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**The mystery of growth mechanism in a centrally planned economy:
Planning process and economics of shortages**

Vladimir Popov

ABSTRACT

Since the economic calculation debate of the 1920-30s, it is known that it is impossible to create a coherent balanced plan that equates supply and demand of millions of goods and services in the national economy, not to speak about the optimal plan. It is not well understood, though, how the centrally planned economy (CPE) really functioned and what were the real determinants of their growth rates, if not the planned indicators. It was shown that forecasts of growth rates based on the extrapolation of past trends were better correlated with actual performance than planned indicators, but it is still unclear what was the real mechanism of growth of CPE and what was the role of the planning process in it.

The hypothesis in this paper is that the drivers of growth in the CPE were the major investment projects initiated by the planners. They led to shortages of supplies, which triggered creeping price increases for scarce goods, which in turn boosted profitability in respective industries allowing them to increase output. *De facto* it was a market economy multiplier process – fiscal and monetary expansion leading to the price and output increases that eventually balanced supply and demand.

Keywords: socialist economies, central planning, economic growth, shortages, economic calculation problem.

JEL: H6, O25, P34, P35, P40, P43.

The mystery of growth mechanism in a centrally planned economy: Planning process and economics of shortages

Vladimir Popov

«Течет вода Кубань реки, куда велят большевики»

(“The water of Kuban river flows to where the Bolsheviks order”)

The centrally planned economy (CPE) in the USSR, Eastern Europe and China disappeared before the economists were able to figure out how it works. Among many unresolved puzzles is the change in the growth rates over time: it was pretty obvious that actual growth rates deviate significantly from the planned targets, but there was no good explanation of why they vary from year to year.

Wassily Leontief, the Nobel prize winner in economics, once noted that an economy using the profit motive but without planning is like a ship with a sail but no rudder. It may move rapidly, but cannot be steered and might crash into the next rock. A purely planned economy that has eliminated the profit motive is like a ship with a rudder but no sail. It could be steered exactly where one wants it to go, if only it moved (Leontief, 1974).

It may well be that this comparison is not doing justice to the CPE in one respect – it could not be steered exactly where the planners want it to go. And why the actual growth rates deviated from the planned targets – sometimes more and sometimes less – still remains a mystery. It was shown that the planned targets do not really determine the actual growth rates – they are less informative in predicting the actual outcome than simple extrapolations based on past trends – but it is still not clear what were the real determinants of growth process in the CPE.

Teleologists, geneticists and stylized facts

An important debate unfolded on the eve of the introduction of central planning and the adoption of the First five-year plan (1928-33) in the USSR between the advocates of the so called teleological and genetic approaches to planning. Geneticists argued that central planning should be constrained by economic laws, such as supply and demand, and operate within the constraints of proportions and potentials of national economy. Teleologists were claiming that proportions of the national economy could be drastically changed by the planners and desired

growth rates could be achieved with appropriate investment. In practical policy matters academic economists defending genetic approach (Nikolai Kondratiev, Vladimir Bogdanov and Vladimir Groman) were supported by prominent communist party leaders (Alexey Rykov and Nikolai Bukharin), and argued for the preservation of market trade and New Economic Policy (NEP), moderate growth rates, focus on light industry and agriculture. Their opponents – teleologists – wanted to speed up industrialization and growth rates by mobilizing the needed savings through rolling back NEP and harsh policies towards the peasants (low procurement prices for agricultural produce). This approach was developed by Stanislav Strumilin and Pavel Feldman, and eventually became the main party line (Gregory and Stuart, 2001).

However, the accuracy of central planning was disappointing, the discrepancy between planned targets and actual indicators was large even for macroeconomic indicators, as the table below shows. For the first five year plans (1930s-1940s) the average deviation was 39 to 58%, it decreased to 14-19% in the 1950-60s, but increased again to 27-31% in the 1970-80s.

Table. Ratio of actual to planned growth rates of key indicators, by Five-Year Plan periods, %

Indicator	First Five-Year Plan, 1928/29-32-33 ^a		Second Five-Year Plan, 1933-37	Fourth Five-Year Plan, 1946-50	Fifth Five-Year Plan, 1951-56
	Initial variant	Optimal variant			
National income produced	76	60	93	168	113
Utilized national income					
Gross industrial output	105	87	105	152	121
- production of means of production	153	116	143	-	114
- production of objects of consumption	66	59	74	-	117
Gross agricultural output	-44	-33	25	-4	-
Labor productivity					
- in industry		5	106	125	88
- in construction				62	82
- in agriculture					92
Retail trade			32	36	127
Real incomes			20 ^b		111 ^b
Average deviation of actual growth rates from planned (in either direction), % of planned growth	52	56	39	58	16

Indicator	Seven-Year Plan 1959-65	Eighth Five-Year Plan, 1966-70	Ninth Five-Year Plan, 1971-75	Tenth Five-Year Plan, 1976-80	Eleventh Five-Year Plan, 1981-85
National income produced	94	114	-	-	-
Utilized national income			72	80	92
Gross industrial output	105	103	91	67	77
- production of means of production	112	101			
- production of objects of consumption	94	112			
Gross agricultural output	21	84	68	56	42
Labor productivity					
- in industry	88	93	87	55	74
- in construction	85	59	78	36	93
- in agriculture	75	87	20	53	34
Retail trade	97	120	86	84	70
Real incomes	75	110	80	85	67
Average deviation of actual growth rates from planned (in either direction), % of planned growth	19	14	27	36	31

^a Planned indicators calculated by fiscal year, beginning October 1; actual rates by calendar year.

^b Real wages.

Source: *EKO*, 1987, N.11, pp. 37-50.

The annual planned targets deviated from the actual indicators for particular types of industrial output even more. In 1987 for different types of machinery and equipment in 11 out of 16 cases the planners were wrong in predicting even the sign of the change – they were planning the increase of output, but in reality there occurred a decrease (Shmelev, Popov, 1989).

The results for the annual plans in volume terms for particular enterprises were especially frustrating. It was demonstrated that correlation coefficients between planned targets and actual indicators are generally not significant and, if they are significant, they are positive as often as they are negative (i.e. the higher the planned targets, the lower the actual production volumes). For 27 territorial electric energy enterprises simple extrapolation of the trend for recent 5 years gave a better prediction for the volume of output in the sixth year than the planned targets established for this sixth year. Even the extrapolation based on the actual volumes of output in

recent 3 years in half of all cases was more informative than the planned targets (Medvedev, 1986).

Theory and practice of central planning

The theory of central planning was based on general equilibrium models (Leon Walras, Gerard Debreu, Kenneth Arrow) and input-output models (Wassily Leontief). Leonid Kantorovich, the only Soviet economist that won the Nobel Prize (in 1975 together with an American Tjalling Koopmans), published in 1959 “*The Best Use of Economic Resources*“ (Kantorovich, 1959), proving mathematically that not only equilibrium, but also equilibrium at the optimal level is theoretically possible in a static CPE.

The simplified basic equation of the input-output model describes the distribution of output of each particular product:

$$x_i = \sum_{j=1}^n a_{ij} x_j + y_i + E_i - I_i + s_i ,$$

where x_i , y_i , E_i , I_i , s_i - volumes of production, final consumption, export, import and change in stocks of i -product respectively,

a_{ij} - input-output coefficients, i.e. inputs of i -product per unit of j -product output.

Output of the product i (for instance coal) is equal to the intermediate consumption, i.e. consumption for production purposes) plus final consumption by households, plus net exports (exports minus imports), plus change in stocks. Intermediate consumption in turn is equal to the multiple of technological coefficients and volumes of output of other products – coal consumption, to continue the example, is equal to the expenditure of coal for the production of one kilowatt of electrical energy multiplied by the total number of kilowatts produced, plus the expenditure of coal for the productions of one ton of steel multiplied by the total number of tons of steel produced, and so forth.

If n is the number of products, there is n equations with $2n$ unknowns (x_i and y_i – volumes of output of every single product and final consumption of these products respectively). The system becomes solvable, if the structure of consumption is fixed and the total consumption is maximized:

$$F = ay_1 + by_2 + \dots + wy_n = \succ max,$$

where a, b, \dots, w - parameters, fixing the structure of final consumption.

Even more so, in theory this optimal equilibrium could be attained through setting prices for inputs and outputs (“objectively determined valuations” – shadow prices), not through setting production quotas in physical units (so called “dual problem” of production planning). It was shown that there is one and only one set of prices that possesses the magic property – when these prices are assigned to products and producers are instructed to maximize profits, they are inevitably choosing exactly the optimal plan that was previously computed by the planners. The hope was that with greater capacity of computers and better techniques to manage unforeseen technological developments the computation of the optimal plan would become feasible.

In practice, however, there were too many products and the costs of gathering all the necessary information on technological coefficients were prohibitive. Worse, there were unobservable variables, e.g. technological coefficients for new products and technologies, parameters of the changing demand function. Even if the information gathering and processing problem were resolved, if all technological coefficients (expenditure of i -input for the production of j -good) were precisely calculated and infinite size matrix could be easily inverted by super powerful computers, the dynamic problem still persisted.

Technological coefficients tend to change and new products tend to emerge not according to a plan, but spontaneously, due to technical progress that is not predictable by definition. This was exactly the argument of Ludwig von Mises (1920) in his article "Economic Calculation in the Socialist Commonwealth". It was later developed by Friedrich Hayek (1944) in “The Road to Serfdom” – he argued that the planners will never have enough information to carry out reasonable allocation of resources. In his lecture “Competition as a Discovery Procedure” he argued that outcomes of competition are “unpredictable and on the whole different from those that anyone would have been able to consciously strive for” (Hayek, 1968, p. 10).

As a result, the attempt to establish billions of industrial proportions (to balance supply and demand for millions of goods and services for every year and month) from the centre, especially in a dynamic economy with unpredictable technical progress and innovations,

resulted in numerous deficiencies. Even with the use of input-output models and most powerful computers it was actually possible to develop a reasonable balanced plan for less than 1% of products (at the very best), for which the planners actually established production quotas in physical units.

To add insult to injury, in the XX century there were no powerful computers and no information on all technological coefficients for millions of goods, so the real planning process looked totally different from theory. In the USSR, input-output models were developed only for several hundred aggregated positions (only starting from the 1960s) and used only in the pre-planning calculations. The actual planning was carried out through so called material balances – supply and demand estimates for particular goods (production + imports = intermediate consumption + final consumption + exports + increase in stocks). *Gosplan* (State Planning Committee) was responsible for material balances for about 2,000 aggregated product groups, *Gossnab* (State Supply Committee) disaggregated these into about 15,000 positions, industrial branch ministries – into about 50,000 positions. Finally, each product position was sub-divided into 10-15 specific products at a stage of linking suppliers and users of these particular products. So altogether about 0.5-0.75 million items were planned, whereas 25 million varieties of goods were actually produced (not counting services).

Whenever material balances did not add up, the bargaining process started between *Gosplan*, *Gossnab*, branch-industry ministries and enterprises (“could you increase the supply?”, “could you limit the demand?”), and whenever the iteration process of multi-phased negotiations was still not allowing to make the ends meet, shortages of supplies were supposed to be eliminated through new investment (expansion of existing and construction of new production capacities) and imports. Finally, the enterprises were asked to make delivery contracts with one another, and after these contracts were approved by the planners, they received a status of the adopted plan that was made into law by the supreme legislative bodies.

But the plans were not fulfilled on time and pervasive shortages emerged. The hypothesis of this paper is that the real work mechanism of the CPE was triggered by prioritized investment projects that were the first to receive financing from the budget or state banks. When these projects created the demand for materials and supplies, shortages emerged and demand impulses precipitated through the rest of the economy causing increases in prices and output.

Structural shortages – scarce supply of some goods and excess inventories of the other goods – are easy to explain: these were the natural and logical consequence of the inability of the planners to produce a balanced plan and to set prices for millions of goods and services at the market clearing level (Campbell, 1958; Shmelev, Popov, 1989). But the general shortages, i.e. pervasive scarcity of most, if not all goods, is still a puzzle because a simple increase in prices could have eliminated them and helped to avoid many nuisances associated with constant scarcity. Even more so, that these shortages most of the time were not really significant and could have been eliminated by relatively modest price increases (Popov, 2020).

The explanation suggested in this paper is that the growth mechanism of the CPE was based on cycles of creating shortages and their elimination: prioritized investment projects financed by the state increased the demand for labor and materials => there emerged shortages of materials and supplies, which resulted in creeping uncontrolled inflation for some goods and organized price hikes for the other => higher prices led to higher profitability => higher profitability allowed to finance investment and increases in production.

The shortage economy did not result from soft budget constraints. It is the multiplier process that created and alleviated shortages

Two most well-known features of the CPE – shortage economy and soft budget constraints (SBC), both were described initially by Janos Kornai (Kornai, 1980; Lindbeck, 2007). "In our day and age, – argues Grzegorz Kolodko (2018), – there is basically a consensus that in the case of real socialism it was the state ownership of means of production that caused the soft budget constraints, and these, in turn, caused inflation – more or less repressed or more or less open, depending on time and place, so depending on the systemic and political context".

“The main finding, a conception which now forms the central maintained hypothesis of Kornai’s school of thought, is that the socialist economy is characterized by endemic and persistent shortage; moreover that this shortage is maintained over time by a variety of mechanisms all grounded in rational behavior by enterprises, central planners and other agents given their information and expectations, the constraints they experience, and the organizational structures which tie the system together” (Hare, 1989).

The shortage economy is believed to be connected with the soft budget constraints. Lindbeck (2007) claimed that “Kornai’s two most celebrated characterizations of real world socialist

economies – “shortage economies” and production units with “soft budget constraints” – are analytically closely connected”.

On the one hand, when the state covers the losses of the unprofitable enterprises, wages and profits exceed the value of output produced, so consumer and investment demand can exceed the supply of goods. If prices are controlled and not allowed to rise to clear the market, shortages emerge. This phenomenon is known also as forced savings or monetary overhang or delayed demand.

On the other hand, enterprises themselves do not have any constraints in expanding their demand for resources, so shortages emerge. “As a result of the soft budget constraint, – writes A. Lindbeck, – firms tend to expand investment and production until they encounter nonfinancial resource constraints (hence shortages). This assertion was based on the rather realistic assumption that managers in such economies are mainly interested in the size, or rate of expansion of production” (Lindbeck, 2007).

Some authors, however, pointed out that the correlation between shortages and SBC is not inevitable, that “sufficiently high prices for consumer goods would nevertheless be able to abolish any consumer goods' shortages” (Gomulka, 1985), but somehow the two concepts are regarded as an indispensable characterization of the socialist (centrally planned) economies and entered textbooks on Comparative Economic Systems.

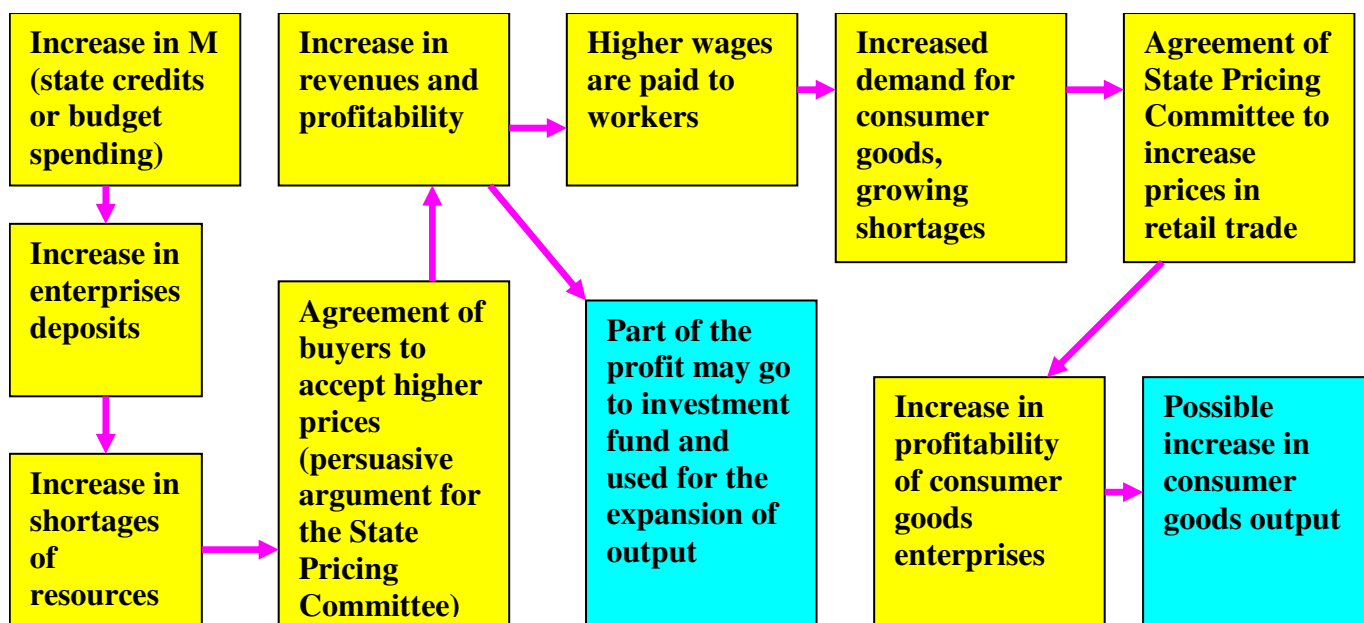
Nuti (2014) notices that Kornai himself was well aware that there were no shortages in China, but tended to explain it by the existence of private sector and openness to foreign trade. “But it might be simpler to say that shortages are not caused by the SBCs associated with socialism, but by prices set below market clearing, which may or may not be a necessary feature of socialism, and indeed in China today they are not. Even in China’s past, for a long time prices fixed below market clearing for a share of the quantities supplied were accompanied by additional supplies being available at free prices – not in black markets but under the official dual-track price policy typical of China” (Nuti, 2014).

In reality the shortage economy is not connected at all with the soft budget constraints. Budget constraints were much harder in former socialist economies than in market economies – in developing countries of the same level of development and even in advanced capitalist economies. And whenever the soft budget constraints were present in socialist economies, it

was industrial policy, sometimes good (export orientation in China and Vietnam), sometimes not so good (import substitution in Eastern Europe and former Soviet Union), but definitely not the policy caused by inability of the state to resist the pressure from the loss-making state enterprises to finance their losses (Popov, 2020).

The true *raison d'être* for the pervasive shortages was the CPE mechanism of growth itself. This mechanism was associated not so much with the plan (it was physically impossible to create a balanced plan anyway), but with the small and big pushes to the economy that came from the financing of the projects that were prioritized. Such a financing started with the allocation of funds for capital investment from the state budget and/or credits from the state banks and triggered a process shown at fig. 1.

Figure 1. How the increase in money supply leads to the increase in prices and output in the CPE



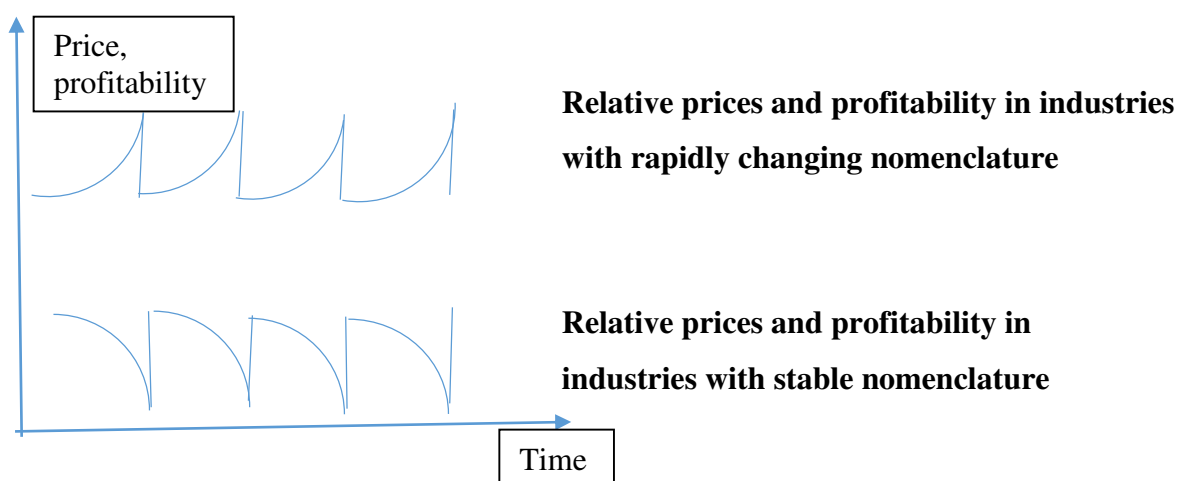
New project – say, construction of a railway or a new plant – led to the increase in demand for the supplies that resulted in shortages of particular materials and components. A shortage of supplies allowed producing plants to ask for price increases and to get an “understanding” from the head of construction project where supplies were needed (they knew that otherwise they

will not get the supplies at all), and such an “understanding” was a persuasive argument for the State Committee on Prices to agree to price hike.

Sometimes the price increases occurred in a creeping way – via transition to the new varieties of products: in industries with the large and rapidly changing nomenclature of output (machine building, consumer goods, construction, services) introduction of the “new” product that was basically the same as the old one, but with few bells and whistles, was a widely used method of increasing prices. The calculation of the higher costs reflecting the “higher quality” was sent to the State Committee of Prices and eventually approved – the officials of the Committee knew all these tricks, but were physically incapable to check millions of new calculations.

In other cases, in industries that produced few varieties of products and had stable nomenclature (resource industries, agriculture) prices were increased by the regulator (State Pricing Committee) periodically in a one-time hike: it was necessary to do it every 5-7 years because the creeping inflation constantly going on in other industries that delivered supplies to resource industries and agriculture undermined their profitability (fig. 2).

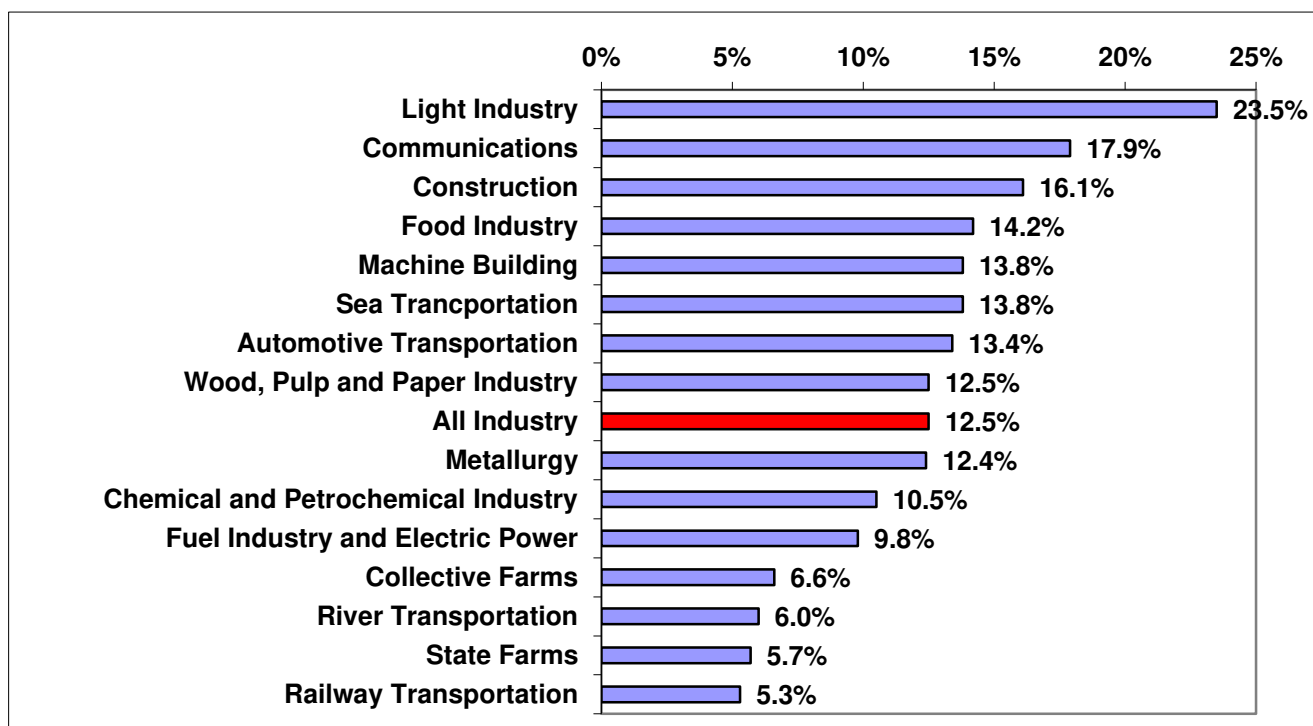
Figure 2. Price cycle and profitability cycle in industries with slowly and rapidly changing nomenclature of goods



Thus agriculture and resource industries periodically experienced the decline in their profitability and were even getting into red before a one-time price increase for their produce restored their profitability to make it comparable with the other industries (Shmelev, Popov,

1989). As fig. 3 shows, the profitability of machine-building, light industry, construction, communication, and food industry in the USSR was the highest, whereas fuel and electricity, transportation and agriculture were low profitable.

Figure 3. Profitability of particular industries in the USSR in 1986, %



Source: Goskomstat.

Price increases in both groups of industries led to the greater profitability and higher wages (wage fund was planned *de facto* as a percent of the total output and higher profits allowed to pay bonuses to workers), whereas higher profitability allowed to expand output because part of the profit could have been used for investment into the expansion of production capacities (fig.2). As a result, the initial small and big impulses generated by the prioritized investment projects transformed themselves into price and output increases – pretty much like it happens in a market economy as a result of the increase in government spending and/or expansion of the money supply.

Shortages and excess inventories were inevitable in CPE almost by definition. But it was not only a structural mismatch – the total value of shortages exceeded that of excess inventories. Excess demand created by priority investment projects in particular industries was a driving force of CPE

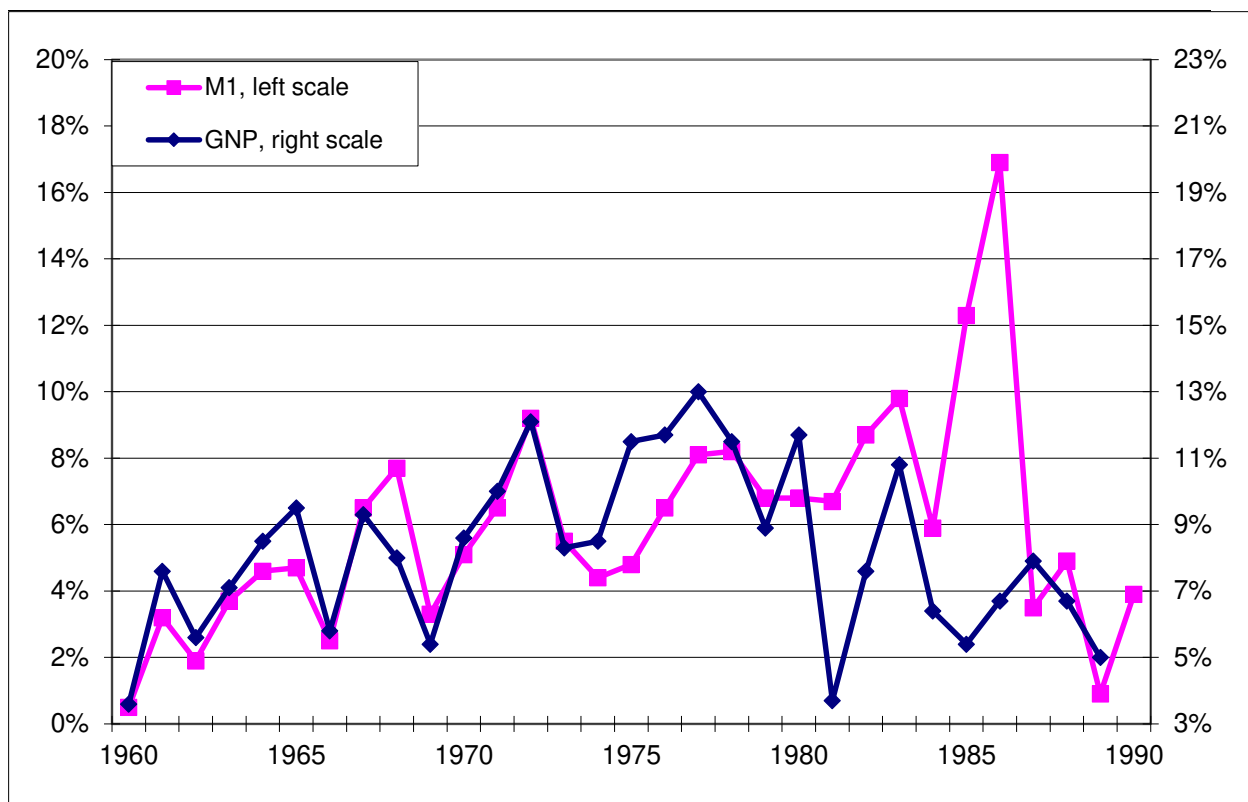
and precipitated into the rest of the economy via the multiplier process of chain increases of prices and output.

Capital investment was regarded as a major tool of eliminating the bottlenecks resulting from shortages. So capital investment was diverted to areas where new production capacities were needed to expand the production of scarce goods. The whole planning process thus looked like an endless chain of the urgent decisions forced by emergency shortages of different goods that appeared faster than the planners were able to eliminate them. This was a sort of a vicious circle, a permanent race against time, in which decisions to make capital investment were predetermined by existing and newly emerging shortages. And this was the transmission mechanism for the increase in output and prices – it was causing both, inflation and economic growth.

Evidence

There is a well-known relationship between the expansion of money supply and the growth of prices and output. Normally, the increase in the money supply is causing some growth of output in the first 12-18 months and then triggers the increase in prices (inflation). If the economy operates close to the potential (low unemployment and high capacity utilization), impulses of the money supply expansion are causing more inflation and less output growth, but in case of the large output gap (between potential and actual output), there is a good chance to expect that money supply impulse would result predominantly in output growth, not in inflation. In any case, *ceteris paribus* (or to be more precise, in the absence of changes in money velocity), increase in the money supply is exactly equal to the increase in output in current prices, which in turn is equal to the sum of growth and inflation. Fig. 4 confirms that the money velocity is in fact quite stable – in the US in the 1960-80s the fluctuations of the growth rates of money supply were very much in line with the fluctuations of the growth rates of GDP in current prices.

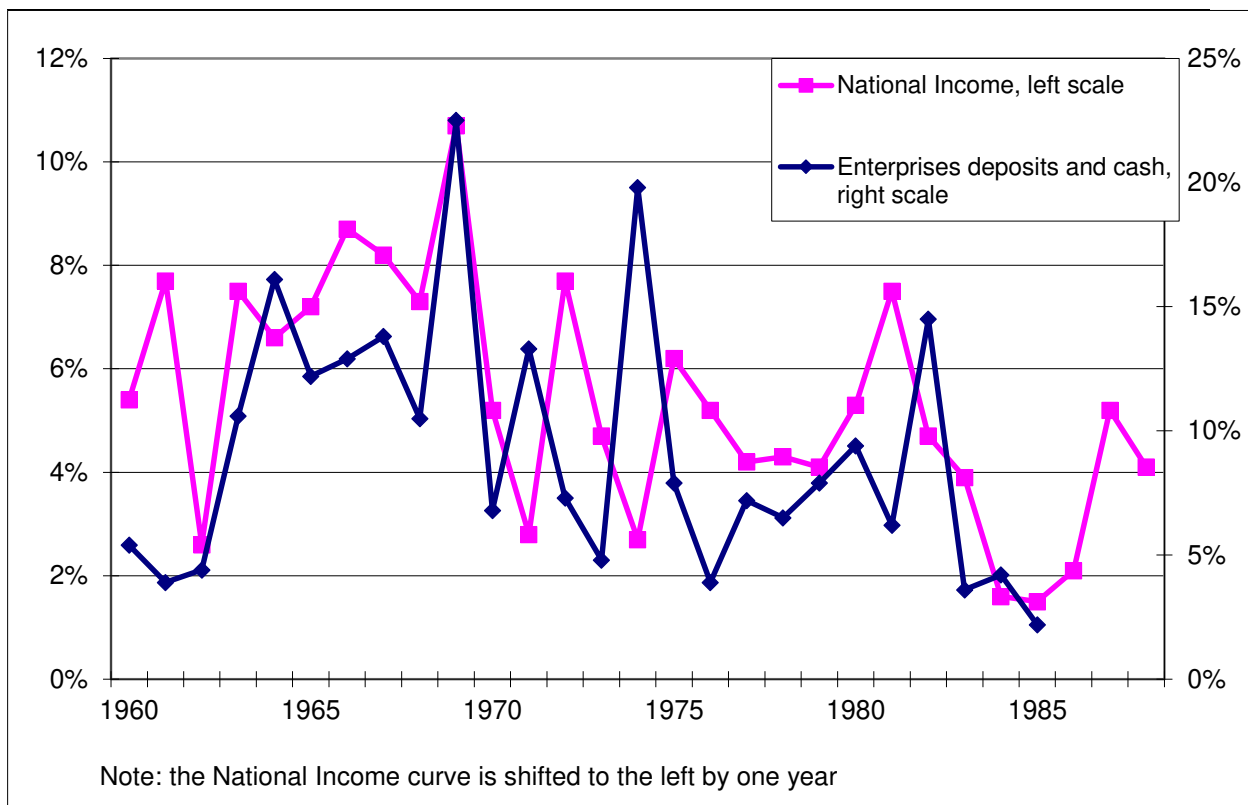
Figure 4. US money supply and GNP, annual growth rates, %



Source: Economic Report of the President.

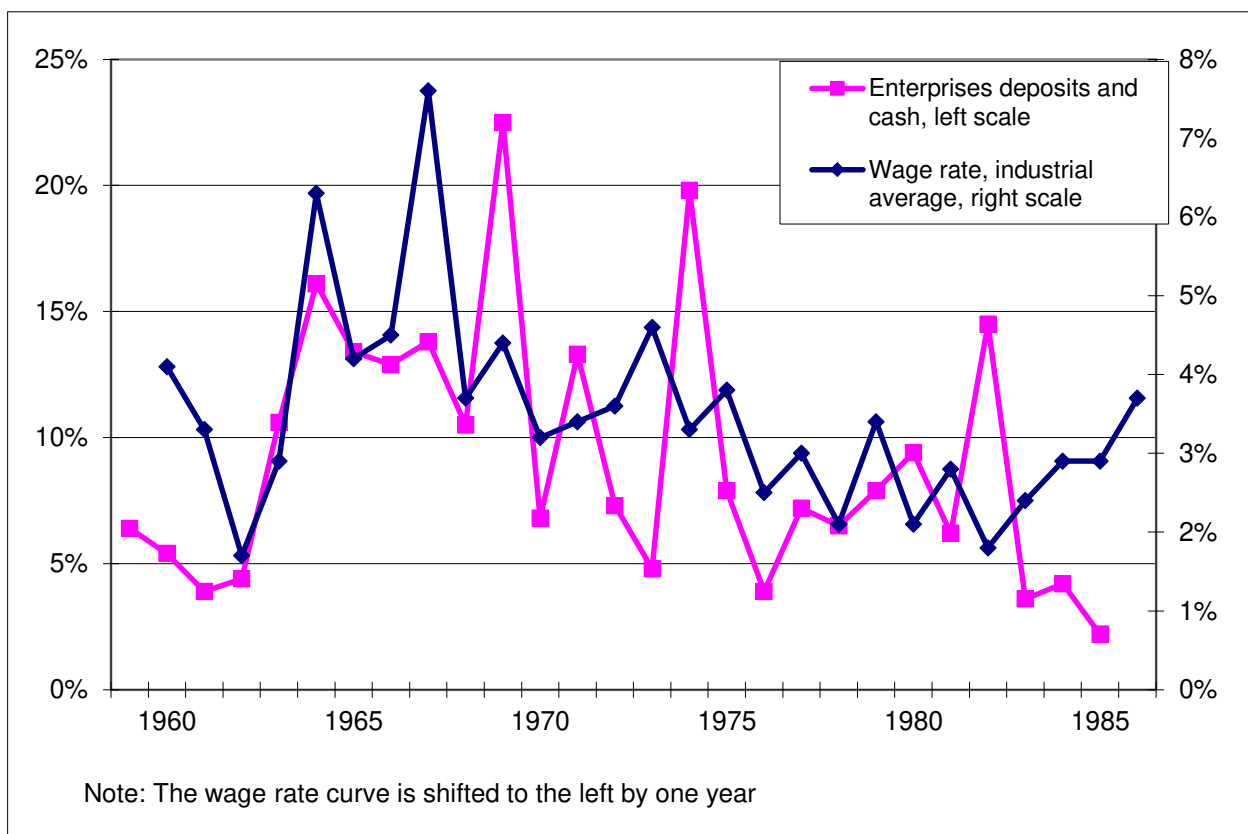
It may be surprising to see the same relationship in the CPEs – planning of the money supply was carried out by the State Bank (*Gosbank*), planning of prices – by State Committee on Prices (*Goskomtsen*), planning of output – by the State Planning Committee (*Gosplan*) and branch-industry ministries, and yet, in 1-2 years, these indicators fell into the relationship typical for the market economy. Growth rates of the national income in current prices in the USSR in the 1960s-80s, sometimes without the lag and sometimes with a lag of 1 year, reflected the fluctuations of the growth rates of most important component of money supply – deposits of enterprises (fig. 5). And the variations in the growth rates of enterprises’ deposits with a lag of about one year led to the fluctuations in wages growth rate (fig. 6). Finally, growth rates of personal deposits were quite correlated with the growth rates of retail sales – again, with a one-year lag (fig. 7).

Figure 5. Enterprises deposits and national income in current prices, annual growth rates, %



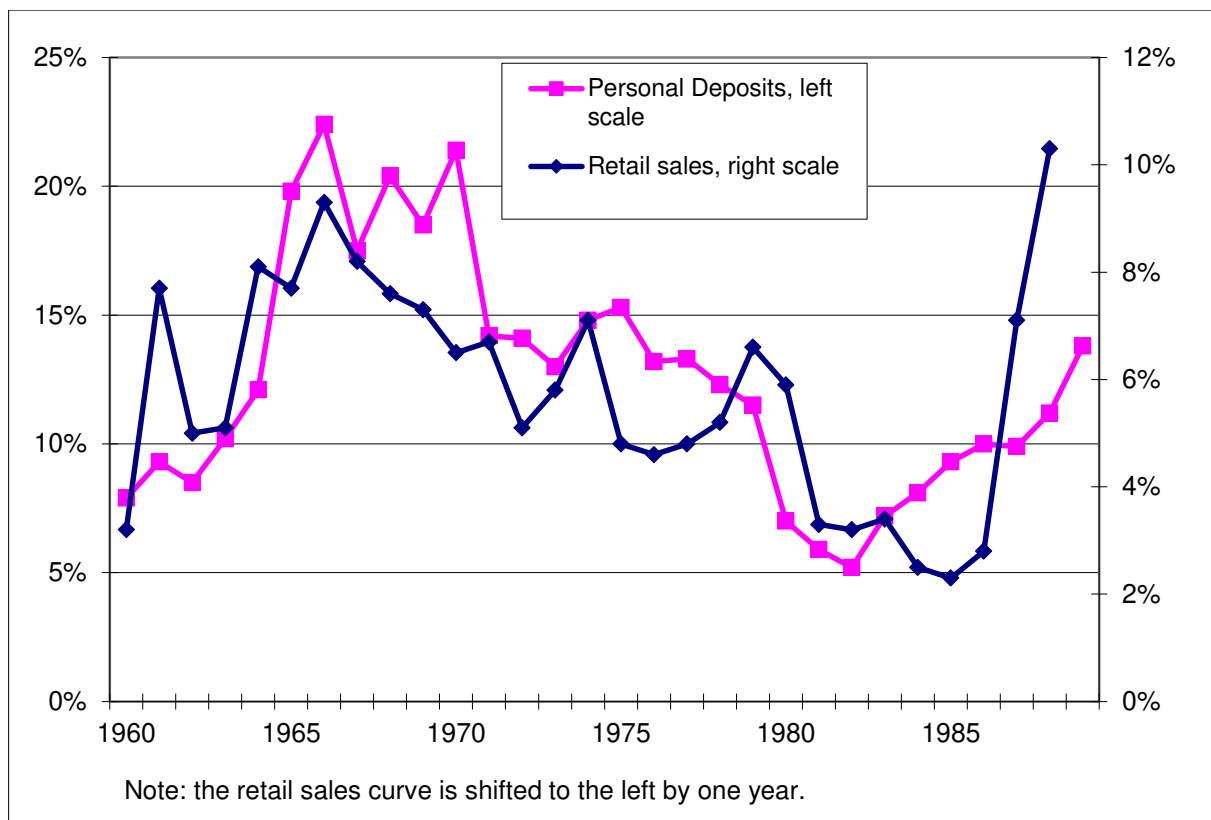
Source: Goskomstat.

Figure 6. Money supply and wages, annual growth rates, %



Source: Goskomstat.

Fig. 7. Personal bank deposits and retail sales in current prices, annual growth rates, %



Source: Goskomstat.

This relationship between the growth of money supply and growth of prices and output, and increase in wages and retail sales confirms in the first approximation the hypothesis about growth mechanism in the CPE: when money supply expands due to increased financing of particular investment projects, there are automatic mechanisms at play to transmit the initial impulse into other industries, so it causes the increase in prices, output and wages.

Conclusions

Centrally planned economy (CPE) is sometimes characterized as an antonym of a market economy, but this is not true. The ability of the central planning authority to develop and implement a coherent balanced plan for the national economy (not even to speak about the optimal plan) is limited and hence the vacuum is being filled with the automatic mechanisms of self-regulation that are in essence similar to the market adjustment process. In particular, fiscal and monetary shocks in the CPE lead to the increase in output and prices, very much like the fiscal and monetary impulses in the market economy. The mechanism of the transmission of these impulses implies the emergence of shortages due to the launch of small and big

investment projects and the elimination of these shortages through largely self-propelled process of price and output increases. Initial investment led to shortages of supplies, which triggered creeping price increases for scarce goods, which in turn boosted profitability in respective industries allowing them to increase output. *De facto* it was a market economy multiplier process – fiscal and monetary expansion leading to the price and output increases that eventually balanced supply and demand.

Such an interpretation explains the large gap between the planned targets and actual indicators. Even though it was demonstrated that the growth rates of the CPE are not really determined by the planners and planned targets, it was not really clear, what are the true determinants of the variations of growth rates. This paper argues that the planners influenced the development of the national economies not so much via adopting the planned targets, but by choosing the investment projects to be launched first. The financing of these projects gave impulses to the other industries via multiplier process that triggered either price increases or output increases, depending on the gap between the potential and actual output, very much like in a market economy.

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