prob > chi2	=	0.0000	
lnCDC	Coef.	Semi-robust Std. Err.	z	P> z	[95% Conf. Interval]	
lnCDC						
lnGDPPCR	3.157656	.5578785	5.66	0.000	2.064234	4.251077
lnIRD	-.3931579	.0707693	-5.56	0.000	-.5318632	-.2544526
lnICD	.0856584	.0194167	4.41	0.000	.0476024	.1237144
lnER	.4547697	.0561553	8.10	0.000	.3447073	.5648321
lnITY	2.734005	.9596801	2.85	0.004	.8530665	4.614943
lnITC	6.26108	1.351817	4.63	0.000	3.611567	8.910593
lnUNEMP	.5805144	.082569	7.03	0.000	.4186822	.7423466
lnEPE	1.039832	.1189887	8.74	0.000	.8066186	1.273046
lnLAW	.1086266	.0364989	2.98	0.003	.0370902	.1801631
_cons	-38.45905	7.749934	-4.96	0.000	-53.64864	-23.26946
ARMA						
ar						
L1	-.6314044	.2144107	-2.94	0.003	-1.051642	-.2111672
/sigma	.0774958	.0096304	8.05	0.000	.0586204	.0963711

### Misspecification and Diagnostic Testing

Augmented Dickey-Fuller test statistic for CDC (ln), allowing for intercept	DF=-2.023249	p=0.2757
Autocorrelations CDC (ln)		
to lag 1	0.809	significant at 5%
to lag 2	0.620	significant at 5%
Partial Autocorrelations CDC (ln)		
to lag 1	0.809	significant at 5%
to lag 2	-0.099	insignificant at 5%
Jarque-Bera-Test for normality of residuals	JB=2.07784	p=0.3538
Chow-Test for structural discontinuity (break in 1992)	F=0.719689	p=0.69258

**Table 8.2.2: *Model 2; endogenous variable – ratio of cash holdings to checkable deposits***

Regression with robust standard errors

Number of obs = 27  
 F( 9, 17) = 61.29  
 Prob > F = 0.0000  
 R-squared = 0.9761  
 Root MSE = .03018

CD	Coef.	Robust Std. Err.	t	P> t	[95% Conf. Interval]	
lnGDPPCR	.955584	.3060869	3.12	0.006	.3097972	1.601371
lnIRD	-.016046	.0294922	-0.54	0.593	-.078269	.0461771
lnICD	.0110516	.0077473	1.43	0.172	-.0052937	.0273969
lnER	.1036066	.0247887	4.18	0.001	.0513071	.1559061
ln1TY	.6388118	.4550076	1.40	0.178	-.3211702	1.598794
ln1TC	2.540876	.780976	3.25	0.005	.8931608	4.188591
lnUNEMP	.1882893	.0405422	4.64	0.000	.1027526	.2738259
lnEPE	.1418428	.0458676	3.09	0.007	.0450706	.2386149
lnLAW	-.0548818	.0180049	-3.05	0.007	-.0928689	-.0168947
_cons	13.99786	4.205684	3.33	0.004	5.124641	22.87108

*Misspecification and Diagnostic Testing*

Augmented Dickey-Fuller test statistic for CD, allowing for linear trend and intercept	DF=-3.636635	p=0.0496
Autocorrelations CD to lag 1	-0.164	insignificant at 5%
Jarque-Bera-Test for normality of residuals	JB=0.3833	p=0.8255
Chow-Test for structural discontinuity (break in 1992)	F=1.15806	p=0.43572

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

Table 8.3.1: Estimation based on results for the size of the shadow economy of model 1

Regression with robust standard errors					Number of obs = 26	
					F( 10, 15) = 13.32	
					Prob > F = 0.0000	
					R-squared = 0.8335	
					Root MSE = .01284	

GGDPPC		Coef.	Robust Std. Err.	t	P> t	[95% Conf. Interval]
GGDPPC	L1	-.2629509	.1612578	-1.63	0.124	-.6066638 .080762
lnIR		-.2254838	.0577104	-3.91	0.001	-.3484906 -.102477
lnER		.2632671	.06913	3.81	0.002	.1159201 .4106141
lnDI		.1654638	.0432984	3.82	0.002	.0731754 .2577523
lnFDI		.0089727	.0097609	0.92	0.373	-.0118321 .0297776
lnPOP		-.9161309	.244562	-3.75	0.002	-1.437403 -.3948592
lnSPC		.2272284	.2845838	0.80	0.437	-.3793475 .8338043
lnLPA		.2573861	.1387967	1.85	0.083	-.0384521 .5532244
lnPCGDP		.0841792	.0615094	1.37	0.191	-.046925 .2152834
lnSECDC		.1217409	.0321453	3.79	0.002	.0532249 .1902569
_cons		13.09541	4.03344	3.25	0.005	4.498331 21.69248

Table 8.3.2: Estimation based on results for the size of the shadow economy of model 2

Regression with robust standard errors					Number of obs = 26	
					F( 10, 15) = 10.10	
					Prob > F = 0.0001	
					R-squared = 0.7978	
					Root MSE = .01416	

GGDPPC		Coef.	Robust Std. Err.	t	P> t	[95% Conf. Interval]
GGDPPC	L1	-.0655616	.1643578	-0.40	0.696	-.415882 .2847588
lnIR		-.0804363	.0367388	-2.19	0.045	-.1587432 -.0021294
lnER		.1470995	.0494955	2.97	0.009	.0416023 .2525966
lnDI		.0879795	.0360712	2.44	0.028	.0110957 .1648634
lnFDI		.0182829	.0082669	2.21	0.043	.0006623 .0359034
lnPOP		-1.237556	.3084985	-4.01	0.001	-1.895105 -.5800065
lnSPC		.502118	.2963264	1.69	0.111	-.1294868 1.133723
lnLPA		.3469825	.1225701	2.83	0.013	.0857306 .6082344
lnPCGDP		-.0699046	.0526908	-1.33	0.204	-.1822125 .0424032
lnSECD		.1039372	.0366512	2.84	0.013	.025817 .1820574
_cons		18.94332	4.923052	3.85	0.002	8.450081 29.43655

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