A RISK THEORETICAL MODEL OF PRIVATIZATION VOUCHERS

Ülo ENNUSTE

"Whenever a theory appears to you as the only possible one, take this as a sign that you have neither understood the theory nor the problem which it was intended to solve". (K. Popper. Objective Knowledge. An Evolutionary Approach. New York, Oxford University Press, 1972, 266.)

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The article tries to explain the economic conditions and objectives under which it is appropriate to introduce privatization vouchers, their optimal quantity and connections with the traditional monetary aggregates. The Walrasian model has been used, which is derived from the social optimum planning model. An important factor of the analysis is the difference between social and individual risks that influence the consumption and investment decisions. The mathematical treatment is heuristic and schematic.

INTRODUCTION

It can occur mostly in anomalous and especially in transitional economic situations that some elements of the economic system or complete elements of the market mechanism that should be there are lacking and it is expedient for the stabilization of the economy to implement supplementary untraditional systems or quasi-mechanisms or their elements. From the standpoint of the present article it may be said that just in that lies the gist of the theory of J. M. Keynes, and one can find numerous examples on that also in his basic work [1].[1]

The following example might explain the expediency of the introduction of such a quasi-element — the privatization vouchers, or, more exactly, "privatization credits" [3]. Let it be a small transitional economy under a great economic risk and without substantial deposits (as a result of hyperinflation or a monetary reform). Let there be in such a situation an intention to carry out extensive privatization of certain fixed properties. The traditional realization of this operation requires a considerable increase in the amount of credits. Yet, two undesirable phenomena may occur if one is to do it by way of increasing the quantity of traditional monetary aggregates. First, individuals under

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[1] A. Vercelly has put the same statement in different, and more philosophical context: "According to Keynes, economic theory must be conceived not as a doctrine but as a method" [2, p. 5].

the high risk tend to increase the consumption, more than socially optimal, as a result of which the inflationary pressures increase in the consumption markets correspondingly. Here we presume that the individuals' relative risks in economy are much higher than economy's social risks, and there are no economic insurance mechanisms to reduce these differences. Second, the privatized properties are mainly acquired by less risk-averse public — so the allocation of properties will be uneven and socially undesirable.

In order to get rid of these shortcomings in legal tenders and avoid inflationary pressures in consumption it might be appropriate to implement some form of vouchers[2] the sole purpose of which would be to buy the fixed assets liable to privatization — provided, of course, that such privatization is accompanied by the decrease in the volume of public wealth [3]. Since this quasi-money or privatization vouchers are not valid in the sphere of consumption, there should not occur inflationary pressures, at least not to any great extent. And the result is also the even and socially appropriate allocation of privatized fixed assets in the population.

Now, I will try to explain the problems described above by means of a mathematical model, though schematically and heuristically (it is assumed that the model is "well behaved" and has all "good" qualities for the analysis). First let us set the social optimal planning model, taking into consideration social risk, and the social utility is maximized by means of optimal distribution of consumption and privatized assets between economic agents. For constraints there are corresponding resource limits on consumer goods and privatized fixed assets, as well as the condition of the payment balance for the economy. For the sake of simplification it is assumed that the volume of exports is fixed (both for consumer goods and fixed assets), and the foreign market prices are independent of the exports (small economy).

By transforming the initial model by means of the Lagrangean relaxation and adding the prerequisite of optimal allocation of incomes, the equivalent Walras economy is derived. In this economy agents are individually facing considerably higher relative risks than the economy as a whole due to the lack e.g. of complete contingency markets, etc. The analysis of this economy is used to explain the suitability of privatization vouchers, their optimal quantity and connection with other monetary aggregates (incl. credits, instalment sales, etc.).

In the process of mathematical transformation the important concepts are equilibrium prices and exchange rates, and essential role in the analysis is played by, as mentioned above, the difference between relative social risks and individual risks.

DESCRIPTION OF THE MODEL

Let us define the following variables:

$j = 0, 1, \ldots, n$ — economic agents, $j = 0$ foreign countries,

$u_j (\cdot)$ — utility function of agent j,

r — risk-adjustment factor,

s_j — standard deviations of the optimized indicators of agent j,

$\hat{c}_j$ — consumption of domestic production of agent j,

$\check{c}_j$ — consumption of imports of agent j,

v_j — property to be privatized to agent j,

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[2] Some specific examples of voucher implementation are explained in [4].

$\hat{q}$ — domestic production less exports (fixed),
q_0 — exports (fixed),
$\hat{v}$ — state-owned property to be privatized,
p_f — foreign price of consumer goods,
b_f — foreign price of property,
v_0 — sale of property abroad (fixed),
p^0 — equilibrium price of domestic consumer goods,
b^0 — equilibrium price of privatized property,
e^0 — equilibrium exchange rate,
$h^0 = 1/e^0$,
m_j^0 — optimal money income of agent j,
m_{1j}^0 — optimal money income of agent j for consumption,
z — supply of credit,
z_j — agent's j credit taken for buying property,
k_j — voucher income of agent j,
k — supply of vouchers.

Let us assume that the utility functions of agents $j=1, \ldots, n$ are described by means of expectations of optimized indicators and their risk-adjusted standard deviations.[3] Let the latter be $\frac{1}{r} s_j(\cdot)$ and the utility functions $u_j(\hat{c}_j, \check{c}_j, v_j, \frac{1}{r} s_j(\cdot))$. Here $s_j(\cdot)$ is supposed to depend on the activities of agent j. Now, let us assume that in the social utility function of the whole economy the deviations (risks) of an agents's indicators may compensate for each other, and therefore in this function we use reduced utility functions with standard deviations: $r>1$ (e. g., for independent normal distributions might be taken $r=\sqrt{n}$). But for the individual market agents (post-command situation) $r = 1$, i. e. in this case there are greater risks due to the lack of proper insurance mechanisms.

In order to simplify our problem, let us assume that the economic resources are fixed (domestic production, exports, and property to be privatized), so in addition to resource constraints we can apply the constraint for the balance of payment so as to model the exchange rates as well (with the help of the dual variable at this constraint). In virtue of the above statements we get the following optimal model:

$$\max \sum u_j\left(\hat{c}_j, \check{c}_j, v_j, \frac{1}{r} s_j(\cdot) \right) \tag{1a}$$

subject to

$$\sum \hat{c}_j \leqslant \hat{q}, \tag{1b}$$

$$\sum v_j \leqslant \hat{v}, \tag{1c}$$

$$\sum p_f \check{c}_j \leqslant p_f q_0 + b_f v_0. \tag{1d}$$

Let us assume that model (1) is strictly concave and regular, and that the optimal prices (dual variables) of the Lagrange form of this model are given. Let them be in keeping with the constraints (resources): p^0-(1b), b^0-(1c) and h^0-$1/e^0$ (1d), where e^0 is the equilibrium exchange rate of domestic currency for foreign currency and h^0 the equilibrium

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[3] The risk-adjustment method is widely exploited in the theory of capital markets [5]. It should be noted that in this theory to the risk-adjustment belong the expected values of the assets, but in our case the agents utility functions are risk-adjusted.

exchange rate of external currency for domestic currency. Next, let us assume that the total money cost of economic resources at equilibrium prices $m^0 = p^0\hat{q} + b^0\hat{v} + (p_j/e^0)\, q_0 + (b_f/e^0)\, v_0$ is allocated optimally between agents and this allocation m^0_j, $\sum m^0_j = m^0$ has been given (for details see Appendix 1 in [6] and [7]).

Now the following Walras economy $j = 1, \ldots, n$ is equivalent to the problem (1):

$$\max u_j \left(\hat{c}_j, \ \check{c}_j, \ v_j, \ \frac{1}{r} s_j(\cdot) \right) \tag{2a}$$

subject to

$$p^0\hat{c}_j + \frac{p_j}{e^0}\, \check{c}_j + b^0 v_j \leqslant m^0_j, \tag{2b}$$

where (2b) is a budget constraint for agent j.

It is easy to see that using the logic of this economy the optimum quantity of money (M_3) can be introduced into the model. This can be done with overlapping generations [8] or extending the model by means of saving rates [9]. What is essential in our case is the fact that the optimal quantity of money is conditional upon the values of equilibrium prices; also, the latter are dependent, through Lagrange's function, on the value of r. As follows from the decline of r, the consideration of risks will increase and the values of equilibrium prices of properties may decline, especially as regards the properties with long-term returns (assuming risks are involved in them in particular, and therefore their relative demand would most probably decline). Decline in property prices is to be followed by the decline in demand for money, especially for near money $M_3 - M_1$ (on the assumption that this aggregate of money will be applied mainly in real estate transactions). At the same time, following the decrease of r, consumption expenditures will relatively increase as compared to investment expenditures.

SUITABILITY AND OPTIMAL QUANTITY OF PRIVATIZATION VOUCHERS

Problems (2) $j = 1, \ldots, n$ have been set taking into consideration social risks-adjustments ($r > 1$). To make agents in the post-command economy individually consider the risks in this way in addition to the already presumed mechanisms (for formation of equilibrium prices and allocation of incomes), the presence of some kind of insurance mechanisms that would concert social and individual risks should exist. In case of their absence, agents will individually use as a result, the condition $r = 1$; in which case (2) is no longer equivalent to (1), and the propensity to consume will grow in this economy to the detriment of a decline in investments and the property prices and a decrease in the demand for near money.

To improve the situation, the primary quasi-measure would be the creation of favourable conditions for agents by means of additional credits for buying fixed properties (including the sale of fixed properties on the instalments). Let the respective volume of credits be z. However, it is expedient to use this method only in limited optimum volume z^0, because this method gives rise to greater heterogeneity in the ownership structure as compared to what is socially optimal (solution v^0_j, $j = 1, \ldots, n$ of the problem (2)). It is due to properties concentrating in the possession of a group of less risk-averse individuals together with ensuing consequences.

To avoid this, it is expedient to introduce a special unreturnable single-purpose legal tender or privatization voucher k for buying fixed properties. Its optimum volume k^0 being conditional as regards the cost of properties to be privatized, the choice of z^0 as well as the expected use of near money in privatization.

Taking into consideration the above assumption, let us construct a Walrasian model with two budget constraints, the latter of which containing optimal allocation of privatization vouchers k_j^0:

$$\max u_j(\hat{c}_j,\ \check{c}_j,\ v_j,\ s_j(\cdot)) \tag{3a}$$

subject to

$$p^0\hat{c}_j+\frac{p_f}{e^0}\check{c}_j \leqslant m_{1j}^0, \tag{3b}$$

$$b^0 v_j \leqslant k_j^0+z_j^0+(m_j^0-m_{1j}^0), \tag{3c}$$

where m_{1j}^0 is optimal income of agent j in circulation money (M_1) and $m_j^0-m_{1j}^0 \geqslant 0$ is agent's j optimal investment in near money (M_3-M_1), $k^0=\sum k_j^0$ and $z^0=\sum z_j^0$. In this constraint we still leave near money $m_j^0-m_{1j}^0$ for privatization. We use this amount for explanation of possible inflationary pressures at the end of the section.

The main statement now is that in case there being no insurance mechanism for agents against risk, the problems (3) $j=1, \ldots, n$ is a good approximation to the problem (1), and problems (3) hold in constraint the optimum distribution of the vouchers k_j^0, $j=1, \ldots, n$, $z^0=\sum z_j^0$.

In order to get this result, it is necessary to pay with public dis-investments in volume k^0. At the same time it is clear that the primary division of k^0 or the allocation of k_j^0 should be compensatory [3]. The agents have participated in this formation at least in four ways: with their work that has remained partly unpaid; with their property that was in social use and for which no full rent has been paid; with their deposits for which no full interests have been paid; and, finally, with their nationalized property.

This principle of primary division however does not exclude the buying and selling of privatization vouchers in the private sector. This may arouse inflationary pressure in the consumption market. The latter may arise when vouchers are bought for the money meant for investments and the new owner of the money uses it for consumption. But as we assumed, only a small quantity of deposits does exist ($m_j^0-m_{1j}^0$ is small compared to m_{1j}^0), the additional inflationary pressure from voucher trade cannot be considerable. But to avoid this pressure the quantity of vouchers should not saturate the privatization market.

CONCLUSIONS

By means of Walras' model derived from the economic social optimum model, it is possible to find out the suitability and place of privatization vouches in a small post-command economy, their optimum quantity and connections with the traditional monetary aggregates. The guiding criterion here is to take into account the differences in relative risks (risk-adjustment) at social and agent's level, and on the presumption that in post-command market economy there is no insurance mechanisms to compensate for those differences.

The introduction of privatization vouchers on these conditions might help to solve the problems of the shortage of credits accompanying privatization, and according to this model (recall the motto) without considerably increasing the additional inflationary pressure in the sphere of consumption at that. Also the implementation of vouchers forms a more homogenous ownership structure of fixed properties. This will be achieved on the assumption that privatization is carried out at the expense of decrease in public wealth.

The cost of all properties in this model is calculated at equilibrium prices and on the basis of the equilibrium rate of exchange. Demand for money and privatization vouchers is contingent upon the cost of resources. With proportional optional change of the scale of prices and the exchange rate, it is possible to change the nominal quantity of the demand for money and voucher-money (while retaining the previous proportions of economy).

Under certain conditions (e. g., the lack of deposits and relatively high prices of fixed properties) the circulation of privatization vouchers in the private sector does not increase the inflationary pressure on consumer goods. The selling of vouchers in external markets increases the balance of payment and raises the equilibrium rate of exchange.

The primary income from privatization vouchers in the private sector is equivalent to the sum of properties to be privatized for vouchers at equilibrium prices (prices keeping demand and supply in balance). This sum should be divided between agents (from the viewpoint of social justice) in accordance with their rate of participation in the formation of the property to be privatized, or in the form of compensation. They should be formed on the basis of four kinds of compensation: for the nationalized property, for work, for insufficient rent of real properties, and for insufficient interest rates on deposits.

For the sake of economic efficiency there should be various organizational forms for investing privatization vouchers (individual owners, joint-stock companies, partnerships, pension and investment funds, and the sale of vouchers in the private sector and abroad).

ACKNOWLEDGEMENTS

REFERENCES

1. **Keynes, J. M.** The General Theory of Employment Interest and Money. London, 1936.
2. **Vercelly, A.** Methodological Foundations of Macroeconomics: Keynes and Lucas. Cambridge University Press, Cambridge, 1991.
3. **Wiseman, J.** Privatization in the command economy. — In: **Ott, A., Hartley, K.** (eds.). Privatization and Economic Efficiency. Edward Elgar, Harts, 1991, 257—270.
4. **Utt, R.** Privatization in the United States. — In: **Ott, A., Hartley, K.** (eds.). Privatization and Economic Efficiency. Edward Elgar, Harts, 1991, 73—86.
5. **Copland, T., Weston, J.** Financial Theory and Corporate Policy. Addison-Wesley Publishing Company, New York, 1988.
6. **Ennuste, Ü.** On stochastic equilibrium of centrally coordinated optimum plans. — Proc. Acad. Sci. ESSR. Social Sciences, 1985, 34, 3, 237—245.
7. **Ennuste, Ü.** Some models of stochastic planning mechanism. — Finnish Economic Papers, 1989, 2, 2, 116—124.

8. Gagey, F., Laroque, G., Lolliver, S. Monetary and fiscal policies in a general equilibrium model. — Journal of Economic Theory, 1986, 39, 2, 329—357.

9. Bandyopadhyay, T., Ghatak, S. Monetary growth models: The role on money demand functions. — In: Bandyopadhyay, T., Ghatak, S. (eds.). Current Issues in Monetary Economics. Harvester Wheatsheat, London, 1990, 302—315.

ERASTAMISTÄHIKUTE ÜKS RISKITEOREETILINE MUDEL

Ülo ENNUSTE

Artiklis on selgitatud majandustingimusi, mille puhul põhivarade erastamistähikute rakendamine on otstarbekas, ning uuritud tähikute optimaalset mahtu ja seoseid traditsiooniliste rahaagregaatidega.

On kasutatud Walrasi mudelit, mis on tuletatud sotsiaalsest optimümülesandest. Seejuures on analüüsis oluliseks teguriks sotsiaalse ja individuaalse riski erinevus ning kasulikkuse funktsioonide vastav kohandamine.

Matemaatiline käsitlus on heuristiline ja skemaatiline.

Kasutatud mudeli abil tehtud analüüsi alusel ei tekita erastamistähikute rakendamine olulist lisainflatsiooni tarbimissfääris.

ОДНА МОДЕЛЬ ВАУЧЕРНОЙ ПРИВАТИЗАЦИИ НА ОСНОВЕ РИСКА

Юло ЭННУСТЕ

В статье проанализированы проблемы, связанные с ваучерной приватизацией, ее объемом и отношением с традиционными монетарными агрегатами. Анализ проведен на основе модели Вальраса с учетом различных уровней социального и индивидуального риска. Результаты показывают, что ваучерная приватизация не повлечет за собой значительной дополнительной инфляции в сфере потребления.