The Shadow Economies in Central and South America with a Specific Focus on Brazil and Columbia: 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 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 2005/06. The most important factors driving the shadow economy are indirect taxation, regulation and the unemployment quota. Considering the size and development of the Brazilian (Columbian) shadow economy, it ranges from 36.4% (38.2%) in the year 1995 to 42.3% (48.4%) in 2004.

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

Keywords: shadow economies of Middle and South American countries, Brazilian and Columbian shadow economies, currency demand method, DYMIMIC-method, taxation, unemployment, regulation.

Contents

1 Introduction

As rather large shadow economic activities are a fact of life around Middle and South America, these countries 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.

The main focus of this study is the estimation of the size and the development of the shadow economies over time in 21 Middle and South American countries and as case studies the shadow economies of Brazil and Columbia. The paper is divided in four parts. After this short introduction, in part 2 some theoretical considerations about the shadow economy 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. In part 3, the econometric results of regression models based on the DYMIMIC procedure for 21 countries are shown. Moreover, part 3 contains two case studies, the size and development of the shadow economies of Brazil and Columbia. Finally, part 4 concludes with a summary of the main findings.

2 Theoretical Background

2.1 Defining the Shadow Economy

Researchers attempting to estimate the size of shadow economy face the problem of defining it. 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

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[1] 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.

that circumvent or other wise 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			
• trade with stolen goods • drug dealing and manufacturing • prostitution • gambling • smuggling • fraud • etc.		• 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*
• unreported income from self-employment • wages, salaries and assets from unreported work related to legal services and goods	• employee discounts, fringe benefits	• barter of legal services and goods	• 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.

My paper uses a more narrow definition of the shadow economy[3]: 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

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[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 activities that are illegal and fit the characteristics of classical crimes like burglary, robbery, drug dealing, etc.[4] 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.[5] 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.[6] Figure 2.1 illustrates the great importance of tax and social security contribution burdens on the size and the development of the shadow economy.[7]

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[4] 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 activities in the calculations of an underground economy. Unfortunately, due to a lack of reliable data in this respect the author needed to refrain from basing his estimations of the size of the shadow economy on this broader definition.

[5] See Enste in Bajada/ Schneider (2005), Schneider (2005, 2006), Alm (1996)

[6] However, even major tax reforms with major tax rate deductions may not lead to a substantial decrease of the 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)).

[7] 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).

Figure. 2.1: Main causes for the increase of shadow economic activities.
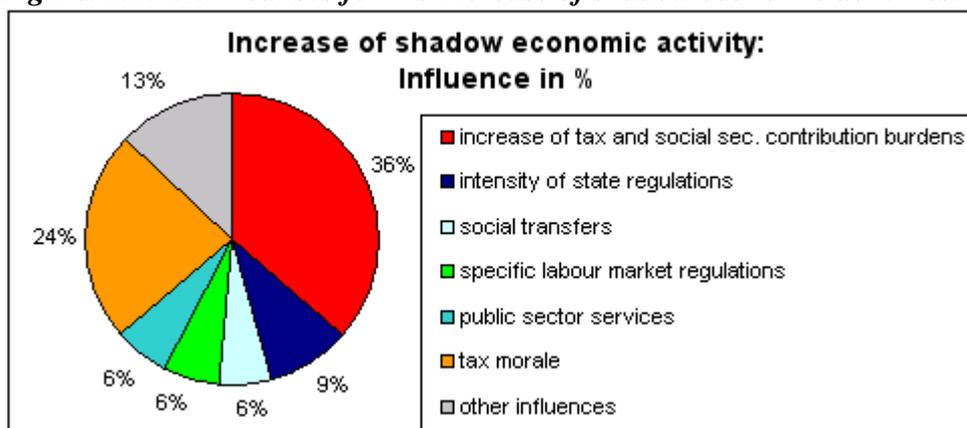
Source: Schneider (2006).

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, fullfilling laws normally causes supplementary cost and may therefore have a negative influence on production possibilities and competitivity 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 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.[8]

2.2.3 Changes in labour market conditions and the employment system

Most regulations on the official labour market, e.g. the introduction of a minimum wage rate or a regulation of the retirement grades have the effect that most people would have more leisure 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

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[8] 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

desired income 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.[9]

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.[10]

2.2.4 Changes in individual values and general attitude towards shadow economic activity

In all 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 everybodies' idea of morality and understanding of justice (Besozzi (2001)). This means that people have no bad feelings 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

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especially the survey of Schneider and Enste (2002).

[9] 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 (Gijsel (1984)).

[10] Schneider/ Enste (2002), Wagner (1984), Enste (2005) and Kirchgässner (2006).

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.[11]

2.3   Theoretical reasoning about the interaction between official and inofficial economies

Obviously there are many interactions between the official (registered) and inofficial (shadow) economies, hence a strict separation of these two parts of the economy is not possible.[12] 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 allocation and biased effects of economic policies. The interactions and their effects originating from these three main sources are summarized in table 2.2.

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[11] Schneider (2000) and Gretschmann (1984).

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

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
tax system	*tax evasion*	Redistribution policies to finance qualitative and quantitative improvement of public goods are impaired, thus economic growth may be negatively affected (Schneider (2005)).
	additional tax revenues	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)). ***Which effect is dominating is open, however, in most developing countries the tax evasion effect dominates!***
Allocations	*stronger competition and stimulation of markets*	more efficient use of scarce ressources (Schneider 2003a)
		incentives for firms and individuals, stimulation of creativity and innovation
		enlargement of market supply through additional goods and services
		cost advantages of producers acting from the shadow economy may lead to ruinous competition for those in the official economy
		problems in information flows for producers and consumers due to reduction in transparency and lack of structure in inofficial sector
policy decisions	*bias in officially published data*	stabilizing, redistributional and fiscal policies may fail desired effects[13]

Various empirical studies (e.g. Schneider (2005 and 2006)) demonstrate the interaction between the official and the shadow economy, but still 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.

Schneider and Hametner (2007) empirically investigate the relative and absolute influence of the shadow economy on the "official" economy of Columbia from 1976 to 2005. This growth equation was econometrically estimated over the period 1977 to 2006 and nearly all coefficients of the explanatory variables (like education, capital stock, FDI, etc.) show the

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[13] 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).

expected sign and most are statistically significant. For the most interesting independent variable, the shadow economy, the regression results shows a 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.

Applying a dynamic simulation of a growth model, 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 from a growth equation provides the concrete influence of the shadow economy on "official" GDP growth for each year in percentage points.

While average values of the growth of real GDP per capita vary between -5.96 and +5.66 % or -46 and +30 USD over tow years, the average values of the relative and absolute influences on growth by shadow economic activity lie between -2.06 and +1.14 percentage points and -11.0 and +6.0 USD respectively, which shows a moderate but still important effect of underground activity on economic growth. To summarize: In Columbia the average growth rate of real GDP per capita between 1977 and 2005 is 1.22 %, and on average 0.33 percentage points of the growth is explained by shadow economic activities.

3   Empirical estimates of the size of the shadow economies

3.1   *Econometric Results for 21 Middle and South American Countries*

In tables 3.1 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 six different points of time 1999/2000, 2001/02 2002/03, 2003/04, 2004/05 and 2005/06. As cause variables I use 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.

The estimation result for the 21 countries in Middle and South America is shown in table 3.1. 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.

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, I use the already available estimations from the currency demand approach for Columbia, Argentina and Peru.[14] 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.[15]

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[14] See e.g. Schneider and Hametner (2007) or Schneider (2007).
[15] This procedure is described in great detail by Dell'Anno and Schneider (2005).

Table 3.1: DYMIMIC Estimations of the size of the shadow economy of 21 Middle and South American countries 1999/00, 2001/02, 2002/03, 2003/04, 2004/05 and 2005/06

Cause Variables	Estimated Coefficients
Share of direct taxation (in % of GDP)	$\lambda 1 = 0.147^{(*)}$ (1.70)
Share of indirect taxation and customs duties (in % of GDP)	$\lambda 2 = 0.274**$ (3.55)
Burden of state regulation (Index, Heritage Foundation: score 1 most economic freedom, 5 least economic freedom)	$\lambda 3 = 0.345**$ (3.47)
Unemployment quota (%)	$\lambda 4 = 0.284**$ (3.41)
GDP per capita (in US-$)	$\lambda 5 = -0.140*$ (-2.27)
Lagged endogenous variable	$\lambda 6 = 0.201$ (1.21)
Indicator Variables	
Employment quota (in % of population 18-64)	$\lambda 7 = -0.523*$ (-2.41)
Annual rate of GDP	$\lambda 8 = -1$ (Residuum)
Change of local currency per capita	$\lambda 9 = 0.417**$ (3.69)
Test-statistics	RMSE[1] $= 0.0060^{(*)}$ (p-value = 0.943) Chi-square[2] $= 9.90$ (p-value = 0.953) TMNCV[3] $= 0.070$ AGFI[4] $= 0.724$ N $= 131$ D.F.[5] $= 36$

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; RMSEA < 0.05; 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 Σ (θ) (model implied covariance matrix). This test has a statistical validity with a large sample (N $\geq$ 100) 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 0.5 (p + q) (p + q + 1) – t; with p = number of indicators; q = number of causes; t = the number for free parameters.

3.2 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 six 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 5)[16]. Due to these shortcomings a detailed discussion of the (relative) ranking of the size of the shadow economies is not done.

In Table 3.2. 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 43.1% of official GDP in 2002/2003 and since then declined to 42.0% of official GDP in 2004/05. This up and down holds for most of the countries, except for Dominican Republic, Haiti, Paraguay and Venezuela, 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 Haiti with 59.6% and Peru with 58.2% of official GDP. The median country is Brazil and Columbia with 40.8% and 41.1% and at the lower end are Chile with 19.4%, Costa Rica with 26.3%, and Argentina with 27.2% of official GDP.

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.

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[16] See also Thomas (1992, 1999), Tanzi (1999), Pedersen (2003) and Ahumada, Alveredo, Cavanese A and P. Cavanese (2004), Janisch and Brümmerhoff (2005), Schneider (2005) and Breusch (2005a, 2005b).

Table 3.2.: The Size and Development of the Shadow Economy in Twenty-One Central and South American Countries over 1999/2000 to 2005/06

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	2005/06
1	Argentina	25.4	27.1	28.9	28.6	27.2	26.1
2	Bolivia	67.1	68.1	68.3	68	67.2	67.1
3	*Brazil*	*39.8*	*40.9*	*42.3*	*41.6*	*40.8*	*39.4*
4	Chile	19.8	20.3	20.9	20.3	19.4	18.5
5	*Colombia*	*39.1*	*41.3*	*43.4*	*42.3*	*41.1*	*39.4*
6	Costa Rica	26.2	27	27.8	27.1	26.3	25
7	Dominican Republic	32.1	33.4	34.1	34.4	34.8	35.2
8	Ecuador	34.4	35.1	36.7	36.1	35.2	34.1
9	El Salvador	46.3	47.1	48.3	48.1	47.2	46.8
10	Guatemala	51.5	51.9	52.4	51.1	50.3	49.1
11	Haiti	55.4	57.1	58.6	59.3	59.6	60.3
12	Honduras	49.6	50.8	51.6	50.8	49.3	48.4
13	Jamaica	36.4	37.8	38.9	39.2	38.4	38
14	Mexico	30.1	31.8	33.2	32.6	31.7	30.3
15	Nicaragua	45.2	46.9	48.2	48.8	48.1	49.3
16	Panama	64.1	62.3	60.7	58.4	56.2	54.24
17	Paraguay	37.4	39.2	41.4	43.5	45.7	47.3
18	Peru	59.9	60.3	60.9	59.1	58.2	57.2
19	Puerto Rico	28.4	29.4	30.7	29	27.4	25.8
20	Uruguay	41.1	41.4	41.9	39.2	38.1	36.9
21	Venezuela, RB	33.6	35.1	36.7	38.1	39.4	41.3
Unweighted Average		**41.1**	**42.1**	**43.1**	**42.6**	**42.0**	**41.4**

Source: Own calculations.

3.3   *Results for Brazil[17]*

3.3.1   Reasons for a Brazilian Shadow Economy

The Brazilian Shadow Economy is quite sizeable due to the following two reasons:

1) Brazil has a high tax burden (direct and indirect taxes as a percentage of GDP); and

2) the Brazilian government excessively regulates the foreign trade and the labor market.

These two elements are analyzed in more detail, beginning with the excessive tax burden that exists in Brazil. The following table 3.3.1 shows the evolution of the tax burden over the last 9 years taken from SRF (Brazilian Internal Revenue Service) data:

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[17] This chapter has been taken from Arvate, Lucinda and Schneider (2005), p. 5-18.

Table 3.3.1: Total tax burden for Brazil in terms of GDP

Year	(% of GDP)
1998	29.74
1999	31.77
2000	32.48
2001	33.84
2002	35.86
2003	34.91
2004	35.96
2005	37.40
2006	36.40

Source: SRF

To demonstrate how the burden from excessive tax and social security contribution makes it more advantageous to work in the shadow economy (SE), a study prepared by McKinsey (2004) is presented, in which they compare the difference between the net income of someone who works formally and informally in the food retail sector in Mexico and Brazil, see figure 3.3.1.

Figure 3.3.1: Comparison between Mexico and Brazil of net income in the formal and informal sectors in the food industry, year 2003.
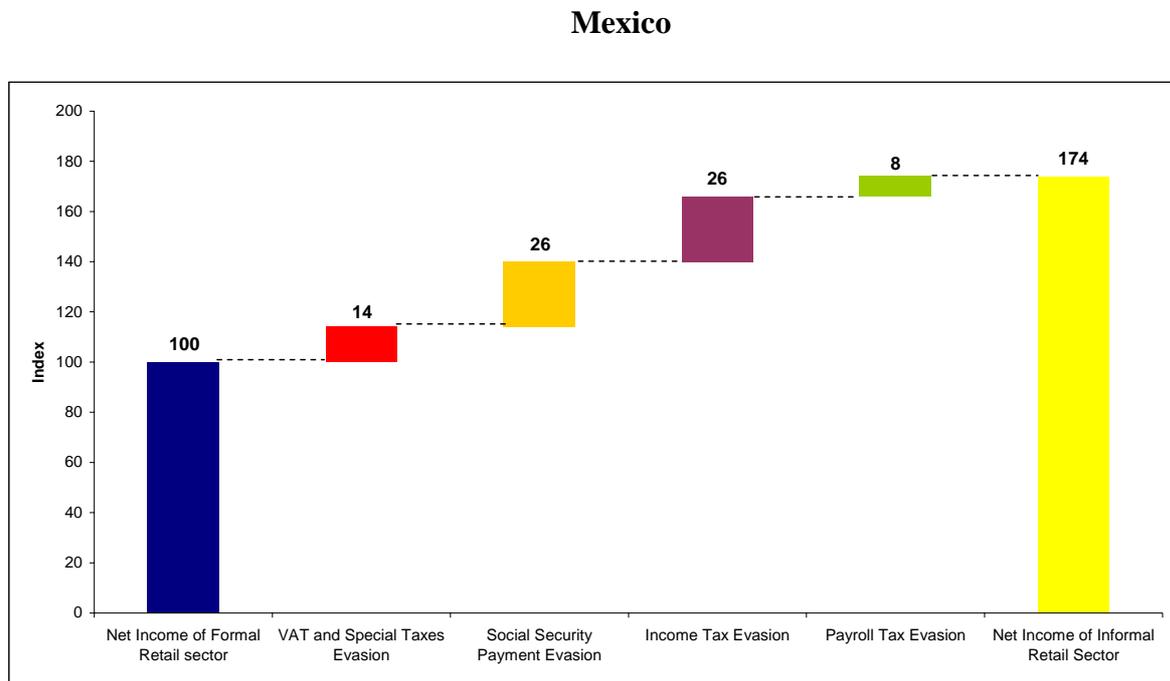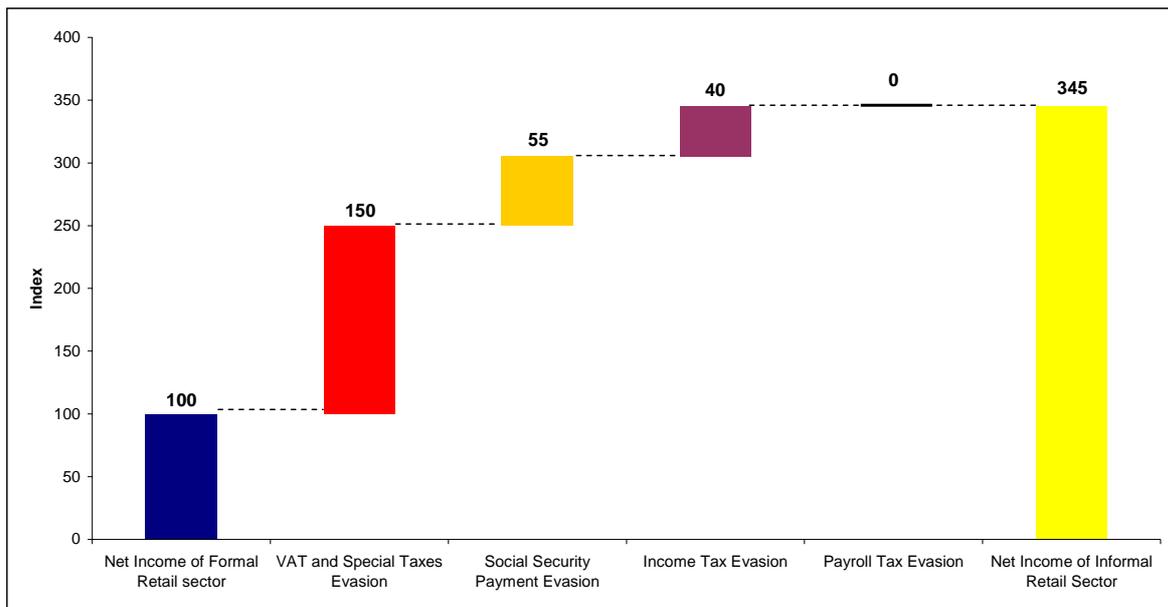
Mexico

Brazil

Source: McKinsey Consulting (2004)

In 2003 in Mexico the difference between net incomes in the formal and informal sector reaches 74% while in Brazil it gets as high as 245%. In Mexico this difference is diluted among the various items presented in the table, while in Brazil it is concentrated in value added tax and special taxes.

The second point refers to excessive government intervention in markets. One of the most important examples of this is the excessive protection from foreign competition enjoyed by some sectors in the economy. Frieden, Ghezzi and Stein (2000) show how an (appreciated) exchange rate, fiscal (taxes) and quantitative instruments (import restrictions on some products) were used throughout this period.

One can also see excessive intervention in the labor market, both as setting the Minimum Wage for the whole country, as well as in the high costs associated with the formal hiring of labor, a consequence of the current legislation for hiring an employee. The following figure 3.3.2 shows Brazil as one of the three countries with the most rigid labor laws in the world:

Figure 3.3.2: Degree of rigidity in labor legislation, 2003.
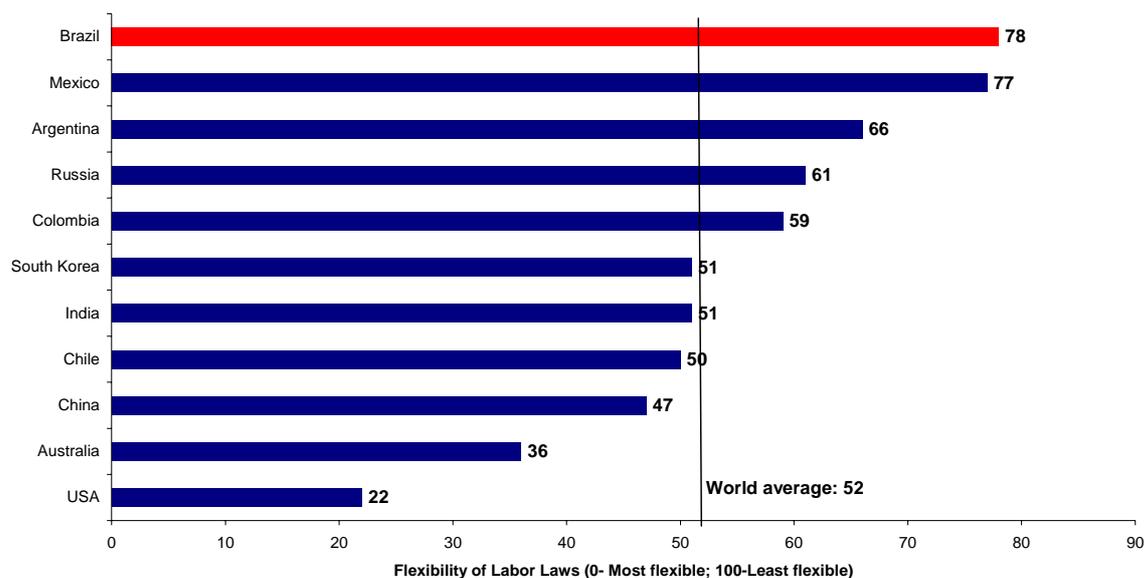
Source: McKinsey Consulting (2004)

In Brazil hiring an employee in accordance with current legislation costs the company twice the remuneration received by the employee. The following table 3.3.4 shows the calculations made by Pastore (2003) of the expenses associated with hiring employees per working hour:

Table 3.3.4: Labor costs per working hour in Brazil

Type of Expense	% of wage
Group A – Social charges	**36.30**
Social security	20.00
FGTS (obligatory redundancy fund)	8.50
Educational salary	2.50
Workers' compensation (average)	2.00
SESI/SESC/SEST (workers' funds)	1.50
SENAI/SENAC/SENAT (workers' funds)	1.00
SEBRAE (support for small enterprises)	0.60
INCRA (agrarian reform)	0.20
Group B – Time not worked I	**38.23**
Weekly rest period	18.91
Vacations	9.45
Vacation bonus	3.64
Public holidays	4.36
Notice period (payment for unjustifiable dismissal)	1.32
Nursing assistance	0.55
	38.23
Group C – Time not worked II	**14.12**
13th salary	10.91
Dismissal expenses	3.21
Group D – Cumulative incidences	**14.81**
Cumulative incidence of Group A/ Group B (there are expenses in Group A that are charged on items in Group B, which is why they are called cumulative)	13.88
Incidence of FGTS on 13th salary	0.93
General total	**103.46**

Source: **Pastore (2003)Table 3.8: Labor costs per working hour in Brazil**

This is one of the main reasons why, according to data published by IBGE (2004), nearly 60% of the Economically Active Population (45 million), works in the informal market, the majority of them self-employed. [18]

3.3.2   The MIMIC estimation of the Brazilian shadow economy

To estimate the shadow economy of Brazil the MIMIC procedure is used, which consists both indicator and casual variables.

(i) Indicator variables:

- **Gross Domestic Product (GDP)** – Dell´Anno (2003) showed that the behavior of GDP will be a good indicator of the SE because either a downtown in the economic official activities lead to a loss of jobs and this drive more individuals into de SE or it represents a life jacket for firms and individuals in financial problems and for that reason, it increases when the GDP decreases, or rather more growth means more opportunity to evade.

- **Number of workers without an Employment Register** (**NTSCT**) - The number of works without an Employment Register is a good indicator of SE because the Brazil is one of the countries with the most rigid labor laws in the world. The McKinsey Consulting (2004) showed that on scale from 0 (most flexible) to 100 (Least flexible), the Brazilian Economy has vale 78. [19] On the other side, in accordance with current legislation, the cost to the company in Brazil of employee is twice the remuneration received by he/she.[20] This is one of the main reasons why, nearly 60% of the Economically Active Population (45 million) works in the informal labor market. The majority of them self-employed.[21]

- **Currency in circulation outside of banks** (**PMPP**) – The currency outside of banks is a good indicator to the size of SE because a part of transactions are undertaken in the form of cash payments, leaving no observable traces for the authorities.

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[18] Without an employment contract between the company and the employee, formally registered in a booklet called the employment register – for this reason, in the PME statistical investigation formal employment is registered as that where the employee has his employment register book signed, and informal employment, where the employment register book is not signed.

[19] The world average is 52. For ex ample, the Argentine has 66 and the USA has 22.

[20] Following Pastore(2003), the labor costs per working in Brazil is around of 103,46%.

(ii) Causal Variables

- **Fee on Financial Transactions (CPMF)** - This variable was chosen because of its possible consequences on the BSE. Just one among many fees in force in Brazil, the CPMF-fee was exclusively created for the purpose of generating funds for the Health sector. More than this, its proponents also discussed its ability to act as a powerful instrument to counter tax evasion because the information generated in collecting it (at each financial transaction, a bank debit fee is levied) might point out an estimate of each taxpayer's actual income (each taxpayer's estimated funds would be compared to his or her annual reported income). Therefore, the CPMF might not only raise funds for the Health sector but also cut back on tax evasion and the size of the SE. More than a normal "tax" payment, the fear of individuals is the level of information that the government will have about them. After the introduction of CPMF, the individuals tried not use the bank system whenever possible. A positive sign of this coefficient will support the hypothesis than an increase in "regulation" gives an incentive to operate in the unofficial economy.

- The index of Exports plus Imports divided by the GDP (**TRADE**) - This shows the degree of openness in the economy. This is not a variable that is normally used in international literature but is here used as an indicator of regulation in the Brazilian economy; a negative sign is expected.

- **Rate of Unemployment (DESEMP)** - The expected effect of this variable on the SE is positive. The unemployment always contributes to the size of the SE by the informal labor market. Dell´Anno (2003), Ribeiro and Bugarin (2003) and Schneider (2007) found the same positive sign for this variable.

- **Gross Revenue (RTRIB)** – In the literature the most popular determinant of tax evasion or of the shadow economy is fiscal (tax) burden. The common hypothesis is that an increase of tax burden creates a strong incentive to work in the shadow economy. This is a variable used in various international papers, among which, work by Giles (1999), Dell'Anno (2003) and Schneider (2004). The expected sign for this variable on SE is positive.

- **The disposable income divide by the civilian labor force employment (DIEP)** – If the taxes increase (decrease), ceteris paribus, the disposable income reduces (increases) and the size of the BSE increases (reduces). With higher taxes, the household will have more incentives to work on informal labor market.

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[21] Data published by IBGE (2004),

(iii) The MIMIC Estimation of Brazilian Shadow Economy

The above mentioned variables were taken using real values (July 1994=100). The period, for which the variables were used, was from August 1994 to December 1999 (quarterly data). For the selection of specifications, the following criteria were used: the Akaike Information Criterion (AIC), the Browne-Cudeck Information Criterion (BCC), the Minimum Value of the Discrepancy Function (C), the Minimum Value of the Discrepancy Function less the Degrees of Freedom (C-df)[22]. The best models in accordance with each one of these criteria are presented in table 3.3.5:

Table 3.3.5: Econometric Results of the Brazilian shadow economy Using Different Specifications of the MIMIC Model, period 1994-1999

Variables	1	2	3	4	5
Indicator					
NTSCT – Workers without employ-ment register	0.198** (0.027)	0.196** (0.027)	0.191** (0.028)	0.187** (0.026)	0.187** (0.027)
PMPP – currency in Circulation outside banks	1	1	1	1	1
D(GDP) – First different of GDP					-0.005 (0.018)
Causal					
CPMF – Regulation Measure: Contri-bution to Financial Movement	0.299** (0.040)	0.244** (0.036)	0.216** (0.036)	0.212** (0.034)	0.213** (0.034)
TRADE . (Export + Import)/GDP	5.947** (0.762)	6.012** (0.767)	5.232** (0.726)	5.529** (0.719)	5.483** (0.717)
DESEMP – Rate of Unemployment		6.046** (1.612)	5.792** (1.639)	5.47** (1.633)	5.474** (1.633)
RTRIB – Total Tax Burden (Tot. Revenues/GDP)			0.326** (0.094)	0.407** (0.097)	0.411** (0.097)
DIEP – Disposable Income per Capita (… labor force)				0.337(*) (0.207)	0.322 (0.207)
Test statistics					
Minimum Value of Discrepancy	348.66	337.42	333.18	331.68	==331.52==

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[22] The models presented above were those which presented the lowest values for each criteria for all specifications.

Function (c)					
C-less the Degrees of Freedom (C-df)	323.66	313.42	310.18	==309.68==	310.52
Akarke Information Criterion (AIC)	386.66	377.42	==375.18==	375.68	377.52
Browne Cudick Information Criterion (BCC)	390.63	381.60	==379.57==	380.29	382.33

Source: Arvate, Lucinda and Schneider (2005).

One can see that from the five models selected, Model 3 is the one that proves to be the most suitable in two of the model selection criteria (AIC and BCC). Furthermore it is very close to those considered the best ones both in C-df, and all independent variables are significant at confidence level to 5%. For these reasons I consider Model 3 to be the most suitable for representing the SE in Brazil.

Observing the effect of the causal variables on the latent variable (**NTSCT – workers without Employment Register**), we can see that the causal variables **CPMF** (regulation of measure: fee on financial transactions; expected effect positive), **DESEMP** (rate of unemployment; expected effect positive) and **RTRIB** (tax burden; expected effect positive) increasing the size of SE. Also the causal, the variable **TRADE** (expected effect negative) has a statistically positive influence on SE, which is clearly the wrong sign.

3.3.3. The Calibration Procedure

As Dell´Anno (2003) mentioned, it is necessary to convert the relative values of the time series of the BSE have to be calibrated to obtain the actual values of underground economy in terms of GDP. As there were no other estimates to Brazilian Economy, it was decided to calculate estimates using an other method: the currency demand approach. We used a Vector Error Correction Model to determine the volume of money in the SE in Brazil as proposed by Bajada (1999). This is done in Arvate, Lucinda and Schneider (2005)[23] and the values are used here to calculate the Brazilian Shadow Economy in % of GDP over 1995 to 2007. They are shown in Table 3.3.6.

Table 3.3.6: Size and Development of the Brazilian Shadow Economy from 1995 to 2007

Year	Brazilian Shadow Economy in % of official GDP from the MIMIC estimates	Panel Estimation of the 21 countries for Brazil
1995	20.71	36.4 [1)]
1996	20.96	-
1997	25.69	-
1998	28.64	-
1999	31.69	-
2000	34.92	39.8 [2)]
2001	37.23	-
2002	39.40	40.9 [3)]
2003	41.34	-
2004	42.60	42.3 [4)]
2005	41.30	40.8 [5)]
2006	40.69	39.4 [6)]
2007	40.23	-

Source: Own calculation based on the MIMIC estimate in Tables 3.2 and 3.4.1 and on Arvate, Lucinda and Schneider (2005)
1) Average from 1994/95; 2) Average from 1999/2000; 3) Average from 2001/02; 4) Average from 2003/04; 5) Average from 2004/05; 6) Average from 2005/06.

Table 3.3.6 clearly shows an increasing trend of the Brazilian shadow economy from 1995 to 2004; the shadow economy rose from 20.7% (of official GDP in 1995) to 42,60% in 2004. Since then one observes a slight reduction to 40.23% in 2007. If one makes a comparison of these figures with ones of the panel estimation, the increase of the panel estimation is much less pronounced; the Brazilian shadow economy ranges "only" from 36.4% (1995) to 42.3% (2004) and decreased to 39.4% (2006).

3.4   Results for Columbia[24]

3.4.1   Estimation method and variables

Another possibility to estimate the size and development of the shadow economy is to use the currency demand approach[25]. I have chosen this approach for Colombia because it is the only method to get a shadow economy series for an extended time period (here 1976 to 2005); in my case for 30 years! I have applied two variants of the currency demand model: The first uses as dependent variable, the currency demand per capita (*CDC*), the second uses as

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[23] See Arvate, Lucinda and Schneider (2005) part 3.4, pages 10-13.

[24] This part is taken from Schneider and Hametner (2007).

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 usual 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*), and

(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.[26]

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

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

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

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

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

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[25] For a detailed description and criticism on the currency-demand method see appendix 7A1.

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:

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

3.4.2. Estimation results

Table 3.4.1 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. 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.[27] For model 2, a standard OLS regression has been run as test statistics here do not indicate time series problems.

Table.3.4.1: Regression results using the currency demand method.

regression results		
	model 1	**model 2**
endogenous variables	**currency demand per capita**	**ratio cash holdings to checkable deposits**
exogenous variables	estim. coefficients	
GDPPC: real GDP per capita	4.8757*	0.0281
IRD: interest rate on bank deposits (yearly average)	-0.4042*	-0.1002*
ICD: cumulative value of cash dispensers	-0.0097	-0.0213
ER yearly average exchange rate COP/USD	0.5982*	0.1121
TY: average net tax rate on income	1.7158	0.873
TC: average net tax rate on consumption	6.8970*	4.1290*
UNEMP: unemployment rate	0.4241*	0.3250*
EPE: real expenditures for public employees (% of real GDP)	-0.2734	-0.0381
LAW: number of new laws issued per year	0.2401	0.0021
constant term	-66.2709*	-1.7031
* significant on 5 % level *all variables in logarithmic form*		

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

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[26] For a detailed description of the variables used see Schneider and Hametner (2007), appendix 8B, Table 8.1.1.
[27] For test results see Appendix B1.

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.[28] 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 itensity of state regulation even enters with the wrong sign. One should consider that the dependent variable 1 of model 2 is a ratio (CID), so that different results may come from a variation of D which has nothing do with the shadow economy.

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 6.90 % and the ratio of cash holdings to checkable deposits by 4.13 %, 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 percent, currency demand per capita increases by 1.72 % and the ratio of cash holdings to checkable deposits increases by 0.87 %. 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.

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[28] In this paper we follow the usual procedure to declare coefficients as "statistically significant", if their

3.4.3 Calculation of the size of the Columbian shadow economy

To calculate the size and development of the Columbian 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 official/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.[29] 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 3.4.1. 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, carried out by the Colombian Central Bank[30] are shown to give a comparison to our estimates based on a narrower definition of the shadow economy.

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statistical significance is given on a 5 % or better significance level.

[29] For a detailed discussion on possible corrections with respect to the restrictions mentioned see Ahumada, Alvaredo, Canavese (2007)

[30] 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

Figure 3.4.1: Simulations of the estimated size of the shadow economy in % of nominal GDP for Colombia, 1977-2005.
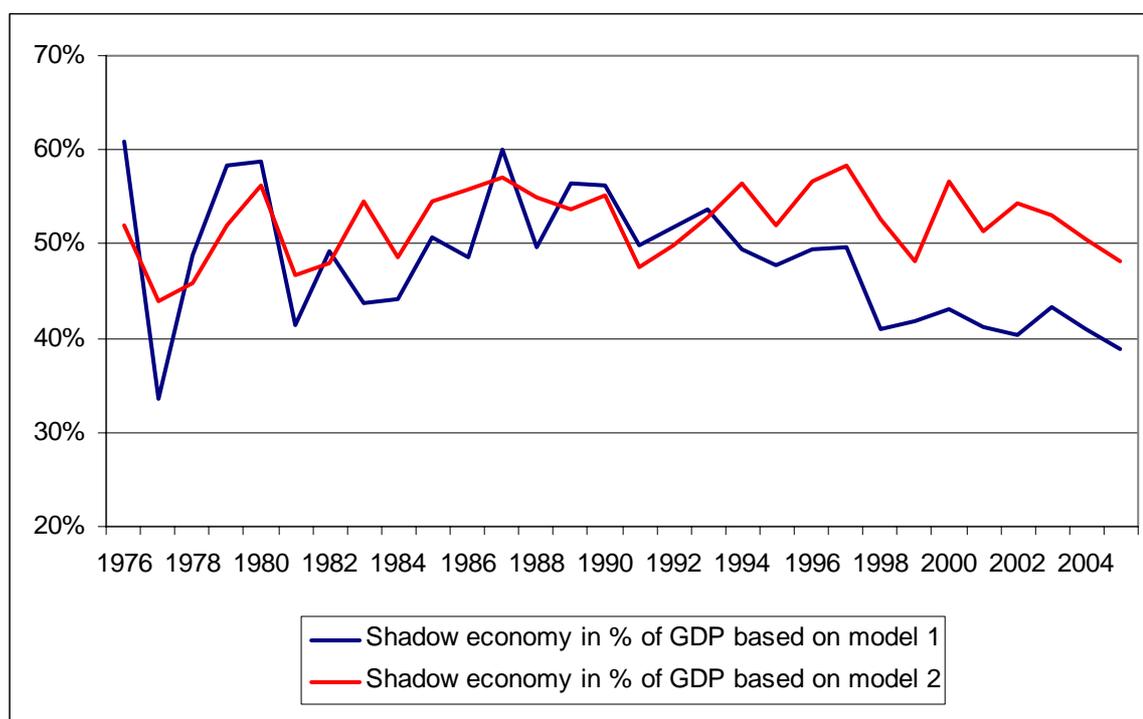
Source: Model 1 is based on the regression results of model 1, using currency demand per capita as endogenous variable whereas model 2 uses the results of the second regression based on the ratio of cash holdings to checkable deposits as endogenous variable. The figures based on the MIMIC estimation 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 up to 2005.

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 trafficants in cartels and the

method by Schneider (2002) giving a size of the Colombian shadow economy of 39 % of GDP for 1999/2000.

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 substitiution followed until then in combination with a new constitution, two events that certainly caused some incertainty 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 Columbian shadow economy coming from the DYMIMIC results in part 4.1 of this paper are quite similar with a range between 39 and 42% of official GDP for the 90s compared with the results using the currency demand approach.

4.   Summary and conclusion

Applying the DYMIMIC procedure for 21 Middle and South American countries and the currency demand approach for Columbia, the **first major finding** of my paper is the large size of the shadow economy in Brazil and in Colombia and in other South American countries (except Chile). The shadow economy in Brazil steadily increased from 20.7% in 1995 to 42.6% in 2004 and since then decreased to 40.2% in 2007. The size of the shadow economy in Brazil (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.

Considering the two findings, I draw the **following conclusion**:

Even if the econometric estimates provide a preliminary 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. The government in Brazil and Colombia should be aware about these lost potentials by not using these underground productivities and hence should implement various programs to integrate the shadow economy in the official economy. It may be more reasonable to follow this strategy in order to benefit more from the shadow economic potentials.[31]

5.   Appendix A: Methods to estimate the size of the shadow economy

5.1.   *Appendix A1: 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 several 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.

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

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.[32] 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, …, k) the size of the shadow economy X_t, in time t and the indicators Y_{jt} (j = 1, 2, …, p) is shown in Figure 5.1.

Figure 5.1: Development of the shadow economy over time.
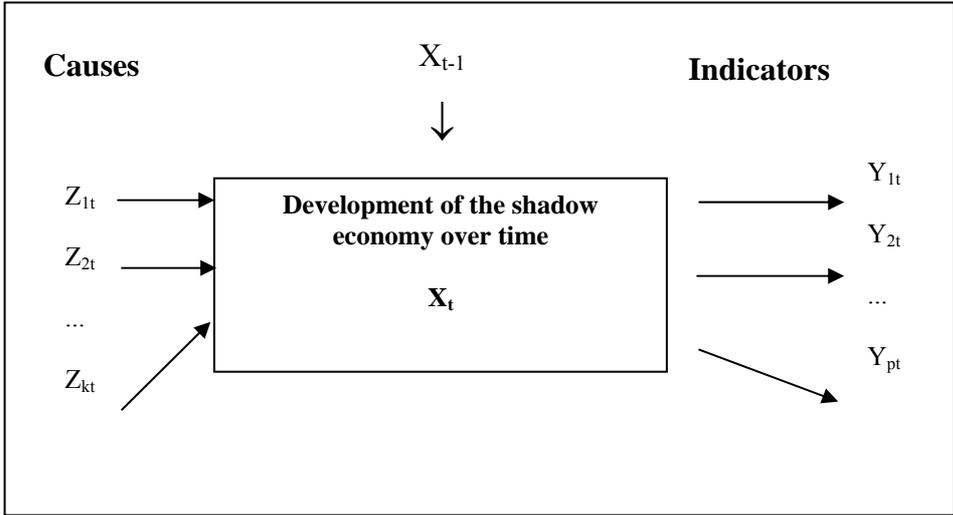
There is a large body of literature[33] on the possible causes and indicators of the shadow economy, in which the following three types of causes are distinguished:

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[32] 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).

[33] Thomas (1992); Schneider (1994a, 1997, 2003, 2005); Pozo (1996); Johnson, Kaufmann and Zoido-Lobatón (1998a, 1998b); Giles (1997a, 1997b, 1999a, 1999b, 1999c); Giles and Tedds (2002), Giles, Tedds and Werkneh

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.[34]

Indicators

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

(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.

An intensive 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

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(2002), Del'Anno (2003) and Del'Anno and Schneider (2004).

[34] 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.

proper attention to the non-stationary, and possible co-integration of time serious 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.

5.2.   *Appendix A2: 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.[35] 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[36] but has nevertheless been criticized on various grounds.[37] 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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[35] 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.

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

[37] 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.[38] (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.[39] Frey and Pommerehne (1984) and Thomas (1986, 1992, 1999) claim that Tanzi's parameter estimates are not very stable.[40] (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.[41] (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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[38] 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).

[39] 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.

[40] 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).

[41] Ahumada, Alvaredo, Canavese (2007)

6. Appendix B Detailed regression results using the currency demand method

Table 6.1.1: <u>Model 1; endogenous variable – currency demand per capita (ln)</u>

```
ARIMA regression
Sample:  1976 to 2002                      Number of obs     =         27
                                           Wald chi2(10)     =   57138.53
Log pseudo-likelihood =  30.48775          Prob > chi2       =     0.0000
------------------------------------------------------------------------------
             |              Semi-robust
lnCDC        |    Coef.     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
ln1TY        |   2.734005   .9596801     2.85   0.004    .8530665    4.614943
ln1TC        |    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
------------------------------------------------------------------------------
```

<u>Misspecification and Diagnostic Testing</u>

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 6.1.2: *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

------------------------------------------------------------------------
             |             Robust
         CD  |    Coef.   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

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