2 Barter relationships

CANICE PRENDERGAST AND LARS STOLE

1 Introduction

Economists interested in barter and non-monetary exchange often talk at cross-purposes to anthropologists and sociologists. Central to the anthropological literature is the notion of 'delayed reciprocity', where barter deals 'require delays in payment and several exchanges before the transactors are satisfied' (Humphrey, chapter 3 in this volume). This observation has been a central theme in the anthropology of exchange since Mauss (1990[1954]) and Malinowski (1961), and an important component of this research has focused on the realisation that such exchange requires institutions that persuade people to reciprocate favours. However, traditional monetary economics has largely dealt with cases in which such enforcement issues are absent, either by assuming simultaneous barter or enforceable long-term borrowing and lending contracts. Missing from this literature is the importance of implicit arrangements which are based on trust.\(^1\) The purpose of this chapter is to redress this somewhat, relying on a large, recent literature on self-enforcing contracts, which often examines trade where money is absent. We argue that useful insights on barter can be obtained by using an economic analysis of repeated exchange with little or no money or external enforcement mechanisms, but where trust plays a central role.

This chapter is not meant to provide a holistic view of non-monetary social exchange in general, which involves an array of moral, religious, cultural and economic aspects. Instead, its objective is to address some aspects of repeated exchange which operate in the wild economic

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\(^1\) For example, Lemon (1998) cites economists as 'believing barter to be the extreme case in which no trust is present in the system'.

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environment of Russia.² It considers the operation of agents (firms or individuals) in an ‘economy of favours’ (Ledeneva, 1998a), each of whose objective in exchange is to maximise their own economic return subject to whatever social, institutional, or implicit constraints that they and their trading partners face. Given the breakdown of social commitments and moral obligations which characterise the descriptions of Russian exchange in this volume, we believe that the tools of economics can provide a useful framework for understanding some phenomena.³

Throughout the chapter, we borrow liberally from recent advances in the economic literature on repeated-game theory which studies environments in which there is little external enforcement of contracts, but where the individuals themselves must design informal institutions to manage trade.⁴ With some notable exceptions such as Kranton (1996, 1998), there have been few attempts to understand barter arrangements from this perspective – a perspective which recognises the delay and trust which is inherent in barter exchange. We have also tried to minimize as much as possible the technical difficulties of the chapter. For those interested in a more technical treatment of some of these issues, see our companion papers (Prendergast and Stole, 1998a, 1998b, 1998c). In cases where some technical details are required, they are largely relegated to an appendix (p. 65) to render the chapter more readable.

A number of themes run throughout this chapter. The first theme which we emphasise is the costs of barter relative to a monetised economy. This is a central concern of classical monetary theory which emphasises reductions in trade which arise because there is an absence of a static double coincidence of wants.⁵ Money, because of its commonly accepted value, provides for this double coincidence. We leave such inefficiencies

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² As described in this volume, the environment of exchange is characterised by ‘pride in acquiring’ rather than giving (Humphrey, chapter 3 in this volume), replete with opportunities for ‘cheating, defaulting and illegalities’ and where there are ‘no longer pregiven social commitments’ (Anderson, chapter 12 in this volume). These aspects will be features of the economic model we offer below.

³ Having said that, neither author is an expert on Russia, and we may ignore an aspect of Russian culture or institutions which will render an observation of less relevance or importance than it might be. Despite this, we believe that the theoretical apparatus offered here should help at least to frame some of the discussion of demonetisation, despite its absence of a ‘thick description’ of barter in Russia.

⁴ For those interested in learning more about this literature, we recommend Fudenberg and Tirole (1991). For early work on self-enforcing contracts, see Telser (1980); Klein and Leffler (1981).

⁵ To take a trivial example, if you only have broccoli to trade for my coffee, and I don’t like broccoli and can’t easily trade it on to someone else, the trade is unlikely to be consummated.
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largely in the background and instead emphasise a series of more subtle and less studied issues. First, we begin with the most basic model of reciprocated exchange in section 2, where two individuals would like to trade with each other over time, but do not have money to facilitate exchange. The individuals are symmetric in that they value each other’s good equally and with similar frequency, though (importantly) their demands are not simultaneous. In this simple setting, we illustrate the ability of the individuals to reciprocate trade when the penalty for failing to do so is the dissolution of the relationship, a common enforcement mechanism in many societies (see Sahlins, 1972, on this). In our simple benchmark model with similar traders, the ability to trade depends on the importance of the relationship – namely, the frequency of interaction and the patience of the individuals, where traders compare the benefits of reneging on the relationship with the lost surplus that would ensue if they did.

The purpose of section 2 is simply to illustrate how the modern tools of economics can aid in our analysis of the decisions taken by agents and the resulting levels of trade. The simple economic model we present, while useful in developing an understanding of the importance of future interactions, is limited in that there are many dimensions on which the model fails to capture important aspects of observed exchange. Recognising these limitations, we proceed through the remaining sections of the chapter by introducing variations into our framework to explore these additional issues.

In section 3 we adapt our model of repeated exchange to deal with the fact that one agent may need the good of this trading partner more than vice versa, or one agent may be more ‘powerful’ than the other. In this section, we demonstrate a second theme: such asymmetries can cause additional barter inefficiencies through different outcomes than those which would occur in an exchange environment mediated with money. For example, when individuals find it difficult to enforce trade through reciprocal exchange, production of ‘unwanted’ goods is typically higher than those which are in greater demand, in sharp contrast to the outcome

6 In this sense, we differ little from Firth’s (1939, p. 421) observation on the Maori that ‘the main emphasis of the fulfillment of obligation lie ... in the desire to continue useful economic relations’.

7 By ‘modern’ we mean the economic tools which have been developed in the past 25 years to deal with incomplete information and strategic interaction. These tools are complementary and distinct to the well developed methodology of neoclassical economics which has largely assumed full information and ignored strategic interaction. We make this distinction precise because it is our experience that most non-economists narrowly define economics as the application of the neoclassical paradigm.
of a monetised economy. The reason for this is that these unwanted goods serve, in part, the role of currency and one may find 'liquidity' value in them as a means of exchange. We also relate the resulting outcomes to discussions of pricing in chapters 10–13 of this volume, where we show how the terms of trade offered to those with 'unwanted' goods depend on the trading relationship. Specifically, the price paid for valued goods (in terms of 'unwanted' goods) gets worse as relationships become less important.

Another recurring theme of the chapters in this volume is the importance of networks for facilitating trade. Section 4 analyses a simple network to illustrate some issues which appear relevant to the Russian experience. Foremost among these issues is an understanding of the distributitional implications of barter exchange in Russia, a third theme of the chapter. It seems clear from the work presented by Lemon (1998), and chapters 10–12 in this volume by Humphrey, Ledeneva and Anderson, respectively, that transacting through personal contracts does not lead to a level playing field. One can think of established network links as a scarce economic resource which takes time to develop, and whose presence tilts economic power towards the linked trading partners. In particular, established firms, often those from the Soviet era, appear to be in a particularly good position owing to both the volume of trade that they are involved in and the central position that they hold in production networks. These are the 'good old' contacts described by Ledeneva in chapter 11 in this volume. By contrast, some firms and individuals appear to have been left behind in this world of contacts, not least the Roma described by Lemon (1998). An additional implication of this, modelled in section 4, is the demand which this generates for middlemen, who appear to play a central role in many of the network discussions in this volume. However, these middlemen typically take advantage of their position in the networks and extract some of the surplus from the trade based on whatever they can contribute to the exchange. This section also points to an additional distributional implication of the barter economy – namely, that there are likely some individuals who have benefited from the demonetisation of the country, largely because it increases the value of their advantaged position in networks, which in a monetised economy would be of lesser importance.

A fourth theme which we address is how individuals choose to construct their networks. Many sociologists take a rather structuralist approach to networks (see Burt, 1992, for example), where networks are simply assigned, even though it frequently appears to be the case that individuals explicitly and strategically create networks. In Section 5 we consider an additional aspect of networks in that when money is
interact to supply goods to each other. To do so, we set up a stylised 'repeated game', in which two individuals trade with each other, but where the only way to reward a trade partner is by offering a good in the future; there is no money to satisfy a static double coincidence of wants. Periodically, each party demands goods from the other, and the other must make a voluntary choice whether to provide those goods. The individuals interact repeatedly so that one partner can use the threat of terminating the relationship as a way of persuading the other partner to supply goods to them. As a result, agents weigh the personal gain from continuing the relationship and supplying goods to the other at some immediate cost against violating the implicit duty to supply which would end the relationship. In this setting, not surprisingly, the importance of the future relationship to the individuals plays a critical role, with trade being easier to enforce when the relationship has dense or highly valuable future trading opportunities than when trade is sporadic or of low value.

The formal model we offer requires some notation but is logically straightforward. In keeping with the specifics of much of Russian barter, we assume an absence of a double coincidence of wants; instead there is some delay between exchanges so that the individuals must reciprocate goods and favours to each other over time. Consider two individuals who interact over time, potentially providing goods to one another other whenever called upon to do so. Each party to the relationship has a good which their partner may demand in any period of time. To be specific, we assume that when a good is demanded by individual $A$ and $q$ units are supplied by individual $B$, a value of $q$ accrues to agent $A$ at a cost of $c(q) = \frac{1}{2} q^2$ which is borne by individual $B$; the reverse is true when the demand is made by individual $B$. We can then define $v(q) = q - c(q)$ as the joint surplus created from the trade of the good. Importantly, agents cannot satisfy their own needs. We consider the arrival of demands (which we sometimes refer to as projects) to be a random process with a project for person $i$ arriving during a short period of time, $\Delta$, with probability $\lambda \Delta$ – i.e. projects arrive according to a Poisson process.

This seemingly complicated dynamic process is in fact extremely simple to deal with, as we will see below. With this description of the availability of productive projects, we can think of a higher $\lambda$ as corresponding to more frequent trading opportunities. Indeed, simple statistical calculations verify that $1/\lambda$ represents the average time between opportunities. Another attraction of thinking about projects arriving randomly over time according to our $\lambda$ distribution is that that a double static coincidence of wants occurs with insignificant probability; as a result, reciprocal exchange over time is the only possible avenue for trade.

Visually, the trading network can be illustrated as in figure 2.1.
Recall that $1/\lambda$ represents the average time between trading opportunities. The time between trades is relevant as people are impatient: Everything else being equal, consumption today is better than consumption next year, and production today is more costly than production next year. We model this impatience by assuming that individuals have a subjective discount rate which can be thought of as an internal rate of interest; we denote this rate with the notation $r$. Mathematically, it will be the case that the ratio of the interaction rate to the value of that time, $\lambda/r$, will be the critical determinant for whether or not cooperative trade is sustainable. This ratio is a measure of the relative frequency of trade. A higher ratio implies that the expected present value gains from ongoing trade is higher, and hence we will see that cooperation through dynamic reciprocity is easier to sustain. Lower values of this ratio indicate that the relationship is more transient with only sporadic interaction.

To see the role of this ratio more precisely, consider trade in this environment where there is potentially reciprocated exchange. Here, the agents enforce reciprocal trades through the threat of dissolution of the partnership.\(^8\) We initially consider symmetric solutions to this problem, where each agent receives the same quantity of $q$ from the other.\(^9\) Then if one agent requires $q$, the other agent is willing to provide it only if

$$V(q) \geq c(q), \quad (2.1)$$

where $V(q) \equiv \lambda/r[v(q)]$ represents the expected return of the indefinitely recurring relationship to a trader. Therefore, $V(q)$ is the value of the relationship. Note the importance of the $\lambda/r$ term: a higher ratio directly implies a higher value to the relationship.

The requirement for cooperation in the incentive equation above forms the foundation for this chapter, so it deserves some elaboration. The person who is called upon to produce has a choice: either produce the good, which costs $c(q)$ or renege, in which case no costs are incurred. All other things being equal, the person would prefer not to incur this cost. However, if she fails to produce, she has reneged on the relationship and loses the future value of that relationship, which is $V(q)$, as the relationship is dissolved.

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\(^8\) 'We know what happens when a trade partner is disinclined to reciprocate – the sanction everywhere is dissolution of the partnership' (Sahlins, 1972, p. 312).

\(^9\) This is the outcome that arises when maximising the sum of the two individuals' utilities.
Therefore only if \( V(q) - c(q) \geq 0 \) will she actually carry out her obligations.

The next step in solving this problem is in understanding how much trade individuals will be willing to fulfil. If each party could pay for the goods in a commonly accepted currency, the quantity traded would be \( q^{\text{eff}} = 1 \) – this is the 'efficient' level of trade which maximises the relationship's value, \( V(q) \). However, our agents do not have money and must rely on the reciprocal exchange of favours. They choose the maximum level of \( q \) (up to the efficient level of 1) that the provider of the good is willing to offer. The trades can be characterised by two regions. For large enough \( \lambda/r \), the incentive constraint (2.1) does not bind at the efficient level of trade, \( q^{\text{eff}} = 1 \), so they will produce efficiently. In other words, if agents interact frequently, or the surplus is large enough, trade is efficient and the absence of money is overcome by the existence of repeated exchange. In more colloquial terms, trust can substitute for cash. For lower rates of interaction, both quantities are below the efficient level, as the value of the relationship does not make producing higher output worthwhile. Note that the quantities of both goods continuously increase in \( \lambda/r \) so that as the relationship becomes more important, quantities rise to the surplus-maximising levels.

**Example 1** For an illustrative case consider the setting in figure 2.2. The curve in the top graph gives the (maximal) flow value from the relationship \( rV(q) \) as a function of the frequency of interaction (normalised by the cost of time) \( \lambda/r \). This is the total surplus generated for each party. The curve in the bottom graph measures the provided quantity as a function of \( \lambda/r \).

Figure 2.2 illustrates the importance of \( \lambda/r \) for trade, with quantities traded increasing in the frequency of interaction, up to the point of efficient trade, beyond which there is no reason to increase trade further. This section demonstrates the importance of repeated interaction in effecting barter exchange. If money were freely available, there would be no reason for repeated exchange. With money absent, the threat of dissolution acts to constrain cheating, and so it is important that the agents value the relationship in order to act honestly.\(^{10}\) This section therefore illustrates one cost to

\(^{10}\) In one sense, this section is little more than a formal illustration of the schema of reciprocity offered by Sahlin (1972). He characterises different types of reciprocity based on the distance of a trade partner from the individual. At the top of this hierarchy is generalised reciprocity, where high levels of trade are possible with members of one's own kinship groups. At the other extreme is the negative reciprocity offered to strangers, where an individual will happily harm the person he is trading with. This model describes distances in terms of \( \lambda/r \).
Figure 2.2 The effect of interaction frequency on dynamic reciprocity

Barter exchange in repeated settings – namely, that individuals are sometimes focused on short-term gains so much that they renege on their reciprocal obligations. (Or, to phrase it another way, as individuals value relationships less and less, smaller quantities of trade can be supported.) There is much evidence to suggest that such inefficiencies arise. First, many of the contributors to this volume cite the ‘wild’ nature of the Russian economy where incentives to default prevail, while Ledeneva (chapter 11 in this volume) also emphasises the critical importance of ‘good old’ personal contacts for ensuring that trade actually happens.

3 Inefficient, delayed rewards and the liquidity value of trade

This section deals with cases where one agent’s goods are of higher value that those provided by the other. Put simply, how does reciprocity operate
in situations where one agent demands more from the other than vice versa? So far, we have offered one reason why economic relationships without money can be inefficient: trade is not frequent enough (or, alternatively stated, individuals are not sufficiently patient). However, there are other problems which can arise when money is absent, many of which related to inherent asymmetries between the two parties. (Remember that in the previous section, we assumed that the two parties valued each other's goods equally.) A recurring theme on barter in this volume is that many of the goods traded are not so desirable to one of the parties, and may take time and involve other costs to offload. Equally there are cases where one party needs things frequently from the other, while the reciprocal demands from the other party are much more intermittent. There is furthermore considerable evidence from these chapters that the terms of trade depend on what currency is bartered, which this section also addresses.

When individuals value each other's contributions differently, two additional insights arise. First, agents trade with one another not simply for the consumption value of trade but also to provide 'liquidity', serving a role as a quid pro quo for the exchange.¹¹ The role of commodities as a form of money gives rise to qualitatively different outcomes than those which arise in a monetised economy. Second, pricing depends on both the goods traded and on the importance of the relationship, where low-value goods and goods in sporadic relationships may receive poorer terms of trade relative to high-quality goods.

**Asymmetric values in trading relationships**

In order for such liquidity provision to play a role, we first consider asymmetries between the agents, where one agent values a unit of consumption of the other's good more than vice versa. To this end, we extend our basic model of section 2 by assuming that one individual, person \( A \), values a unit of the other agent's good at \( \alpha q \), where \( \alpha > 1 \). We call this high-valuation consumer the \( \alpha \)-agent. The other individual, \( B \), continues to have unit marginal utility for consumption. Note that higher optimal production, \( \bar{q} = \alpha > 1 \), is called for when serving the \( \alpha \)-agent, relative to the other agent for whom optimal production remains at 1. These are the outcomes of a monetised economy. However, to induce the other person to offer higher quantities of the \( \alpha \)-good in a barter setting, the agent must offer something in return. In the absence of money, this becomes the

¹¹ See Calvert (1989), who applies a similar game-theoretic approach to log-rolling by politicians.
other good, so that production decisions will be partly determined by the
desire to satisfy the other agent’s demands at the higher level of produc-
tion. In this sense, production decisions will be partly determined by a
wish to create a dynamic double coincidence of wants, as there is no static
coincidence of wants.\textsuperscript{12} The lower-quality good has a ‘liquidity’ or quid
pro quo value in a barter exchange which accounts for why it is over-
traded relative to the allocation in a monetary economy.

Our interest here is in identifying the quantities of goods which the
individuals are willing to trade. In order to render the chapter more
readable, we relegate much of the technical detail to the appendix
(p. 65), where a more formal proof of the propositions is offered. In
words, the quantities traded have the following characteristics. First, if
the agents do not interact frequently, trade is below its efficient level, and
trade of the low-value good exceeds that of the superior good. Ironically,
the worse is the low-value good relative to the superior, the greater is its
relative production. For intermediate rates of interaction, trade in the
low-value good is below that of the superior good, but higher than
the efficient level which would arise if money were available. Finally,
if the individuals interact frequently enough, there is no difference
between the outcomes with barter and with money.\textsuperscript{13}

A visual characterisation of the solution is given in figure 2.3, where \( \bar{q} \)
is the production of the superior \( \alpha \)-good and \( q \) is the production of the
lower-valued good. In this example, we set \( \alpha = 1.2 \).

Remember that if money was freely available, the outcomes would be
\( \bar{q} = \alpha \) and \( q = 1 \) regardless of the rate of interaction, \( \lambda/r \). Such efficient
levels emerge under dynamic reciprocity only if the rate of interaction is
high enough; again, if the relationship is sufficiently important, trust can
substitute for cash. More generally, though, from figure 2.3 one can see that
there are three separate regions. The one that seems of most relevance to

\textsuperscript{12} Throughout this section, we simply maximise the sum of utilities. An interpretation of
this is that each agent is ex ante identical, where nature determines which agent is the
\( \alpha \)-agent. Decisions on the equilibrium are taken before the draw from nature, so all
agents agree on the objective function.

\textsuperscript{13} In this chapter, we implicitly assume that \( \alpha \) is not too large so that the asymmetries are
not too great for sufficiently patient traders to overcome; to be precise, we require that
\( \alpha < \sqrt{2} \). If \( \sqrt{2} < \alpha \), the agent who produces the \( \alpha \)-good will be unwilling to produce at
efficient levels, even when \( r = 0 \). In other words, his costs of production exceed the
(instantaneous) value of the other good. If this is the case, then as \( r \) tends to zero, the level
of the low-value good produced will be higher than 1, as it is the only means of rewarding
the agent. In this sense, over-supply of goods can occur for liquidity reasons, in the
absence of anything to do with the repeated interaction that underlies the chapter. These
are akin to the classical inefficiencies that are discussed in the static literature on barter.
These issues are discussed in detail in Prendergast and Stoie (1998b).
the examples cited for Russia concern those where interaction is infrequent (λ/r low). This is the part where both lines are upward-sloping. For example, Humphrey (chapter 3 in this volume) cites the 'short horizons' of many barter participants. Note that when interaction is infrequent, production of the worse good \( q \) is higher than production of the better good and liquidity concerns reverse our normal intuition on the supply of goods, where goods with higher marginal valuations have higher production.\(^{14}\)

We can easily rephrase these results in terms of pricing behaviour: in relationships where interaction is infrequent, those with poor barter goods get bad prices. In order to consume something that they like, those with poor barter goods generally pay a dear price, sometimes having to produce large quantities to get anything in return. This appears to correspond to a recurring theme in many of the chapters in this volume. For example, Anderson (chapter 12 in this volume) describes the 'exploitative side' of these trades, with barter prices being 'more expensive than purchasing goods at wholesale prices'. It is easy to translate our results into relevant prices: the price is the quantity of one good which must be

\(^{14}\) It is worth briefly noting the two other regions of trade here, though it is not our primary focus. First, note that trade in the less desirable good declines in λ/r after some point. The reason for this is that in this region, as λ/r increases, the value of the relationship rises for all agents, thus reducing the need to over-supply the less useful asset. Thus increased patience reduces some trades. Finally, for large enough λ/r, the efficient allocation (i.e. the outcome of a monetised economy) occurs.
offered to get a unit of the other. Not surprisingly, as the difference between the two goods' qualities increases, more of the low-valued good must be offered to get a unit of the better good; in effect, the price of the better good rises. From this perspective, it is hardly surprising that the prices denominated in petrol would be better than those denominated in electric energy which 'is not an easy currency' and 'produces big discounts' (Ledeneva, chapter 4 in this volume). In essence, prices reflect the quality of the bartered goods.

Another implication of this simple model is that it shows how pricing varies by the importance of the relationship. Figure 2.4 plots the price of the $\alpha$-good denominated in terms of the other good as $\lambda/r$ changes. This represents the amount of the less desirable good which must be offered to get a unit of the better good. It is immediately seen that the relationship is (weakly) downward-sloping, so that the cost of getting the better good falls as the relationship becomes more important. Also note that in relationships which are more important, the terms of trade get closer to the efficient level, with traded quantities similar to those which would emerge in a world with money.\footnote{With money the ratio of production of the unwanted good to the other is $\frac{1}{12}$.} When the relationship is unimportant, the price of getting the preferred good is highest and most out of line with the efficient price level. Thus pricing depends on relationships, as in Humphrey (1992, p. 123).

These observations illustrate how non-monetary exchange operates in a different fashion to monetary exchange. For instance, it is one of the most basic premises of economics that goods which have higher marginal surplus will have higher production than those which are less valuable.
But this basic premise is violated here where there is more production of the less useful good. In addition, we have pointed out the poor terms of trade which arise when agents have goods which have poor liquidity: those who pay in petrol generally do better than those paying in bricks.

Asymmetric bargaining power

So far, we have considered only those cases where bargaining power worked such that the sum of individual utilities was maximised. Yet many of the papers in this chapters focus on the advantaged position of some agents relative to others, manifesting itself in terms of asymmetric bargaining power. A central theme of recent contributions to economics concerns inefficiencies that can be generated by bargaining distortions. Two cases are generally considered: those in which everyone knows the other's valuations and those where valuations are unknown. In this section, we consider the simplest case, where two agents trade with known valuations but where there is asymmetric bargaining power. In two related papers, we develop the effects of barter upon bargaining distortions in environments of incomplete information.\footnote{Prendergast and Stole (1998a, 1998c).}

When money is freely available, such asymmetric bargaining power worries economists little, as higher bargaining power results in a weak agent simply paying more money, with no change in the efficiency of the allocation. There is only a pure distributional effect, about which we have little to say. However, this is not so in the case of barter; here asymmetric bargaining power directly affects the efficiency of the allocation – judged relative to a monetary economy – as greater bargaining power is now manifested in terms of inefficient distortion of goods. For example, a farmer in Russia with little bargaining power may be required to hand over excessively large quantities of food to a powerful buyer, who offers little in return. In a monetary economy in which both parties had ample monetary assets, such bargaining power may result in large cash transfers, but not in inefficient allocations of goods. Such distortions in production are the standard efficiency losses of economics.\footnote{It is worth emphasising that when we claim that asymmetric bargaining power in barter settings can generate inefficient allocations we are measuring the inefficiency relative to the monetary outcome. A barter allocation is still efficient in a money-less world, but the introduction of money could raise everyone's level of consumption without anyone being harmed by allowing an efficient reallocation of consumption across individuals.}

In order to isolate the effect of bargaining power \textit{per se}, consider a case where agents interact so often that the incentive constraints are irrelevant (in the context of the formal model, assume that interaction is very high)
and their demands are assumed to be symmetric, as in section 2. Suppose instead of simply assuming that the agents split the surplus, they bargain over the allocation. Following work by Rubinstein (1982), a simple way of parameterising bargaining power relates to the patience of the individuals involved. In this case, those with weak bargaining power cannot wait to consume the good, while those with stronger bargaining power are content to sit out some time before consuming. Although trades in these models occur immediately, the terms of trade benefit the more patient bargainer. Suppose initially that each party is equally patient. Then the bargaining outcome offers $q = 1$, the same outcome as with money. (Remember that we are restricting attention to the case where the agents have symmetric demands and interact frequently, so that we do not have to worry about the problems of the previous subsection.) This merely replicates our earlier results. However, the presence of asymmetric bargaining power will generate differences between the two allocations. As an example, consider the case where agent $A$ has all the bargaining power, allowing her to make a take-it-or-leave-it offer to her trading partner. Then the barter allocation has $B$'s consumption given by $q_B < 1$ and agent $A$'s consumption given by $q_A > 1$. In other words, asymmetric bargaining power per se causes problems, with the party with more bargaining power getting quantities which are too high while his less patient partner consumes too little relative to a monetised economy.

4 Networks and distributional effects of barter

Perhaps the dominant theme of the chapters in this volume has been the importance of contacts and networks in current economic exchange in Russia, and some of the more fascinating contributions illustrate the quite incredible sophistication of the networks which sometimes develop to satisfy a 'double coincidence of wants'. Ledeneva's (1998b) contribution here (chapter 11) is particularly apposite. The importance of this institution of exchange should not be under-estimated in understanding how barter affects modern Russia. First, as Anderson (chapter 12 in this volume) nicely puts it: 'the logic behind market economies is that commodities, such as money, are intended to bind together many diverse communities of exchange. The series of Russian financial crises ... (lhasi) disqualified the [new] rouble from the role of an instrument of social integration'. Or to put it another way, one person's money is as good as another's, so money facilitates exchange between individuals.

18 More precisely, $q_B = 2^{-1/3}$ and $q_A = 2^{1/3}$.
with little in common. By contrast, one person’s social contacts are clearly not the equal of another’s.

This transition from an economy based on money to one based on contacts surely has important effects on distribution and social integration. In terms of the simple model above, individuals differ in terms of their trading intensities (i.e. $\lambda/r$), where those with less frequent interactions become excluded from trades which would otherwise occur with money. There can be little doubt from Lemon’s (1998) contribution that this has adversely affected the Roma, who are often seen as untrustworthy by Russians. Equally, Humphrey (chapter 10 in this volume) notes that farmers are restricted to simultaneous barter arrangements, as they lack the relationships to ensure delayed reciprocity. Yet such exclusion is not restricted solely to particular ethnic or occupational groups. Instead, it is clear that individuals seek out trade partners with good pedigrees, or at least pedigrees where there is evidence of dense trade. As Anderson notes (chapter 12), there is a difficulty in building ‘networks of alliance in a space where there are no longer pregiven social commitments.’ Ledeneva (chapter 11) emphasises the importance of ‘good, old’ contacts, while Humphrey (chapter 10) notes the importance of networks that are often ‘quite simply based on Soviet-era links’, where firms ‘prefer to work with solid government-supported firms’. Clarke (chapter 7) notes that two classes of contacts become important: those who ‘had their roots in old administrative structures’ and ‘those outside the law’.

These observations seem to point to the importance of established trade partners, those with links to many other firms, which may be necessary to provide the ultimate ‘cash’ of the barter arrangement. Those with few links to other networks become poor trading partners, at least in the absence of middlemen. It is our sense that this is of critical importance for the Russian economy, and perhaps the political future. One implication of such barter networks is that they exclude individuals on the periphery (the Roma being the extreme social example of this) and also give a huge advantage to those who are already in established networks. It is not hard to see potential implications for restructuring and government in Russia. Particularly, because of demonetisation, older established firms, often those which are the ‘dinosaurs’ of Humphrey’s (1998) analysis in chapter 10, are increasingly becoming central to economic exchange, despite the extinct nature of the outputs that they produce. Since these firms often have strong contacts to local government, it is also not hard to imagine a link to political entrenchment.

The importance of networks for facilitating trade has numerous implications. First, as described above, it can exclude peripheral individuals
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from exchange. A second implication, which we briefly model here, concerns the importance of middlemen to economic exchange. As Clarke (chapter 7) notes, 'to find new customers and suppliers, enterprises had to turn to intermediaries, ... individuals who had their own contacts and sources of finance'. To illustrate this, we consider a simple network which requires a middleman to facilitate exchange. However, an additional purpose of this is to note that the middleman does not come for free; positions in networks generate rents which reduce the value of trade to the parties who are involved in production. Indeed, we will show below that middlemen may actually benefit from the demonetisation process: they are needed only when times are sufficiently bad, and so (in some cases) may disappear when times get better.

This section also deals with the fact that not all trade consists of reciprocal barter. There is some liquidity in the system, though the trading individuals cannot be assured of having enough. To model this and the need for middlemen, we begin by extending the model of liquidity trade in section 3 by assuming that another individual can provide liquidity: as noted above, parties A and B may not interact enough to get to the same outcome as the monetised economy. This is where middlemen play a role. They can in effect partially monetise the barter transaction by providing transfers between the parties with some regularity. We model this simply here by assuming that there is another party, C. This party fills a need between A and B in the following way. We assume that A has a project with C where he can transfer a good to C. For simplicity we ignore the productive value of the trades with C by assuming that transfers from A to C are welfare-neutral, where a transfer of goods costing x to A has value x to C. In turn, C can transfer something to B, where a transfer of goods costing x to C has value x to B. Thus C plays no role other than to shuffle resources from A, the consumer of the superior good, to B the consumer of the low-value good.\(^{20}\) Thus, when A wants something, B will provide it and gets (possibly) two things in return: goods from A and and a transfer from C. These occur some time in the future. (Without the middleman, B can obtain only goods from A.) The role of party C, who acts like a bank, is that it can transfer resources to B when available and required. To retain symmetry in the model, we also assume that C receives each of his projects (the project from A being one, the project to B being the other) with frequency \(\mu\lambda\), where a higher

\(^{20}\) In effect, the welfare-neutrality of C's transfer are as if the parties transact cash. But this is for simplicity. A perhaps more natural assumption would be to make the trades between C and the other parties inefficient rather than just neutral. In that case, the choice over using the middleman would depend on whether the liquidity creation by the middleman outweighed the costs of the inefficient trades.
value of \( \mu \) is akin to increasing the liquidity available to party \( C \). As with the liquidity model of Section 3, agent \( A \) prefers the good provided by \( B \) (with marginal utility \( \alpha > 1 \)) relatively more than \( B \) likes \( A \)'s good (which has marginal utility of 1).

Visually, our network is given in figure 2.5.

Of course, the agent providing liquidity will not do so for free; \( A \) must pay him. Since it facilitates trade, \( C \) will demand a share of the increase in trade by threatening to abscond whenever he is required to give something to \( B \). \( A \) must provide \( C \) with a credible promise of future returns to prevent this behaviour. Thus, when \( A \) has an opportunity to transfer value to \( C \) via some project, she will do so to the extent required. As with the previous sections, we assume that the parties maximise the sum of their utilities, subject to the relevant incentive constraints of the type described in section 2.\(^{21}\) The main difference in the formal model is now that party \( C \) must be induced to hand over a transfer to \( B \) when he is called upon to do so.\(^{22}\)

As in the previous sections, we do not provide exhaustive details of our theoretical results. Instead, we simply provide an example to illustrate the

\(^{21}\) Some readers may be uncomfortable with this and would prefer a more explicit bargaining structure. An obvious alternative would be to use Nash bargaining. Nash bargaining is equivalent to maximising the product of the agent's utilities, subject to the relevant incentive constraints. However, as we show in other work (Prendergast and Stole, 1998c), this involves additional complications when monetary and non-monetary allocations are compared, as it changes the nature of the bargaining game. This adds additional complications which we do not discuss here: see our earlier work for details.

\(^{22}\) Suppose that as part of an equilibrium allocation, agent \( C \) is required to give a transfer of \( t \) units of his good to \( B \). Let \( V_C \) be the present value of the utility of agent \( C \) from the trading relationship with \( A \) and \( B \). Then it must be the case that \( V_C - t \geq 0 \) for the agent to be willing to make the transfers when required to do so. Figure 2.6 takes account of these additional incentives.
main implications of allowing middlemen. The outcome of the provision of liquidity by the middleman is provided in figure 2.6, where we assume that $\alpha = 1.5$ and party $C$ has money with frequency $15\lambda$, so $\mu = 15$. In figure 2.6 we provide two effects of the middleman. The top curve describes the increase in surplus to all three parties from the existence of the middleman. Since this is positive for levels of interaction above $\lambda = 0.5$, middlemen can improve overall surplus which explains why the agents use them. However, the bottom curve in figure 2.6 plots the middleman's profits. In other words, how much of the net gain accrues to the middleman?

As can be seen clearly, $C$ gets some of the surplus that he creates, illustrating important distributional consequences of their role: middlemen do not come for free and sometimes can be very expensive. There are three regions worth remarking upon. In the first region, for sufficiently low interactions, there is no value to an intermediary such as $C$. The cost of transferring value through $C$ is too high relative to the benefit of improved exchange between $A$ and $B$, since $A$ and $B$ are unable to trade at even moderate levels. In the middle region of interaction, the use of $C$ is a complement to $A$ and $B$'s interaction: the more they interact, the more value there is to transferring returns from $A$ to $B$ via $C$, as such transfers allow for more efficient (and asymmetric) exchanges. For sufficiently high levels of interaction, however, $A$ and $B$ can replicate the role of $C$ in an autarkic trading network, so additional increases in interaction levels are a substitute for $C$'s services. The reason for this fall is that parties $A$ and $B$ interact enough to execute their own trades and they need the middleman less as the interaction becomes more frequent. But then the interests of the middlemen towards demonetisation differ from
those of the other parties, unlike the middle region. In particular, the two parties trading goods would prefer a sufficiently high level of interaction (or other monetary substitute) so that they can fulfil their trades themselves. By contrast, the middleman would be harmed in this case, as his role would become redundant.\textsuperscript{23} In the context of Russia, this relates to the possibility that the ‘dinosaurs’ which Humphrey (chapter 10 in this volume) places in the centre of her networks may be harmed by the remonetisation of Russia, as their services are no longer necessary and the outputs they produce are of little value in a monetised economy.

The purpose of this example is not simply to show that there is a demand for middlemen when barter arrangements predominate. Instead, its main purpose is to show that there are important distributional consequences from that derived demand. In the examples given above, it also points to the fact that there could be a group of agents who benefit from the demonetisation process, as it implies that these individuals occupy a more central role in the required networks to facilitate trade. Since many of these central individuals in networks are also closely linked to local government, it raises the interesting question of the incentives of local government to aid any remonetisation process.

5 Choosing friends

So far, we have discussed two implications of network structure – (1) that peripheral groups can be excluded and (2) that there is a demand for middlemen who can extract rents for their services. In this section, we consider an additional issue of network choice – namely, how to choose a network, and how barter affects the diversity of agent with which one can trade.

Economics offers one simple rule for choosing trade partners: comparative advantage. In particular, one obvious advantage of markets is that it allows consumers and producers to profit from comparative advantage. This simple observation is the linchpin of many theories arguing in favour of free trade. One can phrase this in more familiar terms: that individuals should seek very diverse networks because they may find that the best provider of a given service varies across goods. The purpose of this section is to illustrate that with social exchange there exists a countervailing effect which argues for restricting the ability of agents to trade with each other.

Individuals often spend considerable time investing in relationships, and must explicitly choose which relationships to cultivate. As illustrated

\textsuperscript{23} Of course, such middlemen may also have productive roles in monetised economies just as banks frequently add value.
Barter relationships above, trust is central to economic efficiency in a barter environment and may imply a different rule, namely, to 'put all your eggs in one basket' rather than hold a diverse set of networks. The reason for this is that although it may be inefficient (in the usual economic sense) to rely too much on a small number of personal contacts, trust is more likely to operate when trade is dense than when trade is spread across many trading partners. As a result, it can make sense to select a small number of partners and trade intensively with them, even though they may not be the least-cost providers of some goods that one may want. Thus the need for trust can make trading relations so tight that standard economic efficiency considerations are overturned.

In particular, we address the role of restricted trading networks in social relations, and argue that such restrictions are an integral component of social exchange. We show that the decision on whether to restrict trades boils down to a simple trade-off between comparative advantage and contract enforcement considerations. If the comparative advantage is sufficiently small (i.e. no person is any better at producing a good than another), there is a role for restricted networks. Furthermore, as interactions become less frequent, denser networks become more likely. In other words, when agents interact less frequently, denser networks become more important. To put this in more familiar terms, the trend towards short termism in Russia that Humphrey (chapter 3 in this volume) emphasises makes efficient restricting of networks more likely.

We extend the basic model of section 4 to allow for (1) comparative advantage and (2) more agents, so that there is the possibility of choosing tighter or looser networks. We assume that there are four agents who can produce any of four goods. All trade must be enforced through reciprocity. We model comparative advantage by assuming that although each agent may produce any good at a cost of \( c(q) = \frac{1}{4} q^2 \), for three of the four goods the resulting consumption value to the other traders is \( q \) but for one good the resulting value to the other traders is \( \alpha q \), where \( \alpha > 1 \). Moreover, each agent has a comparative advantage in producing a

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24 Restrictions on the ability to trade take many forms. First, social sanctions can serve to restrict the willingness of agents to trade with one another. For instance, it is rarely socially approved for individuals to engage in extra-marital affairs, an obvious restriction on trade in sex. In many countries, such trade is illegal. Second, there are a plethora of historical and anthropological examples where clans were willing to trade only with one another, and would have little to do with 'outsiders'. In some primitive societies, individuals are assigned a trade partner who has an obligation to help him and to whom he will reciprocate. Such obligations do not operate for other individuals and attempts to steal a trade partner were often dealt with harshly. For instance, among the Sio of North East New Guinea it was considered an offence worthy of homicide to attempt to lure away one's trade partner (Harding, 1967).
unique one of these four goods. Thus the model extends that in section 4 by allowing agents to be talented at producing different goods. For notational convenience, let agent $i$ produce good $i$ with greater value, where $i = 1, \ldots, 4$. For simplicity, we assume that the agent does not demand the good in which he has a comparative advantage, but demands other goods with a common rate $\lambda$. As before, we also assume that each agent must obtain these other goods from other producers; the agents cannot produce to satisfy their own demands.

The standard economic model of comparative advantage in a monetary economy would say that each individual produces one good – the one that he is most efficient at producing. Thus, there would be specialisation, a characteristic of a monetised economy. In such an economy, if an agent demands good $j$, he will trade with agent $j$ for $\alpha$-units of the goods (as this is the efficient level, where marginal benefits equal costs), with surplus created of $\frac{1}{2} \alpha^2$.

Suppose, instead, that agents trade in a barter environment. In this case, networks will matter. We take a simple approach to understanding network structure by assuming that in order to trade with someone, an initial investment must be made at the start of any relationship. In other words, at the beginning of the game, a decision must be made by the agents whether to form a link with the other agents. If the link is not formed then, it cannot be generated later. To keep matters simple, all agents can see the network structure and the initial cost of forming a link is small enough to be ignored. Our main point in this section is to show that even when forming a link is (essentially) free, the agents may decide not to do so. Instead, they commit to put ‘all their eggs in one basket’ to facilitate trust.

What this setup is meant to reflect is that once alliances are formed, it is hard to find other trading partners. (An extreme example of this is marriage, where bigamy is illegal and extra-marital affairs frowned upon.) Our model simply assumes that once a network is formed, it is impossible to break into another; realistically, this is too extreme as individuals can spend time building up such links. Our objective is simply to show that restrictions on letting people easily move between networks may make economic sense in a world of barter.

What matters then for working out how much trade occurs is the punishments meted out to those who deviate: the greater the punishments, the more likely is an individual to produce as required. This in turn depends on who observes the behaviour of the individuals. If all agents observe any deviation from cooperative trade and are willing to punish the deviator by refusing to trade with the him in the future, then there is no value to restricting the trading network to obtain the socially
optimal allocation of goods. (This would require everyone to cut off an agent from trade, even if that agent has reneged on only one of his obligations.) This statement is no longer true when there is limited observability of trades, or where agents are unwilling to punish transgressions which occur between other trading partners. We consider the case where only the agents involved in the trades can observe the behaviour of the parties (and the level of trade between them), so that the maximum punishment that can be imposed on the agents is that the bilateral relationship breaks down. More formally, we consider a class of equilibria where trade between any two agents is independent of relations between any other links.

In this setting, we consider two natural networks. First, we address the case where all agents trade according to comparative advantage. In other words, if any agent requires good $i$, the good is produced by person $i$. Thus, all links are formed. We then compare this to an institution where each agent is assigned a unique trading partner where they trade all their desired goods with that agent. This has the disadvantage that it reduces the value of comparative advantage in the economy, but will be shown to increase the threat attached to cheating.

As with the previous sections, we relegate the technical details to the Appendix, where the formal model is analysed. Nonetheless, it is intuitive that the tension in choosing networks is between the advantages of wide networks (taking advantage of comparative advantage) and their costs (when a trading partner is not very reliant on one, the temptation to renge is greater). The main result from the appendix is easily explained. First, for low enough levels of comparative advantage (i.e. if $\alpha$ is below some critical value $\alpha^*$), the socially optimal network will consist of two distinct bilateral trading networks, even though these trading relationships fail to capitalise on some of the comparative production advantages which are present. This critical value of $\alpha$ always exceeds one if efficient levels of trade cannot be obtained without trading partners. Restricting networks increases welfare, thus overturning standard economic logic regarding the advantages of free trade. Furthermore, the desirability of such restricted trade increases as interactions become less common (or as the agent discounts the future more). In other words, there is little need to restrict trades among agents who interact extremely frequently, but as interactions become more frequent some constraints are needed.

The implications of this section are illustrated in figure 2.7.

Here we illustrate situations in which it is efficient to restrict networks in terms of frequency of interaction ($\lambda/r$) and the importance of comparative advantage ($\alpha$). Below the curve drawn, it is efficient for individuals to trade with only one trading partner. They will forgo the benefits
of comparative advantage (i.e. trading with all three individuals), but can support more trade with their single trade partner when they are more reliant on one another. Above the line, agents should form more diverse links. Note that the line is downward-sloped, which implies that as interactions become more frequent it is less likely that the individuals need to restrict their networks.

The formal model above is simply meant to emphasise the importance of dense trade for reciprocity to operate. As a result, individuals may dedicate a large fraction of their trades to a single agent, even though that agent may not be the most effective provider of that good. At a more informal level, it also points to a difficulty which smaller firms may have in the network process. Although these new smaller firms may be more efficient providers of goods in the usual cost sense, trade partners may be hard to find as they see the importance of their existing networks, which though sometimes inefficient, are at least trustworthy.

6 Liquidity shocks and prices
So far, we have largely looked at barter arrangements as if there were not a money market also operating in tandem. This section, based on Prendergast and Stole (1999), begins to address what we feel is an important but unexplored topic in the context of barter societies – namely, the interaction between many currencies which simultaneously circulate, as occurs in Russia. It remains very unclear how these currencies interact.
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with one another; their effects are hardly neutral on each other but exactly how the existence of roubles affects the use of pasta or social contacts remains unclear. Central to current trading in Russia is the absence of liquidity that drives much of barter trade. Our interest in this section specifically is in understanding the response of prices to a liquidity shock. To describe the issue, consider the following trivial example. Suppose that before the August 1998 shock everyone in Russia had £2 but that after the shock, liquidity dried up so that everyone has £1. An immediate question that arises is why prices do not adjust such that the real quantity of money is unchanged. In other words, why aren’t prices simply cut in two?

Our answer to this relies on two building blocks. First, we assume that prices may not be set competitively. To model non-competitive setting of prices, we consider the standard monopoly setting where there is uncertainty about the valuation of a buyer for the seller’s good. We assume that when a seller is offering his good to a buyer, the buyer values a single unit of the good at \( v \), where \( v \) is uniformly distributed between 0 and 1. Only the buyer knows how much he values the good. Assume further for simplicity that the quantity supplied is discrete, equal to either 0 or 1, and that the cost of the good is zero. As a result, of these assumptions, it is always efficient (but not necessarily most profitable) to supply the good. If there are no other constraints or opportunities, it is simple to show that the monopoly seller would choose his price

\[ 25 \text{ As in the other sections of the chapter, we do not provide much technical detail but instead offer an example which illustrates some of the relevant effects. This example is based on Prendergast and Stole (1999). The reader is referred there for more details.}

\[ 26 \text{ There is a considerable amount of discussion of current pricing arrangements in Russia. For example, in chapter 10 in this volume Humphrey notes the prevalence of exploiting opportunities by mispricing, where fixed prices are 'replaced by agonised bargaining', while Ledeneva in chapter 11 devotes considerable time to understanding the negotiations that operate in barter networks. One view of such pricing arrangements has been emphasised above - namely, that the prices that are charged are merely a manifestation of the fact that barter goods are not a general claim on goods in the way that, say, pounds would be, and so sellers demand more in cases where these goods are hard to sell on. For instance, this surely is the primary reason why prices denominated in bricks would exceed those in petrol. It may also explain why Commander and Mumssen (chapter 5 in this volume) find lower prices denominated in \emph{veksels} than for straight barter deals. Yet there remains the suspicion that some of the pricing decisions that are being described also reflect the absence of competition that often characterises networks where there are a small number of traders. This would seem closer to the descriptions of many of the authors in this volume than simply the observation that efficient barter prices are being offered at all points in time, and raises the issue of how liquidity shocks, of the type that occurred in August 1998, affected the evolution of prices. In this section, we consider how liquidity shocks affect the exercise of monopoly power in a situation where barter exchange is also possible.} \]
to be \( \frac{1}{2} \). In such a case, only half the population (those with valuations above \( \frac{1}{2} \)) would buy, but profits would be greater than at any other price.

The additional assumption we make, however, is that there are liquidity shocks, where the buyer may be liquidity-constrained with not enough money to pay for the good. To fix this idea, we assume that he has \( m \) units of currency with which he can buy the good. Then his 'effective willingness to pay' will be the minimum of his valuation \( v \) and his money stock \( m \). This represents a simple way to analyze the effects of liquidity.\(^{27}\) However, importantly, not everyone is affected equally by the liquidity shock. Specifically, we assume that those who have low valuations are also likely to have little money. Put in loose terms, poor people are less likely to buy and are also those who are most affected by shocks to liquidity. Those in wealthier initial positions are more likely buyers both because of their wealth and because they are more likely to have money even after the liquidity shock, perhaps because of their better positions in trading networks, as described in Section 4.

One natural way to model this is through a correlation between valuations and money holdings. We use a particularly simple form of correlation, where we assume that \( m = a + bv \), \( a < 0 \) and \( b > 1 \).\(^{28}\) In other words, a 1-unit increase in valuations increases money stocks by \( b \). What this means can be most easily seen from figure 2.8, where we have taken a simple example in which \( b = 1.25 \) and \( a = -0.25 \).

The solid line represents the effective willingness to pay. For those who have high valuations (above \( z \) in figure 2.8), the underlying valuation of the buyer is less than his money holdings. In other words, liquidity constraints are not important for that person, as he has enough money to pay for the good. However, this is not true for all individuals who value the good at less than \( z \). In that case, the agents do not have enough money to pay their valuation: instead all that they can pay is their money holdings, \( m \).\(^{29}\)

Start by imagining that there are no opportunities for barter: this is not meant to reflect current reality in Russia, but is simply a counterfactual against which we will consider a world with barter. What we are most interested in is how prices are affected by the liquidity shock. Now remember from figure 2.8 that those who have valuations below \( z \) are

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\(^{27}\) Some readers may be uncomfortable with defining inherent valuations independently of money holdings. The simplest way to think of this is that \( m \) refers to a distinct composite good, where the marginal value of the seller's good (relative to the composite) is \( v \).

\(^{28}\) Of course, such a formulation has the unattractive aspect that money holdings can be negative for low valuations. This is only to simplify notation. Instead, one should think of money holdings as given by \( \max\{0, a + bv\} \) and nothing in our results would be altered.

\(^{29}\) In the absence of a correlation between \( m \) and \( v \), there is no opportunity for strategic segmentation of markets of the type studied here.
liquidity-constrained. Therefore, as $z$ gets bigger, the environment becomes more liquidity constrained.\footnote{This is equivalent to decreasing $a$ with the technology above.} The dotted line in figure 2.9 gives optimal prices which arise as a function of the liquidity shock.

It is simplest to begin at the two extremes: (a) where $z$ is low (less than $\frac{1}{2}$), so few are liquidity-constrained, and (b) where $z$ exceeds 1, so everyone is liquidity-constrained. First, when few are liquidity constrained, the price charged is $\frac{1}{2}$, unchanged from the case where there is no liquidity shock. This arises simply because the only people affected by the shock...
are those who would not have bought anyway: hence the optimal price is unchanged. When the liquidity shock is large, specifically when $z > 1$, everyone is affected by the shock. In this case, prices fall below their level when there is no liquidity shock. This reflects the imagined direct effect of an absence of liquidity on prices: if people don’t have any money, you should not demand as much as when they do.

However, the intermediate regions are also of interest, as they illustrate how liquidity shocks cause sellers to increase prices over some range and then to reduce them. This arises for the following reason. Consider a liquidity shock which causes some marginal buyers (those around $\frac{1}{2}$) to be liquidity-constrained. One possibility is to reduce the price to pick these up: but this reduces the revenues on those with higher valuations who would have bought anyway. An alternative is to ignore these customers and choose a price at which only those who have high valuations (and money holdings) will buy. For intermediate ranges of liquidity shocks, the latter effect always dominates, so the optimal pricing strategy is to increase the price as customers initially become liquidity-constrained in the relevant demand region. In short, the liquidity shock decimates the demand of the moderate purchasers, so it now is more profitable for the seller to focus attention on the cash market’s high-end purchasers.

But firms have another option which we have so far ignored: they can barter their goods through the kind of networks described at length in this volume. Rather than fully model the repeated barter environment as we have done in the previous sections, we instead simply consider a ‘reduced-form’ structure of barter where we note that there is some cost to trading through barter rather than directly selling for cash. This could be the cost which must be paid to a middleman, as in section 4, or the inefficient production which arises when goods are not equally valued by both parties, as on p. 46. Specifically, we assume that there is a ‘tax’ on barter which reflects this: where a unit of the buyer’s ‘commodity cash’ (i.e. the goods which the buyer transfers to the seller in exchange for satisfying the buyer’s demands) has value $x$ to the seller (in terms of the composite), but which costs $tx$ to the buyer to generate. We assume that $t > 1$, reflecting the standard inefficiencies of barter.

How does the opportunity for barter affect the cash market? Clearly, it now gives sellers the opportunity to sell their goods not only for cash but also they can offer their goods for barter also. This provides them with an additional outlet for their goods which increases their profitability, but importantly also gives buyers an alternative option, where they can barter instead of buying for cash. The solid line in figure 2.9 plots optimal money prices when barter is also an option. In this figure, we assume
that $t = 1.5$. Our primary focus is on the difference between the hatched line and the solid line: in other words, how does the existence of barter exchange affect money pricing? Again, consider the extremes. When the liquidity constraints are not important, there is no difference in the price charged, for the reason that the barter market is never used. At the other extreme, where $z > 1$, when liquidity constraints are extreme, prices when barter is an option are still lower than when there is no liquidity problem. However, they are higher than when only the cash market operates. In other words, the existence of the barter market limits the incentive to reduce prices with liquidity shocks. In this region, both currencies circulate simultaneously, where those with high enough valuations (and money) use the cash market while those who do not will use the barter market.

Why is it that prices are higher when barter is an option? The reason is that the benefits to a price reduction in a world without barter are that customers who would not otherwise buy the product now will purchase it at the lower price. When barter is present, a price reduction (holding the barter terms fixed) will serve only to convert bartering buyers into cash buyers. While this is profitable to the seller, conversion is not as profitable as new sales. Hence, the presence of barter limits the incentive to reduce prices when liquidity shocks hit the system. Thus multiple currencies interact in non-trivial ways.

For intermediate liquidity shocks (for $z$ between 0.5 and 1), prices are lower when barter is an option. In this region, firms realise that if prices are too high, customers can substitute into barter. The firm then faces a trade-off when it increases money prices that it must simultaneously also make barter deals less attractive to the consumer. In this intermediate region, the costs of doing so are enough to constrain price increases, and so the firm does not target only the higher-valuation consumers in the way that it would if barter were not available.

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31 The more general importance of this assumption is that for the example we have computed it is the case that $t \geq b$. We have not yet analysed the case where this condition does not hold.

32 One might imagine that those buyers without money would be offered the opportunity to barter in this region. However, this is not the case because there is the temptation that those who would otherwise pay with cash will now switch to barter. The cost of this transition is enough to cause the firm to offer no barter swaps.

33 It should be noted that we have ignored one possibility here, which is where there is no cash market and instead the only form of exchange which occurs is where all goods are bartered. This will occur if the liquidity shock is so great that the firms decide that it is simply not worth selling on the cash market. We have ignored this here by extending the plot only to $z = 1.4$ (figure 2.9), and at this point the firms still use both forms of exchange.
7 Conclusion

Why write this chapter, which offers an economic model of the type of delayed reciprocity more commonly studied by anthropologists? If theoretical economics has anything to add to understanding non-monetary exchange, it must be through the insights that arise from the models (formal and otherwise) that it offers. Obviously, it is hardly valuable to convert anthropological ethnographies and descriptions into mathematical models simply for its own sake. Despite the fact we provide little in the way of the ‘thick description’ that is often advocated by anthropologists such as Geertz (1973), it is our belief that much can be learned from simple models of the type offered here. We believe that the role of such models is twofold.

First, economics typically deduces the behaviour of individuals from a small number of principles, such as profit and utility maximisation subject to the relevant social and institutional constraints. The behavioural assumptions under which our agents operate are one-dimensional (personal gain) and cast individuals as calculating the angles when choosing whether to cooperate with another or not. These principles do not explain the entire motivation of individuals when they make decisions; they are not meant to. Instead, they offer a parsimonious structure to understand how well simple specifications of preferences can explain observed phenomena. In this chapter, our premise is that individuals engage in trade to maximise economic gain, with the threat of dissolution acting to constrain cheating. Using this simple structure, we have offered what we feel are plausible outcomes which are consistent with the evidence cited in this volume so that it may be that a theory based on simple, broadly defined notions of rational choice can generate predictions which mirror the evidence provided by sociologists and anthropologists studying Russia. At a minimum, the models offered here should serve to clarify the way in which many economists think of barter in a repeated setting.

Second, economists use models for predictive purposes, an activity to which anthropologists are less inclined. By positing responses by individuals to various stimuli, we have provided predictions about the response of trade in Russia to its various stages of demonetisation. These predictions could be right or wrong, but at least they can conceivably be tested by looking at the response of trade, prices and networks to the economic environment. First, in section 2 we characterised the decline in trade which has occurred through demonetisation, with the greatest responses occurring in relations where trade was previously sporadic. A natural implication of this is that any subsequent remonetisation is likely to most directly affect those with weakest links to others. Second, we have
pointed to the use of commodities as currencies, where we predict 'excess' trading in goods that is not highly valued compared to trade in a monetised economy. This arises as such goods must be used as commodities, and we would predict that the production of such goods may actually fall after a remonetisation process, unlike trade in more desirable goods. A related point is our prediction that the prices obtained for such less desirable goods is likely to be especially bad in sporadic relationships. Third, we have argued that there are distributional consequences from the demonetisation of Russia, and that not everyone may have lost out. In particular, the 'dinosaurs' of Humphrey's analysis chapter 10 in this volume occupy a central position in many networks, which they can use to their benefit. At the very least, we would argue that these firms have probably suffered less from the demonetisation than firms on the periphery. Fourth, we have pointed to changes in optimal network structures, where we believe that there is now increased pressure to find trading partners through which much trade travels rather than use looser, more diverse networks. Furthermore, such problems are most severe for those who do not have strong existing networks. Finally, we have illustrated how liquidity shocks affect prices in non-monotonic ways and also how the existence of barter exchange limits price changes with liquidity shocks. While these predictions obviously await more specific empirical testing, many of the contributions in this volume at least appear to support them.

Appendix: proofs of results

The liquidity value of trade: section 3

First, under what conditions will the agents be willing to supply the (first-best) efficient levels of output? The relevant incentive constraint is that of the agent required to produce $\tilde{q} = \alpha$ good while enjoying consumption of $\tilde{q} = 1$. He will be willing to provide quantity $\alpha$ iff

$$\frac{\lambda}{r} \left( 1 - \frac{\alpha^2}{2} \right) \geq \frac{\alpha^2}{2},$$

or $\lambda/r(2 - \alpha^2) \geq \alpha^2$. This equation is nothing more than the analogue of the incentive constraint in section 2. Note that this condition can be satisfied only if $\alpha < \sqrt{2}$. Assume that this is the case for the moment; we will return to the situation where it is violated below. Then if $\lambda/r < \alpha^2/2 - \alpha^2$, the agent who values his good least will be unwilling to provide the efficient quantity for the other agent. The equilibrium to
this problem is that the $\alpha$-agent (i.e. the agent which has high value of consuming) will 'over-produce' in order to provide the other agent with a *quid pro quo* for him with production of the high-valued $\alpha$ good. Thus production has both a consumption value and a liquidity value. Let $q$ be the production level of the low-value good and let $\bar{q}$ refer to the production of the better good.

**Proposition 1** Assume that $\alpha < \sqrt{2}$. If $\lambda/r(2-\alpha^2) \geq \alpha^2$, the first-best level of trade arises. For all other values of $\lambda/r$ and $\alpha$, (i) trade in $\bar{q}$ is increasing in $\lambda/r$, (ii) there exists a critical value of $\lambda/r$, such that trade in the low-value good, $q$, is increasing up to that critical level, and is decreasing in $\lambda/r$ above that critical level. Finally, there exists a range of $\lambda/r$ such that the low-value good is over-supplied in equilibrium.

**Trading partners: section 5**

First consider the case where agent $i$ produces good $i$ for all agents when it is demanded. Since there is limited observability of trades, the cost of cheating the demander is that no trade will occur in future with that agent. Let $\bar{q}$ be the quantity traded in this equilibrium. Then the incentive compatibility constraint is that

$$\frac{\lambda}{r}(\alpha \bar{q} - c(\bar{q})) \geq c(\bar{q}).$$

The efficient level of $\bar{q}$ is $\alpha$, so if $\lambda/r \geq 1$, this level of output can be attained. If this is the case, there is never any need to restrict trade to assigned trading partners. However, if $\lambda/r < 1$, the threat of dissolution of the bilateral relationship will not be sufficient to yield efficiency. As a result, straightforward manipulations yield a level of $\bar{q}$ for each good given by

$$\bar{q} = 2\alpha \frac{\lambda}{\lambda + r},$$

with total utility for each agent (across all three trades) given by

$$U^{ca} = 6\alpha^2 \left( \frac{\lambda}{\lambda + r} \right)^2.$$
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implies that each person will be provided with only one 'high-quality' good, as distinct from three in the previous case. This provides the obvious cost of requiring concentration of trades.

Consider the set of enforceable trades with this trading norm. Notice that the efficient level of trade here is where agent \( i \) produces a quantity \( \alpha \) of good \( i \) and a quantity \( 1 \) of the other two goods demanded by his partner. More generally, let \( \bar{q} \) refer to the traded quantity of the 'high-quality' good and let \( q \) be the traded quantity for the other goods. Then the incentive compatibility constraints for the agent are

\[
\frac{\lambda}{r} [\alpha \bar{q} + 2q - c(\bar{q}) - 2c(q)] \geq c(\bar{q}),
\]

if the agent is required to produce the good he has a comparative advantage in, and

\[
\frac{\lambda}{r} [\alpha \bar{q} + 2q - c(\bar{q}) - 2c(q)] \geq c(q),
\]

to produce the other goods.

First, for high enough \( \frac{\lambda}{r} \), the agents will supply the required level of each good. Straightforward calculations show that this is the case if \( \lambda/r \geq \alpha^2/2 + \alpha^2 \). This yields utility of \( \lambda/r(\alpha^2/2 + 1) \). Next, there is a region of the parameter space where the agent is willing to supply a quantity of \( q = 1 \) but not a quantity of \( \bar{q} = \alpha \). This implies that the agent will provide the efficient level of the goods in which he does not hold a comparative advantage but will provide some quantity strictly between 1 and \( \alpha \) of the goods he produces best. The quantity level chosen on this good is determined by the \( \bar{q} \) at which the incentive-compatibility constraint binds, which is given by

\[
\bar{q} = \frac{lv + \sqrt{(lv)^2 + 2l(1 + l)}}{1 + l},
\]

where \( l = \lambda/r \). This region occurs for values of \( \lambda/r \) between \( \alpha^2/2 + \alpha^2 \) and \( 1/2\alpha + 1 \). Finally, for \( \lambda/r < 1/2\alpha + 1 \), the agent is unwilling to supply output of 1 so all constraints bind, yielding quantities traded of \( \bar{q} = q = 2\lambda(\alpha + 2)/r(1 + 3l) \).

A simple way of understanding these components of the problem can be seen from figure 2A.1.

Here we have plotted the quantity levels as a function of the parameter values. Note that for \( \lambda/r \geq 1 \), efficient trade levels occur with comparative advantage. For lower parameter values, trade governed by comparative advantage falls but for some region remains constant with
trading partners, owing to the extra sanctions associated with cheating. Next as $\lambda/r$ falls further, the agents refuse to produce $\alpha$ but are willing to produce unit output, the optimal level for the goods in which the agent does not hold a comparative advantage. Finally, for $\lambda/r < 1/2\alpha + 1$, the agent is not even willing to trade unit output on any good.

Determining the optimal trading relation then simply becomes a comparison of the utilities on the two regions. Allowing trade with all agents has the advantage that the agents are producing the goods at which they have the greatest ability. However, this has the problem that the costs of deviating are possibly smaller than with a trading partner, as the maximum punishment is exclusion from trade in a single (albeit more desirable) good. This effect can be seen from the fact that without the trading partners, the agent is willing to supply the good at the efficient level if $\lambda/r \geq 1$, while with the greater costs of deviating from a trading partner the agent is willing to supply if $\lambda/r \leq \alpha^2/2 + \alpha^2 < 1$. This simply illustrates the advantage of requiring trades to be concentrated. Proposition 2 identifies the main results regarding trading partners.

*Proposition 2* There exists a critical value of $\alpha$ given by a function $\alpha^*(\lambda/r)$ such that for all $\alpha < \alpha^*(\lambda/r)$ restricting trades to a single partner increases welfare, and for all $\alpha > \alpha^*(\lambda/r)$ allocating trades according to comparative advantage maximises welfare. Furthermore, for all $\lambda/r < 1$, $\alpha^*(\lambda/r)$ is strictly greater than 1 and is declining in $\lambda/r$. 
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