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APPLICATION OF MONETARY MODELS FOR ESTIMATING UNDERGROUND ECONOMY IN ROMANIA

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Abstract: Article addresses the issue of sizing the underground economy by recognized methods in the literature based on empirical data provided by official statistics in Romania. The monetary method to assess non-accounted economy dynamics studies to date has defined two types of measurements in terms of velocity of money. The first is the accountability one, used in banking statistics, calculated by reporting GDP to the money supply from the M2 point of view, and the second was called operational, considered to be the real one, meaning the equivalence between the volume of transactions and the GDP (including commercial credit) which comes for the monetary unit. The relationship between the two methods was achieved by means of a β coefficient, which measures the monetary distortion induced by arrears and the disturbing form of "dollarization" of the economy. Also to be noted that there are not yet adequate information and a suitable algorithm to reasonably approximate the output size of unreported taxable income, of household production for own consumption and of illegal economic activities. Therefore, we must resort to partial estimates, and their use must be considered with care all the conceptual and statistical assumptions on which they rely.

KEYWORDS: underground economy, monetary rate method, simple cash demand method, method of transaction

JEL CLASSIFICATION: D63, H26, E26.

A number of recent studies revealed that there is a close link between the prevalence of cash payments and size of underground economy in a country.

In Romania, the low level of intermediation of payments, but also small number of electronic payments per capita are elements that suggest the prevalence of intermediate cash trade, which can be a sign of expansion transactions unreported, unrecorded and untaxed, respectively dynamism underground sector (hidden).

Based on the assumptions that unreported income produced by a monetary unit traded in the underground sector reported income equals income produced by a

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monetary unit traded in the formal sector, that cash is the only medium of exchange in transactions not reported and that the rate of monetary deposits, respectively at sight, is subject to changes only because of unreported income growth based on simple monetary rate method proposed by Cagan (1958) and Gutmann (1977), we estimated the underground economy in Romania.

Deposit rate in the formal sector was assumed to be constant in size over time, maintaining the base year level. We took that approach in initiating base year 1940, the proposed year by the initiator of the method. We found that the association is relevant because at that time, prior to the introduction of taxes on income, the development of unrecorded transactions and therefore do not make sense at the time the underground economy, unreported, there

Therefore, in calculations we used a rate of deposits / cash demand qual

$$k_o = \left(\frac{C_o}{D_o}\right)_{1940} = \left(\frac{C}{D}\right)_{1940} = 0{,}217\ ^{74}.$$

The results reported in monetary aggregate M1, are summarized in Table 1

Estimating the underground economy in Romania based on simple monetary rate method

Table1.

- milion lei comparabile price, 1990 = 100 -

Year	GDP	Cash in circulation	At sight liquid assets	Estimated non-registered income	The balance between non-registered income and the GDP (%)
1990	85.79	9.2	15.7	26.011	30.32
1991	74.7	0.176	0.52	7.45536	9.98
1992	68.136225	13.9275	20.9081667	25.1453	36.90
1993	69.143793	11.8491	13.3514063	38.0932	55.09
1994	71.843021	7.59021	8.04906806	42.8574	59.65
1995	76.946896	5.42549	4.79492287	57.8213	75.14
1996	79.968545	5.74087	6.17599667	46.8211	58.55
1997	75.106309	6.75267	6.99562213	46.179	61.48
1998	71.48081	3.422	3.14289788	51.2057	71.64
1999	70.645061	3.32137	2.35107847	69.4088	98.25

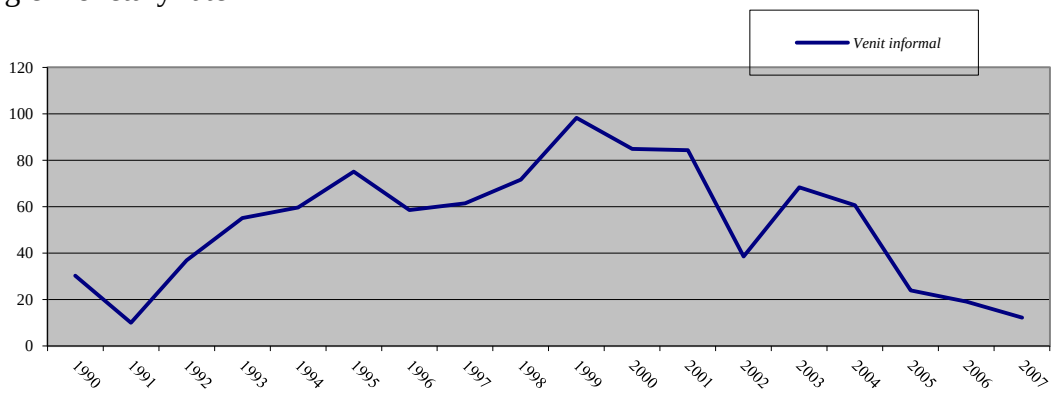
[74] Is the rate used by Gutmann (1977), resulting from estimates made by him for the period 1937 to 1941 in the United States of America. Value was taken by Richard Porter & Amanda Bayer - Monetary Perspective on Underground Economic Activity in the United States, in The Underground Economies. Tax Evasion and Information Distortion, Edgar L. Feige edited by, Cambridge University Press, 1989, pag. 132.

Year	GDP	Cash in circulation	At sight liquid assets	Estimated non-registered income	The balance between non-registered income and the GDP (%)
2000	72.160487	3.33219	2.66515646	61.267	84.90
2001	76.8268	3.19898	2.5739217	64.7594	84.29
2002	81.504138	2.9974	4.3632749	31.4739	38.62
2003	85.744136	3.10748	2.96298006	58.6025	68.35
2004	93.031153	3.24217	3.39805895	56.3481	60.57
2005	96.887076	4.28154	8.41401182	23.2352	23.98
2006	104.47313	5.07104	11.2601079	20.0322	19.17
2007	110.96719	6.49769	17.7195022	13.6495	12.30

Source: National Statistics Institute and own calculations.

For the period under review the average income unregistered (underground economy) accounted for 52.72% of official GDP.

Figure 1 - Evolution of unregistered income in Romania, according to the method single monetary rate



There is a very sinuous evolution in time of informal income, but this does not seem relevant. Therefore, I think the model is not suitable to be applied to the Romanian economy, being one of the main reasons and using market exchange transactions, mainly after 1990.

Because the results are significant, we proceeded to use a modified version simple monetary rate. We accepted the hypothesis that cash transactions is predominantly informal in nature and velocity of money is the same in both sectors, official and underground. However, we calculated the monetary velocity by dividing income officially registered in M2. We also considered as the currency in circulation as statistically reported as cash outside banks, savings and population are not stored as bank deposits. The category includes both deposits were term deposits in lei and demand and foreign currency deposits of residents.

We also found that for Romania in the context of statistical information available, it is impossible to be determined a base year in which income was not unregistered products, such as informal. However, the results following the application of this method are significantly influenced the choice of base year. Therefore, we considered 1990 as baseline year, but I attributed this level of shadow economy represents 5% of official GDP. Based on this assumption we calculated a rate of deposits in the formal sector (ko) I used it in calculations for other years and we expressed all data used in comparable prices in the year 1990.

The results are collated in Table 2. Summary data are presented in Figure 2.

Estimating the underground economy in Romania based on a modified version of the simple monetary rate method

- million comparable prices, 1990 = 100 -

Table 2.

Year	GDP	Currency in circulation	Deposits	Revenue estimated unregistered	Share of unregistered income in GDP (%)
1990	85.79	34.1	17.2	4.29999	5.01
1991	74.7	43.8	59.5	29.038	38.87
1992	68.136225	27.7872	35.106743	25.1581	36.92
1993	69.143793	19.1461	31.367898	29.9398	43.30
1994	71.843021	17.0055	19.734535	24.7509	34.45
1995	76.946896	12.8365	13.537757	24.1662	31.41
1996	79.968545	15.1344	17.217284	27.0628	33.84
1997	75.106309	21.5542	24.063002	24.9753	33.25
1998	71.48081	12.6167	14.857281	24.9412	34.89
1999	70.645061	10.8233	14.819805	27.6061	39.08
2000	72.160487	9.09886	14.856348	31.1931	43.23
2001	76.8268	8.91775	15.365611	34.0781	44.36
2002	81.504138	8.84344	15.733493	36.6778	45.00
2003	85.744136	8.44499	16.2496	39.8651	46.49
2004	93.031153	9.15615	18.842147	44.359	47.68
2005	96.887076	4.28154	28.145495	57.585	59.44
2006	104.47313	5.07104	31.945043	61.8503	59.20
2007	110.96719	6.49769	38.3654	65.2799	58.83

Source: National Statistics Institute and own calculations

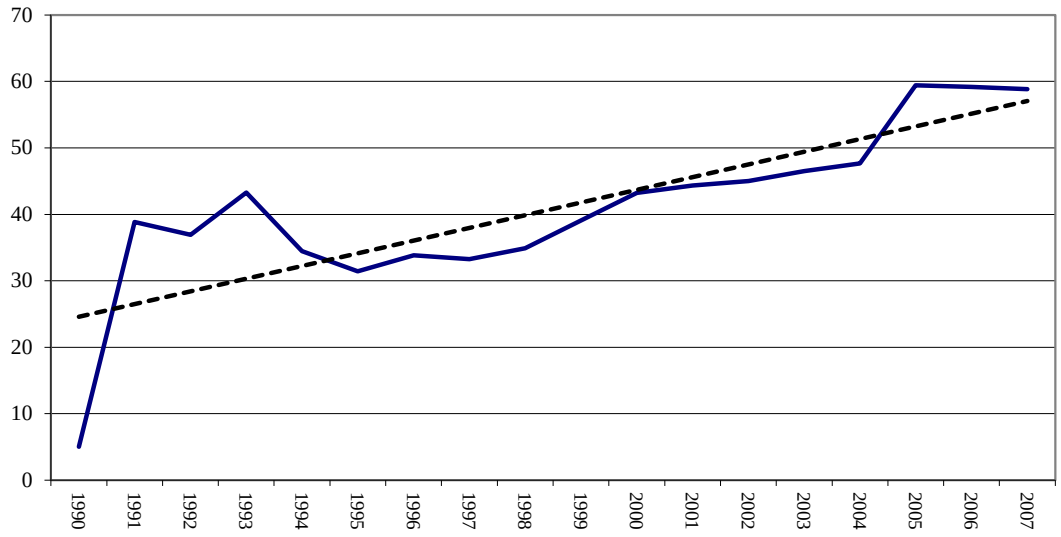
As can be seen in Figure 2, the development trend informal income to GDP is raising official. However, it should be kept in mind that the deposit rate in the formal sector, i.e. the ratio of cash in circulation and bank deposits, may undergo changes

due to an accumulation of reasons. Underground economy is not the only reason and far most important. I think more important is the development of means of payment in the form of checks, cards and transfers, electronic payments and the emergence of new types of savings. Therefore, this method is most effective in estimating the underground economy in Romania.

An alternative method of simple monetary rate, cash demand method (Tanzi, 1983) is used also to estimate the size of informal activities. Unlike the original model, it includes the effects exerted by tax on cash in circulation. Also, the regression equation proposed variable proportion among wages and salary gains in national income, the average interest rate on savings deposits, and income per capita.

Any excess of cash, which cannot be explained by conventional factors outlined above, is attributed to increasing taxation and other factors that determine the orientation of individuals towards the ground.

Figure 2 - Share of unregistered income in GDP, according to the modified version of the simple monetary rate method



The model includes the assumption that it is possible to increase the share of demand for cash in M2 even if real per capita income and lower interest rates for deposits. Also, the share of wages in national income positively affects the above report and reflect changes in the methods of payment used by the population, but directly proportional to the tax. Where there is an increase in taxation, monetary benefits arising from involvement in the economy grow, generating an upward trend in demand for informal transactions necessary cash[75].

[75] Porter Richard & Bayer Amanda – Monetary Perspective on Underground Economic Activity in the United States, in The Underground Economies. Tax Evasion and Information Distortion, edited by Edgar L. Feige, Cambridge University Press, 1989, pag. 133

Cash and cash demand associated with the underground economy is calculated as the difference between size, determined following the application of model based on historical data to forecast the dependent variables and size in the context of lack of taxation. Since the velocity of money is supposed to be the same in the official economy, and in the underground, underground GDP will be the balance obtained by multiplying the underground currency monetary velocity. Based on these considerations, we applied the model using annual data available specific to our country for the period 1998 - 2007.

For the estimation of cash in circulation in the general context of taxation, at an appropriate rate of tax burden, the regression equation was used

$$\ln C/M2 = -138870 + 6{,}3470 \ln(1+t) - 0{,}1331 \ln(S/VN) - 0{,}3929 \ln(R) + 1{,}2909 \ln(VN/P) + u, \quad (1.)$$

$R^2 = 0{,}889$; DW = 1,06.

And in the context of zero taxes

$$\ln C/M2 = -9.7972 + 0{,}0268 \ln(S/VN) + 0{,}5747 \ln(R) + 0{,}9679 \ln(VN/P) + u, \quad (2.)$$

$R^2 = 0{,}882$; DW = 1,04.

where:

t - rate of tax burden;

S / VN - the share of wages in national income;

R - the average annual interest rates on deposits;

VN / P - national income per capita.

Sizes of these indicators were expressed in comparable prices in the year 1998 (1998 = 100).

Table 3 summarizes the main data used in calculations on the estimated size of hidden activities (underground) in Romania in the period, cash on demand method described above.

Estimating the underground economy in Romania using cash demand model **(Tanzi, 1983)**

Table 3.

- million comparable prices, 1998 = 100 –

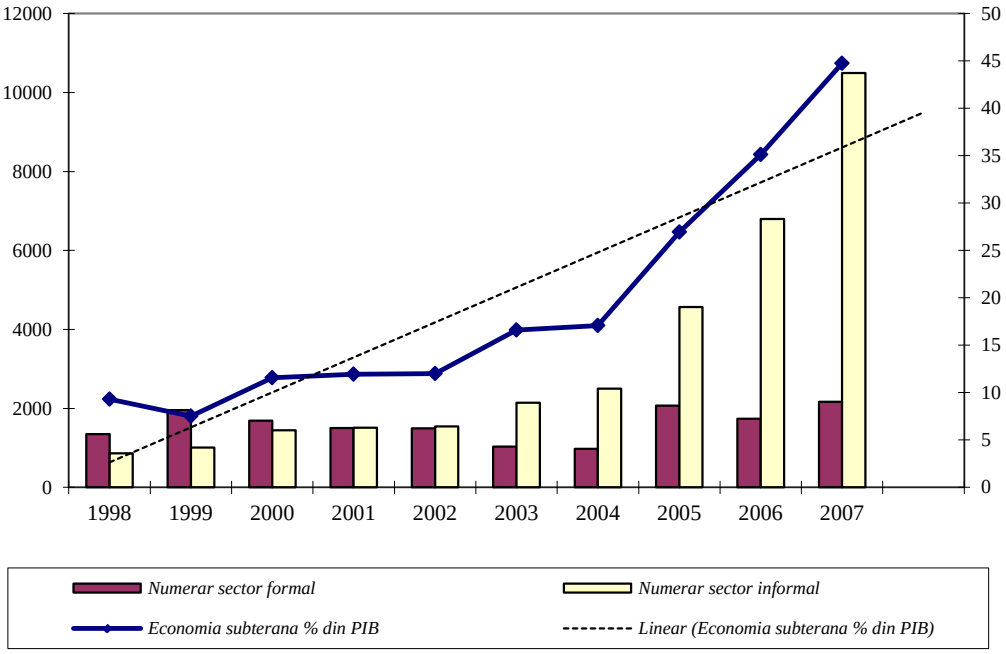
Year	Cash Demand in the underground	Official GDP	M2	Speed movement money	GDP hidden (underground)	Undergound economy (% from official GDP)
1998	862.013741	24074.10	9253	2.6	2242.75	9.32
1999	1006.34088	36949.95	13412.3	2.8	2772.39	7.50
2000	1448.74382	37742.57	18506	3.0	4364.06	11.56
2001	1515.73199	40183.23	27051.2	3.2	4795.41	11.93
2002	1542.68525	42629.64	37371.3	3.3	5115.98	12.00
2003	2144.19555	44847.32	46074.1	3.5	7445.03	16.60

Year	Cash Demand in the underground	Official GDP	M2	Speed movement money	GDP hidden (underground)	Undergound economy (% from official GDP)
2004	2499.76245	48658.69	64461.7	3.3	8306.06	17.07
2005	4571.35623	50675.48	86230.3	3.0	13658.50	26.95
2006	6801.09403	54643.27	110442.3	2.8	19195.21	35.13
2007	10498.7415	58039.90	148043.6	2.5	25968.23	44.74

Source: National Statistics Institute and own calculations

Not allow us to compare data with those obtained by applying other methods, the conclusion can be drawn is that Romania economy is part of a trend of upward evolution, the average period being analyzed 19.28%.
However, we cannot be convinced that the velocity of money is the same in both sectors, but no increase in deposits is that a consequence of the underground sector development. Moreover, informal transactions do not think that mediation is made compulsory cash

Figure 3 - Demand for cash and evolution of the underground economy in Romania



An alternative method based on so-called monetary transactions method (Feige, 1979, 1980), who estimated informal activity to a change in monetary transactions to GDP ratio, focusing on cash flow managed through monetary aggregates. The method assumes that the total value of transactions in an economy is

directly proportional to the total economic activity (the sum of official and underground activities). Economic income is the sum total of official income (a view that is represented by GDP) and income or unregistered underground.

Although we think the major changes occurring in the relationship between the volume of transactions (or payments) in an economy and total economic income can be explained without reference to factors associated with the underground economy, we performed a simulation of the evolution of the underground economy based on this method.

Adopting specific method that is the sum of three components transactions - transactions associated with the production of final output, real or financial transactions and securities transactions generated by the direct financial transfers (or direct payments) - Net transactions to determine the size of Romania have defined following financial categories:

A - Cash in circulation outside the banking sector;
B - bank deposits (demand and time deposits, savings of the population etc.).
C - Amount of cash in transit upon request;
D - Amounts in transit at the request of bank deposits;
E - The total amounts of trading shares and negotiable securities;
F - oriented capital flows outside the country, expressed through the balance of foreign trade;
G - government payments expressed through budget transfers from the state budget and public sector personnel costs (staff salaries budget);
H - The amount of insurance contributions and taxes on wages or personal income;
I - Net volume of transactions.

Net transaction amount (I) resulting from adding categories A, B and G and reducing the value obtained with the corresponding amounts categories C, D, E, F and H. In Table 4 are presented data were the basis for determining the level of net transactions in Romania during 1990-2007, expressed in comparable prices to 1990 levels

The estimated level of net transactions in Romania between 1990 – 2007

Table 4

- million comparable prices, 1990 = 100 -

	A	**B**	**C**	**D**	**E**	**F**	**G**	**H**	**I**
1990	9.2000	42.0000	0.0000	0.2800	1.8500	-10.0000	12.5000	15.0000	56.5700
1991	17.6000	85.5000	1.0000	23.5100	4.6400	-12.2300	14.9000	17.2200	83.8600
1992	13.9275	48.9529	0.0068	5.2491	4.8933	-20.5862	16.7740	15.5100	74.5815
1993	11.8491	38.6716	0.0147	1.7768	3.5638	-14.8131	13.0351	14.9655	58.0481
1994	7.5902	29.1426	0.0662	0.6662	1.7968	-5.6795	10.2475	11.1114	39.0192
1995	5.4255	20.9443	0.0594	0.4275	0.9551	-7.1563	6.9172	6.6133	32.3879
1996	5.7409	26.5909	0.0509	0.6048	1.0798	-11.4307	8.3060	7.0988	43.2341
1997	6.7527	38.8648	0.0049	0.0756	1.1487	-15.4554	12.8017	10.2359	62.4095
1998	3.4220	24.0520	0.0559	0.0415	1.5220	-9.4927	7.1024	4.5126	37.9370
1999	3.3214	22.3217	0.0251	0.0444	1.8308	-6.1838	5.0885	1.9802	33.0349

	A	B	C	D	E	F	G	H	I
2000	3.3322	20.6232	0.0243	0.0639	1.6983	-7.8781	4.1924	3.4198	30.8194
2001	3.1990	21.0845	0.0486	0.0790	2.3336	-10.9454	3.6454	3.8644	32.5487
2002	2.9974	21.5795	0.0007	0.0433	2.1385	-8.6868	3.1981	3.1121	31.1672
2003	3.1075	21.5871	0.0016	0.0589	2.0265	-11.3680	3.4325	2.9592	34.4491
2004	3.2422	24.7561	0.0029	0.0221	2.1827	-12.8838	3.7549	3.1442	39.2851
2005	4.2815	28.1837	0.0009	0.0381	2.8278	-14.0203	3.1149	2.5828	44.1510
2006	5.0710	32.3703	0.0003	0.0994	3.1808	-17.6346	3.4352	0.8495	54.3810
2007	6.4977	44.3066	0.0003	0.0152	4.2660	-22.0431	4.0092	0.9653	71.6099

Source: National Statistics Institute and own calculations

According to theory, income is determined based underground proportionality between the volume of net transactions and total income generated in the economy. Series of transactions with net income calculation follows a route similar underground applied to currency demand method. It's about choosing a period / year is assumed that there was no activity hidden / underground. In the simulation we realized we considered 1990 underground activities characterized as null. The choice does not have a scientific reason, but is purely coincidental.
The volume of "ideal" official transactions in each year of the analysis is obtained by multiplying the ratio of volume of transactions and total income of the year considered to be free from hidden income (year 1990, the ratio is 0.659401) officially registered with the income each year. The difference between the "ideal" of transactions and actual transactions is the ground (Table 5).

Unregistered income generated by underground transactions in Romania during 1990 – 2007

Table 5

- million comparable prices, 1990 = 100

	Neat transactions	Transactions in "ideal" conditions	Official income (GDP)	Underground income	Total estimated income	Under ground income (% of GDP)
	(1)	(2)	(3)	(4=2-1)	(5=3+4)	
1990	56.57	56.57	85.79	0	85.79	0.00
1991	83.86	127.17	74.70	43.31	118.01	57.99
1992	74.58	113.10	68.13	38.52	106.65	56.54
1993	58.04	88.03	69.14	29.93	99.12	43.36
1994	39.01	59.17	71.84	20.15	91.99	28.05
1995	32.38	49.11	76.94	16.72	93.67	21.74
1996	43.23	65.56	79.96	22.33	102.30	27.93
1997	62.40	94.64	75.10	32.23	107.34	42.92
1998	37.93	57.53	71.48	19.56	91.07	27.41

	Neat transactions	Transactions in "ideal" conditions	Official income (GDP)	Underground income	Total estimated income	Under ground income (% of GDP)
	(1)	(2)	(3)	(4=2-1)	(5=3+4)	
1999	33.03	50.09	70.64	17.06	87.70	24.15
2000	30.81	46.73	72.16	15.91	88.08	22.06
2001	32.54	49.36	76.82	16.81	93.64	21.88
2002	31.16	47.26	81.50	16.09	97.60	19.75
2003	34.44	52.24	85.74	17.79	103.54	20.75
2004	39.28	59.57	93.03	20.29	113.32	21.81
2005	44.15	66.95	96.88	22.80	119.69	23.54
2006	54.38	82.47	104.47	28.08	132.56	26.89
2007	71.61	108.59	110.96	36.98	147.95	33.33

Source: National Statistics Institute and own calculations

According to estimates, the average underground income as a percentage of GDP is 28.9% official. Obviously, the figures may differ depending on the year considered to be devoid of such transactions underground. Also, an econometric evaluation of the method is very difficult transactions because not yet have a solid theory on the total volume of transactions in an economy.

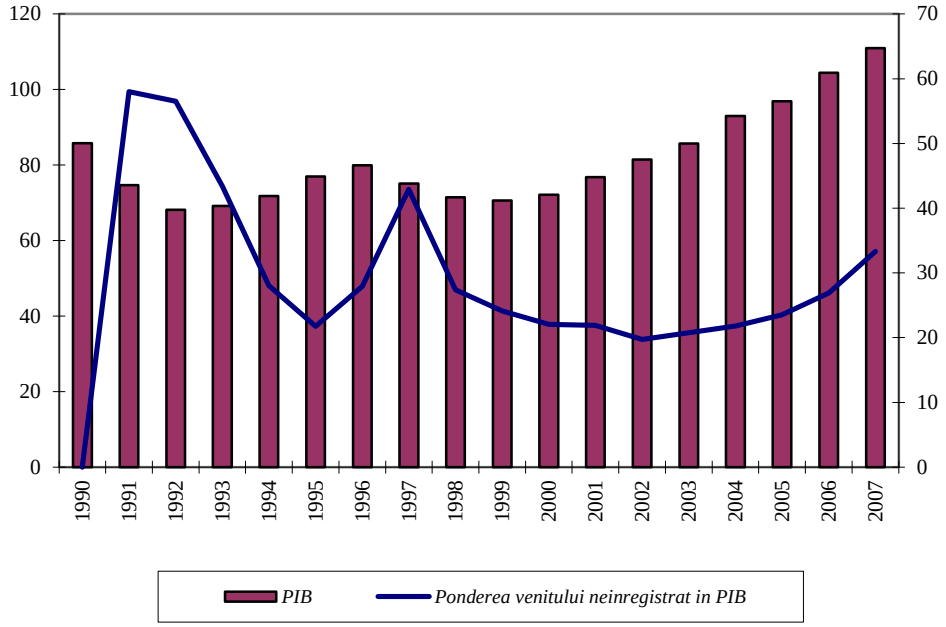
However, compared to other methods of monetary origin, the method has several advantages transactions, at least theoretically. It is, first, that does not involve any assumption on monetary velocity in the formal sector or in the underground. Also, do not use the assumption that cash is the medium of exchange used exclusively in informal transactions and bank deposits are placed in similar cash.

On the other hand, the method requires the establishment of year there is no unrecorded revenue and similar other method, its choice is crucial in terms of relevance of the results of estimates.

In practice, the biggest problem in implementing the transaction method is the limitation of available data. To estimate the required data series based on existing statistical data we proceeded to their adjustment and the inclusion of several approximations in the calculations. We also eliminated a number of additional transactions.

In conclusion, estimation of underground economy in Romania based on their methods of monetary statistics, although in different numbers and weights, suggests a relatively upward trend of underground activities in Romania.

Figure 4 - Total estimated revenue and unrecorded revenue share in GDP (1990-2007)



Estimates made on the basis of simple monetary rate method and the method depend on the overwhelming demand for cash by the ratio of cash outside the banking system to GDP, and the share of cash and bank deposits in the monetary aggregate M1 or M2. Cash and bank deposits are used in the same proportion in the underground. Also, the ratio of unregistered income and GDP is influenced by the official estimates of income. Transactions method, although avoid this, do not provide reliable estimates for Romania not only for the situation our country is unique (not taken into account so-called dollarization), but also because a number of methodological difficulties involved in separating financial transactions pure from other transactions. It also notes that increased transactions that increase their development is mainly due to bank deposits, not cash.

Figure 4 shows an estimate of the evolution of unregistered income share in GDP for the period 1990 to 2007. This development must however be seen as an attempt to commensurate unregistered income, because it is based on solid theory of total transactions in the economy, and the simulation results we have achieved a simple predictions are.

Conclusions

Application methods for estimating monetary economy in Romania shows the low level of intermediation of payments, but also a small number of electronic payments per capita, elements that facilitate the trade intermediated by cash, which can be a sign of unreported, unregistered and untaxed transactions expansion, and of the underground sector dynamism respectively (hidden).

Based on the assumptions that unreported income produced by a monetary unit traded in the underground sector reported income is equal with the income produced by a monetary unit traded in the formal sector, that cash is the only medium of exchange in transactions not reported and that the rate of monetary deposits, respectively at sight, is subject to changes only because of unreported income growth based on simple monetary rate method we obtained an estimate of the average level of income unregistered (underground economy) in Romania from 1990 to 2007 amounting to the average of 52,72% of official GDP.

The evolution of income sinuous underground NII not thought relevant to characterize real progress, the model is not suitable to be applied to the Romanian economy, being one of the main reasons and using market exchange transactions, mainly after 1990. Because we considered the results as having real significance, we used a modified version of the above model, by adapting to the realities of our country. We thought that, for Romania in the context of statistical information available, it is impossible to be determined a base year in which income was not unregistered products, such as informal. However, the results following the application of this method are significantly influenced the choice of base year

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