

EERC PROJECT 97-1091.

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**MACROECONOMIC AGGREGATE MODEL
FOR RESEARCHING ARREARS AND STABILIZATION OF THE
RUSSIAN ECONOMY"**

(Final report)

MOSCOW 1999

1. ABSTRACT

On the basis of analysis of vast statistical information that was assembled by author it is shown that arrears reflect the system changes that have place in the Russian economy in transition, in particular, changing regime of the system of financial circulation. The results of the analysis are used for specification and estimation of parameters of a system of econometric models that includes two models of money demand and arrears. The main feature of the model of money demand is the inclusion of arrears as one of the factors. On the basis of these econometric models the new rather simple macroeconomic aggregate model, described by the system of linear equations, is developed. It helps to assess the main relations between main economic factors and provides better understanding the influence of arrears on the GDP in the short and long-run.

In the Appendices the shortened economic analysis of stages of the transition period and estimates of main statistical indicators are given.

2. GENERAL DESCRIPTION OF THE RESEARCH PROJECT

2.1. Statement of the research problem

One of the most interesting and the most urgent problems due to necessity of investigation of stabilization processes is the problem of arrears that reflects the system changes in the Russian economy. It is obvious that in the long run the arrears lead to decrease of efficiency of the economy. However in the short run their influence is not so definite because they can help to saving production potential of enterprises under some conditions.

The investigation of the literature shows that the analysis of main factors influencing proliferation of arrears and barter on both macro- and micro-level is necessary. It is appropriate to assess the influence of some of these factors with the help of econometrical models for money demand and arrears. The urgent problem is to construct an aggregate macroeconomic model to receive analytical relationships for investigation of the influence of arrears on the GDP and elaboration of recommendations for stabilization of the Russian economy.

The project contains three main chapters:

characteristics of arrears and barter, analysis of specific features of the transition in Russia and main factors of proliferation of arrears and barter, as well as the investigation of process of formation of two regimes of financial circulation;

specification and assessment of parameters of econometric models of arrears and money demand;

development of macroeconomic aggregate model including arrears taking into account the results of the econometric research, determination of relationships between the GDP and volume of arrears; elaboration of recommendations for decreasing arrears and stabilization of the Russian economy.

The received results are based on analysis of vast statistical data, estimates of some indicators and identifying stages of the transition period (see Appendices)

2.2. Objectives of the study

The project focuses on the following:

analysis of statistical data, determination of main stages of the transition period and factors influencing process of stabilization of the Russian economy;

analysis of specific features of the Russian economy connected with arrears and barter;

development, specification and estimation of parameters of a system of econometric models of money demand and arrears including some additional factors typical of the Russian economy;

development of the macroeconomic aggregate model for better understanding problems connected with arrears and their influence on the GDP and process of stabilization of the economy in the short and long-run;

development of recommendations for choosing rational ways of resolving problem of arrears

and stabilization of the Russian economy.

2.3. Review of the literature.

There is already significant number of papers on analysis of stabilization in Russia. Among them the periodical analytical reviews that contain vast economic and statistical information (Russian Economic Trends (1993-1998) [1], Granville (1994-1997) [2]), as well as monographs (Aslund [3], Granville & Shapiro [4]) and papers (Easterly and Wolf [5], Granville and Fergusson [6], Fisher [7], Polterovich (1995) [8], etc.) have to be mentioned at first. Results of research of foreign authors (e.g., Dornbush (1990, 1993, 1994 [9])) permit to understand reasons of inflation and choice of paths of stabilization in countries with market economy, as well as in countries of the Eastern Europe.

In the field of modeling there is significant number of papers devoted to macroeconomic econometric models, described, as a rule, by a single equation (Easterly and Wolf [5], Granville [10], Polterovich (1996) [8], De Masi and Coen [11], etc.). Thus, in (Granville and Barbe (1996, 1997) [10]) models for the assessment of real GKO (Russian T-bills) yield, MIBOR (Moscow Interbank offer rate) and exchange rate are developed. Model for money aggregate M2 with exogenous real GDP and exchange rate as well as inflation rate is developed in (Granville and Barbe (1996-1997)). In (Easterly and Wolf [5]) models for assessment of real money aggregate and exchange rate are represented. In (De Masi and Coen) the model of price index for different goods is elaborated. The macroeconomic model that is described by several equations is proposed in the paper [Wiplosz, Kirsanova, and Grafe [12]]. It contains three blocks as follows: money demand (endogenous variable - real money base, exogenous - growth rates of real wealth and GDP and income, expected rates of inflation and GKO yield); GKO yield (endogenous variable - GKO yield, exogenous ones - real GKO outstanding, real wealth, inflationary expectations and exchange rate); inflation (endogenous variable - rate of inflation, exogenous - exchange rate, real budget deficit, and excess supply). The assessment of parameters of model were executed on the data for 1995 and first half of the 1996. In the paper of [Tullio & Ivanova [13]] the two-step procedure is used for assessment of parameters of the error correction model of money demand. The authors estimated the demand functions for banknotes and cash money, using the following variables: real wage bill net of wage arrears, expectations of exchange rate, nominal interest rate on GKO, etc.

These works are mainly focused on development of models that link some indicators (money aggregates, yield, price index, etc.) with conventional exogenous factors. However they do not take into account some specific features of the Russian economy as they do not analyze the problems of arrears, barter, and etc.

The problem of arrears for countries in transition involves at present the attention of many researchers both in Russia and abroad. The earlier works of the foreign economists, analyze the reasons of occurrence and methods of reduction of arrears in countries of the East Europe [Calvo & Coricelli [14]] and, in particular, in Romania [Clifton & Khan[15]] and Poland [Gomulka[16]], mentioning predominate macroeconomic aspects of this phenomenon. There are also rather many papers of domestic researchers that investigate the problem mainly on the micro-level.

In this connection it is appropriate to pay attention on the papers where specific features of the Russian economy in transition were analyzed, especially on the papers that are concentrated on problems connected with arrears, working capital of the Russian enterprises, wages, money surrogates, dollarization, and etc. Among them are the papers of (Alfandari & Schaffer^[17]) on arrears in the Russian enterprise sector, (Makarov & Kleiner^[18]) on problems of barter in the transition economy, (Klistorin & Cherkassky [19] on money surrogates, (Novikov [20]) on natural payment for labor and taxation, (Vilensky, Domnina & Maevskaya [21]) on the problems of bill legislation in Russia and practice of its utilization, (Lisitsian [22]) on problems of current capital, process of changing of capital cost, and arrears, (Alekseev & Gertsog [23]) that describes the national peculiarities of forming the working capital, (Gaddy & Ickes[24]) where the problems connected with restructuring of enterprises are discussed, (Expert, 1996 [25]), etc. In the papers of the author (Var-

shavsky (1996), (1997) [26]) the attempt to include arrears in the model of money demand was made.

On our sight, macroeconomic approach can give the additional information on character of proceeding processes, and the use of specially constructed economic and mathematical models, including econometrical ones could deepen understanding the influence of the various factors on development of the economy under conditions of arrears and barter.

2.4. The data

The project is based on the statistical information from the Goskomstat and Central Bank of Russia, periodical editions, e.g. Russian Economic Trends (1993-1998) Monetary reports (1994-1997), and other publications. It is necessary to note, that the statistical information, especially for the first stages of the transition period, was not reliable. Moreover during the period under investigation the methodology of the statistical data collection was changed several times by the Goskomstat and Central bank of Russia. This circumstance not only considerably hindered to analysis but has also determined the approach for choosing methods econometric analysis. As it is known, using exact econometric methods without reliable statistical information loses a sense and, moreover, as shows our experience, leads very often to incorrect conclusions. Therefore the main attention was given to the preliminary graphic analysis of time series and etc. The procedure used by the author for the analysis of time series was close to offered, for example, in (Granger, 1997[27]) for research of cointegration; it includes plotting the series against time, plotting the series against each other in pairs, some formal pretesting, etc., as well as to researching the reaction of variable on shocks that are few in number. On the basis of the given analysis the specification of econometric models was executed and significance of estimates of parameters was checked up first of all by proceeding from an opportunity of their economic justification. Analysis of the statistical information has shown that for increasing accuracy of assessing parameters of the model it was necessary to identify stages of the transition which are characterized by specific features of change of indicators. Their brief description is given in Appendix I. In the Appendix II the estimates of some indicators characterizing arrears, which were made on the basis of the official statistical information, are given.

3. CHARACTERISTICS OF ARREARS AND BARTER IN THE RUSSIAN TRANSITIONAL ECONOMY

3.1. Specific character of transition in Russia

To analyze the process of proliferation of arrears in Russia it is necessary to take into account specific problems for the country that were enlightened after disintegration of the old system and transition to a new political and economic system accompanied by the investment recession and significant structural changes in the economy. In their number:

- desire of the bank system, that is not formed yet, to grow very fast the capital at the expense of speculation and its isolation from the real sector of the economy characterized by deficit of the working capital; problems of development of the system of financial circulation;

- bad payment of taxes in the service sector and use of large volumes of cash money without accounting;

- weakness of federal government under conditions of fragmentation of the country on numerous small-sized regions, weakening of economic links between regions on huge territory, because of fast growth of the transport tariffs;

- excessive concentration of the main part of the financial capital of the country in Moscow and as a consequence - the aspiration to centrifugal tendencies to independence of the greater part of regions;

- sharp reduction of production in the defense industry;

- the burden of social infrastructure on the enterprises, especially big ones;

- unpreparedness of the legislation basis for transition to market, etc.

The sharp decrease of the current capital of enterprises, the growth of prices first of all on fuel and energy as well as transport tariffs, debts of the government for the products made by its orders, use of money for speculation by financial organizations, etc. stimulated the broad proliferation of barter, money surrogates and other non-monetary instruments.

As a result the whole system of financial circulation was divided on two sectors as follows: sector of real money circulation (cash and non-cash money) and parallel sector connected with barter and non-monetary instruments. Thus it is possible to think that the policy of rough monetary stabilization had led to system changes in the Russian economy.

In some degree all these facts prove the law of Le-Chatelier (proposed by Samuelson for economics) that tells that if a system in the state of equilibrium is influenced by some exogenous factor then its reaction will be directed to decrease this influence (see, e.g. [28]). In our case the Russian enterprises without current assets and under condition when there is no possibility for them to take credits, compensate the negative influence of the exogenous factors by broadening trade credit, arrears and barter. That is they try to survive in the broad sense by providing simple or even broad re-production, conservation of labor and production potential, as well as social infrastructure connected with them.

Thus, the research of the Institute of social and economic problems of the population of the RAS shows, the directors of enterprises name, as main problems only those that are directed exclusively on current survival. Among them: searches of sources of financing and crediting - 59 %, providing sales promotion of production - 39 %, maintenance of deliveries of raw materials and parts - 27 %, decision of social problems of labor - 23 %, maintenance of labor discipline and of production and technological cycle - 16% for both; they underlined that when they accept key management decisions the importance of preservation of labor collective is the same as of the profit - 43% [Vremya, 4 November 1998 [29]].

It is known that the large scale use of barter and non-monetary instruments leads to decrease of effectiveness of the economy in the long-run. In the given work it is proposed that in the short-run period the large-scale barter with money surrogates and arrears it can provide decrease of slow down of the economy and conservation of production potential (though it is well known that in the long run it leads to decrease of the efficiency of economy).

Economic analysis, results of modeling and analytical results obtained on the basis of rather simple aggregate macromodel, proposed by the author, cannot rule out this hypothesis. They help more deep understanding causal links that were formed during the process of formation of arrears which, as it is shown in the project, have to be analyzed together with investigation of barter and system of financial circulation. They also provide better substantiation of recommendation for stabilization of the Russian economy.

3.2. General indicators of arrears

On the 1.01.1998 the *total liabilities* (total creditors of enterprises and liabilities to banks) of enterprises of industry, construction, agriculture and transport in Russia reached to 1453,0 trln. rubles, including overdue liabilities equal to 782,2 trln.rubles. Thus, the share of overdue liabilities in total liabilities was grown in 1993-1997 by 1,8 times and reached 53,8% of the total liabilities or 209% of the money aggregate M2 (30,1% of GDP of Russia) to the beginning 1998.

Total creditors of enterprises of 4 branches reached to 1288,3 trln.rubles including overdue total creditors equal to 756,1 trln.rubles. The share of overdue creditors in the total creditors of enterprises of industry, construction, agriculture and transport was grown by 1,7 times and reached 58,7% of total creditors or 202% of the money aggregate M2 (29,1% of GDP).

The total debtors was equal to 846,1 trln.rubles including overdue debtors equal to 458,4 trln.rubles [Social and economic situation in Russia [30]]. Share of overdue debtors in the total debtors was grown only by 1,3 times and reached 54,2% or 122,5% of M2 (17,6% of GDP), see tab. 1 (Appendix II).

The debts of the enterprises to the budget and state outbudget funds grow the most fast: for period 1996 - 1997 the share of overdue payables to suppliers in total volume of overdue creditors decreased from 50,1% to 45,6 %, overdue payables to employees from 6,1 % to 5,3 %, overdue payables to budget - from 25,4% till 21,5%, but ones to the state outbudget funds increased from 13,0% to 20,4%.

Relatively to the money aggregate M2 the level of arrears if the Russian enterprises is near to the same indicator for Romania in 1991 (though it is much higher than in Poland).

In Romania the arrears of enterprises presented a significant problem in the beginning 90-es: to the beginning of 1992 they in 2 times exceeded volume of "broad money, and the velocity of money was equal to 3,7-4,0. The arrears have here appeared as a substitute to decreasing credits of banks for the enterprises, and cash money - as main means of payments [15].

Analysis of a situation in Poland in 1992-1993 has shown, that only for 10 % of the enterprises there were problems of the indebtedness, the interest rate was high for good enterprises and the access to the credits for bad ones was blocked by banks that elaborated a cautious policy [16].

However the quantitative characteristics of proliferation of arrears in Russia are very specific.

For Russia the significant growth of the share of overdue liabilities and receivables after 1993, as well as the more fast growth of overdue creditors and debtors more than 3 months, and very big period of payments comparatively with other countries is typical. The share of *overdue creditors more than 3 months* in the total value of overdue creditors was equal to 77,2% to the beginning of 1998; it increased more than by 1,2 times at the period 1996-1997. The share of overdue debtors more than 3 months in the total value of overdue debtors was equal to 81,8%; it was grown also by 1,2 times at the same period [31].

The average payment period is increasing especially for the overdue creditors: only at the period 1.12.1996 - 1.12.1997 it was grown by 1,45 times and became more than 6-7 months at the end of 1997 (tab. 2, Appendix II). Some surveys show that average payment period in Russia exceeds the same parameter in normal market economy (thus, the survey of the 210 largest enterprises has shown that the mean payment is made in 7.9 months and only 5% of enterprises paid at the first two months, 51% - at the period less than 6 months and some enterprises mainly in energy sector - at the period more than 3 years (The Russian Economic Barometer [32], [Starostenkova [37]).

That is in Russia *the average payment period is in 2-4 times higher than in other countries*: in Poland it was equal to 2 months, in Italy - 3, in France - about 3.5 months [Rostowsky, p. 230 [33]]; it is worth to note that in Poland the average payment period decreased almost by two times in 1989-1991 [Rostowsky, p. 276 [33]], while in Russia it increased more than in 4 times in 1992-1997).

It is worth to note that *increasing period of payments is going together with decrease of the payments with real money and growth of barter* (in Russian Economic Barometer, 1998 [32] it is shown that the share of payments with money is equal to 4-18% when the delay of payment is more than 9 months, 25% when it is less than 6 months, and 42% for delay less than 3 months).

Estimates of the scale of using barter in Russia that are given in the economic literature are not reliable, but all of them indicate its high proliferation simultaneously with arrears.

Thus, for example, Russian Economic Barometer [32, 34] shows that in the third quarter of 1998 the share of barter reached 52-54% (in May 1992 it decreased from 12% in 1991 till 4%, and then from the spring of 1993 it became grow: 9% in 1993, in 1994 - 17%, in 1995 - 22%, 1996 - 35%, and 1997 - 42% (see also Yakovlev & Glisin [35]), however reliability of the data is small; in [Makarov & Kleiner [18]] it was indicated that in 1996 from 34 up to 50% of the turn-over of industrial production was executed on the barter basis, and in volume of initial resources the share of barter reached up to 70 - 80 %; in [Expert, 2 November 1998] it was written that in October 1998 the level of barter has reached 52% of the turn-over of industrial production in comparison with 42% in 1997 [36]).

Recent results of several surveys of the Russian enterprises at microlevel, aimed on deepening of understanding processes, occurring in the Russian economy were recently published also. In particular, survey of 210 the largest enterprises fulfilled by the to interdepartmental balance commission has shown that more than 70% of operations in the Russian economy is not connected with money, and the share of offsets in tax transfers to the federal budget is equal to 92% [Starostenkova; Russian Economic Barometer [37,32]]. It was shown there as well that the value of liabilities of enterprises to government and for payment of salaries exceeds by 23% the volume of money that enterprises have. The data of the Ministry of finances show that in some regions payment by money does not exceeds 11% and the rest of payments is made with barter and veksel [38].

More exact are the data for separate enterprises - thus, in the machine-building company Sibagromash the barter and offsets reached 81% in 1997 in comparison with 5 % in 1993 [Proskurina [39]]; on AMO ZIL the share of barter has reached 95% in the middle of 1998, the enterprise receives about 5 % real money for its production, whereas in 1996 it received 25% [Nikitin [40]]; in [Gaddy & Ickes [24]] an example of machine-building enterprise is indicated, which only 7 % of the income from re-alized production receives in money.

It is well known that barter economy is ineffective; the main factors of it are given in [41]. In Russia we have the same factors as in other economies.

Nevertheless we can *propose the hypothesis that barter in Russia, under conditions of transition period characterized by severe economic and political crisis and high economic risk helps to conservation of production potential of enterprises* (though in the long- and even medium run its results must be negative). To prove this hypothesis lets analyze the specific features of arrears and barter proliferation in Russia.

3.3. Main factors of arrears and barter proliferation

As quantitative estimates show, *liberalization of prices has led to qualitative change of factors that stipulate transition to barter*: Before 1992 the deficit of high quality goods and material resources was the main factor of it [42] as well as growing of the stock of goods; in 1992 in spite of decrease of demand and utilization of production capacities as well as real money because of the hyperinflation, the production continued by inertia with the help of the stock of goods and materials as well as commercial credits; at last, beginning from the spring 1993 when the stocks were exhausted and enterprises had no money on their accounts the transition to barter has began with very high rates due to new factors. It is possible to identify among them the following ones.

3.3.1. High price of credit and gap between real sector of the economy and financial structures

Beginning from December 1993 the real refinancement rate has become positive (its nominal yearly value was equal to 210%) that made it difficult for enterprises to get credits (see Appendix I). The share of long-run credits was only several percents. From the end of 1995 it was more difficult for the enterprises to receive the credits: in the structure of obligations of the enterprises and organizations of industry, construction, agriculture, and transport the share of overdue creditors to banks and loans decreased by 2 times till 3,3% at the period 1996-1997 (insignificant share of the overdue creditors to banks testifies about outflow of money from the real sector of the Russian economy). The main reason of it was utilization of money on market of GKO; to the middle of 1998 the volume of GKO and OFZ in circulation was by 1,2 times higher than the aggregate M2. Our analysis has shown that at the same time the real value of overdue creditors correlates rather high with the ratio of the volume of GKO and OFZ in circulation to money aggregate M2 (fig. 1).

Thus, banks that used financial resources for speculation, participated indirectly in formation of overdue debts taking money away from the real sector of economy. The significant role belonged also to the big part of cash in circulation that was not accounted. The short-run credits of bank concentrated mainly in trade and their price corresponded to high profit of this branch due to unaccounted cash money and very high prices on imported goods. Under these conditions, the main

source of formation of money resources of the enterprises became the own means (83% for large and 81% for small enterprises in 1996).

The state credits and the grants were equal to 4,9 % and 7,2 %, and long-term credits of the private sector - to 1,6% and 2,1%, short-term credits of private sector - 7,6% and 2,6% and short-term loans of the enterprises-partners - 2,9% and 6,2% correspondingly [System of statistical observation for development of the private sector [43]]. It is worth to note that the share of own means of Russian enterprises significantly exceeds the same indicators (by 10-20%) for France and Germany in 1959-1964 when rebuilding of their economy after the Second World War has finished.

Fig. 1. Change of logarithm of real overdue creditors ($\ln N/P$) and relation of volume of GKO and OFZ in circulation to M2 ($GKO/M2$) in period 1995:1 - 1998:5.

3.3.2. *Aspiration for tax evasion*

The deficit of money and inventories under conditions of high interest rate and correspondingly impossibility to get credits reflects the system peculiarities of the Russian economy that stimulate proliferation of large-scale barter. This fact was marked by [Alfandari & Schaffer, p. 17 [17]].

Among the main stimulus of transition to barter we can distinguish the opportunity to evade taxes by transition to barter and use of cash money (enterprise receives an opportunity not to pay the taxes, as during the period of transition of a bill the products transferred to consumer are considered as shipped ones; as soon as the consumer pays for the products they begin to be considered as realized and the supplier should pay the profit tax; in practice even after payment of production by the consumer the supplier tries not to find out that the bill is reset and accordingly receives an opportunity to continue evading from taxes [Expert, 1996, N. 8 [25]]).

Nontransparent accounting under conditions of barter makes it less difficult to evade from taxes as well (when enterprises have large arrears they can have less transparent accounting reporting that facilitates tax evasion and decrease payments of dividends; it is important to note as well the existence of lag in transition to the modern system of accounting (now transactions in money and by kind are accounted similarly).

3.3.3. *Significant role of the State in formation of arrears*

For better understanding the role of the state in formation the arrears we have to analyze together *overdue payables to suppliers and overdue receivables from customers*. At the beginning of 1998 overdue receivables from customers were *approximately in 1,25 times larger* than overdue payables to suppliers. This fact shows that the debts of government lead to multiplicative growth of arrears in the economy with multiplicator equal approximately to 4. This estimate coincides with estimates of CBR and some institutes of RAS (their estimates give the multiplicator equal to 4-5). Thus, the state became the agent that initiates the growth of overdue debts of enterprises, transition to barter and payments to budgets by goods and services.

At the beginning of 1998 the overdue payables to suppliers was equal to 45,6% of total overdue creditors of enterprises (analysis of the branch structure of overdue creditors shows that in the total value of the overdue creditors the overdue payables to suppliers for goods take about 39-64%), tab. 3 and 4, Appendix II. But the main part of overdue debtors belongs to overdue receivables from customers (80-92%) for goods and services (tab. 5, see also the tab. 6, Appendix II, where in denominator of the second and third columns the ratio of overdue payables to suppliers to overdue receivables from customers debtors by branches are given). That is why the balance between overdue payables to suppliers and overdue receivables from customers change the sign comparatively with balance between overdue creditors and debtors.

This conclusion is proved indirectly also by the high share of overdue debtors in the total debtors in the beginning of the transition period (41,3% in 1993) when enterprises continued production by the government order but the government could not pay for them, see tab.1 (about a half of production was excluded from the financial control as enterprises produced under the former conditions of sys-

tem of the government orders without taking into account the possibility to get money for it [44]). In the composition of overdue liabilities the wage arrears, that are the result of budget arrears and the lack of own means of enterprises, are of especial interest (tab. 7, Appendix II).

It is worth to note the weakness of the federal government that is reflected in the attitude of managers of industrial enterprises to the governmental policy (the data from [32] show that the share of managers comprehending the government economic policy decreased from 26% in 1993 till 20% in 1998, not comprehending - increased from 45% to 56% relatively; share of managers approving the government economic policy decreased from 14% to 4% and not approving - increased from 47% to 68%; managers' estimates about time remaining until the end of crisis increased from 6 to 7,4 years).

3.3.4. *Change of the cost's structure*

The growth of prices on fuel and energy to the world level that had taken place during the first stages of transition have significantly changed the structure of production costs. The data for industry show that costs of fuel and energy for period 1990-1996 have increased in 3,2 times concerning other components of costs, whereas the share of costs on payment of salaries and assignment on social needs as well as depreciation was in 1996 at the level of 1986-1990 (tab. 8-9, Appendix II).

Usually, the influence of overdue payables on prices is explained as follows: state enterprises-producers expect that enterprises-buyers receive bank credits in some time; these expectations lead to inflation in the short-run as suppliers increase prices to compensate their losses from credit. So, money is transferred with help of banks from producers of final products (manufacturing enterprises) to producers of intermediary products and raw materials [Rostowsky, [33] p. 342].

However, for Russia *it is typical the specific mechanism of crediting with the help of arrears*. The flow of money in Russia is going from transport, energy and fuel branches, which in its turn are crediting from budget (and, only partially, by banks), to manufacturing and raw production (except fuel). Thus, in Russia there is a specific redistribution of money [Economic monitoring of Russia [45]]. It is worth to mention that prices on fuel reached world level and do not grow as it was before.

The most fast growth of overdue creditors to suppliers occurs at the expense of the enterprises of branches - natural monopolies (first of all, electric power industry, transport and communication).

The role of natural monopolies becomes more transparent when we analyze the balance of the overdue payables to suppliers and overdue receivables from customers. At the end of 1996 balance of the overdue payables to suppliers and overdue receivables from customers was positive in the industry at the expense of the energy and fuel sector, as well as in construction and transport (tab. 10, Appendix II). Thus the ratio of balance of the overdue payables to suppliers and overdue receivables from customers to the overdue payables to suppliers of the enterprises was the largest in transport, construction and electric power industry (tab. 11, Appendix II).

3.3.5. *Sharp reduction of volume and deformation of structure of current assets of enterprises*

The liberalization of prices, very big interest rate, growth of prices on products of natural monopolies and the lack of money in government to pay for its own debts, as well as impossibility of restructuring and bankruptcy of enterprises have led to *sharp decrease of current assets at the enterprises*.

Scales of this reduction it is possible to show with the help of analysis of the ratio of inventories to fixed capital. In particular, if in 1980-1990 this ratio was equal to 25-28 %, then by 1997 it has decreased up to 1, 6 %, i.e. in 15-17 times (tab. 12, Appendix II).

As follows from statistical data, under conditions of economic crisis and existence of natural monopolies the *structure of current assets of the enterprises has considerably changed*. In 1990 the share of inventories in current assets of enterprises and organizations of main branches of the Russian economy was equal to 64,7%, cash and noncash means - 17,5% and accounts receivable - 5,7%, but to 1996 these parameters changed significantly, as follows: 33,6%, 2,6%, and 52,2% correspondingly, see tab. 13, Appendix II.

3.3.6. Problems inherited from the former planning system

It is worth noting that there are some factors inherited from the former planning system, first of all the following:

- refusal from the former system of noncash payments (in its basis there were obligatory opening of an account by enterprises in bank, utilization valid for one occasion only of documents for payment in bank without any veksel (bills), etc.;

- conservation of traditions and experience of managing and links that were formed at the soviet period that help to activity of enterprises under barter;

- difficulties of declaring existing enterprises by bankrupts because of an opportunity of serious aggravating social tension and connected with it desire of local authorities to conserve the control under enterprise.

3.4. Two sectors of finance circulation in the period of transition

Significant growth of arrears, broad use of barter and money surrogates have led to system changes in financial circulation. As the analysis of the system of financial circulation in Russia in 1990-s shows, it is possible to distinguish two regimes of its functioning, as follows: normal (regime I) and barter (regime II).

3.4.1. Regime I (normal).

In the normal market economy with an uniform system of the financial circulation barter, home and foreign currency are real substitutes, that is the following equation exists:

$$M+n*N+DL*e=A(\mathbf{z}), \quad (1)$$

where M - money (home currency), N- volume of arrears, e - exchange rate, DL - volume of foreign currency in the country, $A(\mathbf{z}) = PY/V_0$, Y - real GDP, V_0 - money velocity, $\mathbf{z} = (z_1, z_2, \dots, z_n)$ - vector of exogenous factors, n - relation between barter and market prices, P - consumer price index.

From this expression it is seen that the increase (decrease) of one of the three variables leads to decrease (increase) of the sum of two other ones when $A=\text{const}$, i.e. correspondingly to conventional theory money and arrears are negatively correlated.

For the transition period, when significant changes of exchange rate, GDP, and other indicators have place, the task of estimation of real correlation between money and arrears becomes rather difficult. However the analysis of changes of M2 and overdue creditors N as well as rates of their change ($d\ln M2$, $d\ln N$) shows that during 1992 and some quarters of 1993 the correlation between them was mainly *negative* but in the middle of 1993 and after the first quarter of 1994 - *positive* (see fig. 2).

Fig. 2. Change of rates of growth of money aggregate $d\ln M2$ and overdue creditors $d\ln N$ in the period 1992:3 - 1998:5.

Thus, analysis of data, at least, does not refute hypothesis that on the first four stages of transition (see Appendix I) arrears and broad money substituted each other, i.e. the system of financial circulation was indivisible.

In favor of this hypothesis tells us the fact that the real refinancement rate in 1992-1993 was negative, the part of enterprises could get direct credits from budget, the market of GKO was not formed yet and it could not distract large volumes of money, prices on the major part of products including fuel and energy were lower than world prices till the end of 1993, and the share of money in the current assets of enterprises was not so low. Enterprises did not influenced significant pressure from these factors in direction to barter (see before).

3.4.2. *Regime II (barter).*

3.4.2.1. **Division of system of financial circulation by two sectors**

Beginning from the 4-th stage of period of transition (in the end of 1993 - beginning of 1994) the real refinancement rate became positive (Appendix I), direct crediting enterprises by government decreased, prices on energy and fuel as well as on some other products reached the world level, the growing volumes of money were distracted for speculations with GKO and OFZ; correspondingly, the share of money in current assets of enterprises decreased sharply (tab.13, Appendix II).

As a result, the system of financial circulation divided on two relatively independent parts, as follows:

sector I - real money circulation (by cash and without cash transfer) including home currency and foreign currency;

sector II - barter, mutual clearing of arrears, and bills that reflect overdue creditors and debtors.

Obviously, enterprises had to pass rather quickly to this system of two sectors of circulation of financial means because such action was their adaptation to toughening the policy of macroeconomic stabilization that has begun on the 4-th stage (see tab. 1A, Appendix I). Thus, under condition of enormous decrease of current assets of the Russian enterprises and use of money surrogates and barter, two sectors of money circulation, practically independent, have arisen.

At present, by some very approximate estimates, the volume of dollars in Russia is near to money aggregate M0 and volume of money substitutes approaches to money aggregate M2. The main part of bills plays the role of money surrogates (Vilensky, Domnina, Maevskaya [21]), that is seen from comparing these estimates with the small share of arrears in bills. Correspondingly, the money velocity estimated by yearly values of GDP was equal in 1991-1992 to 1,4-2,5, however it increased after that from 4,4 in 1993 till 6,2 in 1994, and reached maximum that was equal to 7,6 in 1996 (results of estimation of money velocity on the basis of monthly data is given in [26]).

3.4.2.2. **Asymmetrical links between two sectors of financial circulation**

It is possible to expect that the character of interrelations between overdue creditors and money should be different in comparison with a situation, when money and money surrogates replace each other (perfect substitutes). In particular, we can propose that the links between two sectors are asymmetrical.

The lack of own cash in the working capital of Russian enterprises is both the reason and simultaneously the evidence that the flow of money from sector I to sector II of the financial circulation is limited. It is determined mainly by necessity of payment of salaries by cash and, in rare cases, by problems of development of production; elasticity of arrears relatively this flow of money is small. On the other hand, existence of demand on money for payment of salaries is proportional only to some part of the GDP.

From here it follows, that elasticity of demand for money relatively the size of overdue creditors is not equal to zero and is positive due to the fact that some part of overdue creditors comes back to the suppliers in the form of money, though through a very large period of payment.

Asymmetrical links between two sectors of finance circulation are proved also by two levels prices in barter economy.

The price of production, which is received by barter, frequently appears higher then market price, as two levels of prices exist: on products delivered by barter, and on products delivered with payment by money. At the same time there are many evidences that the price of products received by barter can be less than their market price or even near to zero. Thus the price level loses its significance; the level of prices can be very different - from maximum to minimum possible level [18, 23, 32, 37].

It is important to note that in transition of the enterprise from barter market on money market with the purpose of reception of money, the prices, as a rule, are reduced, i.e. the expansion of barter

is accompanied by the periodically arising and often augmenting needs of the enterprise in real money and appropriate realization production for money, necessary for various payments. This is confirmed, for example by numerous facts of changing money surrogates for real money by the lower prices (in Russian Economic Barometer, 1998 [32] the example of the Sibenergo is given whose vekselns are sold for money with discount equal to 80% and for goods from Siberia with discount equal to 54%). Thus, realization of production, delivered by barter, for real money can be made, at the best, with the market prices, or more probably with prices below than on the market because of general economic recession, shortage of money of buyers, and necessity of formation of multi-stage chain of sales (see also Appendix III and [46]). It is very important that in [Alekseev & Gertsog [23]] it is noted that usually the director of enterprise signs two different lists of prices on the same produced goods that are shipped by barter or for money. Relative autonomy of two sorts of prices, is, from our point of view, the additional confirmation of significant independence of two sectors of circulation of money and money surrogates.

Thus, it is possible to assume that there exist two asymmetrically linked sectors described by the following equations:

$$\text{sector I: } M + e \cdot DL = A_1(z_1) + B \cdot N, \text{ or } M = A_1(z_1) + B \cdot N - e \cdot DL, B > 0, \quad (2a)$$

$$\text{sector II: } N = A_2(z_2). \quad (2b)$$

For the purposes of investigation, as we cannot strictly estimate the volume of dollarization of the Russian economy, it is possible to propose to change the member $e \cdot DL$ in the latter equation by $e \cdot D$, where $D = E[DL] > 0$, and sign E stands for mean value.

From (2a,b) it is seen that it is possible to propose a hypothesis that the demand for money depends, besides the conventional factors (GDP and interest rate), also on volume of overdue creditors (positive correlation) and exchange rate. At the same time, the demand for trade credit with money surrogates and barter depends on the rest part of the real GDP and level of tax deductions, etc.

At the next section it is shown that these propositions are not refuted by results of estimation of parameters of econometric models.

4. ECONOMETRIC MODELS OF ARREARS AND MONEY DEMAND

4.1. General system of equations

We can write the latter equations as the following system of two equations:

$$M/P = f_1(u, N/P), \quad (3a)$$

$$N/P = f_2(v), \quad (3b)$$

where u and v - vectors of factors that determine change of money demand and arrears (excluding values of money demand and arrears).

Analysis of arrears in the Russia made before shows that we can choose the following factors (components of the vector v) as explaining variables of the model (3b):

refinancement rate of the Central Bank of Russia or interbank rate, etc.;

volume of GKO in circulation (level or in relation to M_2);

GDP connected with barter sector of economy; level of inflation (or consumer price index);

average taxation;

level of the fine on enterprises when they evade taxes; time and other variables (in particular, dummies for description of some events, e.g. connected with 'black Tuesday' of 1994, president elections in 1996, etc.

Components of vector u are the following: real GDP and refinancement rate (conventional factors), and exchange rate, N/P is the output of the model (3b), see below.

Asymmetrical character of these equations can be checked also by test for causality of arrears N and \dot{M}_2 (test for causality) [47]. To check null hypothesis H_0 : "M2 does not determine change of

N“ or H_{02} : “N does not determine change of M2”, the estimates of parameters of two lag equations (unrestricted and restricted) were made.

Calculations were made for different intervals of observation beginning from the second half of 1994 till May 1998 for $m = 3$ è $m = 6$ where m - the number of lags. Their results do not reject the hypothesis about asymmetry of links between $\dot{I}2$ è N , as F - criteria for H_{01} was, as a rule, more or equal to corresponding F - criteria for H_{02} .

In particular, for interval 1995:3-1998:5 calculations show for $m = 3$ that for H_{01} : $F = 3,85$ and for H_{02} : $F = 7,45$ with critical value of $F_{cr} = 4,51$ for 1% level of significance; for $m = 6$ we had for H_{01} : $F = 2,06$ and for H_{02} : $F = 2,58$ with $F_{cr} = 2,49$ for 5% level. That is H_{01} (M2 does not influence N) cannot be rejected, but H_{02} (N does not influence M2) have to be rejected.

Nevertheless, as it seems, these results are not very reliable and it is necessary to use economic evidences given before. Besides that we have to choose and estimate parameters of the system of equations (3a,b). As these equations describe two sequential models of arrears and money demand (arrears as endogenous variable of the first model is the input or exogenous for the second one), we have to begin with model (3b).

4.2. Model of arrears

4.2.1. Choice of variables

After additional investigation and modeling the following factors were chosen: real refinancement rate of the Central Bank of Russia - R ; GDP connected with barter sector of economy - $Y2$ (estimated on the basis of monthly GDP - Y that was smoothed for period 1992:3-1998:5: $\text{Ln}Y = -2.51887 + 1.90456 \cdot \text{Ln}T$; t -statistics for coefficients are equal -14.53 è 38.08 correspondingly; $Y2$ was estimated as the growing part of GDP Y with the help of data about the share of barter taken from [32], see before); volume of GKO in circulation divided on M2 (GKO/M2); dummy for description of events connected with ‘black Tuesday’ of 1994 - $D1$ equal to $d\text{Ln}P$ for period 1994:11-1995:2 and 0 in other points ($P = \text{CPI}$).

4.2.2. Tests and estimates of parameters

Analysis of variables of the model included conventional procedures of correlation analysis, unit-roots test and cointegration.

Unit-roots test has shown that the null hypothesis can not be rejected: taking into account that critical value of the Dickey-Fuller criteria is equal to $-3,4168$, we can conclude that all variables included in the equation belong to the class $I(1)$ (see tab. 4-1 where all variables except R are taken in logarithms).

Table 4-1

Summary of Unit root tests

	Ln(N/P)	GKO/M2	R	Ln(Y2)	D1
		Test Statistics			
Wtd.Sym.	-1.0024	-0.5732	-1.2640	0.04552	-2.5993
Dickey-F	-2.7691	-2.4745	-2.2613	-1.4809	-2.5376
		P-values			
Wtd.Sym.	0.9732	0.9924	0.9433	0.9988	0.2352
Dickey-F	0.2085	0.3408	0.4554	0.8356	0.3094

On the next stages of research the error correction model (ECM) was used.

Cointegrating vector:

Ln N/P	1.0000
GKO/M2	-0.0009
R	-0.0278
Ln(Y2)	-0.8088
D1	-2.0951

Summary of Engle-Granger (tau) cointegration tests:

TestStat	Pvalue	Num.lags
-3.0449	0.7230	8.0000

In this case there are rather small number of points of observation (57 points) needed for obtaining reliable estimates of cointegration. However taking into account Durbin-Watson statistic DW we see that it is equal to $DW = 1.0978$ that is significantly higher than its critical value $DW_{cr} = 0,386$ for 5% level of significance [47], we can conclude that cointegration exists.

The regression analysis of many variants of equations has shown that we can choose the following ECM:

$$dLn(N/P)_t = a_1 * dLn(N/P)_{t-1} + a_2 * dLn(Y_2)_t + a_3 * UN_{t-1}, \quad (4a)$$

where

$$UN = Ln(N/P) - [b_0 + b_1 * Ln(Y_2) + b_2 * R + b_3 * Ln(GKO/M2) + b_4 * D1]. \quad (4b)$$

It is worth to note that this model can be used for period between reforms of arrears (the first one was made in 1992; the second one - in 1996 was not realized; the last scheme was elaborated in the October [48]).

The estimates of coefficients of (4b) were made for period 1993:5-1998:1 and of (4a) - for period 1994:4-1998:1.

In analysis of estimates the main attention was put on tests of misspecification, signs of coefficients and t-statistics of coefficients, value of Durbin-Watson statistic and Durbin's h., heteroscedasticity test (Breusch-Pagan heteroscedasticity test) and test for stability (Chow-test for stability).

Estimates of coefficients of ECM and corresponding statistics are given in tab. 4-2a

Table 4-2a

Estimates of coefficients of the models (4a,b)

No. Of equation	Dependent variable	Explaining variables	Coefficient	t-statistic
(4a)	dLn(N/P) _t	dLn(N/P) _{t-1}	.4424	3.7589
		dLn(Y ₂) _t	.6314	3.6623
		UN _{t-1}	-.1148	-1.9222
(4b)	Ln(N/P)	C	7.3727	17.7045
		Ln(Y ₂)	.7836	7.6215
		R	.0370	13.6290
		GKO/M2	.7338E-02	7.7838
		D1	2.4640	7.9723

Chow test for stability for two intervals: 1994:4-1995:12 è 1996:1-1998:1 (stages 4-6 and 7-10, Appendix) show that for 5% level of significance we cannot reject hypothesis of stability: $F = 1.738$ (critical value of the F - distribution is equal to 2,613 for $n=46$, $k=3$).

Heteroskedasticity test shows that the critical value of the chi square (χ^2) with 3 degrees of freedom is equal to 7,81 for 5% level and 11,34 for 1% level of significance, so using Breusch-Pagan test (6.538) we can not reject the null hypothesis of homoscedasticity in favor of presence of heteroscedasticity.

Durbin- Watson statistic and Durbin's h (1.85 and .122) show that it is possible to accept the null hypothesis that no serial correlation is present (see tab. 4-2b).

The R-squared of the regression equation (4a) that does not include the constant term is not very high, but this fact cannot cast some doubt upon the correctness of specification of the model as F-test gives rather good result; it is worth to note also that the R-squared for the model (4b) is equal to 0,95.

Table 4-2b

Statistics for model (4a)

Dependent variable: dLn(N/P)	Adjusted R-squared = .6018
Current sample: 1994:4 to 1998:1	Durbin-Watson statistic = 1.8499
Number of observations: 46	Durbin's h = .1219
Mean of dependent variable = .0302	Durbin's h alternative = .4660
Std. dev. of dependent var. = .0458	Chow test = 1.7379
Sum of squared residuals = .03623	Breusch-Pagan het. test = 6.5375
Variance of residuals = .8434E-03	F-statistic (zero slopes) = 34.5390
Std. error of regression = .0290	
R-squared = .6195	

Thus, the results of modelling correspond to conclusions from the economic analysis made for main factors that determine the volume of arrears. They confirm that the growth of arrears is correlated with increase of interest rate, volume of GKO in circulation (relatively to money aggregate M2), growth of barter and the volume of the GDP in the barter sector of the economy; some shock factors as “black Tuesday” of the 1994 are also of great significance.

4.3. Model of money demand

4.3.1. Choice of variables

The demand for money is modeled usually as a function of real GDP (Y) that reflects the transaction motive and the refinancing rate (R) that indicates on the existence of store-of-value motive of the demand for money. Thus, real money demand is specified by the following equation: $M/P = f(Y, R)$, where all variables are logarithms (except R). The results of regression analysis for Russia have shown that statistical estimates of parameters of this equation are insufficient.

The analysis given in the previous chapter explains why the additional factors specific for the Russian economy in transition, connected, first of all, with arrears and dollarization of the economy were included in the model of money demand as follows:

$$M/P = f(Y, R, N/P, e), \quad (5)$$

with Y - real GDP, R - real refinancing rate, N/P as real overdue payables that characterizes level of arrears (it is exogenous variable for this model that is obtained as the output of the model (4a,b) and denoted below as NE/P), and e as exchange rate (ruble/\$).

4.3.2. Tests and estimates of parameters

As a whole, analysis has shown the follows.

Unit-roots test has shown that the null hypothesis can not be rejected for the major part of variables included in the equation that belong to the class I(1) (see below where all variables except R are taken in logarithms). Only variables Y (real GDP) belongs, as it seems, to I(0), as the results of Dickey-Fuller (tab. 4-3).

Table 4-3

Summary of Unit root tests

	Ln(M2/P)	LnY	R	Ln(NE/P)	Ln(e)
		Test Statistics			
Wtd.Sym.	-1.2380	-2.6049	-1.2640	-0.1363	-0.7324
Dickey-F	-1.2565	-3.6416	-2.2613	-1.8846	-1.9139
		P-values			
Wtd.Sym.	0.9473	0.2323	0.9433	0.9979	0.9879
Dickey-F	0.8983	0.0265	0.4554	0.6626	0.6474

On the next stages of research the error correction model (ECM) was used.

Cointegrating vector:

Ln(M2/P)	1.0000
LnY	-0.4881
R	0.0100
Ln(NE/P)	-0.1504
Ln(e)	0.2437

Summary of Engle-Granger (tau) cointegration tests):

TestStat	Pvalue	Num.lags
-4.1367	0.1865	3.0000

In this case, as before, there are rather small number of points of observation (57 points) needed for obtaining reliable estimates of cointegration. However taking into account Durbin-Watson statistic DW we see that it is equal to $DW = .4065$ that is significantly higher than its critical value $DW_{cr} = 0,386$ for 5% level of significance [47], we can conclude that cointegration exists.

The regression analysis of many variants of equations has shown that inclusion of the term with real exchange rate e_r does not give good estimates but with nominal exchange rate e estimate of the coefficient has very good statistics and correct sign.

Thus it is possible to offer the following ECM model of real money balances M2:

$$dLn(M2/P)_t = a_1 * dLn(M2/P)_{t-1} + a_2 * dLn(Y)_t + a_3 * dLn(NE/P) + a_4 * dLn(e)_t + a_5 * UM(t-1), \quad (6a)$$

where

$$UM = Ln(M2/P) - [b_0 + b_1 * Ln(Y) + b_2 * R + b_3 * Ln(NE/P) + b_4 * Ln(e)], \quad (6b)$$

where NE/P is the output of the model (4a,b).

The estimates of coefficients of the error correction model and corresponding statistics are given in tab. 4-4 a,b.

Chow test for stability for intervals: 1993:6-1995:12 è 1996:1-1998:1 (stages 3-6 and 7-10, Appendix) show that for 5% level of significance we cannot reject hypothesis of stability: $F = 1.3839$ (critical value of the F - distribution is equal to 2,45 for $n=56$, $k=4$); for intervals 1993:6-1995:1 and 1995:2-1998:1 Chow test gives analogous result for 5% level of significance.

Heteroskedasticity test shows that the critical value of the chi square (χ^2) with 4 degrees of freedom is equal to 9,49 for 5% level and 13,28 for 1% level of significance, so using Breusch-Pagan test (4.1016) we can not reject the null hypothesis of homoscedasticity in favor of presence of heteroscedasticity.

Durbin- Watson statistic and Durbin's h (2.2197 and -1.3246) show that it is possible to accept the null hypothesis that no serial correlation is present (see tab. 4-4b).

The R-squared of the regression equation (6a) is of the same value as for (4a) and F-test gives rather good result; it is worth to note as well that the R-squared for the model (6b) is also equal almost to 1.

Table 4-4a

Estimates of coefficients of the models (6a,b)

No. Of equation	Dependent variable	Explaining variables	Coefficient	t-statistic
(6a)	dLn(M2/P)t	dLn(M2/P)t-1	.5954	6.8589
		dLn(Y)t	.1467	3.4387
		dLn(NE/P)	.1920	2.6130
		dLn(e)t	-.2717	-4.5635
		UM(t-1)	-.2269	-3.5151
(6b)	Ln(M2/P)t			
		C	6.1900	35.0062
		Ln(Y)	.4602	5.4488
		R	-.0113	-5.1094

		Ln(NE/P)	.2696	8.3439
		Ln(e)	-.1895	-5.0590

Table 4-4b

Statistics for model (6a)

Dependent variable: dLn(M2/P)	R-squared = .6965
Current sample: 1993:6 to 1998:1	Adjusted R-squared = .6727
Number of observations: 56	Durbin-Watson statistic = 2.2197
Mean of dependent variable = -.3687E-02	Durbin's h = -1.3246
Std. dev. of dependent var. = .0495	Durbin's h alternative = -1.1023
Sum of squared residuals = .0410	Chow test = 1.3839
Variance of residuals = .8039E-03	Breusch-Pagan het. test = 4.1016
Std. error of regression = .0283	F-statistic (zero slopes) = 29.1579

On the basis of the model of money demand (6a,b) the model for assessing inflation was elaborated (see also [26; 1996, 1997]); its analysis shows that the growth of arrears leads to some increase of demand on money and at the same time to slow down of the growth of consumer price index.

Thus the results of estimation of parameters of the system econometric models of arrears and money demand show that the hypothesis about division of the system of financial circulation by two sectors cannot be rejected. For more deep analysis of influence of arrears on the GDP under specific for Russia conditions of transition a theoretical model was elaborated with taking into account arrears and barter sector of economy; it is given at the next chapter of the report.

5. MACROECONOMIC AGGREGATE MODEL WITH ARREARS

5.1. Main equations

The settling the arrears' problem in Russia, as it was shown earlier, represents a difficult task due to the specific peculiarities of the Russian economy. The plan of settling the problem proposed at the end of 1998 reminds the scheme that was used in 1992 and can lead to the same consequences - to growth of inflation and decrease of the GDP [49]. In this connection, it seems urgent the construction of macroeconomic model for better understanding influence of analyzed earlier factors on economic indicators, primarily on the GDP.

In this chapter rather simple aggregate macro-economic model is proposed. Main equations of the proposed model are based on well known IS-LM of model offered for the first time by Hicks and frequently met in different modified forms. With the purpose of simplification of obtaining analytical results we shall assume, that there are not lags between variables and all dependencies are linear. Besides, we take into account the results of estimation of the parameters of equations (4a,b) è (6a,b).

The model includes income identity and equations for demand of money, arrears, and investment. On their basis analytical dependencies are obtained that permit to show ambiguous possibility for changing GDP with growth of arrears. It is shown with their help that under some conditions arrears can provide slow down of economic recession and conservation of production potential.

As a whole it is possible to distinguish the following blocks of the model.

1. The first dependence used in model is identity

$$Y = G + I + C + X, \quad (7)$$

where Y - income (GDP), G - governmental expenditures, \tilde{N} - consumption, I - investment, X - net export.

2. As the first main assumption of model it is supposed that the income (GDP) consists from two parts:

$$Y = Y_1 + Y_2, \quad (8)$$

where Y_1 - income produced by enterprises of real sector of economy which use barter and money substitutes in rather small scales and do not escape from taxes under the rate t_1 , determined by the law;

Y_2 - income, made on enterprises, belonging to the barter sector of economy and maximally concealing their income and thus minimizing the rate of the tax up to the level $t_2 < t_1$.

3. Accordingly with (8) in (7) the function of consumption of the kind

$$C = cY_1(1-t_1) + cY_2(1-t_2). \quad (9)$$

can be taken.

The consumption function (9) can be taken, taking into account (8), as the function of $Y \rightarrow Y_2$:

$$C = cY(1-t_1) + cY_2(t_1-t_2). \quad (10)$$

The function (10) differs from consumption function of the conventional kind:

$$C = c_1Y(1-t_1). \quad (11)$$

From (10) and (11) it is easy to receive dependence between the coefficients c and c_1 , as

$$cY(1-t_1) + cY_2(t_1-t_2) = c_1Y(1-t_1), \text{ or}$$

$$c_1 = c + cY_2(t_1-t_2) / Y(1-t_1) = c[1 + Y_2(t_1-t_2) / Y(1-t_1)] = f*c,$$

where usually $f > 1$.

4. The equation of money demand is based on the model (6a,b) with four factors (see above). Here we use its very simple linear modification as follows:

$$M = a_0 + a_1Y - a_2r + a_3N + a_4(e/P), \quad (12)$$

where M - real money aggregate M_2 , P - CPI, Y - real income (GDP), r - real refinancement rate or interbank credit rate, N - real value of arrears (it is supposed as earlier that the overdue creditors determines the volume of arrears), e - exchange rate in rbl/\$. All coefficients of the (12) are nonnegative.

It is supposed also that money demand M is equal to money supply M^s :

$$M = M^s.$$

5. The third equation is based on the equations (4a,b); it is in some degree is similar to (12) where instead of money aggregate some analog of real demand for arrears (more correctly on overdue creditors) N is estimated:

$$N = b_0 + b_1Y_2 + b_2r + b_3t_1 + b_4T + b_5(GKO/M_2), \quad (13)$$

where Y_2 - income received on the enterprises which use predominate barter, r - real refinancement rate or interbank credit rate, t_1 - tax rate, T - time (is included for accounting of the daily fine when the enterprise escapes from the taxes), GKO/M_2 - ratio of GKO in circulation to M_2 .

It is possible to propose that the demand on arrears (overdue creditors) N is equal to supply N^s ($N=N^s$); here we suppose that supply of arrears is really the total supply of trade credit, money surrogates and barter agreements by enterprises. The supply of arrears is entered analogously to money supply but it differs from it because we cannot speak about analogy with money authorities. The most simple to think about supply of arrears in the case of two enterprises when one of them demands for a trade credit and another one supply it. In the scales of the economy it is dispersed by separate groups of enterprises which form barter chains in distinction to centralized supply of money by money authorities).

In equation (13), as well as in (12), all coefficients $b_0 - b_4$ are supposed nonnegative, however the sign before the coefficient b_2 have to be positive as the arrears grow with increase of interest rate.

6. The dependence of investments from real interest rate is described by the simple model:

$$I = m_0 - m_1r. \quad (14)$$

5.2. Analytical relationships

5.2.1. Relationship between GDP and arrears (without limitation of budget deficit)

The equations (7), (12) - (14) taking into account (8)-(11) form the linear system of equations that can be written in the aggregate form as follows:

$$Y[1-c(1-t_1)] = G + X + m_0 - m_1r + cY_2(t_1 - t_2) = G_0 - m_1r + cY_2(t_1 - t_2), \quad (15a)$$

$$M = M^s = A_0 + a_1Y - a_2r + a_3N, \quad (15b)$$

$$N = N^s = B_0 + b_1Y_2 + b_2r, \quad (15c)$$

$$\text{where } A_0 = a_0 + a_4(e/P), \quad (15d)$$

$$B_0 = b_0 + b_3t_1 + b_4T, \quad (15e)$$

$$G_0 = G + X - m_0.$$

To resolve the system of equation (15a) - (15c) we determine expressions for Y_2 and r from (15b)-(15c) and substitute them in (15a):

$$Y = \{G_0 - [m_1A_0 + c(t_1 - t_2)(A_0b_2 + B_0a_2)] / b_1\} / a_2 + M[m_1 + c(t_1 - t_2)b_2 / b_1] / a_2 + N[c(t_1 - t_2)(a_2 - a_3b_2) / b_1 - m_1a_3] / a_2\} / \{1 - c(1 - t_1) + [m_1a_1 + c(t_1 - t_2)a_1b_2 / b_1] / a_2\},$$

or

$$Y = D_0 + k_1M + k_2N, \quad (16)$$

$$\text{where } k_1 = [m_1 + c(t_1 - t_2)b_2 / b_1] / a_2 > 0, \quad (17a)$$

$$k_2 = [c(t_1 - t_2)(a_2 - a_3b_2) / b_1 - m_1a_3] / a_2, \quad (17b)$$

k_2 may be $>$, $<$ or $= 0$.

Thus, the GDP (Y) - endogenous variable of the model (16) is considered as the function of the money demand M and arrears N . The variables Y_2 - income, made on enterprises, belonging to the barter sector of economy, and r - real interest rate are endogenous.

The most important result follows from formula (16) and (17b): we can see that the growth of arrears when $k_2 > 0$ promotes the growth of income (GDP) Y .

It is possible, as it follows from the expression for k_2 , when

$$\tilde{n}(t_1 - t_2)(a_2 / a_3 - b_2) / b_1 > m_1. \quad (18)$$

5.2.2. Relationship between GDP and arrears (case of limited budget deficit)

The formula (16) is valid in the case when the size of the ratio of the budget deficit to GDP is not limited, the governmental expenditures are exogenous. We can limit this indicator as follows:

$$BD \leq sY,$$

then for $BD = sY$ (when the share of budget deficit in GDP - s is fixed) the governmental expenditures can be determined as the sum of the budget revenues and deficit as follows:

$$G = BD + Y_1t_1 + Y_2t_2 = Y(t_1 + S) - Y_2(t_1 - t_2). \quad (19)$$

Substitution of (19) in formula (15a) gives the following expression for the coefficient k_2 :

$$k_2 = [(c-1)(t_1 - t_2)(a_2 - a_3b_2) / a_2b_1 - m_1a_3] / a_2 \quad (20)$$

As always $c < 1$, then from (20) and (16) it follows that *when s is limited then the growth of arrears leads to decrease of GDP.*

Thus, the limitation of the ratio budget deficit to GDP leads, from one hand, to decrease of the GDP when existing conditions are conserved, and, from other hand, it is one of the important factor of decreasing barter sector under a policy aimed on transition from shadow economy to normal one.

5.2.3. The conditions of growth of the GDP in the barter economy

The main conclusions that follows from received analytical expressions tell us that it is possible to determine conditions under which proliferation of arrears and barter provide decrease of slow down or conservation of the GDP.

Obviously, the probability of that, which depends whether condition (18) will be satisfied or not, will be increased in the following cases:

with increase of the tax rate t_1 , as well as difference between the rates of the taxation ($t_1 - t_2$) for normal and barter sectors of a economy;

with increase of sensitivity of money demand to change of real refinancement rate or with decrease of sensitivity of money demand to change of arrears (i.e. when coefficient a_2 , which determines the dependence of money demand from real interest rate grows relatively coefficient a_3 , describing dependence of money demand from arrears, see (12), (18));

with decrease of sensitivity of arrears to change of the GDP in the barter sector of economy that corresponds to slow down of coefficients b_1 è b_2 that characterize the dependence of arrears from GDP in the barter sector of economy and real refinancement rate, see (13), (18);

with decrease of sensitivity of investment and saving to change of real refinancement rate (i.e. with decrease of coefficient m_1 , that characterize the dependence of investments from the real refinancement rate, or with decrease of the ratio m_1 / c).

Analysis of the formula (16) confirms also, that arrears and dollarization of the economy can result in significant growth of the money velocity (see also [26; 1996, 1997]).

Thus, the dependence of economic growth from volume of arrears is ambiguous: under certain conditions the arrears can promote conservation of level of the GDP or decreasing rates of reduction of the GDP during transition to market

5.2.4. *Checking theoretical results by estimation of the model's parameters*

Checking hypothesis that at present (in short run) the barter and arrears lead to decreasing rates of reduction of the GDP during transition Russia to market is difficult due to our suggestion about linear character of equations, small number of points in time series, and non-reliable statistical information for some variables that. Obviously, the estimation of parameters for a such simplified model it is needed only for illustration of the theoretical ideas. It is worth to note as well that the chosen linear dependencies and short time series as well as insufficiency of the statistical information for some variables make using complex modern econometrical methods of estimation and determination of statistical characteristics inexpedient. That is why it is necessary to look at the results given below as rather approximate ones. Nevertheless, from our point of view, it is possible to use them for approximate assessment of a possibility of existence of a such relationship between coefficients of the macromodel when the condition (18) is satisfied.

Lets examine the peculiarities of determination of parameters of the model.

The estimates of parameters of (14) for I were received on the basis of annual data for GDP (only six points) and structure of its utilization with the help of share of gross accumulation of fixed capital (almost the same results were received with use of share of investment in the fixed capital).

The coefficient \tilde{n}_1 , see (7) - (10), was determined taking into account that the final consumption expenditures of households and noncommercial organizations, servicing home facilities were equal to 50,2% GDP in 1996 (1993 - 46,3%, 1994 - 47,1%, 1995 - 51,4 %), see a structure of using GDP (Russian statistical year-book [50]), and share of the total sum of tax deductions in GDP t_1 , determined from the account of formation of the income as the sum of the net taxes on production and import (including taxes on products - VAT, excises, and etc. and taxes on imported goods and services) plus charges on wages, was equal in 1994, 1995 and 1996 about 28%, 27,5% and 29% GDP accordingly. Thus, for 1996 the coefficient of consumption was equal to $c_1 = 0,71$.

Comparison of this value with parameters for other countries shows that it is significantly lower then in USA - 0,88, France - 0,78, Germany - 0,80 etc. [⁵¹]. It is worth to note that this indicator is relatively stable, thus in France of 1960-s it was equal to 0,79 [⁵²].

The estimates of the coefficient $c = c_1 / f$ were made for $f=1,0 - 1,2$.

The estimates of parameters of linear equations (12)-(13) were made by two ways.

The first way was based on linearization of equations (4a) and (6a), calculation of coefficients of linearized equations in several points and their substitution in the expression for k_2 (17b) or in

(18). Linearization of expression like $x = \ln T$ in (4a) and (6a) was made with the help of Taylor's series at the point (x_0, T_0) [26; 1984]:

$$x \cong x_0 + x'(T_0) \cdot (T - T_0) = \ln T_0 - 1 + T/T_0.$$

Then linearized variant of the model (4a) has the following view:

$$N = B_0 + [b_1 \cdot (N_0/Y_2)]Y_2 + [b_2 \cdot N_0](R - R_0) + [b_3 \cdot (N_0/(GKO/M_2)_0)](GKO/M_2) + [b_4 \cdot N_0](D_1 - D_{10}),$$

where B_0 is a weighted sum of coefficients of (4a).

Substitution of calculated coefficients a_2 , a_3 , b_1 and b_2 at the left side of (18) has shown that at the end of period under consideration the condition (18) was true, i.e. $k_2 \geq 0$ ($a_2 = 1,45 - 1,71$; $a_3 = 0,15 - 0,13$; $b_2 = 8,49 - 11,25$; $b_1 = 5,59 - 4,76$).

The second way was based on econometric estimation of parameters of approximate models (12)-(13) with using minimum statistical characteristics. It gave the following results for the period (1993:4-1997:8): $a_2 = 1,90$ (6,18); $a_3 = 0,134$ (4,91); $b_1 = 5,80$ (12,20); $b_2 = 2,31$ (8,51); $m_1 = 0,044$ (0,011), where in parenthesis standart deviations are given. Substitution of these coefficients in (18) shows that $k_2 = > 0$ for $f = 1 - 1,2$.

Thus, the received estimates show that condition (18) is satisfied and do not refute the hypothesis that in Russia arrears and barter in a short-term period act in the direction of preservation of economic and technological potential.

5.3. Main conclusions and recommendations for reduction of arrears and stabilization of the economy

The received results permit also to offer a number of macroeconomic recommendations for reduction of arrears, and subsequently stabilization of the Russian economy. *First of all, the reduction of arrears is necessary to execute stage by stage taking into account that at the first stage direct reduction of arrears and barter by various prohibitive measures can result in decrease of the GDP and collapse of the economy.*

Analysis of the model (16) shows that the *decision of problem of arrears is a system task which demand for its resolving the following:*

first, it is necessary to increase sensitivity of the economy, including investment activity to change of interest rate "r" at the expense of its gradual reduction (thus coefficients m_1 , a_2 and b_2 of the model which depend nonlinearly from r will grow);

secondly, it is expedient to lower the general total rate of taxation t_1 (taking into account also the taxes for governmental non-budget funds) with simultaneous toughening control of tax collection;

thirdly, transition to the circulation of the real bills instead of money substitutes is necessary; it will allow to restore links between two sectors of the money and goods circulation (it is possible to expect that this measure will lead to respective change of coefficient a_3); it have to be analyzed the possibility of using non cash money;

at the next stage a system of arrears should be destroyed on the basis of appropriate legislative measures, wide use of procedure of bankruptcy, and etc. (this measure will allow to increase considerably efficiency of the economy); on this stage it is necessary to state more strong limits on the budget deficit with its changing by profit (thus the coefficient k_2 as a result of these measures, as appear, will change its sign on negative and the reduction of arrears N will lead to growth of the GDP); it is possible to propose also that the consumption will be increased.

The main measures on financial improving of the economy, restructuring of debts should provide, obviously, gradual replacement of barter, bills of enterprises, and commodity credits by payments in money with amelioration of structure and increase of current assets as well as under condition of decrease of tariffs on the products and services of natural monopolies. At last, it is appropriate to think over (for the short-run period) using two kinds of money for cash and non-cash payments.

Thus, the solution of problem of arrears, that is aggravated by system changes in the Russian economy, and correspondingly, of stabilization and market reforms demand the realization of the

whole complex of subsequent measures, in particular those aimed on providing financial stability, realization of industrial policy, support of rights of investors (both residents and non-residents), decrease of risks and strong social differentiation, etc., for which the more strong governmental control is necessary.

6. CONCLUSIONS

The received results indicate on the system changes in the Russian economy which are characterized by changing the regime of the system of money circulation after the first stages of transition and its breaking down to two relatively autonomous sectors.

Results of economic analysis became the basis for specification and assessment of parameters of the system of econometric models that includes model of money demand and model of arrears; the specific feature of the model of money demand is the inclusion in it arrears.

On the basis of economic analysis of arrears and barter in the Russian economy and constructed econometric models the new rather simple aggregate macroeconomic model, described by system of linear equations, is elaborated. With its help some analytical relationships were received that help to explain the influence of different economic factors and elaborate some recommendations for resolving problem of arrears and stabilizing the Russian economy.

7. APPENDIX I. MAIN STAGES OF TRANSITION TO MARKET

In the Appendix the shortened characteristics of main stages of transition identified by the author is given. In the qualitative investigation of processes in the transitional economy the phase diagrams were widely used. With their help the analysis of stages of transition, appropriate to decisions that were accepted according to conventional monetarist theory is facilitated. These stages are easily distinguished at the analysis of a trajectory of change of money aggregates. In particular, the phase diagram, describing mutual change of real money aggregates M0 and M2 and some other (fig. 3a,b) reflects well changes in the money and credit policy and reaction of the economic system on them.

It is worth to note that investigation of stages of transition is necessary step before econometrical estimation of parameters of the models elaborated in the project.

The economic analysis permits to distinguish the following stages of transition.

1. January - June 1992. The main efforts were concentrated on liberalization of prices and balancing the budget. To the end of February the level of monthly inflation was equal to almost 40% (after 245% in January) and in the beginning of June 1992 it reached about 12%. The real money aggregates M0 and M2 have decreased in 3.7 and 4.5 times accordingly relatively to their values on 1.1.1992 (fig. 3a). The share of M0 in M2 was increased from 17.9% up to 22%; the share of money on accounts of banks and some enterprises has considerably grown from 36.3% on 1.1.1992 up to 50.8% on 1.7.1992 at the expense of double decrease of share of deposits of the households in Sberbank (from 40.1% up to 20,9%). To the end of the stage the real volumes of total credits of the CBR and seigniorage have come close together (tab. 1A), the credits of the CBR have partially compensated losses of enterprises from the inflationary tax; the arrears increased significantly.

2. July - September 1992. The withdrawal from tough money and credit policy. To a great extent due to increased crediting the economy and liquidation of arrears the former volumes of production were restored. The lag between emission of money and inflation promoted the growth of real money aggregates: M0 was increased more than in 1.5 and M2 - in 1.6 times. As a result the real GDP has increased. The seigniorage has on average grown almost up to 30% of GDP, the level of reserves was increased up to 0.4 - 0.5. The rates of inflation have increased up to its level on the first stage. The monthly average wage was not almost increased (23 US\$).

3. October 1992 - June 1993. Having toughened in October and beginning of November, the money and credit policy was softened before the 7th Congress of deputies; after that it was again toughened with the purpose to receipt the first half of the IMF credit on system transformations. From beginning of April 1993 the limits on level of the credits of the CBR were established and to the end of the period their increase as well as the technical credits to countries of the CIS were stopped. The rate of refinancement was sharply increased from 100% up to 140% in June 1993. As a result, surplus of the budget was received. The seigniorage relatively to GDP has decreased till 14% on the average. The share of deposits of the population in the aggregate M2 was equal to 14,6 %. The level of real wages was about 30 US\$ to the end of the stage. The real money aggregates M0 and M2 were again reduced - to 18 % and 46 % accordingly; to the end of the year the share of M0 in M2 was increased up to 23,9 %. The excessive reserves of commercial banks exceeded the required ones. During 1.2.1992-1.2.1993 the level of coefficient c was the lowest: $c = 0.2-0.4$, the norm of total reserves r has significantly increased up to 0.6; to the end of the period the share of reserves in money base has decreased a little but still was high (more than 57%), as a result the multiplier μ has decreased from 3.2 till 1.3-1.7.

July - December 1993 . In the third quarter of 1993 the money and credit the policy was again softened because of aggravating social problems. The budget was adjusted by Parliament in the direction of increasing the deficit. Besides, in July the first part of the IMF credit for system transformations (1,5 US\$ bln) was received. The main part of the credit to government was financed under

the preferential rate equal to 10 % by the CBR; the issue of GKO was insignificant. The policy has been toughened in September, but after tragic events in the beginning of October and due to elections of new Parliament in December the monthly average wage was considerably increased; at the end of the stage it was in 2.5 times higher than in the beginning (on the average for the stage it has become equal to 76.5 US\$). It should be noted that the growth of the average wage corresponds also with the termination of technical credits to the CIS countries and the subsequent elimination of subsidized credits at the end of September, the reduction of import subsidies and liberalization of prices on energy as well. The real aggregates M0 and M2 decreased by 11% and 31% accordingly. The share of M0 in M2 has reached 36,2% to the end of the period. The share of reserves in money base has decreased from 60% till 49%. From the middle of the third and during the fourth stage the money multiplier μ changed insignificantly in the range 1.4-1.7, and the transition to the new trajectory with higher parameter c and smaller r has occurred. The international reserves have considerably grown (see tab. 1A).

Fig. 3a. The phase diagram: M0/P (M0/PCI) versus M2/P (M2/PCI).

Fig. 3b. The phase diagram: M0/P (M0/PCI) versus M2/P (M2/PCI).

Table 1A

Main indicators of the money and credit system by stages of transition

Year&month, end of period	92:7	92:10	93:7	94:1	94:11	95:4	96:1	96:7	97:6	97:10
Stage number	1	2	3	4	5	6	7	8	9	10
TIME, N of month	7	10	19	25	35	40	49	55	66	70
Indicators										
M0/P, in average for a stage, conditional units	44,7	64,0	58,9	53,7	51,6	37,6	39,2	43,7	45,7	43,3
M2/P, in average for a stage, conditional units	221,8	271,4	217,5	142,4	129,6	108,0	109,5	119,6	131,5	152,6
MB/P, in average for a stage, conditional units	54,2	79,0	78,5	68,6	66,7	52,0	52,5	56,5	58,1	69,8
Seigniorage / GDP(Δ MB2/GDP), %	18,9	31,0	13,1	11,5	6,4	2,6	4,5	2,6	1,0	2,7
Seigniorage / GDP(Δ MB1/GDP), %	9,2	14,4	10,3	8,8	5,5	1,9	4,2	2,6	0,8	2,5
Consumer price index (P), change at a stage, times	6,7	12,4	45,1	176,7	425,2	917	1552	2033	2255	2446
Inflation, in average for a stage, %	61,0	11,0	22,4	20,0	9,1	13,8	5,6	2,5	1,1	0,4
$c = M0/D$, in average for a stage	0,26	0,31	0,38	0,62	0,66	0,53	0,56	0,57	0,53	0,59
$r = R/D$, in average for a stage (total)	0,32	0,47	0,49	0,49	0,43	0,38	0,33	0,26	0,24	0,24
$rr = Rr/D$, in average for a stage (required)	0,06	0,07	0,13	0,17	0,19	0,20	0,19	0,17	0,15	0,14
Multiplicator, in average for a stage	4,1	3,4	2,8	2,1	2,0	2,1	2,1	2,1	2,2	2,2
V(M0), in average for a stage, yearly estimate	24,9	23,3	27,9	24,7	24,3	29,8	30,0	22,1	24,5	19,9
V(M2), in average for a stage, yearly estimate	5,1	5,5	7,8	9,4	9,7	10,3	10,7	8,0	8,5	7,4
Exchange rate, ruble.	158	286	736	1155	2071	4032	4633	4915	5550	5824
GDP/PCI in average for a stage, conditional units ^{*)}	92,3	125,4	136,1	110,8	104,5	92,4	97,7	80,1	92,7	93,6
GDP/PWI in average for a	88,6	101,7	99,1	71,8	62,3	54,8	50,0	41,4	46,4	47,6

stage, conditional units ^{*)}										
Wage, \$., in average for a stage	20,3	22,7	29,7	76,5	95,5	81,6	115,9	150,6	157,8	171,4
Overdue payables / P, in average for a stage, conditional units	62,2	148,8	66,0	56,9	104,9	110,3	119,2	154,7	231,4	278,9
Overdue payables / M2, in average for a stage, times	0,28	0,55	0,30	0,40	0,81	1,02	1,09	1,29	1,76	1,21
International reserves, \$, mln. in average for a stage			1839	5660	4904	4422	12018	15109	12921	19633
Exchange rate, change at a stage, times	0,7	2,5	2,7	1,2	2,5	1,6	1,0	1,1	1,1	1,05

*) Data of the Goskomstat for the beginning of 1992 are very approximate.

5. January - October 1994 . The monthly rate of inflation was reduced till 5-8 % due to more tough finance and credit policy aimed on the receipt of 1,5 US\$ bln from the IMF. Beginning from 1.6.1994-1.8.1994 the money policy has especially become tough, seigniorage has decreased almost in 2 times and it could not already compensate the budget deficit. The absence of money in treasury was compensated by non-traditional actions of the CBR that have led to so named "black Tuesday" in October 1994 when ruble has fallen by 28 % in relation to dollar and international reserves from 6.2 US\$ bln (as of 1.8.1994)) till 3.3 US\$ bln (as of 1.11.1994). The deficit of the federal budget was financed mainly at the expense of the credits of the CBR and the issue of GKO has gradually become to be expanded. Though the monthly average wages was increased up to 95.5 US\$ (partly due to the growth of domestic prices on production of manufacturing up to the world level), at the end of the stage it decreased to 77 % of the level on 1.1.1994. The real money aggregates M0 and M2 on the average for the period have not changed; the level of reserves has decreased on the average below 40%. Cash/deposits ratio ($c = 0,64-0,75$) was on the average in 1,5 times higher then the norm of reserves r ; money multiplier μ changed insignificantly (1.4-1.5).

6. October 1994 - beginning of April 1995 . The money and credit policy in 1995 was aimed at decrease of monthly rates of inflation to 4%. The use of direct credits of the CBR for financing budget deficit of the federal was practically terminated, and already in the 1st quarter of 1995 the income from GKO and KO gave almost 80% of internal financing budget deficit. The seigniorage/GDP ratio was again reduced almost in 2 times. The tough money and credit regulation influenced negatively development of science-intensive industries and agriculture. The monthly average wage was decreased by 14% (till 81.6 US\$) [53]. Real aggregates M0 and M2 has sharply reduced by 39% and 31% accordingly. The ratio cash/deposits has decreased, on the average, to $c = 0.55$, the money multiplier has exceeded 1.7, the norm of reserves has decreased, on the average, by 5-6 %. The real refinancement rate had practically no influence on change of money aggregates and some other parameters.

7. April 1995 - February 1996 . More tough finance and credit policy aimed on decrease of budget deficit to 4% of GDP in 1996 has resulted in increase of non-payments. In June and especially in July 1995 the total sum of credits has for the first time decreased, that in coincidence with slow down of dollar (relatively to ruble) and decrease of income from issuing GKO has resulted in bank crisis in August 1995. The real money aggregates M0 and M2 have grown as well as the seigniorage has increased a little relatively to GDP. However additional money resources were not assimilated by economy, they were periodically transferred, with speculative purposes, from the bonds market to exchange market and back. Since September 1995 the level of international reserves was relatively stabilized. From 1.08.1995 till 1.01.1996 the cash/deposits ratio has again increased and reached 0.62 on the average; the multiplier was equal to 1.6. The wages were increased by 53% on the average [54].

8. January - June 1996 . In the beginning of 1996 the decree about pricing has come into force, limiting increase of the prices on products of natural monopolies by the rate of inflation. The

enterprises performing in 1996 current tax obligations, have received the right on deferment of the old debts. However the analysis of data for the period of 1.02.1996-1.06.1997 has shown that this measure (investment tax reduction for five years which meant writing off debts) in certain measure has calmed debtors, and the real size of the overdue arrears gradually increased. The preparation to the president's elections has considerably affected the money and credit policy. GKO Yield was sharply increased. During March the seigniorage has increased relatively GDP, to the middle of July the yield from GKO has reached maximum level (215% annual). In the beginning of June the CBR has transferred to the Federal budget 5 trln. rubl. from its profit. Reserve requirements for commercial banks were simultaneously increased from 18 up to 20 % for the ruble deposits for the period of 30 days and from 1.25 up to 2.5 % on currency deposits. To the end of period lower limit for net and gross international reserves and upper limit for internal net assets and credits to federal and consolidated budget were established. In April and May, with the purpose of slowing down growth of volume of money, the CBR has sold more than 3 US\$ bln. of currency reserves. The quantity of money that was in circulation increased almost by 20 %, that was connected with preelection promises; money base was increased, and the multiplier has decreased a little to the end of the period. The M_2 aggregate was increased basically for account of the M_0 . Such a large growth of the cash money supply was called by two reasons: repayment of the wage arrears to the workers of budget branches before president's election, and some decrease of deposits in foreign currency in commercial banks because of increase of risks. The real GDP at the first half-year 1996 has decreased by 3 %. The level of the tax collection has decreased to 77 % from planned one because of the fall of monthly inflation to 1.6 %. The nonpayment of taxes has increased also because of shortage of liquid assets of enterprises as a result of financial stabilization. The deficit of consolidated budget in the first half-year 1996 reached 5.5 % of GDP.

9. July 1996 - June 1997. In the beginning of the stage the CBR has canceled, under pressure of commercial banks, the decision to increase the reserve requirements. After president's elections the IMF has accepted the decision to give the February tranche (330 \$ mln.). At the end of November it was announced about extension in 1997 of the exchange corridor with change of limits from 5500-6100 rbl./US\$ (as of 1.01.97) up to 5750-6350 rbl./US\$ (as of 31.12.97). After acceptance of the law on the budget with deficit equal to 3,5 % of GDP and some improvement of a situation with the tax collection the IMF has granted an October tranche (336 \$ mln.). Deficit of the Federal budget in 1996 was equal to 3.6 % of GDP with significant decrease of the revenues relatively to the plan. The program of financial stabilization was fulfilled for parameters of money-credit aggregates, but the lower limit for gross and net international reserves was not fulfilled. In the beginning of February the Government has declared decision to continue restriction of the tariffs on production of natural monopolies, and the IMF has paid to government the November and December (1996) tranches (647,2 \$ mln. each) of the extended credit (10.1 US\$ bln). To this time the rate of refinancement was reduced up to 42 %. At the end of March the CBR has declared downturn of the reserve requirements for ruble deposits and increasing them for deposits in foreign currency since May 1, 1997.

The structure of the internal credit was considerably changed to December 1996 as the demand for the credit was characterized by accelerated growth due to claims of extended government (gradual growth of share of net credits to extended government from 40,9 % up to 55,6 % during 95:9-96:11). Crediting enterprises of private sector and nonfinancial state enterprises changed very weakly because of the high rate of refinancement.

10. July 1997 - beginning 1998.

There were some indicators of slowing down the economic recession in Autumn 1997, that show decrease of inflation, growth of real money and GDP, wages, etc. However, unstable financial positions due to growth of the government debt connected with GKO and large volume of it in hands of non-residents (about 20 \$bln. that was equal to international reserves, see tab. 1A) made the economy very sensitive to external factors that was seen in 1998. The growth of arrears was faster than growth of the GDP and money that reflected serious problems of the stabilization policy.

**8. APPENDIX II.
TABLES WITH MAIN STATISTICAL DATA AND ESTIMATES**

Table 1

The share of overdue liabilities and receivables of enterprises in the Russian economy, % (estimated by the data from [Russian statistical year-book] and [Social and economic situation in Russia [30]]).

	1993	1994	1995	1996	1997
Share of total overdue liabilities in the total liabilities	30,0	43,8	43,5	50,5	53,8
Share of overdue creditors in the total creditors	34,9	51,9	49,5	54,6	58,7
Share of overdue liabilities to banks in the total liabilities to banks	9,7	12,4	11,6	18,9	15,8
Share of overdue debtors in the total debtors	41,3	53,6	45,6	50,7	54,2

Table 2

Share and average payment period of overdue creditors and debtors, end of period (estimated by the data from [Social and economic situation in Russia, [30]]).

	Share of overdue creditors and debtors more than 3 months, %		Average payment period of overdue creditors and debtors, months	
	overdue creditors	overdue debtors	overdue creditors	overdue debtors
January 1996	63,1	65,9	...	...
November 1996	71,3	75,4	4,9	3,5
January 1997	72,7	75,3	6,1	4,3
November 1997	77,1	81,2	7,1	4,7
December 1997	77,2	81,8	6,1	4,0

Table 3

Structure and dynamics of the overdue liabilities of enterprises in the Russian economy (industry, transport, construction, agriculture), % (estimated by the data from [55]).

	Total overdue creditors of enterprises	including overdue payables to suppliers	to the budget	to the extra-budgetary funds	overdue wages
January 1996	100	50,1	25,4	13,0	6,1
January 1997	100	47,1	22,2	18,8	6,7
November 1997	100	45,0	22,4	19,7	5,4
December 1997	100	45,6	21,5	20,4	5,3

Table 4

Overdue creditors by main branches of the Russian economy, 1.01. 1998, % (estimated by the data from [55]).

	Overdue creditors	overdue payables to suppliers	overdue payables to the budget	overdue payables to the extra-budgetary funds	overdue wages	with period of payment more than 3 months
Industry	100	44,9	22,6	19,9	7,7	75,7
Agriculture	100	38,7	13,1	36,2	10,9	85,7
Construction	100	35,2	25,8	20,7	4,8	73,1
Transport	100	58,1	18,4	11,6	2,7	81,4

Table 5

Structure of the overdue debtors by branches of the Russian economy, numerator - as of 1.01.1997, denominator - as of 1.01.1998, % (estimated by the data from [55]).

	Overdue debtors	overdue receivables from customers	including overdue receivables by bills	of government for supplied products	with period of payment more than 3 months
Industry	100/100	85,7 /86,6	1,3 /1,0	3,2 /2,4	81,8
Agriculture	100/100	81,2 /79,9	0,8 /0,6	4,2 /2,3	84,9
Construction	100/100	90,0 /88,6	1,0 / 0,8	9,7 /7,2	73,5
Transport	100/100	94,0 /91,5	0,1 /0,2	0,2 /0,1	94,0

Table 6

Ratio of overdue creditors (total and overdue payables to suppliers) to overdue debtors (total and overdue receivables from customers) by branches, % (estimated by the data from [55]).

	1.01.1997 *)	1.01.1998 *)
Total for four branches	...	152,3/ 80,2
Industry	154 / 81,6	158/ 81,9
Agriculture	394 / 205	423/ 253,3
Construction	113 / 49,3	125/ 49,7
Transport	104 / 71,7	115/ 73,0

*) in a numerator - a ratio of overdue creditors to overdue debtors (total), in a denominator a ratio of the overdue payables to suppliers to the overdue receivables from customers (product of data from tab. 6 and tab. 4, divided on data from tab. 5).

Table 7

Structure of wage arrears (estimated by the data from [55]).

	Budget overdue payables to employees		Overdue payables to employees due to the lack of the own means of enterprises		Total overdue wages	
	1.01.1998 bln.rubles	1.01.1998 in % to 1.12. 1997	1.01.1998 bln.rubles	1.01.1998 in % to 1.12. 1997	1.01.1998 bln.rubles	1.01.1998 in % to 1.12. 1997
1	2	3	4	5	6	7
Total	4940	53,1	44113	95,4	49053	88,3
including: production branches	2322	93,7	43286	95,9	45608	95,8
including:						

	Budget overdue payables to employees		Overdue payables to employees due to the lack of the own means of enterprises		Total overdue wages	
	1.01.1998 bln.rubles	1.01.1998 in % to 1.12. 1997	1.01.1998 bln.rubles	1.01.1998 in % to 1.12. 1997	1.01.1998 bln.rubles	1.01.1998 in % to 1.12. 1997
1	2	3	4	5	6	7
industry	1245	97,6	25362	95,8	26607	95,9
construction	388	92,1	7069	96,4	7457	96,2
agriculture	73	75,0	7892	97,5	7965	97,2
transport	616	89,9	2963	92,4	3579	92,0
branches of social sector	2618	38,4	827	72,4	3445	43,3
including:						
education	1382	34,8	40	65,7	1422	35,2
health	574	31,2	225	45,9	799	34,3
culture and art	132	29,7	11	87,3	143	31,4
R&D	530	94,5	551	95,2	1081	94,9

Table 8

Structure of costs of production for industry (total = 100%), % (estimated by the data from [55]).

	material costs	from them: raw materials and materials	fuel and energy	salaries and assignments on social needs	depreciation	other
1986 USSR	72,9	...	...	14,4	9,3	3,4
1990 (USSR)	70,2	63,9	6,3	14,9	11,4	3,5
(Russia)	68,6	...	...	15,2	12,1	4,1
1991	70,9	...	...	17,5	3,0	8,6
1992	66,3	...	...	15	2,6	16,1
1993	63,1	40,3	12,9	18,1	0,9	17,9
1994	57,4	32	15,9	18,6	6,2	17,8
1995	63,8	34,2	17,4	14,6	6,4	15,2
1996	60,6	30,6	17,8	15,8	9,3	14,3

Table 9

Change of the ratio of price indexes for the enterprises-producers in the industrial branches to price index for fuel industry (estimated by the data from [55])

	1992	1993	1994	1995	1996
Industry, total	0,36	0,50	0,55	0,53	0,49
Fuel	1	1	1	1	1
Electric power	0,59	1,11	1,22	1,26	1,26
Ferrous metallurgy	0,39	0,64	0,72	0,72	0,62
Non-ferrous metallurgy	0,56	0,51	0,68	0,51	0,40
Chemistry	0,42	0,55	0,66	0,61	0,52
Petrochemicals	0,58	0,61	0,73	0,68	0,58
Machinery	0,29	0,42	0,46	0,45	0,38
Forestry and paper industry	0,22	0,30	0,36	0,34	0,27
Stone, clay, glass industry	0,30	0,52	0,54	0,50	0,46
Textiles	0,14	0,15	0,16	0,15	0,13
Food & beverages	0,29	0,43	0,45	0,40	0,34
Transport	0,38	0,97	1,13	1,06	0,92
Construction	0,17	0,28	0,49	0,46	0,56

Table 10

Balance of overdue payables to suppliers and overdue receivables from customers of the enterprises and organizations of main branches of a economy, bln.rbl. (estimated by the data from [55])

	1993	1994	1995	1996
Total for all branches	4586,5	12502	24596	50321
Industry	3180,2	7471	16850	15359
including:				
power industry	749,8	2703	9810	19041
fuel industries	1137,2	3321	5574	8264
ferrous metallurgy	772,1	1045	404	-2207
nonferrous metallurgy	-165,8	-382	-20	-1987
chemistry	97,4	-715	-1034	-3408
machinery	399,9	1307	1919	-1858
forestry and paper industry	19	-188	-295	-1487
stone, clay, glass industry	29,8	78	-2	-108
textiles	103,1	78	-68	-616
food & beverages	46,6	236	357	-268
Agriculture	69,5	-1229	-3727	-10407
Construction	732,7	3444	8749	16250
Transport	604,1	2816	2724	29119

Table 11

Ratio of balance of the overdue payables to suppliers and overdue receivables from customers to the overdue payables to suppliers of the enterprises and organizations of main branches of a economy, % (estimated by the data from [55])

	1993	1994	1995	1996
Total for all branches	15,8	12,0	9,3	10,3
Industry	14,1	10,2	9,7	4,9
including:				
electric power industry	31,8	19,0	25,1	20,0
fuel industries	18,6	19,1	16,7	15,5
ferrous metallurgy	33,6	14,8	2,5	-8,8
nonferrous metallurgy	-12,7	-9,2	-0,2	-12,2
chemistry	4,0	-10,5	-6,3	-13,1
machinery	11,6	10,4	6,1	-3,5
forestry and paper industry	2,3	-8,5	-5,1	-15,1
stone, clay, glass industry	5,1	4,0	0,0	-1,2
textiles	21,4	6,2	-2,1	-12,1
food & beverages	3,2	8,0	3,9	-2,1
Agriculture	4,4	-24,1	-26,3	-40,0
Construction	28,3	37,6	38,6	40,4
Transport	26,8	16,6	4,9	26,8

Table 12

Dynamics of total fixed capital and inventories in Russia (estimated by the data from [Russian statistical year-book] [55]).

Year	Total fixed capital, bln.rubles	Inventories, bln.rubles	Inventories / Total fixed capital, %
1980	1065	298	27,98
1990	1927	489	25,38
1991	2061	786	38,14
1992	43215	4281	9,91
1993	1189561	71475	6,01
1994	4891691	193294	3,95
1995	13870477	296147	2,14
1996	19126370	307260	1,61

Table 13

Breakdown of current assets of enterprises and organizations of main branches of economy in Russia and the former USSR (the total value of working capital is equal to 100 %), % (estimated by the data from [Russian statistical year-book [55]] and other editions of the Goskomstat).

Year Indicator	1996 (Russia)	1994 (Russia)	1990 (Russia)	1990 (USSR)	1980 (USSR)
Inventories	33,6	37,9	64,7	61,6	74,2
VAT	4,4	...	...	...	...
Receivables account (trade credit extended)	52,2	49,9	5,7	8,4	9,8
Short term financial investments	1,8	...	...	...	...
Cash	2,6	4,0	17,5	15,2	8,8
Other assets	5,4	8,2	12,1	14,8	7,2

9. APPENDIX III. PRICES IN THE BARTER SECTOR OF THE ECONOMY

The mean level of prices at barter, obviously, depends on rates of inflation: at high inflation it grows, that is confirmed by data on index of the wholesale prices of enterprises for 1993-1994 (in this period also the factor of growing home prices relatively the world ones existed) and at low inflation the role of prices is considerably reduced and the index of the wholesale prices changes practically synchronously with index of consumer prices. Comparative analysis of dynamics of indexes of consumer prices and wholesale prices for industry (prices of the manufacturers), as well as volume of overdue creditors shows that the rates of change of arrears correlates with the rate of growth of the ratio of wholesale price index WPI to CPI (WPI / CPI), see fig. 4.

Fig. 4. The change of the ratio of consumer and wholesale price indices (PWI/PCI) and overdue creditors (OVCRE) in 1992:2 -1998:5.

The highest rates of growth of the overdue creditors that were observed till the middle of 1993 when the accelerated growth of the WPI (which can be explained, besides high inflation, also by growing of home prices to the world level) was replaced by a stage of stabilization of the ratio between indexes in the second half of 1993 and beginning of 1994. Transition to the currency corridor and expansion of the market of GKO that was accompanied by strengthening of outflow of money from the real economy into bank and financial sector, promoted the completion of formation of the barter sector in the Russian economy; under conditions of low inflation in the second half of 1995, as appear, proportions between the prices for production exchanged by barter and purchased for money were established and till August 1998 the ratio of prices on goods in real money and in barter rubles was relatively stable within the limits of 1:(1,5-2).

It is necessary also to take into account the peculiarities of price calculation under barter. The determination of revenue from realization of production (work, services) is made thus in accordance with payment or shipment of the goods, fulfillment of work or services; however in any case in the debit of the accounts of realization the cost of production shipped by the enterprise is written off. Thus, the cost of production becomes the basis for the subsequent taxation of the enterprise, in spite of the fact that the agreed prices for exchanged production were specified in the agreement of exchange. However this practice leads to other problems, similar to those which took place in a planned economy when the cost was used as the basis for accounts (see, for example, [Varshavsky, 1986 [56]]).

In addition, at calculation of the profit tax accordingly to instructions of the State tax service the profit for the purposes of taxation should be determined on the basis of the average price of re-

alization of similar production calculated for the month, in which the given bargain was made, or on the basis of price of the last realization, but not below the actual cost. Thus, the agreed price on the exchanged goods is not actually taken into account when taxes are calculated, and the cost and price of realization on the market of similar production becomes the base parameters. Obviously, in this case the overestimate of the cost becomes the main purpose of enterprises participating in the bargain and desiring to lower the size of the profit tax [Dan & Valeksa [57]]. Besides, the enterprises receiving (more often by barter) the raw materials with the overestimated prices, until recently were frequently compelled to use barter, as they could not sell their products with the price below the cost (accordingly to the anticrisis program it is now permitted).

Let's analyze some examples of setting prices in the barter sector of economy.

Metallurgy. On the home market up to 90% of production of metals (enterprises of this branch in the large degree depend from monopolists - suppliers of raw materials, fuel and energy as they consume more than 25% of coal and 25% of the electric energy and their share of cargo rail transportation is equal to 30%) is realized with the help of barter and bill forms of payment. And the home prices on metals are determined by the suppliers - monopolists. As a whole the enterprises of the branch have overdue creditors that more than by 100% exceeds overdue debtors. To receive real money, enterprises of the branch are compelled to export or to sell on the home market their own production by dumping prices [Finansovie izvestiya, 28 May 1998 [58]], see also before.

Automotive industry. An impressive example concerns the situation of prices of cars produced by the biggest Russian car producer "AvtoVAZ" in the beginning of 1998. At present, in accordance with the practice of the last years, one part of cars produced by "AvtoVAZ" is transferred by barter (for shipments of raw materials, materials and parts) and the second part - by advanced payments; correspondingly the network of dealers was developed (we do not write here about the bribery in the beginning of the transition). In the first half of 1998 "AvtoVAZ" offered to the dealers with advanced payment the cars by price that was by 18% lower than selling price of the factory. However retail price of automobiles in the market was on 20-22 % below the selling price of the factory; therefore it was unprofitably for dealers to acquire cars for money and to a middle of April 1998 factory could not ship about 20000 automobiles Apparently, the levels of market prices and prices in the barter sector were quite different [Lange [59]].

Even more indicative is the fall of prices on cargo cars of "KamAZ": in 1997 the price for a lorry has fallen because of barter up to 85 thousand rubles with the cost equal almost to 200 thousand ruble; in May 1998 the price has mounted up to 135-140 thousand rubles due to preliminary payments of government of Tatarstan for lorries intended for agriculture [NG-Politekonomiya [60]]. The production of automobiles at factory in October 1998 was increased by four times in comparison with September due to the commodity credit given by the government of the republic in the form of tires and polyethylene, which were exchanged on components and materials, as well as at the expense of sharp reduction of production costs [Vremya, 4 November 1998, p. 4 [61]].

Such situation is similar as well for other automobile enterprises. For example, cars of factory "UAZ" were sold by the dealers-middlemen by price of 25 thousand rubles, that was below than on market (we can not think about bribery in this case) [Rossiya [62]].

Export of goods. Because of limitation of the market and absence of working capital in enterprises - consumers under conditions of economic recession the export of products very often becomes a major source of raising money. However because of weakness of positions of many enterprises on the world market, they are frequently compelled to sell their products significantly cheaper than on the home market [63] (e.g. the relation between prices on machinery products is equal: for tractor "Ö-30" 9500 \$ on domestic and 5000 \$ on external market, for car "VAZ-2109" - 8300 \$ and 4400 \$, universal lathe - 9000 \$ and 6600 \$, watches - 7 \$ and 4,5 \$ correspondingly).

10. FIGURES

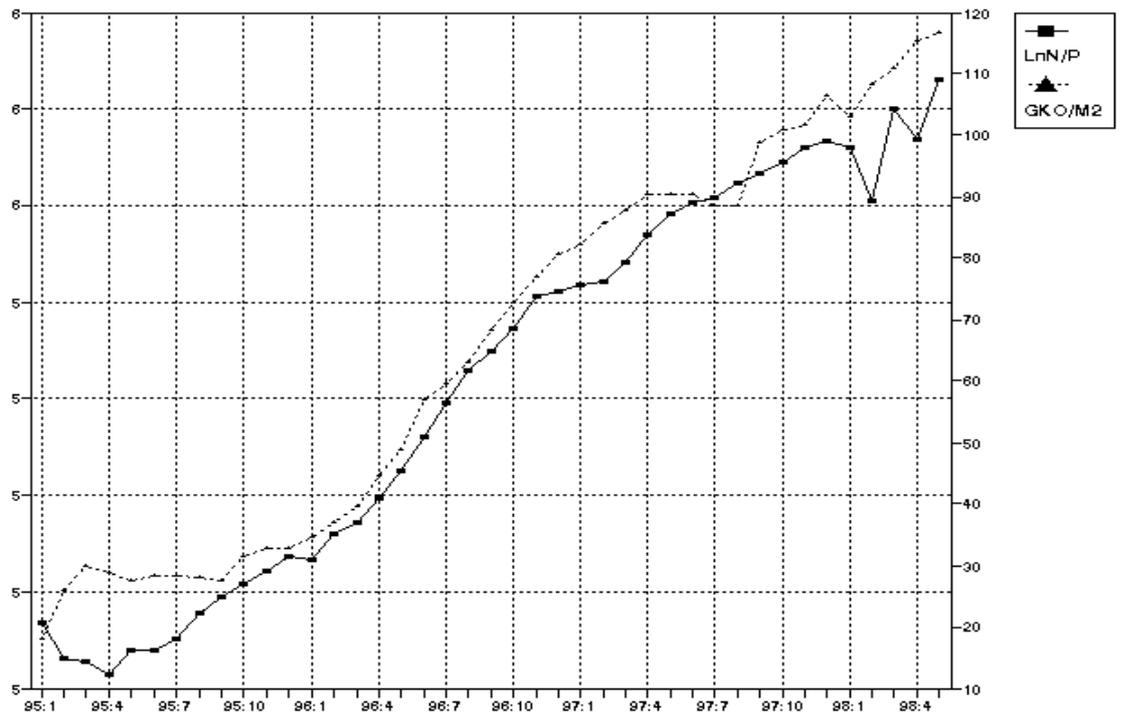


Fig. 1. Change of logarithm of real overdue creditors ($\ln N/P$) and relation of volume of GKO and OFZ in circulation to M2 ($GKO/M2$) in the period 1995:1- 1998:5.

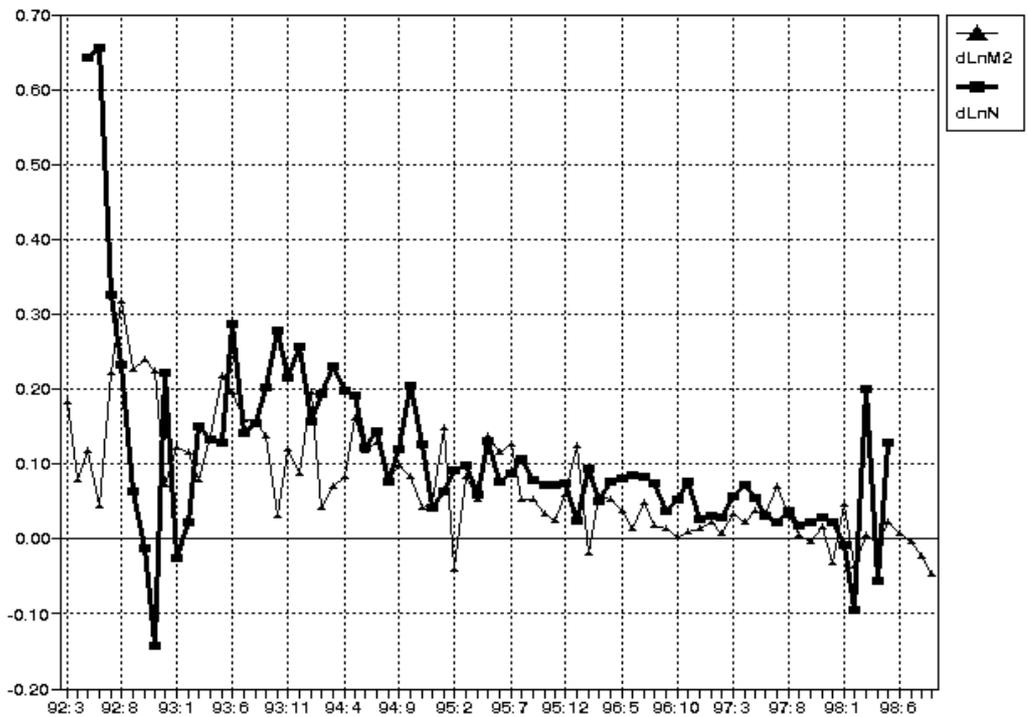


Fig. 2. Change of rates of growth of money aggregate $d\ln M2$ and overdue creditors $d\ln N$ in the period 1992:3 - 1998:5.

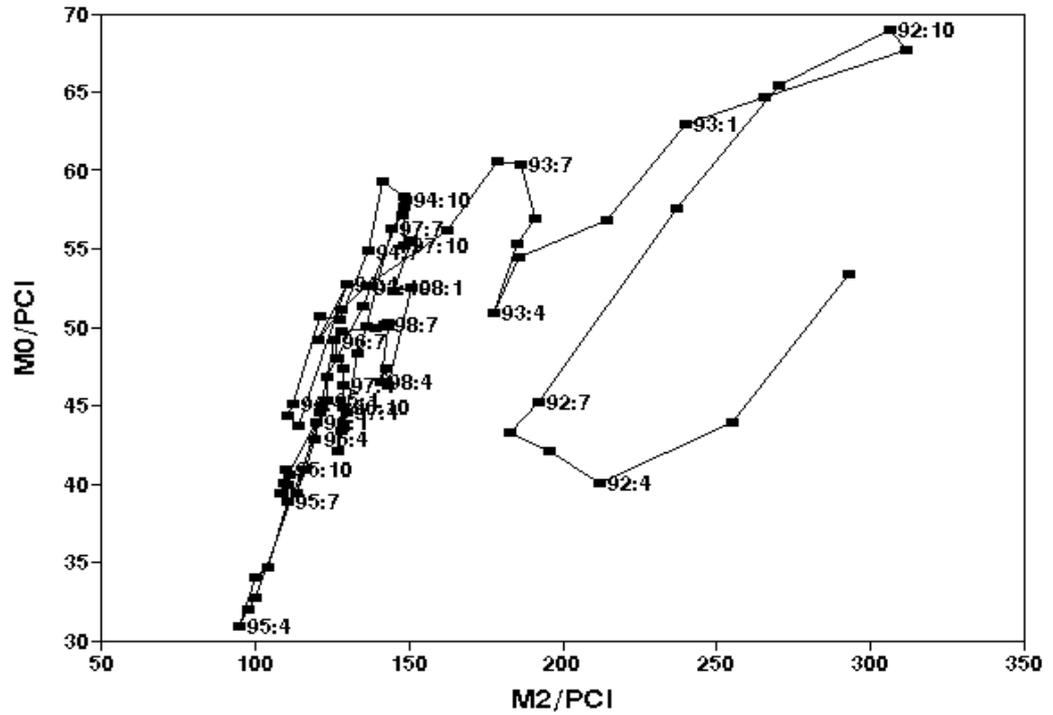


Fig. 3a. The phase diagram: $M0/P$ ($M0/PCI$) versus $M2/P$ ($M2/PCI$) in the period 1992:3 - 1998:9.

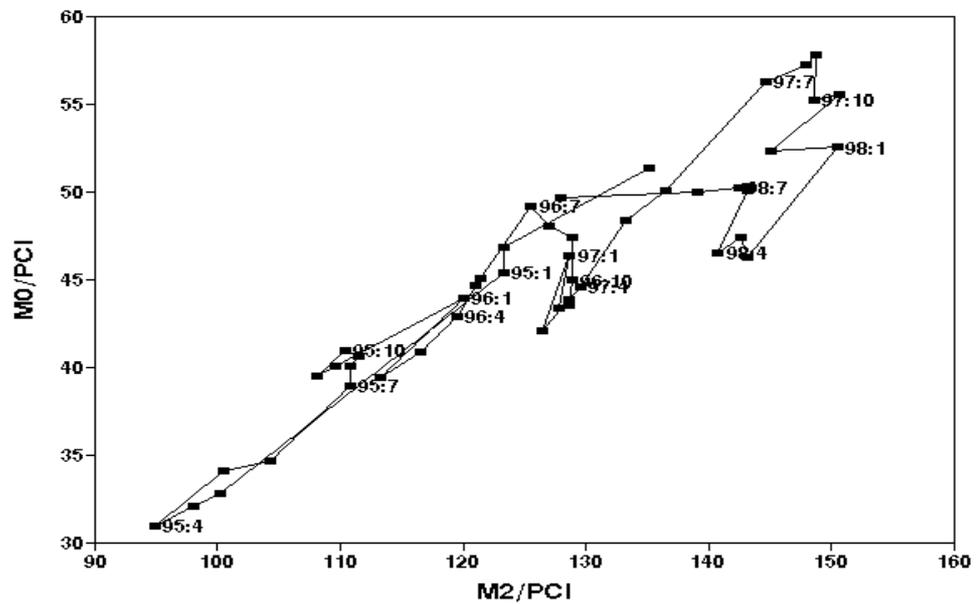


Fig. 3 b. The phase diagram: $M0/P$ ($M0/PCI$) versus $M2/P$ ($M2/PCI$) in the period 1994:11 - 1998:9.

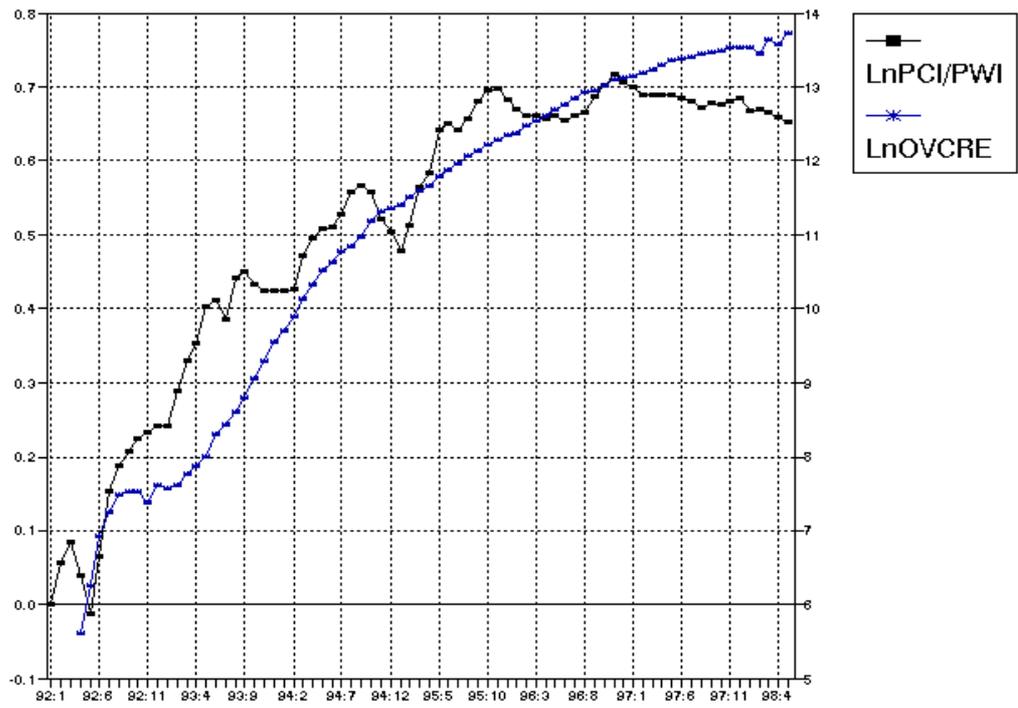


Fig. 4. The change of the ratio wholesale and consumer price indexes (PWI/PCI) and the overdue creditors (OVCRE) in period 1992:2 - 1998:5

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