The Development of Non-Monetary Means of Payment

Minzyuk, Larysa

University of Salento

2010

The Development of Non-Monetary Means of Payment

Larysa Minzyuk [*]

University of Salento

Abstract

This paper develops a model to investigate the private enforcement of non-monetary inter-firm payments in Russia during the 1990s. Since acceptability of means of payment can have a self-reinforcing nature, the dominance of non-monetary means of payment over money in Russia might have been a result of the driving forces of the demonetiziation equilibrium. We propose a very simple search model to explore acceptability of means of payment different from legal tender - fiat money, commodity money, and trade credit. In each case, we show that monetization through the proposed means of payment is always a possible trade pattern.

JEL classification: E00, D83.

Key words: privately created means of payment; fiat money; commodity of money; reputations; Russia.

[*]Corresponding address: Department of Economics, Mathematics and Statistics. University of Salento. Via per Monteroni - Complesso Ecotekne, Palazzina C - 73100 Lecce, Italy. Email address: l.minzuk@economia.unile.it

[†]This paper is based upon my Ph.D. dissertation at the University of Salento.

1 Introduction

One of the distinguishing features of Russia's transition has been the proliferation of non-monetary means of payment (NMP) in inter-firm transactions, where NMP refer to the payment instruments different from legal tender money and bank transfers. In 1992, the share of such operations accounted for about 5 per cent of firm transactions, increasing to 47 per cent in 1997 (Hendley, 1997), and reaching the levels raging from 50 to 70 per cent in 1998 (Aukutsionek, 1998; Commander and Mummsen, 1998; Seabright, 2000).

The spread of non-monetary operations was not homogeneous during the period. They were relatively rare at the start of the transition, and their biggest increase occurred in the period when inflation was declining (1995-1997).[1] Non-monetary operations comprised a variety of transaction types among which the main ones were multilateral barter, offsets,[2] and transactions resolved by means of *veksels*.[3]

The use of non-monetary means of payment as a stable practice in inter-firm trade has stimulated a great debate aimed at identifying its main causes and driving forces. At this moment, competing explanations of this phenomenon can be conventionally distinguished into those viewing non-monetary operations as a part of the active strategy of firms, and others seeing the firms' choice of NMP over money to be in some way induced by economic circumstances.

The main contributions in the first group of explanations include the paradigm of virtual economy, the price discrimination hypothesis and the tax avoiding strategy. Gaddy and Ickes (1998, 2002) propose the stylized model in which the Russian economy is clearly split into real and virtual components. Firms from the real part, mainly

[1] In Russian Economic Barometer and Aukutsionek (1998), the share of non-monetary settlement in a sample of medium-sized companies was: 22 per cent in 1995, 25 per cent in 1996, 42 per cent in 1997, and 51 per cent in 1998.

[2] Multilateral barter consisted in complex chains of deliveries involving many firms and organizations, often arranged by professional intermediaries. Multilateral offsets consisted in network of relationship involving the cancellation of mutual debts or the acceptance of goods or services in exchange for writing off debts or future payments. For detail see Commander and Mummsen (1999).

[3] OECD (1997), Annex II discusses the development of various money surrogates among which *veksels*. *Veksels* are promissory notes or, if tradable, bills of exchange issued by enterprises, banks or government with specified maturities and discount rates. In Russia, *veksels* performed an important role, serving as the equivalent of debt instruments such as certificates of deposit, commercial paper, simple IOUs and bonds.

the natural resources sector, invest in restructuring; while firms from the virtual part, the old manufacturing sector, invest in the creation of relationship capital, namely barter chains. This model predicts that NMP with favorable terms of trade will be used mainly by the manufacturing sector at the expense of the natural resource sector. However, Guriev and Ickes (1999) do not confirm this prediction and find that the vast majority of the Russian firms used a mixture of monetary and non-monetary means of payment. Marin (2002) finds no statistically significant difference in the pricing behavior across sectors in the use of non-monetary transactions. Guriev and Kvassov (2004) propose a model in which barter is used to discriminate price and to take advantage of monopoly power. Using the Russian data, they find the existence of a significant positive relation between the share of non-monetary transactions in sales and the market concentration. In a number of studies, non-monetary transactions are viewed as an instrument to avoid paying taxes (Aukutsionek, 1998, 2001; Hendley *et al*., 1997). Carlin *et al*. (2000), using data from 20 transition economies, report that there is strong correlation between firms' overdue tax payments and the use of barter.

Among the explanations which see the firms' choice to transact without money as dictated, there is one that considers credit and liquidity crisis to be the primary reasons of demonetization (Commander and Mummsen, 1999; Brana and Maurel, 1999; Marin, 2002; and Pissarides *et al*., 2002). Another explanation relies on the slow payment system in Russia during the transition in which monetary payments going through banks took up to several months to clear so that barter represented an alternative way to conduct transactions (Goldman, 1998; Hendley *et al*., 2000; Yakovlev, 2000). The proliferation of non-monetary operations is also related to the state's reluctance to enforce cash payments for tax and utilities, motivated by the desire to safeguard higher levels of output and employment (Commander, 1999; and Pinto *et al*., 1999).

Taken for given that the causes of demonetization were multiple, this paper is concerned almost exclusively with addressing the issue of the settlement of trade relationship in which means of payment are privately created. We believe that this question is as challenging as the question of causes. The acceptability of legal tender money as a means of payment is enforced by the state that uses it to buy goods and services, and accepts it in payment of taxes. The acceptability of a privately-created means of payment as *veksels* and debt offsets is based on the willingness of economic agents to produce and deliver services in their exchange. Given that in the Russian economy, in the mid 1990s, legal enforcement of private contracts[4] and commitment to long-run trade relationships were difficult, if not impossible, and

[4]see Hendley (1997) for a detailed description of the legal development in Russia.

the industrial organization was such that the vast majority of goods were produced through chains in which supplying companies never needed what their customers were producing,[5] it is important to identify the minimal set of mechanisms through which firms promoted the acceptability and, consequently, value of privately created means of payment. In this sense, this study contributes to better understanding of the demonetization process in which the hysteresis effect was important.[6]

We propose a simple search model to explore the acceptability of means of payment. For the purpose of this study, the terms means of payment and means of exchange are used interchangeably. The basic framework of the model is that of the standard search model of money.[7] The paper starts with the re-elaboration of one of Rupert *et al*. (2000) models where the acceptability of means payment is based on the expectations of agents about the quantity of other agents willing to produce for it, which suggests that this economy may have multiple equilibria: barter, partial and general use of means of payment. We, however, illustrate that the acceptability has a self-enforcing nature, that is, once a part of agents start to accept some object (fiat money) as a means of payment, the monetization through it is likely to be self-fulfilling.

The second section shows that the acceptability of means of payment is not its own property, but a property it has in a particular equilibrium. It, however, does not imply that the intrinsic properties of objects or securities to be used as a means of payment are not important. In the third section, we study the case of commodity money. What makes some goods more likely become a means of payment is their saleability, defined as the number of productions to which these goods are input.[8] We find that different equilibria are possible including full and partial monetization

[5] see Blanchard and Kramer (1997) for a detailed description of sophisticated chains of production in the Russian economy at the beginning of the transition process.

[6] Commander and Mummsen (1999) suggest that the initial causes which pushed enterprises to choose non-monetary means of payment might be different from the causes which subsequently determined the situation in which non-monetary means of payment crowded out money.

[7] Among the assumptions of standard search models of money we find difficulty in overcoming a double coincidence of preferences. Gurieve and Ickes (1999) estimate the incidence of the double-coincidence-of-wants problem on barter in Russia. Assuming that the more inputs an enterprise needs, the more searches the enterprise would have to undertake when it chooses to sell for barter, they find that enterprises with a greater complexity of production did not barter less. However, it needs to be pointed that the operations, which were commonly referred to as barter, in reality involved transactions in which goods were traded for goods, and not necessarily transactions based on the double coincidence of preferences.

[8] In Jones (1976), the high level of desirability of some commodities, defined as the quantity of agents demanding them for consumption, is determinant for using them as a means of exchange to complete indirect transactions.

through commodity money.

Finally, in the fourth section, we explore the enforcement of trade arrangement in which agents agree to produce on credit. We use it as a proxy of multilateral barter and offset schemes which were largely used by the Russian firms during the mid 1990s. We show one way in which economic agents can implement multilateral trade arrangement, in the absence of any third party enforcement authority, in which everyone agrees to produce on credit. The private enforcement mechanism relies on the knowledge of agents' reputations in the group as a whole.

2 Means of Payment

Among the functions of money, its role as a general means of exchange is arguably the most important one. A means of exchange is defined as an object which is ′habitually, and without hesitation, taken by anybody in exchange for any commodity.′[9] A related notion is a means of payment which is defined as an object that can be used to pay for any purchase and settle any debt. Though there could exist conditions under which the two concepts differ, for the purposes of this study we ignore them and use the two terms means of payment and means of exchange interchangeably.

In this section we study the acceptability of fiat money as a means of payment. In search models, fiat money is an object that circulates in the market and has two characteristics emphasized by Wallace (1980). It is intrinsically useless, and it is not backed by any government policy. These characteristics, which are used in search models ′to account for the additional value that money has over and beyond its intrinsic value and government intervention,′[10] are the same which render fiat money very different from what is used in real economies as outside money - legal tender. Given the above definition of fiat money, we feel we can use it as a proxy of a generic means of payment whose acceptability in the economy arises through the network of social interactions.

2.1 Physical Environment

Consider an economy in which there is a continuum of types of goods and agents whose quantities are normalized to 1. Time is discrete. Agents live infinitely. They discount future at common rate $r > 0$. Each agent can consume only those goods which belong to his consumption range of the size equal to the fraction $x \in (0, \frac{1}{2})$ of

[9] Wicksell [1906] 1967, p.17.

[10] Shi, S. (2006), p.644.

all goods. And each agent can produce only one good which can be consumed by the fraction x of all agents. Nobody produces for his own consumption needs, and everyone must trade.

In addition to the goods, there is another object in this economy, called fiat money. Its total supply is fixed at M, whereas $M \in (0,1)$. At the beginning of time $t = 1$, money is distributed randomly in the population so that the fraction M of agents hold a unit of it, and the fraction $1-M$ agents have no endowment but are ready to produce. Fiat money and goods are indivisible. Given these assumptions, each trade is always a swap of two indivisible objects: money for good in monetary trade, and good for goods in barter trade.

The utility of consumption of the good that belongs to the agent's consumption range is $U > 0$, the utility of consumption of the good different from the consumption goods is 0. Each agent can produce a fixed quantity of his production good at cost c. The only input to production is previous consumption. Production is instantaneous to consumption.

To describe the exchange process, we call agents with money buyers, and those agents who do not have money, but are ready to produce, producers. In exchange, buyers and producers meet randomly and bilaterally. During a period, each agent has the probability of being matched once with other agent with his consumption good. The trading histories are private information. Given these assumptions, agents can not commit themselves to any kind of credit arrangement.

Because money is useless, each buyer is always willing to exchange it for his consumption good. It occurs with the probability $(1-M)x$, that is, the probability of meeting a producer $1-M$ with one of the buyer's consumption goods x. To exclude the possibility that some goods can be used in exchange as a commodity money, we assume that all goods are non storable, and hence need to be produced and consumed at the same time.

Each producer always produces in meetings with a double coincidence of preferences, which are the meetings in which two producers meet and each one can produce what the other wants. Their probability is $(1-M)x^2$, that is, the probability of meeting a producer $1-M$, times the probability of double coincidence of preferences x^2. The non-trivial decision of the producer is whether to trade for fiat money. Obviously, this decision depends on the willingness of other agents to do the same.

We assume that each agent, before entering exchange, decides his trade strategy on the basis of his individual estimation about the quantity of other agents in this economy willing to produce for money. Since all agents are symmetric, the individual estimations are the same across economy, and equal to p.

2.2 Trade Strategies

In order to find out the conditions under which agents decide to trade for fiat money, it is convenient to use Bellman's equations. We consider the stationary economy in which the value functions of buyers and producers are constant over time.

The value function of holding a unit of money is

$$V_b = \frac{1}{1+r}x(1-M)p(U+V_p) + \frac{1}{1+r}(1-x(1-M)p)V_b. \tag{2.1}$$

Each buyer is always willing to trade his money for a consumption good, but he can do it only if he meets the producer who can provide him with his consumption good, and who agrees to accept money. These three events occur with the probabilities $(1-M)$, x, and p respectively, so that the total probability of consumption is $(1-M)xp$. By consuming, the buyer enjoys the utility U, after which he switches to being a producer whose value is V_p. If a trade fails to occur, the buyer holds his money which has the value V_b.

After rearranging (2.1), we arrive at the following equation of the buyer's value function

$$rV_b = (1-M)xp(U+V_p-V_b). \tag{2.2}$$

The value of being a producer is

$$V_p = \frac{1}{1+r}xMp(-c+V_b) + \frac{1}{1+r}(1-M)x^2(U-c+V_p)$$

$$+\frac{1}{1+r}(1-Mxp-(1-M)x^2)V_p \tag{2.3}$$

Each producer during a period of time can either barter or trade his production good for fiat money. The net gain from trades in barter meetings is $U-c+V_p-V_p = U-c$, times their probability $(1-M)x^2$. The net gain that a producer has in trades with fiat money is V_b-c-V_p, times their probability Mx, times the producer's expectation of the acceptability of fiat money p.

Rearranging the producer's value function in (2.3), we arrive at

$$rV_p = Mxp(V_b-c-V_p) + (1-M)x^2(U-c). \tag{2.4}$$

2.3 Acceptability of Fiat Money

We seek equilibria in trading strategies, in which each agent chooses whether to trade or not in order to maximize his expected discounted utility of consumption net of cost of production, taking the trading strategies of other agents as given. We focus on steady-state symmetric equilibria.

The decision of each agent to trade for fiat money is based on the values of p, V_p, and V_b. All agents being symmetric, the strategy of a buyer is the same for all buyers, and the strategy of a producer is the same for all producers. In order to find out the conditions under which fiat money is used as a means of payment, we define the net gains of buyers and producers from trades with it. The net gain of buyers is

$$\Delta_b = U + V_p - V_b. \tag{2.5}$$

Similarly, the net gain of producers is

$$\Delta_p = V_b - c - V_p. \tag{2.6}$$

Substituting (2.2) and (2.4) in the equations of net gains, and doing some rearranging, we arrive at the following equations of net gains

$$\Delta_b = \frac{(U-c)x(Mp+x(1-M))+rU}{r+xp} \tag{2.7}$$

$$\Delta_p = \frac{(U-c)(1-M)x(p-x)-rc}{r+xp}. \tag{2.8}$$

It is straightforward from (2.7) that the net gain of buyers is positive for all parameter values. This result confirms the assumption that buyers are always willing to spend fiat money to buy their consumption goods. On the other hand, the net gain of producers in (2.8) can be either positive or negative. As a result, the acceptability of fiat money as a means of payment in this economy depends on the sign of net gain of producers.

We define that for those values of $p \in [0,1]$ for which $\Delta_p < 0$, the common strategy of producers is to produce only in meetings with barter. For those values of $p \in [0,1]$ for which $\Delta_p \geq 0$, the common strategy of producers, in addition to producing in meetings with barter, is to provide goods in exchange for fiat money.

Proposition 1. *For any $M \in (0,1)$ and $x \in (0,1)$, there exist three potential equilibria:*

(a) $p \in [0,x]$ is always a barter equilibrium

(b) $p = 1$ *is a monetary equilibrium if* $c \leq \frac{xU(1-M)(1-x)}{r+x(1-M)(1-x)}$

(c) if agents produce at cost $c < \frac{xU(1-M)(1-x)}{r+x(1-M)(1-x)}$*, then some* $p \in (x,1)$ *can be an equilibrium as well.*

Proof. It is straightforward from (2.8) that for any $p \in [0,x]$, $\Delta_p < 0$ and the only possible equilibrium is barter exchange. Nobody produces for money which is not accepted by others or accepted by the fraction of agents which is less than the fraction of agents accepting each agent's production goods x. Consider $p = 1$. For this to be an equilibrium, we require $\Delta_p \geq 0$. Inserting $\pi = 1$ into (2.8) and resolving it for the cost of production, we find that $\Delta_p \geq 0$ if $c \leq \frac{xU(1-M)(1-x)}{r+x(1-M)(1-x)}$, as stated in Proposition 1. If agents produce at cost $c < \frac{xU(1-M)(1-x)}{r+x(1-M)(1-x)}$, then some $x < p < 1$ can be an equilibrium as well. □

As we see, given the values of $x \in (0, \frac{1}{2})$ and $M \in (0,1)$, there exists a positive relation between the number of agents accepting fiat money p, their cost of production c and the discount rate r.[11] Thus, taken for given the number of agents accepting money in this economy $p > 0$, for fiat money to become a generally accepted means of payment, either agents should produce at a relatively small cost or they must be sufficiently patient. This result is driven by the fact that in production for money, agents anticipate the disutility cost with respect to consumption which will occur in future and which agents discount at a positive rate r.

2.4 Extension

We have arrived at the monetary equilibrium solution (p,c) considering symmetric agents. The main reason why agents feel it necessary to use fiat money as a means of payment is the requirement of a double coincidence of preferences in trades with barter. But what might be the reason that some p agents more readily produce in exchange for fiat money, while others decide to do it, only after taking as given the positive decision of the former ones? To answer to this question, we consider an economy in which agents differ by their costs of production. That is, everyone produces at some cost $c \in (0,U)$, and the information about the production costs of agents is public knowledge so that everyone at any moment in time knows how many agents in this economy produce at the cost which is less than, equal to, or higher than his.

[11] The conditions for existence of monetary equilibrium similar to those in Proposition 1 can be determined in terms of discount rate.

Keeping all other things unchanged, we seek the conditions under which money can be used as a means of payment in this economy. Buyers are always willing to spend their money to buy consumption goods, the interesting decision is that of producers to provide goods in exchange for fiat money. To find out the conditions under which money can be accepted in payment for goods, we consider the producer's i net gain in trade with fiat money

$$\Delta_{p,i} = \frac{(U - c_i)(1 - M)x(p_i - x) - rc_i}{r + xp_i} \tag{2.9}$$

where c_i is the agent's i cost of production, and p_i is the number of other agents producing at costs less than or equal to c_i.

We define that for those values of $p_i \in (x, 1]$ for which $\Delta_{p,i} \geq 0$, the agent i decides to produce in exchange for fiat money, otherwise he only trades in meetings with barter. Resolving (2.9) for p_i, we obtain that if the fraction of other agents producing at costs less than or equal to c_i is $p_i \geq \hat{p}$, whereas

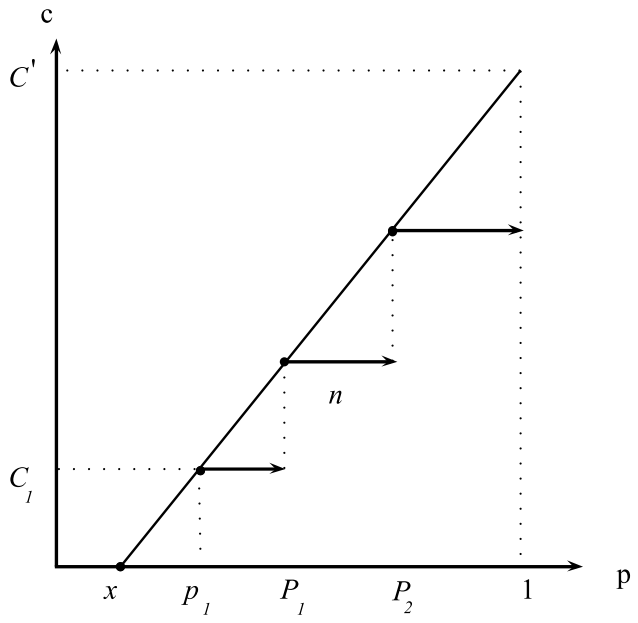
$$\widehat{p} = x + \frac{rc_i}{x(U - c_i)(1 - M)} \tag{2.10}$$

is the critical value for which $\Delta_{p,i} = 0$, the producer i will find it individually optimal to produce in exchange for fiat money.

Suppose that the condition in (2.10) could be satisfied for some fraction P_1 of agents, each of whom produce cost $c \in (0, C_1]$, and not for others, then barter and monetary trade can coexist. However, fiat money, if used at all, can be used much more widely than is apparent from (2.10), and the most efficient agents will promote its acceptability.

From Figure 1, we see that given that individual costs of production of P_1 agents are less than or equal to C_1, each of them will find it individually optimal to produce if the quantity of other agents, producing at sufficiently low cost, is at least equal to p_1, whereas p_1 is the solution to 2.10. Suppose that $P_1 > p_1$, then some other n agents, whose cost of production is greater than C_1, will find it beneficial to produce for fiat money as well, increasing its acceptability from P_1 to $P_2 = P_1 + n$. An increase in the acceptability of fiat money will allow some other less efficient agents to produce in exchange for fiat money as well, further increasing the demand for fiat money for transaction needs. If agents in this economy produce all at costs $c \leq C^{'}$, whereas $C^{'} = \frac{xU(1-M)(1-x)}{r+x(1-M)(1-x)}$ (see Proposition 1), then this self-reinforcing process of acceptability can take this economy very close to full monetization through fiat money.

Figure 1



3 Commodity Money

The above section illustrates one way in which the use of a means of payment and its acceptability can be determined endogenously in the model. We see that the acceptability of fiat money is not its own property, but, instead, depends on which equilibrium occurs. However, this does not mean that the intrinsic properties of objects are not important. We have come to the above result by ruling out the possibility of a rise of commodity money. In particular, we have assumed that all goods are not storable, and have to be consumed and produced at the same time so that the only alternative to barter in this economy is to use fiat money. In this section, we relax the above assumption to study the case of commodity money, defined as an object which, in addition to its value as a means of payment, can be used as a consumption good or a productive input, at least potentially.

The main aim of the analysis in this section is to explore the acceptability of commodity *veksels* which were largely used to settle inter-firm trade relationships in Russia. These securities represented short term inter-firm debt obligations extinguished with provision of commodities. Their number in Russia grew continuously starting in 1995 when, in the situation of sever monetary tightness, firms faced with

the progressive accumulation of arrears,[12] resorted to in-kind payments. Supplying companies started to accept productions of their customers in payment of their goods. If they could not use them directly, they could exchange them sooner or later for something they needed. In this situation, every supplier had a strong incentive to assist his customers in selling their goods for something he would accept more promptly in payment. As a result, firms were progressively involved in a kind of non-explicit cooperation whose main aim was to explore chains of in-kind trade. In this process, goods, which were input to the largest number of other productions, were more promptly accepted for transaction. Among the most $'$liquid$'$ goods there were productions of natural monopolies as Gasprom (gas monopoly), RAO UES (electricity monopoly), and railways. Not by chance, the operation of these companies in the period from 1995 to 1998 become severely demonetized.[13] Obviously, for the transaction scope, it was not goods that changed hands but respective *veksels*.[14]

Commodity *veksles* played the role of commodity money. To account for the acceptability and value that they have had above and beyond the intrinsic qualities of the underlying goods, we propose a simple model in which their general acceptability depends on the equilibrium that occurs.

3.1 Acceptability of Commodity Money

For the simplicity of treatment, consider an economy in which there is no exogenous object which can be used as a means of payment. All agents produce at the same cost c, but differ by demand for their production goods, that is, there is the fraction $M \in (0,1)$ of agents each of whom produces a good consumed by the fraction y of other agents. We call such agents issuers. The remaining $1-M$ agents produce goods which can be consumed by the fraction x of other agents. We assume that $x < y < 1-M$. Neither agent can produce for his consumption need, and everyone must trade.

[12] In the period between 1994 and the middle 1998, in Russia the share of overdue payables increased from around 40 to 55 percent of total payables.

[13] In Pinto *et al*. (2000), cash collections were as low as 12-13 per cent on domestic sales for Gazprom and RAO UES, and about 30 per cent for the railways.

[14] Commodity *veksels* are not exactly commodity money. According to the definition, the value of commodity money comes from a commodity out of which it is made, and, consequently, it is immediately perceivable by its customers. Commodity *veksels* are not made of commodities but can be exchanged for them. As a result, their value is not perceived directly. However, for the purpose of this study, we think that this difference can be ignored and commodity *veksels* can be considered at par with commodity money because we focus on studying *veksels* representing commodities used as inputs to a large number of productions so that firms can have sufficient knowledge about their value.

Keeping all other things unchanged, we define the value function of issuer as

$$rV_I = Mxy(U-c) + (1-M)xy(U-c) = xy(U-c). \tag{3.1}$$

During a period, each issuer may either meet with the probability M another issuer, or he may meet with the probability $1-M$ an ordinary agent. The probability of the double coincidence of preferences in both cases is xy, which is equal to the probability that the issuer can consume the good that other agent produces x and vice versa y.

The value function of ordinary agents is defined as follows

$$rV_o = Mx^2(U-c) + (1-M)x^2(U-c) = x^2(U-c). \tag{3.2}$$

During a period, each ordinary agent may meet with the probability M an issuer, or he may meet with the probability $1-M$ another ordinary agent. In both cases the probability of the double coincidence of preferences is x^2.

Because the value function of issuers is bigger than the value function of ordinary agents, the latter can decide to accept goods of issuers even if they can not consume them. By doing so, each ordinary agent will increase his probability of consumption in the next period from x^2 to xy. Yet, by doing so, each ordinary agent will have to anticipate the disutility of production c with respect to the moment of consumption. Thus, the net gain that the ordinary agent will have in trade with transaction goods, which are the goods that he can not consume but can use to buy consumption in future, is

$$\Delta_O = -c + \frac{xyU}{r} - \frac{x^2(U-c)}{r} \tag{3.3}$$

equal to the payoff from accepting the trade $-c + \frac{xyU}{r}$, minus the payoff from rejecting it $\frac{x^2(U-c)}{r}$.

Issuers seem to have no incentive to produce in exchange for transaction goods, because each of them already produces a good which has the highest demand in this economy. In fact, their net gain from producing in exchange for transaction goods is

$$\Delta_I = -c + \frac{xyU}{r} - \frac{xy(U-c)}{r} \tag{3.4}$$

which is negative for all parameter values. Nevertheless, there exists a possibility to further increase the value of issuers by making transaction goods be a general means of payment. If ordinary agents find it beneficial to produce in exchange for transaction goods, the acceptability of each of them will increase from y to $\Omega = 1 - M + yM$,

that is, each transaction good will be accepted by all ordinary agents $1-M$, and by issuers who can consume it yM. At this point, issuers can decide to produce in exchange for transaction goods as well. By doing so, they will increase the probability of trade from $\Omega = 1-M+yM$ to 1, yet, they will have to anticipate the production cost c with respect to the moment of consumption. Thus, taken as given the acceptability of transaction goods by ordinary agents $\Omega = 1-M+yM$, the net gain of issuers in meetings where they produce in exchange for transaction goods is

$$\Delta_I^{'} = -c + \frac{xU}{r} - \frac{x\Omega(U-c)}{r} \tag{3.5}$$

3.2 Trading Strategies

Each agent will choose whether or not to produce in exchange for transaction goods in order to maximize his expected discounted utility of consumption net of cost of production, taking the trading strategies of other agents as given. That is, each agent will produce in exchange for transaction goods if his net gain from this trade is $\Delta_j \geq 0$ where $j = I, O$.

Proposition 2. *In the model, for any* $x \in (0, \frac{1}{2})$, $M \in (0,1)$, $y \in (x, 1-M)$ *and* $r > 0$, *there are three potential types of equilibria:*

(a) $\Omega = 1$ *is an equilibrium if* $c \leq \widehat{c}_1 \leq \widehat{c}_2$ *or* $c \leq \widehat{c}_2 \leq \widehat{c}_1$

(b) $\Omega = 1-M-yM$ *is an equilibrium if* $\widehat{c}_2 < c \leq \widehat{c}_1$

(c) $\Omega = y$ *is an equilibrium if* $c > \widehat{c}_1$

where the critical values of c are given by

$$\hat{c}_1 = \frac{xU(y-x)}{r-x^2}$$

$$\widehat{c}_2 = \frac{xUM(1-y)}{r-x(1-M+yM)}$$

Proof. To find out the fist critical value $\widehat{c}_1$, we resolve the net gain of ordinary agents (3.3) for the cost production. Similarly, we resolve (3.5) to find out the second critical value $\widehat{c}_2$. If all agents produce at cost $c > \widehat{c}_1$, then no one in this economy will find it individually optimal to produce in exchange for goods that he can not consume. If agents produce at cost $\widehat{c}_2 < c \leq \widehat{c}_1$, then only ordinary agents will use transaction goods as a means of payment. If agents produce at cost $c \leq \widehat{c}_1 \leq \widehat{c}_2$ or $c \leq \widehat{c}_2 \leq \widehat{c}_1$, then the transaction goods will be used as commodity money. □

4 Offsets

Multilateral barter and multilateral offsets have been very important numerically in non-monetary inter-firm operations in Russia. The difference between them is subtle, both worked as a network of non-monetary operations, but multilateral barter was ′primarily a working capital related transaction while offsets [were] a mechanism for settling mutual debts.′[15] Offsets, in addition to being frequent in inter-firm trade, were largely used to clear tax obligations between firms and tax authorities. In this work, we focus exclusively on offsets involving firms, and do not get into the undoubtedly important issue of tax offsets because the latter served scopes which were different from transaction needs.[16]

In this section we illustrate one way in which agents can implement a trade arrangement in which everyone agrees to produce on credit. The challenging issue of this analysis is to show how agents can promote the trust necessary for the implementation of this trade arrangement when each of them has a short run incentive to deviate from it. There exists rich economic literature whose common idea can be illustrated saying that if trade relationship itself is valuable to an agent and he could lose it by deviating behavior, then he would be unwilling to surrender it unless the gain from deviating is sufficiently large to compensate him.[17] The private enforcement mechanism - reputation - relies essentially upon the value of the repeated or long-term trade relationship between economic agents and their customers. We, however, are interested in seeing if the mechanism of good reputations can work in trade relationship in which the parts are not so sure they will trade again in the future. Milgrom *et al*. (1990) show that even in a community in which any particular pair of individuals meet rarely, it is possible for an individual's reputation in the group as a whole to serve as a bond for his good behavior toward each individual member. We follow this idea, and consider a trade arrangement in which each agent's credit, known to the group through the reputation mechanism, substitutes for money, that is, every economic agent agrees to produce only for those who have done the same in the past.[18]

[15] Pinto *et al*. (2000), p.298

[16] for a detailed discussion on tax offsets see Pinto *et al*. (2000).

[17] see Klein and Leffler (1981); Shapiro (1983); Shapiro and Stiglitz (1984); Abreu (1988); Aumann (1985); Fudenberg and Maskin (1986).

[18] In Cavalcanti and Wallace (1999) there is the assumption that a subset of agents is not anonymous; agents in this subset can be monitored or can have reputations.

4.1 Cooperative Agreement

Consider an economy in which all agents are symmetric. Everyone produces at the same cost c one production good which can be consumed by the fraction x of other agents. Keeping all other things unchanged, consider a trade arrangement in which each agent, in addition to producing in barter meetings, agrees to produce for other agents who like what he produces but not vice versa - a meeting with a single coincidence of preferences. This trade arrangement, in which agents get involved in a kind of non-explicit cooperation, generates the maximum possible value

$$V_c = \frac{1}{1+r}x^2(U-c+V_c) + \frac{1}{1+r}x(1-x)(U+V_c) + \frac{1}{1+r}x(1-x)(-c+V_c)$$

$$+\frac{1}{1+r}(1-x^2-2x(1-x))V_c. \tag{4.1}$$

which is equal to the payoff from trade in a barter meeting $U-c+V_c$, times its probability x^2; plus the payoff from trade in a meeting with a single coincidence of preferences in which the agent consumes $U+V_c$, times its probability $x(1-x)$; plus the payoff from trade in a meeting with a single coincidence of preferences in which the agent has to produce $-c+V_c$, times its probability $x(1-x)$; plus the payoff from non trading during a period V_c, times its probability $1-x^2-2x(1-x)$.

Rearranging (4.1), we arrive at the following equation

$$rV_c = x^2(U-c) + x(1-x)(U-c) = x(U-c). \tag{4.2}$$

The value of cooperation is bigger than the value of barter $rV_b = x^2(U-c)$, yet, since agents can not commit ex ante to implement it, to make it work, we need to consider the ex-post incentive condition. To get agents to produce in meetings with a single coincidence of preferences, we require that their net gains are

$$\Delta_c = -c + V_c - V_D \geq 0 \tag{4.3}$$

whereas V_D is the deviation payoff. We consider the case in which agents decide to punish deviators, who are the agent rejecting to produce in single coincidence meetings, by allowing them in the future only to trade in meetings with barter. We can think about an alternative punishment measure - autarky - but its application would require sustaining an additional cost because trade in barter meetings is mutually beneficial and, consequently, it is self-enforcing. If the deviation payoff is equal to the payoff from barter V_B, the above ex-post incentive condition becomes as follows

$$\Delta_c = -c + V_c - V_B \geq 0. \tag{4.4}$$

If agents can observe what happens only in their own meetings but not in others, then, if an agent deviates, the probability that someone he meets later will know it is 0. As a result, agents as a group can not trigger punishment measures against deviators, and the incentive condition in (4.4) reduces to

$$\Delta_c = -c + V_c - V_c < 0. \tag{4.5}$$

Since it is negative for all parameter values, we conclude that if agents can not observe the trade histories of others, nobody in this economy will find it optimal to produce in meetings with a single coincidence of preferences regardless to the fact that the value of cooperation is, ex-ante, bigger than the value of barter.

If, instead, trade histories are observed perfectly so that agents always know what happens in their own and other meetings, then the net gain of producers in meetings with a single coincidence of preferences is

$$\Delta_c = -c + V_c - V_B$$

or

$$\Delta_c = -c + \frac{x(U-c)}{r} - \frac{x^2(U-c)}{r}. \tag{4.6}$$

Solving it for the cost of production, we find that if agents produce at cost $c \leq \underline{c}$, whereas

$$\underline{c} = \frac{Ux(1-x)}{r + x(1-x)} \tag{4.7}$$

is the critical level for which $\Delta_c = 0$, the ex-post incentive condition in (4.4) is satisfied and agents can implement the trade arrangement in which each agent, in addition to producing in barter meetings, agrees to produce on credit.[19]

[19] If (4.4) is satisfied, one can interpret the trade arrangement in this section as a credit system in which there is no need for money. A fundamental result of Kocherlakota (1998) is that money is not essential in the sense that the same allocations feasible with money can be enforced if money is substituted with a record-keeping instrument.

4.2 Enforcement of Cooperation

Situations in which agents observe trade histories perfectly or they do not observe them at all might not be appropriate to describe reality. Thus, we consider another possibility, that is, agents know what happens in the trade meetings of others with some probability $\Phi \in (0,1)$ and the mechanism through which it becomes possible is private reputation.

When two agents meet, each of them learns at no cost the trade histories of his partner and of partners of his partner. Obviously, deviating agents have no incentive to tell the truth about their trade histories. On the other hand, agents, whom trade was rejected, have a strong incentive to make this information known to others. Since we seek a steady-state equilibria in trading strategies, we assume that the probability with which each agent knows the trade reputation of the agent he meets Φ remains constant in time.

Consider the trade arrangement with cooperation outlined in the above sub-section in the situation in which trade histories are observed with probability Φ. Trade in meetings with barter is self-enforcing and does not depend on reputations. Trade in meetings with a single coincidence of preferences is processed only if a producer knows about the good reputation of his counterpart, that is, if producer knows that the agent, who wants his production good, has produced for others in meetings with a single coincidence of preferences in the past. Given this, the ex-post incentive condition in (4.4) becomes as follows

$$\Delta_c^{'} = -c + \Phi V_c - V_B \geq 0 \tag{4.8}$$

or

$$\Delta_c^{'} = -c + \frac{\Phi x(U-c)}{r} - \frac{x^2(U-c)}{r} \tag{4.9}$$

It results from (4.9) that in a specialized economy in which x is sufficiently low, agents, to enforce cooperation, must be able to communicate a great number of reputations, that is the probability with which each agent knows the trade reputations of the agent he meets must be $\Phi > 1-x$. In addition, they should produce at cost $c < \underline{c}^{'} < \underline{c}$, whereas

$$\underline{c}^{'} = \frac{xU(\Phi - x)}{r + x(\Phi - x)} \tag{4.10}$$

is the critical value for which $\Delta_c^{'} = 0$, otherwise the only possible trade is barter.

5 Comments and conclusions

The demonetization in Russia has been peculiar and distinct from what happened in other transition countries, where stabilization policies had as a result increases in payment arrears and trade credit, but did not produce situations in which legal tender money was laterally crowded out by ′surrogate′ money. One possible explanation for the peculiarity of the Russian case (and of some other countries of the former Soviet Union) is the possibility of the existence of multiple equilibria, that is, for the same exogenous setting there may be equilibria either with non-monetary transacting or without it so that the hysteresis effect is to determine which equilibrium the economy will converge to in the end. In 1995, a liquidity shock threw the Russian economy into the trap of non-monetary transacting[20] in which it remains for the following four years.

In this paper, we propose a model to formalize the above idea. In the model the acceptability of means of payment - fiat money, commodity money, and trade credit - depends on the equilibrium that occurs. Furthermore, we formalize the so-called hysteresis effect by illustrating how, once a mechanism of non-monetary transacting is established by promoting the acceptability of a generic means of payment among the minimum sufficient number of economic agents, its further proliferation is likely to be self-fulfilling. This argument predicts that even after the initial causes which propel non-monetary transacting are removed, the system will tend to persist.

Our model is highly stylized, and as such omits many important driving elements in the demonetiziation process, however it clearly illustrates the idea of how economic agents can promote non-monetary transacting in the situation of severe monetary tightness. In addition, it needs to be pointed out that the results outlined in the above sections have been obtained in a very specific context. Given the indivisibility assumption, agents are compelled to trade at given price and, since there is no legal tender money in the model, they chose a trading strategy departing from the situation of pure barter. Further research, relaxing these restrictions, can shed more light on the mechanisms of non-monetary transacting.

References

[1] Abreu, D. (1988). ′On the Theory of Infinitely Repeated Games with Discounting′, *Econometrica,* 39, pp.383-396.

[20] see Commander and Mummsen (1999), Polterovitch (1998)

[2] Aumann, R. (1985). ′Repeated Games′, in George Feiwel (ed.), Issues in Contemporary Microeconomics and Welfare, Micmillan Press, London, pp.209-42.

[3] Fundenber, D. and Maskin, E. (1986). ′The Folk Theorem in Repeated Games with Discounting or with Incomplete Information′, *Econometrica,* 54, pp.533-554.

[4] Aukutsionek, S. (1998). ′Industrial Barter in Russia′, *Communist Economies & Economic Transformation*, 10 (2), pp.179-188.

[5] Aukutsionek, S. (2001). ′Barter: New data and comments′, *Journal of East-West Business*, 6(4), pp.23-35.

[6] Blanchard, O. and Kramer, M. (1997). ′Disorganization′, *Quarterly Journal of Economics*, 112, pp.1091-1126.

[7] Brana, A. and Maurel, M. (1999). ′Barter in Russia: liquidity shortage versus lack of restructuring′, CEPR Discussion paper, 2258.

[8] Cavalcanti, R. and Wallace, N. (1999). ′A Model of Private Banknote Issue′, *Review of Economic Dynamics,* 2, pp.104-36.

[9] Commander, S. and Mummsen, C. (1999). ′Understanding Barter in Russia′, EBRD Working Paper 37, January.

[10] Commander, S. (1999). ′*Barter in Russia*′, *Economic Outlook,* 23(3), pp.19-22.

[11] Gaddy, C. and Ickes, B. (1998). ′Russia's Virtual Economy′, *Foreign Affairs,* 77(5), pp.53-67.

[12] Gaddy, C. and Ickes, B. (2002). *Russia's Virtual Economy,* Washington, DC: Booking Institution Press.

[13] Goldman, M. (1998). ′The Russian ruble and why it collapsed′, Challenge, 41(6), pp.9-13.

[14] Guriev, S. and Ickes, B. (1999). ′Barter in Russian enterprises: Myths vs. Empirical Evidence′, *Russian Economic Trends,* 8(2), pp.6-13.

[15] Guriev, S. and Kvassov, D. (2004). ′Barter for price discrimination′, *International Journal of Industrial Organization,* 22(3), pp.329-50.

[16] Hendley, K. (1997). ′Legal Development in Post-Soviet Russia′, *Post-Soviet Affairs,* 13(1), pp.19-41.

[17] Hendley, K., Ickes, B., Ryterman, R. (1998). ′Observations on the Use of Law by Russian Enterprises′, *Post-Soviet Affairs*, 13 (1), pp.19-41.

[18] Hendley, K., Murrel, P., Ryterman, R. (2000). ′Law, relationships and private enforcement: Transactional strategies of Russian enterprises′, *Europe-Asia Studies*, 52(4), pp.627-56.

[19] Jones, R. (1976). ′The Origin and Development of Media of Exchange′, *The Journal of Political Economy*, 84(4), pp.757-775.

[20] Klein, B. and Leffler, K. (1981). ′The role of Market Forces in Assuring Contractual Performance′, *Journal of Political Economy,* 89, pp.615-641.

[21] Kocherlakota, N. (1998). ′Money is Memory′, *Journal of Economic Theory,* 81, pp.232-251.

[22] Kiyotaki, N. and Wright, R. (1993). ′A Search-Theoretic Approach to Monetary Economics′, *The American Economic Review*, 83(1), pp.63-77.

[23] Marin, D. (2002). ′Trust versus illusion: What is driving demonetization in the former Soviet Union′, *Economics of Transition,* 10(1), pp. 173-200.

[24] Milgrom, P., Douglass, N., Weingast, B. (1990). ′The Role of Institutions in the Revival of Trade: the Law Merchant, Private Judges, and the Champagne Fairs′, *Economics and Politics,* 2(1), pp.1-23.

[25] OECD (1997). *OECD Economic Survey: The Russian Federation: 1997*. Paris.

[26] Pinto, B., Drebenstov, V., Morozov, A. (1999). ′Dismantling Russia's non-payments system: Creating conditions for Growth′, mimeo, World Bank.

[27] Pinto, B., Drebenstov, V., and Morozov, A. (2000). ′Give macroeconomic stability and growth in Russia a chance′, *Economics of Transition,* 8(2), pp.297-324.

[28] Pissarides, F., Singer, M. and Svejnar, J. (2002). ′Objectives and constraints of entrepreneurs: Evidence from small and medium size enterprises in Russia and Bulgaria′, *Journal of Comparative Economics*, 31(3), pp.503-531.

[29] Polterovitch, V. (1998). ′Institutional Traps and Economic Performance′, NES Working Paper.

[30] Rupert, P., Schindler, M., Wright, R. (2001). ′Generalized Search Theoretic Model of Monetary Exchange′, *Journal of Monetary Economics,* 48, pp. 605-622.

[31] Seabrigh, P. (Ed.), (2000). The Vanishing Ruble: Barter Networks and Non-Monetary Transactions in Post-Soviet Societies, Cambridge Univ. Press, Cambridge, UK, pp.1-347.

[32] Shapiro, C. (1983). ′Premiums for High Quality Products as Returns to Reputations′, *Quarterly Journal of Economics*, 98(4), pp.659-679.

[33] Shapiro, C. and Stiglitz, J.(1984). ′Equilibrium Unemployment as a Worker Discipline Devise′, *American Economic Review,* 74(3), pp.433-444.

[34] Shi, S. (2006). ′Viewpoint: A microfoundation of monetary economics′, *Canadian Journal of Economics*, 39(3), pp.644.

[35] Wallace, N. (1980). ′The overlapping generations model of fiat money′, In: Kareken, John H. and Neil Wallace (eds.), Models of Monetary Economies, Federal Reserve Bank of Minneapolis, Minneapolis, pp. 49-82.

[36] Wicksell, Knut. (1906). Vorlesungen über nationalökonomie. Trans. Ernest Classen, Lectures on political economy. Vol. 2, Money. 2nd ed. New York: Kelley, 1967.

[37] Yakovlev, A. (2000). ′Barter in the Russian economy: Classifications and implications′, *Post-Communist Economies*, 12(3), pp. 279-91.