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THE ECONOMIC INSTITUTION OF INTERNATIONAL BARTER*

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Starting with the international debt crisis in the 1980s, international barter increased substantially. More recently, barter has emerged in Russia and South East Asia. This paper examines how barter can help highly indebted countries to finance imports if they cannot use standard credit arrangements. We argue that payment in goods is easier to enforce than payment in money. However, debtors may pay with inferior quality products. We rank goods with respect to these incentive properties and derive the economic institution of commodity money which explains the trade pattern in barter. Our theoretical predictions are consistent with data on barter contracts.

Starting in the early 1980s, the international debt crisis led to a dramatic decline in private lending to developing and Eastern European countries. Even though debtors hesitated to invoke total repudiation, commercial banks have been reluctant to provide new loans, sceptical that they will ever be repaid in full.[1] As highly indebted countries found it increasingly difficult to finance their imports, unconventional forms of trade and trade financing experienced a resurgence. One of the most noteworthy developments has been the rise in barter trade.[2] Barter is a reciprocal form of trade in which an exporter is paid with an offsetting import, either simultaneously or at some later date. Estimates are that about 10–20% of total world trade are governed by barter agreements (Hammond, 1990).

More recently, Russia and the Soviet Republics experienced a turn to international as well as domestic barter when their creditworthiness deteriorated after 1992 and when these countries suffered a severe domestic liquidity and debt crisis. Estimates suggest that, in the Ukraine, 43% of exports and 51% of domestic trade took the form of barter in 1997. Similar estimates are given for Russia in 1998.

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[1] See, for example, Sachs (1989). Gooptu and Soledad (1992) emphasise that commercial banks are reluctant to provide new loans unless they are insured by the creditor's government.

[2] Throughout this paper, we use the term barter in its widest sense, including all forms of counter trade. Bussard (1987, p. 17) reports that the number of countries engaged in barter rose from 27 in 1979 to 88 in 1984. Likewise, the number of barter transactions that was reported by a group of survey respondents increased on average by 50% between 1980 and 1981, by 64% between 1981 and 1982, and by 117% between 1982 and 1983. Hammond (1990) observes that precedents of this striking comovement of debt problems and barter can be found in the late nineteenth century and in the depression of the 1930s. For a theoretical discussion of financing transition economies in Eastern Europe, see Holmström (1996).

Casual evidence suggests that the financial crisis in South East Asia has led to the use of barter in international trade in this region as well.[3]

The negative implications of a high indebtedness for the creditworthiness of a country are well known from the sovereign debt literature. Often the creditors' main concern is not so much that a debtor may become insolvent but rather that he may be unwilling to repay. The problem is that foreign debt cannot be collateralised in the same way as domestic debt (Eaton, 1991). Creditors who finance exports to foreign firms or trade organisations need the assistance of local governments to enforce repayment. However, the more indebted a country is, the less foreign creditors can count on governmental support because the more attractive repudiation becomes from the point of view of the whole country (Cohen, 1991).

Why should countries turn to barter if they face a credit constraint due to the sovereign debt problem? A common explanation is that countries pay with goods if they are short of cash and not creditworthy enough to receive trade loans. However, in the majority of cases, the barter contract contains a credit arrangement in the sense that the export that serves as payment for the original import takes place later.[4]

Why then do we observe the frequent use of barter? In a companion paper (Marin and Schnitzer, 1995), we showed that barter can solve incentive problems related to the technology transfer to developing countries. In that paper, we also suggested that barter can be used to collateralise trade credits. The purpose of the present paper is to analyse in more detail why payments in goods are preferable to payments in money and to show what implications this has for the institution of commodity money that serves as a medium of exchange.[5] In particular, we investigate the choice of barter goods that serve as payments in kind. The pattern of specialisation in barter trade differs significantly from that in conventional trade. Barter exports (from the point of view of the debtor) consist mainly of consumer goods (31.9%) and investment goods (35.5%) whereas, in conventional trade, these two categories account for only 15% and 10%, respectively. We give an institutional explanation for this deviation of the export pattern of barter which complements our previous explanation of the import pattern in Marin and Schnitzer (1995).[6] In Section 2.2, we also discuss some papers which provide complementary arguments for the explanation of the export pattern of barter.

Our analysis suggests that barter has important advantages over traditional credit arrangements. The main difference between a promise on future money and a promise on future goods is that goods have superior credit enforcement properties as compared to money. Money is an anonymous medium of exchange. This

[3] See Marin *et al.* (2000) for the Ukraine and Commander and Mumssen (1998) for Russia.

[4] In our data sample of 230 barter contracts, the time between the original import and the subsequent export ranges between 0 and 120 months (Marin, 1990).

[5] In Marin and Schnitzer (2002), we show how barter can be used to restore the creditworthiness of highly indebted countries when export revenues are stochastic. Prendergast and Stole (2001) offer a different type of reasons for nonmonetary trade, like improved ability to impose social sanctions, improved information revelation, and the prevention of inefficient rent-seeking activities which may complement our results. Ellingson (1998) sees barter as a mechanism to reveal credibly that the debtor has no cash.

[6] For the barter trade pattern, see Marin (1990).

anonymity can prove disadvantageous in trade with countries that lack creditworthiness, since the debtor in the developing country can use it for other purposes than repaying his debt. Goods, instead, can be earmarked as property of the creditor in the developed country. Consequently, the debtor in the developing country is less free to use them for other purposes than paying his debt. Thus, goods act as 'special purpose money'. Since goods are less anonymous and property rights on goods are easier to define and enforce than property rights on future cash flows of the export returns of a country goods are better collaterals than cash.

Our analysis is closely related to the sovereign debt literature. In a seminal paper, Eaton and Gersovitz (1981) have shown how 'reputation effects' can sustain sovereign lending.[7] Our paper shows how formal institutions like barter can restore the creditworthiness of highly indebted countries if informal arrangements such as reputation effects fail to be effective.[8]

The paper is also closely related to the recent developments in the theory of money. Our argument that payment in kind may have advantages over payment in cash contradicts the conventional wisdom in the theory of money. The common view is that barter is inefficient because it does not overcome the double coincidence of wants problem as money does. In recent search theoretic models of the exchange process, money evolves as a medium of exchange which reduces the search and transaction costs associated with barter (Kiyotaki and Wright, 1993). While eliminating the need for a 'double coincidence of wants' is certainly an important advantage of money, we argue that incurring some additional transaction costs by reselling the goods received as payment may be a small price for overcoming a credit constraint that otherwise would prevent trade from taking place at all.

A second, more important objection to payment in kind is raised by Banerjee and Maskin (1996) in their adverse selection theory of money. They argue that, if sellers are paid with goods which they do not use themselves, they will find it difficult to judge the quality of the goods offered as payment. This asymmetry of information gives rise to moral hazard and adverse selection problems since the buyer has an incentive to pay with low quality goods given that the seller cannot distinguish different quality levels. The principal role of money is to overcome the asymmetric information problem that arises in barter. An important implication of this adverse selection problem is that not all goods are equally well qualified to serve as a medium of exchange in a barter contract. We deal with this issue in the second part of the paper where we show how the institution of commodity money explains the export pattern (the goods offered as payment) of barter. Using data on actual barter contracts, we characterise different types of goods in terms of

[7] Bulow and Rogoff (1989) show that reputation effects alone cannot sustain any positive repayment if the debtor can switch to 'cash-in-advance' contracts after repudiation. Kletzer and Wright (1990) point out that the problem caused by cash in advance contracts can be mitigated if it is possible to give initial creditors a seniority right on any monetary transfers made by the country that defaulted on its debt. However, seniority rights on cash are notoriously difficult to enforce.

[8] Greif *et al.* (1994) analyse merchant guilds in the middle ages as an efficiency enhancing institution to deal with moral hazard problems in international trade when a reputation mechanism cannot solve these incentive problems. For an overview of other institutions governing international trade in the Commercial Revolution, see Greif (1992).

anonymity and liquidity and we discuss which of them would be the best candidate for collateralising future payments.

The empirical analysis is based on a survey among firms that are engaged in barter trade and that use Austria as a basis for their activities. The problem is that barter is not documented in official trade statistics and therefore data on the characteristics of actual barter contracts are very difficult to obtain.[9] Our sample consists of 230 contracts, signed between 1984 and 1988. Almost all previous empirical studies on barter use macro data and test (on the basis of relatively few observations) how debt ratios of various countries affect the estimated volume of barter in these respective countries.[10] An important advantage of our micro data set is that it contains detailed information on about 40 aspects of each contract. This allows us to test a much richer set of predictions, in particular predictions on the optimal design of barter contracts, on the basis of a (comparatively) large number of observations. In the last part of the paper, we use these data to test empirical predictions on ranking goods in their collateral value as well as on the optimal choice of commodity money.

The paper is organised as follows. In Section 1, we first compare a credit relationship (payment in cash) to a barter transaction (payment in kind) to identify the advantages of barter. We then turn to the quality problems that may arise in payment with goods and analyse how this affects the optimal choice of commodity money and hence the export pattern of barter. In Section 2, we derive empirical implications of our theory of commodity money and use our data sample to test these predictions. Section 3 concludes.

1. The Institution of Commodity Money

In this section, we develop a simple theoretical model with two potential trade partners, called *A* and *B*. Think of *A* (she) as a firm in a developed country, and *B* (he) as a firm or a trade organisation in an Eastern European (EE) or a developing country. The trade partner in the East wants to buy some import goods from *A*, but is temporarily liquidity constrained and hence needs a credit to finance these imports. If this credit could be guaranteed by the government in *B*'s country, there would be no problem. If, however, *B*'s country is highly indebted, it is likely to be credit-constrained as well, due to the sovereign debt problem. The problem is that *B*'s government cannot be forced by the courts in *A*'s country to repay its debt. It has to meet this obligation voluntarily, either for reputational reasons to maintain future access to international financial markets or because it wants to avoid the international trade sanctions which may be triggered by default on a loan. If a developing country is highly indebted already, the gains from default on existing debt may outweigh the expected future losses,

[9] One of the reasons is that exports and imports frequently take place in different periods. Also, governments are reluctant to release information on their barter activities, concerned they might come into conflict with GATT regulations.

[10] For example, Casson and Chukujama (1990) report evidence (based on 35 observations) that countries with higher debt ratios are more strongly engaged in barter. Hennart and Anderson (1993) use different aggregate variables and find (on the basis of 40 observations) that a country's creditworthiness is positively correlated with its barter activities.

and Western banks will be reluctant to offer additional credit to *B*'s government. Thus, *B*'s credit cannot be guaranteed by *B*'s government.

The question is whether *B*'s creditworthiness can be improved if *B* turns to barter trade. Barter means that instead of selling export goods on the world market and using the export revenues to repay the import credit, *B* delivers the export goods directly to *A*.[11] To see what difference this makes, consider *B* repudiating his debt and trying to sell the barter good to some other party *C*. With barter, the barter goods serve as collateral. This means, *A* has a property right on the barter good. Thus, if she manages to track down this good, she has a direct claim on it and can ask the courts in *C*'s country to seize it. With a credit arrangement *A* does not have a direct claim on the export good. Furthermore, even if the good is seized, the returns from the good have to be shared with all of *B*'s creditors. Thus, a property right on the barter good gives *A* a larger return than a claim on cash. This, in turn, increases *A*'s incentives to track down *B*'s export of the barter good.

This view of barter as a possibility to collateralise trade credits is documented by the legal literature. The 'Legal Guide on International Countertrade Transactions', prepared by the UN Commission on International Trade Law, describes how trade partners can use barter contracts to protect the developed country firm against default on the payment of the original import by using barter goods as collateral.[12] That goods from barter transactions are, in fact, frequently used as a collateral has been reported, e.g. by Welt (1984, p. 61), Verzariu (1985, p. 111) and Barkas (1987, p. 80). The advantages of specifying such collaterals are straightforward. If *B* repudiates his debt and does not deliver the barter goods as promised, *A* can seek legal recourse to claim her collateral goods. This puts her in a much better position than if she had no direct on claim on *B*'s export goods, as in case of a simple credit relationship.

How easy or how difficult it is to track down and seize the goods specified as collateral for the import credit depends on the location of these goods. As long as they are still in *B*'s country, *A* needs the support by courts in *B*'s country which in the countries we consider in this paper is not very reliable, as we argued above. This is exactly why it is not helpful to secure the import credit with the goods originally imported (known as 'retention of title'). The advantage of securing the import credit with export goods rather than the original import goods is that *B* intends to sell these export goods abroad, which means that *A* has a better chance

[11] In this case, either no monetary payments are made at all for the import or, if monetary payments are to be made for both the import and export transactions, they can be set off against each other.

[12] '57. It may be agreed, however, that, if a supplier has not been paid for goods delivered in one direction, that supplier is entitled to withhold payment for goods delivered in the other direction up to the amount of the outstanding claim or to set off the two countervailing claims. ... 60. When it is agreed that a party is entitled to withhold payment or to set off the two countervailing payment obligations, it is sometimes also stipulated that the party who delivered goods first (the exporter) is entitled to take possession of the goods that are to be delivered by the other party (the importer). Taking possession of the goods would enable the exporter, who is holding the outstanding claim, to obtain value and establish a payment obligation that could be set off against the outstanding claim. Such a stipulation is possible where the countertrade agreement specifies the goods that are to be counter-exported. In order to implement such an approach, it is advisable to identify clearly the goods and their location and to consider taking such additional measures as granting the exporter a security interest in those goods and giving the exporter an express right to claim their possession. ....' (UNCITRAL, 1993, p. 158).

to seize them. If the export goods are shipped to *A*'s country, *A* can seek recourse from courts in her own country. If the export goods are shipped to some other country, *A*'s chances of recovering her collateral depend on the legal environment in that particular country. Most developed jurisdictions are prepared to recognise and enforce such rights, either by allowing the creditor to sue locally or on the basis of a reciprocal enforcement convention (Wood, 1995*a*, pp. 260–4). This means that *B* is severely restricted in where he can sell his export goods without fear of legal intervention.[13]

As a matter of fact, very few cases end up in court. When the barter contract specifies monetary payments for both import and export and the importing country defaults on its payment, which happens often enough, the trade partner typically sets off this outstanding payment for the import against his own payment obligation for the subsequent export.[14] Cases where no export goods are delivered at all are very rare.[15] What happens more frequently, is that the export goods delivered are not of sufficiently high quality. This is why the issue of selecting the right barter goods is very important, as we will show in Section 1.3.

1.1. *Anonymous Money*

To make our ideas precise, we will study the questions raised above in a very stylised model, which builds on our example of the two trade partners *A* and *B*. Suppose *B* wants to buy one unit of good 1 from *A* in period 1 but can pay for it only one period later because he is cash-constrained. Without loss of generality, we assume that if such a trade credit is granted this is done directly through *A* (rather than a bank) in form of a supplier credit.[16] *B*'s willingness to pay for good 1 is v_1

[13] Within Europe, enforcement of foreign judgments is made possible by the European Judgment Conventions. Under these Conventions, all judgements are enforceable, no special procedure is required and a foreign judgement may not be reviewed as to its substance (Wood 1995*a*, pp. 232–43). For a comparative discussion of the legal issues involved in different jurisdictions, see Wood (1995*a*,*b*).

[14] See footnote 11 above. This form of collateralising import credits when monetary payments are specified is discussed in Marin and Schnitzer (1995).

[15] One such case has been reported to us by an Austrian trader. In 1998, an Austrian trading company delivered herbicides and pesticides to an Ukrainian firm. This firm, in turn, agreed to pay this delivery in cash or 100,000 tons of sunflower seeds. However, the Ukrainian company delivered only 5000 tons claiming that 'force majeure' due to a poor harvest prevented them from delivering more. The Austrian firm made investigations into the Ukrainian firm's shipments to other buyers. In the registry at the Odessa harbour, it found evidence that the Ukrainian firm had shipped sunflower seeds to *x*, *y* and *z* in France, Italy and Germany. Rather than going for these deliveries, which in case of such anonymous goods as sunflower seeds might have been difficult, the Austrian firm decided to go to court in Ukraine. It used the evidence of the sunflower seeds shipments to *x*, *y* and *z* as proof in court that the Ukrainian firm was able to deliver the sunflower seeds but decided to default on its payment to the Austrian trader and that it had the cash necessary to fulfil its payment obligations. The Austrian trader notes that it could not have made this case in court if the payment obligation had been in cash. In this case, it would have been impossible to prove that the Ukrainian firm had indeed the cash to fulfil its payment obligation. At the time of writing, the case is still pending.

[16] One might ask why *B* obtains a credit from *A*, rather than a third party like a regular foreign customer, in form of a prepayment for future exports. Empirically, this form of prepayment does not seem to play a role. One of the reasons why this may be the case is discussed in Marin and Schnitzer (1995). In this article, we show that tying the original import and subsequent export helps to mitigate incentive problems that arise on the side of the Western supplier of technology goods. Another reason is that many of the importing trade partners are state firms or trade organisations who prefer not to generate free cash that could be expropriated by state authorities.

and A's production cost is c_1, with $v_1 > c_1$. In period 2, B can produce one unit of good 2 at cost c_2 and sell it on the world market. This generates foreign exchange revenues of value v_2. We assume that B's revenues v_2 in period 2 are sufficient to pay for A's production cost c_1 in period 1, i.e. $v_2 \geq c_1$. Thus, a price p_1 can be found such that p_1 covers A's production cost ($c_1 \leq p_1$) and such that B is able to pay p_1 in period 2 ($p_1 \leq v_2$).

A common problem with this kind of transaction between a developed country and an EE or LD country is to enforce B's payment in period 2. Even though B is able to settle his debt, he cannot be forced to do so by the courts in A's country, and the government or the courts in B's country cannot be relied on to enforce A's claim.[17] All A can do in case of default is to ask the courts in her own country to seize assets that B holds in A's country. Let $a \geq 0$ denote the value of these assets. This punishment potential imposes an upper bound on the maximum credit that B voluntarily repays, $p_1 \leq a$. Note that A is willing to deliver good 1 on a credit basis only if $c_1 \leq p_1$ and if B will indeed pay p_1. Thus, we say that B is 'creditworthy' if and only if

$$a \geq c_1 \tag{1}$$

If instead $a < c_1$, we say that B faces a credit constraint because there exists no p_1 such that $p_1 \geq c_1$ and $p_1 \leq a$ are satisfied simultaneously. In the following, we focus on cases where B is not creditworthy in the sense defined above.

A question studied extensively in the sovereign debt literature is to what extent implicit ways of credit enforcement through 'reputation equilibria' are possible if A and B are engaged in a long-term relationship where B intends to buy good 1 on a credit basis not just once, but repeatedly. In a seminal paper, Bulow and Rogoff (1989) pointed out that reputational concerns cannot enforce debt repayment if the debtor country can switch to 'cash-in-advance' contracts. To see whether barter as an economic institution can enforce debt repayment when reputation fails to be effective, we focus in this paper on those cases where reputation cannot play a role to sustain sovereign lending by simply assuming that A's and B's relationship ends after period 2.

1.2. *Nonanonymous Goods*

In the following section, we want to ask whether B's creditworthiness can be improved if B turns to barter trade. Again, we assume that B cannot pay for good 1 in period 1, neither with money nor with goods. However, suppose that instead of selling good 2 on the world market and using its revenues to pay for good 1, B agrees to deliver good 2 in period 2 to A for a price p_2. A's payment is enforced by the courts in A's country.

The advantage of such a contract is that it generates a deal-specific collateral, A's payment p_2. If B delivers good 2 and if

[17] This sovereign debt problem arises in particular if B's country is highly indebted already, and if B is a state-owned trade organisation or has close relations to the government. For a recent survey on the large literature on the sovereign debt problem, see Eaton and Fernandez (1995). In the following, we consider the extreme case where A cannot count on her claim being enforced in B's country at all.

$$p_1 \leq p_2 + a \tag{2}$$

then B's payment p_1 can be enforced. The point is that A can withhold p_1 from her own payment p_2 in addition to seizing assets a.[18] Without loss of generality, we can restrict attention to prices p_1 and p_2 that satisfy (2) since a higher p_1 will not be paid anyway.

With a barter contract, though, a new incentive problem arises. Since B cannot be forced to produce good 2, he must be induced to produce and deliver good 2 voluntarily. This corresponds to the problem to induce B to pay p_1 in a simple credit arrangement. There is an advantage of a barter contract, however. With a credit arrangement, B is supposed to use his revenues from selling good 2 to repay his credit, but if he defaults his revenues cannot be seized by foreign creditors anymore. In case of barter instead, good 2 is used as a collateral for the payment of good 1, giving A a property right on it. This means that B is not free anymore to use good 2 as he wants to. If he refuses to deliver to A, he may not be able anymore to sell good 2 at all. A can seek the help of courts in her own country (or in other industrialised countries) to enforce her claim and seize good 2 when it is shipped somewhere else. However, A's control over good 2 is typically not perfect, and she may succeed in tracking down her collateral only with some positive probability. We model this as follows: given the possibility of legal action by A, B's potential surplus from selling good 2 on the world market, $v_2 - c_2$, is reduced to $\hat{\pi}(v_2 - c_2)$, $0 \leq \hat{\pi} < 1$. This reduction of surplus is due to the risk of the good being seized by courts which severely restricts B's opportunities of where to sell his good on the world market. If the chances of selling good 2 profitably on the world market are sufficiently low, it is optimal for B not to produce good 2 at all but to save his production cost. In this case, $\hat{\pi} = 0$. If A's legal action is less effective, however, it may become optimal for B (given that he wants to default) to produce good 2 and to try to sell it to a third party which generates an expected surplus $\hat{\pi}(v_2 - c_2)$.

The term $\hat{\pi}$ can be thought of as a measure of the anonymity of good 2. If $\hat{\pi} = 1$, good 2 is as anonymous as cash. However, if A can successfully label good 2 as belonging to her, then $\hat{\pi} < 1$. In this case, good 2 is less anonymous than money and it is harder for B to use it for any other purpose than paying his debt to A. Good 2 functions like 'special purpose money' which makes it a better collateral than money.

The sequence of events is summarised in Fig. 1. Before period 1, A and B negotiate prices p_1 and p_2. Good 1 is delivered at the beginning of period 1. At the beginning of period 2, B decides whether to deliver good 2 to A, a decision denoted by $d \in \{0, 1\}$. If $d = 0$, B does not deliver and A takes legal action to seize assets a and to track down good 2. If instead $d = 1$, B delivers and A pays $p_2 - p_1$ if $p_2 - p_1 \geq 0$ and receives $\min(a, p_1 - p_2)$ if $p_2 - p_1 < 0$.

Thus, B voluntarily delivers good 2 in period 2 if and only if[19]

[18] This way of credit enforcement where A simply withholds any outstanding debts from her payment to B is commonly used in countertrade transactions (Barkas, 1987, p. 80).

[19] Note that (3) implies that B's participation constraint is satisfied as well since $v_1 - p_1 + p_2 - c_2 \geq v_1 - \min(p_1, a) \geq 0$ where the first inequality follows from B's incentive constraint (3) and the second inequality from $v_1 > c_1 > a$, ie, the fact that B lacks creditworthiness.

$$p_2 - c_2 - p_1 \geq \hat{\pi}(v_2 - c_2) - \min(p_1, a) \tag{3}$$

On the other hand, A is willing to deliver good 1 in period 0 if and only if she believes that B will deliver good 2 and

$$-c_1 + p_1 + v_2 - p_2 \geq 0 \tag{4}$$

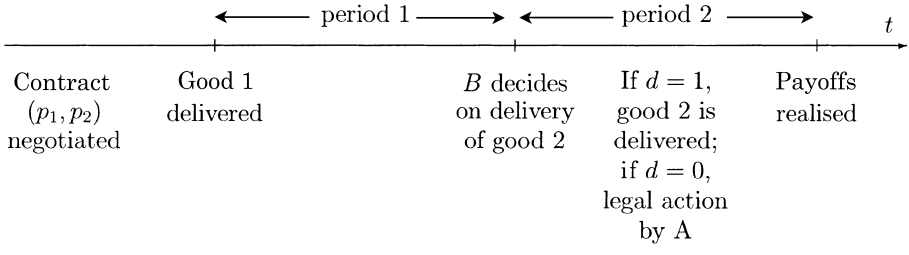

Fig. 1. *The Time Structure*

For barter trade to overcome B's lack of creditworthiness, both conditions have to be satisfied. Proposition 1 shows under which parameter conditions this is possible.

PROPOSITION 1 *Suppose B is not 'creditworthy'. Then there exists a barter contract* (p_1, p_2) *which restores B's creditworthiness and implements the efficient allocation if and only if*

$$(1 - \hat{\pi})(v_2 - c_2) + a \geq c_1 \tag{5}$$

Proof. Comparing condition (5) of Proposition 1 with condition (1) shows that barter relaxes B's credit constraint by an amount of $(1 - \hat{\pi})(v_2 - c_2)$. In both (1) and (5), the left-hand side measures the financial loss B has to incur if he repudiates. With a barter contract B not only loses his assets A, but also the fraction $(1 - \hat{\pi})$ of the surplus $v_2 - c_2$ that can be generated in the second deal. Thus, the easier it is for A to prevent B from selling good 2 to someone else, and the more valuable the second deal is for B, the better can a barter contract be used to improve B's creditworthiness.

We conclude this section with a summary and discussion of the main advantages a promise of goods (barter) offers over a promise of cash (credit arrangements).

ADVANTAGE 1 *Goods are less anonymous than cash and, therefore, it is easier to establish property rights on goods than on cash.*

This means that barter goods can be used as collateral for trade credits.

ADVANTAGE 2 *Property rights on the barter good give A's claim priority over other creditors who have purely financial claims and therefore increase A's expected pay-off in case of default.*

We have assumed that, without a barter contract, it is impossible to seize some of *B*'s returns from selling good 2, but even if this were possible, barter would still be advantageous. The reason is that, without a barter contract, *A* does not have a direct claim on *B*'s revenues from selling good 2. If she manages to track down some of these returns, the returns from good 2 have to be shared by all of *B*'s creditors. Thus, a property right on good 2 gives *A* a larger return than a claim on cash.

This difference of seniority rights of an investor in case of a promise on goods as compared to a promise on cash is analogous to the difference of seniority rights in case of debt (where some investors can have priority rights) and in case of equity (where all investors are treated equally), the importance of which for economic incentives has been stressed by Hart and Moore (1995). Of course, the same effect could be achieved if *A* could be given seniority rights on *B*'s return streams from selling good 2. However, this is typically not feasible for two reasons. First, it is much more difficult to seize cash than to seize physical goods. Thus, it may be impossible for *A* to enforce her claim. Second, if *B* is highly indebted already, there are other creditors having claims on *B*'s return stream who will refuse their consent to giving *A* seniority rights. This is the classical debt overhang problem; see, for example, Krugman (1992). An example for the ineffectiveness of seniority rules in case of financial assets is described by Bulow and Rogoff (1988) who report that, in February 1988, Mexico, as part of a buyback scheme, issued new debt, promising to treat it as senior to existing bank debt. However, the market reaction to this announcement indicates that creditors were not convinced of the enforceability of these seniority rights.

ADVANTAGE 3 *Since A's pay-off in case of default is higher if she has priority rights on goods, her incentive to seek legal recourse and to track down B's export of good 2 is larger. Therefore, the chances of success are higher* (*i.e.* $\hat{\pi}$ is *smaller*).

As seen above, *A* needs legal support to enforce her claims on *B*, either on the barter good or, in case of a simple trade credit, on *B*'s cash revenues. However, the chances of succeeding with her claim depend not only on the legal system but also on her own effort in seeking legal recourse and providing evidence of the justification of her claims. Clearly, the higher *A*'s pay-off from succeeding with her claim, the larger is her incentive to engage in this activity. This, in turn, has a positive impact on the probability of succeeding with her claim.

ADVANTAGE 4 *Barter makes more efficient use of B's export goods as potential collaterals.*

Consider, as argued above, that it is easier to track down goods than to track down cash revenues. One might still argue that, rather than tracking down the barter good, *A* may, in case of default, try to track down *B*'s future exports. In our model with a one shot transaction, this possibility is not considered since there is no further export. In general, though, this possibility has to be taken into account. Interfering with the debtor's future exports is what Bulow and Rogoff (1989) describe as the only viable way to punish for defaulting on debt repayment. The problem with this is twofold. In contrast to seizing *B*'s cash revenues, seizing his

export goods is possible only if they do not belong to some other customer already. Even if this is not the case, if *A* cannot claim to have priority rights on the future exports of *B*, then *A* still has to share all potential revenues with many other creditors, as in the case of tracking down cash revenues, Second, this requires that *B* plans to export regularly, after the default occurs. If, instead *B*, exports rather infrequently, *A* may have to wait for quite some time before she is able to satisfy (part of) her claims. The advantage of barter is thus that *A* can interfere directly with the export that is supposed to pay for the import, without having to wait for future and perhaps uncertain exports.

Our discussion of the advantages of using barter goods to secure trade credits has natural implications for the optimal choice of commodity money used in barter contracts. We turn to the optimal choice of these goods in the next section.

1.3. *Export Pattern of Barter Trade*

The preceding section has shown that barter offers an important advantage over transactions in money: it removes the anonymity of the medium of exchange and thus allows to establish property rights on the medium of future payment. This is why the use of commodity money helps to overcome the credit constraint. However, as Banerjee and Maskin (1996) pointed out, the payment in goods introduces new incentive problems, due to informational asymmetries. The debtor has an incentive to pay with low quality goods because creditors who do not produce or consume the good used as payment are less informed about the physical characteristics (different quality levels) and about the market characteristics (value when resold) of the goods in question. Thus, goods tend to be less liquid than money. Banerjee and Maskin argue that these moral hazard and adverse selection problems lead to inefficiencies which can be overcome only when fiat money is introduced, i.e. a good whose physical and market characteristics can be discerned by everybody.

In this section, we discuss the implications of these quality problems for the choice of commodity money in barter transactions. Since goods differ with respect to their liquidity and anonymity, not all goods are equally suited to serve as a collateral. We argue that by focusing on these incentive problems, we can explain the choice of commodity money and hence the export pattern of barter trade. Recall from Proposition 1 that, in the absence of quality problems, *B*'s creditworthiness problem can be solved if and only if

$$(1 - \hat{\pi})(v_2 - c_2) + a \geq c_1 \tag{6}$$

The term $(v_2 - c_2)$ captures the surplus generated by good 2, whereas $\hat{\pi}$ captures the degree of anonymity of good 2. The surplus $v_2 - c_2$ tends to be larger, the more homogeneous the good. This is due to the fact that homogeneous goods tend to be more liquid, because due to their standard characteristics it is harder to cheat on quality. On the other hand, homogeneous goods have the disadvantage of being relatively anonymous, i.e. $(1 - \hat{\pi})$ is relatively low. Differentiated goods in turn are less anonymous, i.e. $(1 - \hat{\pi})$ is large, but also less liquid, i.e. $(v_2 - c_2)$ tends to be smaller. *A* may not be able to judge the quality of the good she is paid with if

she has no experience with it. Thus, she risks being paid with low quality goods, if at all.[20] Since it is the combination of anonymity and liquidity that counts, it is not clear *a priori* whether to prefer homogeneous to differentiated goods as means of payment.[21]

However, A can take measures to reduce the quality problems in case of differentiated goods. Recall that the asymmetry of information is particularly acute in the absence of a double coincidence of wants, i.e. if A does not use good 2 herself and has no experience with it. One possible remedy to overcome this informational gap is to make some investment in getting better acquainted with good 2. A can, for example, invest in the future marketing of good 2 by taking an active role in the design of good 2. Such an investment, while being costly, offers two advantages. First, it allows A to learn about good 2 and to be a better judge of its quality. This, in turn, reduces B's leeway to cheat on quality. Second, by differentiating and designing good 2 for A's marketing, good 2 becomes even less anonymous and thus worsens B's outside option if he should try to cheat on A and sell good 2 to a third party.

It is straightforward to show that condition (5) is affected by such an investment i as follows.

$$[1 - \hat{\pi}(i)][v_2(i) - c_2(i)] + a \geq c_1 + i \tag{7}$$

On the one hand, i has a positive effect on the liquidity $(v_2 - c_2)$ and it reduces the anonymity $\hat{\pi}$, both of which increases the left-hand side of the condition. On the other hand, the investment causes additional cost i to be borne by A, which increases the right-hand side of the condition. Thus, the advantage on differentiated goods as a collateral is that they can be made more liquid and even less anonymous by investing in marketing the good. However, how preferable it is to choose differentiated goods as collaterals depends on how costly it is to make the necessary investment.

2. Theoretical Predictions and Empirical Evidence

In this section, we discuss testable predictions from our model, look for proxies for the incentive problems we would like to measure, and estimate whether the derived predictions are consistent with data on actual barter contracts.

[20] As one of the referees pointed out, in standard oligopoly models, one should expect higher markups in case of differentiated goods as compared to homogenous goods, due to market power considerations. Our point here is that, for a given level of market power, differentiated goods are subject to more asymmetric information problems and hence more quality problems. Note that these information and quality problems arise not only for the buyer herself but even more so when she tries to resell the goods on the world market. Since producers of differentiated goods in Eastern Europe and developing countries do not have a reputation for producing high quality yet, these goods are difficult to market and can be sold only at a discount price, as compared to the same type of goods produced by Western producers.

[21] Casella and Rauch (1998) introduce information sharing networks as additional determinant of trade in differentiated goods as a mechanism to overcome incomplete information in international markets. Our observation (that the use of homogeneous goods as collateral goods has advantages because of their greater liquidity as well as disadvantages because of their greater anonymity) is similar to a recent argument given by Myers and Rajan (1998) on the paradox of liquidity in the context of external financing of firms. On the one hand, it is easier to raise capital if the firm can offer more liquid assets as collateral. On the other hand, greater asset liquidity reduces the firm's ability to commit to a specific course of action.

2.1. *The Data*

The companies included in our sample of 230 contracts are either firms producing in Austria, or subsidiaries of multinational enterprises with their own in-house barter division located in Austria, or other firms in OECD countries using an international trading firm in Austria to carry out the barter transaction. Of the Western firms of the sample, 30% are based in the European Community and 62.7% in other industrialised countries including Austria, Sweden, Japan and the USA. Each firm was asked for information on about 40 aspects of each barter trade. We personally visited these firms to guarantee a high response rate.

The countertrade partner in Eastern Europe or developing country was a state agency (85.2% of the cases), a state-owned enterprise (9.1%) or a private firm (5.7%). Due to Austria's geographic proximity to Eastern Europe, East–West barter accounts for more than four-fifths of all deals in our sample. More specifically, 14.8% of the transactions are with the former Soviet Union, 24.8% with the former Czechoslovakia, 14.3% with Hungary, 7% with Poland, 4,3% with Romania, 6.5% with former East Germany, 6.5% with Bulgaria, 6.1% with the former Yugoslavia, and 0.9% with Albania. In contrast, North–South counter trade is underrepresented in the sample: only 5.7% of the transactions took place with Africa, 3% with Asia, 2.6% with South America, and 2.2% with China. The deals in our sample are mostly very large in size, ranging from US $ 8400 to US $ 635 million with a mean of US $ 11.1 million. All statistics presented in this paper are based on the number of contracts, rather than trade volume, as the unit of analysis.

Table 1 describes the variables included in the following empirical analysis and reports on some sample statistics.

2.2. *Ranking of Commodity Money*

In Section 1.2, we demonstrated that barter can be sustained only if condition (5) is satisfied. This is possible only if the value of the collateral is sufficiently large. In Section 1.3, we have argued that goods which are used as medium of exchange in barter have to have certain attributes to qualify as commodity money. The challenge is to find goods which are relatively liquid and which exhibit a low degree of anonymity. High liquidity means that there is little uncertainty about the quality of the good offered as payment. Low anonymity means that the creditor is offered a valuable collateral because she can successfully label the collateral goods as belonging to her and the debtor can use the good only for the special purpose of repaying his debt. Homogeneous goods tend to be liquid but also anonymous, whereas differentiated goods tend to be less liquid but also less anonymous.

In this section, we want to classify goods by whether they are homogeneous or differentiated. Furthermore, we identify whether buyer A has undertaken an investment to make the differentiated good more liquid and thus more valuable and also less anonymous. For this purpose, we classify the export goods into three categories: basic goods *BASIC*, consumer goods *CONSUM*, and investment and machinery goods *INVEST*.

Table 1

Definition of Variables and Sample Statistics

Variable	Observations	Description	Mean	Min.	Max.	Std dev.
*DEBT**	226	Debt-to-GDP ratio in 1987 of EE/LDC country	38.9	4.5	326.6	37.5
COMP	230	Compensation ratio: export value as percentage of import value	71.4	2.0	400.0	51.4
*EXPORT**	226	Export-to-GDP ratio in 1987 of EE/LDC country	27.9	4.2	63.9	11.8
*TECHIMP***	222	Share of technology imports in total imports in 1987 of EE/LDC country	33.5	11.6	45.4	7.3
BASIC	230	Type of good exported from EE/LDC country: basic goods or chemical product	D = 1, 63 observations			
CONSUM	230	Type of good exported from EE/LDC country: consumer goods	D = 1, 77 observations			
INVEST	230	Type of good exported from EE/LDC country: investment and machinery	D = 1, 75 observations			
MDIF	224	Characteristics of export good from EE/LDC country: horizontally and/or vertically differentiated	D = 1, 116 observations			
MINF	85	Characteristics of export good from EE/LDC country: good traded on organised market	D = 1, 30 observations			
REGION	230	Region of debtor country: LDC	D = 1, 31 observations			
REPEAT	227	Status of developed country firm (DC-firm): frequent exporter to EE/LDC trade partner	D = 1, 149 observations			
FAMILIAR	212	Status of DC-firm and EE/LDC trade partner: frequent trade partners	D = 1, 97 observations			
MUSE	230	Usage of export good from EE/LDC country by DC-firm: in own production	D = 1, 55 observations			
RELATION	230	Characteristics of export good from EE/LDC country: technologically related to import good from DC-firm	D = 1, 41 observations			
HIGHCASH	230	Characteristics of export good from EE/LDC country: sold at higher price outside barter	D = 1, 20 observations			
LOCAL	230	Usage of export good from EE/LDC country: sold at local market	D = 1, 71 observations			
SPECINV	230	Export good from EE/LDC country purchased at lower price in barter by DC-firm and not sold locally	D = 1, 14 observations			
RISK	221	Fixed price contract	D = 1, 124 observations			
COMPETE	220	Market structure for barter good: small number of suppliers wordwide	D = 1, 38 observations			

* World Debt Tables, World Bank.
** UN, Financial Statistics.

To classify the goods offered as commodity money as homogeneous or differentiated goods, we use the following proxies. *MDIF* indicates whether the good offered as medium of exchange in barter is differentiated. *MINF* indicates whether the particular export good is traded on an exchange. When the good is not differentiated and/or an organised market exists for the good, we assume that A is

not faced with an informational asymmetry, since she can either judge the quality or she can readily obtain information about the physical and market characteristics of the good from the market.

Even if goods are differentiated, *A* may trust *B* to keep promises about quality out of reputational considerations if they have dealt with each other for some time. We capture this familiarity with each other and with the good used as medium of exchange by the variable *FAMILIAR*.

The next set of variables are supposed to capture whether *A* invested to make good 2 more liquid and less anonymous. *A* will have to invest in marketing good 2 if she does not intend to use it herself. Thus, we can interpret the variable *MUSE* as an indicator for the absence of marketing investments. Furthermore, the good will be more liquid and less anonymous when there is a technical relationship between the good 1 *A* sells to *B* and good 2 used as payment by *B* (e.g. good 1 is a machine and good 2 is output produced with this machine). This is measured by the variable *RELATION*.

Additionally, we use the variable *SPECINV* to capture whether *A* makes a relationship specific investment. *SPECINV* combines *HIGHCASH* with *LOCAL*. *HIGHCASH* is a dummy variable equal to 1 when the export good is sold at a higher price outside barter trade. *LOCAL* is a dummy variable equal to 1 if *A* sells the export good locally. *SPECINV* is a dummy variable equal to 1 if *HIGHCASH* is equal to 1 and *LOCAL* is equal to 0. When *A* pays a lower price for the good in barter than in monetary transactions, this indicates either that *A* does not want the good as payment or that *A* has to be compensated for an investment she makes into the medium of exchange. To distinguish between these two cases, we combine *HIGHCASH* with *LOCAL*. *A* has to undertake an investment in marketing good 2 when she does not sell it locally (and the good is differentiated). Thus, when *A* pays a lower price in barter compared to monetary transactions and when she sells good 2 abroad, then we conclude that *A* has invested in the relationship.

The empirical results are given in Table 2. To characterise the properties of the three categories of export goods, we use *BASIC*, *CONSUM* and *INVEST* as the dependent variables in the regressions. All the variables described above are used as independent variables in the estimation. Since *BASIC*, *CONSUM* and *INVEST* are dummy variables bounded between 0 and 1, we report OLS as well as LOGIT estimates.

Consider first the properties of basic goods given in specifications (1) and (2) of the table. *BASIC* is a dummy variable which takes the value of 1 if the export good is a basic good or chemical product, and 0 otherwise. The negative coefficients on *MDIF* and the positive on *MINF* suggest that basic goods tend to be homogeneous goods which are traded on an organised market. These variables suggest that the moral hazard and adverse selection problem of low quality is of little concern when basic goods are used as medium of payment. Furthermore, *SPECINV* indicates that *A* does not invest in the relationship when she is paid in basic goods (the coefficient on *SPECINV* is negative and highly significant). The negative coefficient on *SPECINV* also indicates that basic goods are a desirable means of payment and collateral for *A*. This is additionally supported by the positive (but insignificant) coefficients on *MUSE* and *RELATION* which indicate that *A* need not invest in marketing good 2.

Table 2

Ranking Commodity Money

	BASIC		*CONSUM*		*INVEST*	
	OLS (1)	LOGIT (2)	OLS (3)	LOGIT (4)	OLS (5)	LOGIT (6)
MINF	0.44	2.16	−0.34	−1.92	−0.48	−2.78
	(0.000)	(0.000)	(0.000)	(0.001)	(0.000)	(0.001)
MDIF	−0.12	−0.75	0.19	1.20	0.15	0.72
	(0.037)	(0.030)	(0.015)	(0.008)	(0.065)	(0.083)
MUSE	0.06	0.35	−0.49	−3.07	0.08	0.38
	(0.383)	(0.373)	(0.000)	(0.000)	(0.350)	(0.385)
FAMILIAR	−0.13	−0.76	0.18	1.05	0.14	0.73
	(0.027)	(0.031)	(0.028)	(0.021)	(0.084)	(0.087)
RELATION	0.04	0.18	0.09	0.59	−0.24	−1.23
	(0.628)	(0.671)	(0.310)	(0.255)	(0.038)	(0.039)
SPECINV	−0.26	−1.77	0.37	2.45	−0.01	0.15
	(0.031)	(0.047)	(0.005)	(0.009)	(0.983)	(0.927)
Intercept	0.34	−0.63	0.46	−0.41	0.49	−0.10
	(0.000)	(0.040)	(0.000)	(0.293)	(0.000)	(0.787)
F	7.4		9.0		7.0	
	(0.000)		(0.000)		(0.000)	
Adjusted R^2	0.15		0.27		0.22	
-2 LL		215.9		135.9		143.0
% correct		75.8		73.9		72.5
N	211	211	134	134	131	131

Notes: Ordinary Least Square and Logit regressions. Numbers in brackets are *p*-values.
BASIC Dummy variable equal to 1 when export good is a basic good or chemical product and equal to 0 otherwise
CONSUM Dummy variable equal to 1 when export good is a consumer good and equal to 0 if it is a basic good or chemicals
INVEST Dummy variable equal to 1 when export good is investment good and equal to 0 if it is a basic good or chemicals
MINF Dummy variable equal to 1 when export good is traded on an organized market and 0 otherwise
MDIF Dummy variable equal to 1 when export good is differentiated and equal to 0 otherwise
MUSE Dummy variable equal to 1 when export good is used by *A* herself and equal to 0 otherwise
FAMILIAR Dummy variable equal to 1 if DC-firm and EE or LDC partner have frequently traded with each other and equal to 0 otherwise
RELATION Dummy variable equal to 1 if export good is technologically related to import good and equal to 0 otherwise
SPECINV Dummy variable equal to 1 when *HIGHCASH* equal to 1 and *LOCAL* equal to 0
HIGHCASH Dummy variable equal to 1 if export good is sold at higher price outside barter trade and equal to 0 otherwise
LOCAL Dummy variable equal to 1 if *A* sells the export good locally and equal to 0 otherwise

Finally, the negative and significant coefficient on *FAMILIAR*, in turn, suggests that barter trade with basic goods as the means of payment tend to take place in an anonymous setting, since the parties typically do not know each other from previous transactions. In sum, the data support the suggestion that basic goods are relatively liquid goods which do not require a marketing investment on the buyer's side.

Next, consider the characteristics of consumer goods which are given in specifications (3) and (4) of Table 2. *CONSUM* is a dummy variable equal to 1 if the good is a consumer good and equal to 0 if the good is a basic good or chemical product. Thus, specifications (3) and (4) compare the properties of consumer

goods relative to basic goods and chemicals. In contrast to basic goods, consumer goods tend to be differentiated goods in which the problem of information asymmetry arises (*MINF* has a negative significant sign and *MDIF* a positive significant sign). However, *B*'s incentive to pay with low quality consumer goods is controlled by the fact that *A* and *B* are familiar with each other from previous transactions (*FAMILIAR* has a positive and significant sign).

Furthermore, there seems to be evidence that *A* reduces her quality uncertainty by investing in the relationship, becoming more active in the quality design of the good and establishing a market for it. Both *MUSE* and *SPECINV* have a negative and significant coefficient. Only *RELATION* is insignificant. This investment makes the consumer good a medium of exchange specifically designed as payment for *A*. In sum, consumer goods are less liquid and less anonymous goods than basic goods. The moral hazard problem of quality is alleviated, however, because *A* invests in the relationship and because part of *B*'s behaviour is governed by trust due to *A*'s and *B*'s repeated interaction.

Finally, consider the properties of investment goods given in column (5) and (6) of Table 2. They differ in one important dimension from consumer goods. *A* typically does not invest in making the medium of exchange more liquid and less anonymous when she is paid in investment goods. The coefficient on *MUSE* and *SPECINV* is insignificant. *RELATION* is negative and significant. Investment goods tend to be disposed by *A* on the local market. *A* typically accepts investment goods as payment when she knows *B* from previous transactions. In sum, investment goods are less liquid and more anonymous goods than consumer goods. Moreover, investment goods seem to be less anonymous than basic goods (the coefficient on *SPECINV* is positive, although insignificant, while negative in the *BASIC* equation).[22]

The properties of commodity money described in Table 2 suggest a hierarchy with respect to quality problems and, therefore, with respect to their usefulness as collateral goods. According to the table, basic goods are expected to be the most liquid medium of exchange, followed by consumer goods. The most illiquid medium of exchange with severe quality problems is expected to be investment goods. We confront this prediction with data on the trader's judgement of the quality of export goods compared to an average quality of the same goods on the market. Table 3 indeed supports the prediction that commodity money can be ranked by quality problems. Of our sample, 58% of all basic goods and chemical exports, 49% of all consumer good exports, but only 31% of all investment good exports in barter trade were ranked to be of excellent-to-good quality relative to a market standard.

2.3. *Economic Incentives and Trade Pattern*

In this section, we check how a country's incentive problems of debt repayment affect the choice of collateral goods used as payment in barter contracts. For this purpose, consider once more condition (5).

[22] That basic goods seem to be more anonymous than investment goods is reasonable because the former are often fluid goods (like oil) for which property rights are harder to define than for bulky products (like a machine).

Table 3

The Liquidity of Commodity Money

	Investment goods	Consumer goods	Basic goods	Row total
Excellent-to-good quality	(23.2)	(38.9)	(37.9)	95
	[31.0]	[49.3]	[58.1]	[45.7]
Others	(43.4)	(33.6)	(23.0)	113
	[69.0]	[50.7]	[41.9]	[54.3]
Column total	71	75	62	208
	(34.1)	(36.1)	(29.8)	(100.0)

Total number of cases; numbers in paranthesis are row percentages, numbers in brackets are column percentages.

$$(1 - \hat{\pi})(v_2 - c_2) + a \geq c_1 \tag{8}$$

From this condition follows immediately that the larger the country's creditworthiness problem, because the assets that can be seized are small, i.e. the smaller a, the larger the value created by the collateral good has to be, i.e. the more liquid (captured by $v_2 - c_2$) and the less anonymous (captured by $\hat{\pi}$) the good used as payment has to be.

The preceding section gives us no clear ranking of basic and consumer goods. Basic goods are, in principle, more liquid than consumer goods but buyers have to undertake an investment to ensure the quality of the consumer good and as Table 3 suggests, this attempt tends to be successful. Moreover, the investment makes the consumer good less anonymous compared to basic goods. The good becomes specifically designed to be used only by the creditor, thereby reducing its attractiveness for potential other parties. Investment goods instead seem to be clearly inferior as payment in kind. When paid with investment goods the buyer does not invest to market the good and, indeed, the quality delivered is typically worse compared with consumer goods. Thus we expect that the lower the debtor country's creditworthiness, the more likely it is that basic goods and consumer goods and the less likely it is that investment goods are used to collateralise future payments.

To test this hypothesis, we use as a proxy for the creditworthiness of the debtor country the debt-to-GDP ratio *DEBT* as reported by the World Debt Tables of the World Bank. The idea is that the more B is indebted already, the fewer assets remain to be seized by A in case of default, and thus the lower B's creditworthiness.

The results are given in Table 4. We report LOGIT estimates because the dependent variables measuring the choice of collateral goods *BASIC*, *CONSUM* and *INVEST* are bounded between 0 and 1. As expected, we find in specification (1) that *DEBT* has a significant positive impact on the choice of basic goods as opposed to all other goods. The coefficient on *DEBT* is insignificant in specification (5), indicating that debt does not make consumer goods more or less preferable to basic goods. However, investment goods are clearly not used if outstanding debt is large as the significant negative coefficient in specification (9) indicates.

In specifications (2), (6) and (10), we introduce a regional dummy to control for the possibility that the product choice is driven by comparative advantage.

Table 4

Choosing Collateral Goods

	BASIC				*CONSUM*				*INVEST*					
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
ln *DEBT*	0.5	0.2	0.3	0.2	−0.2	0.0	0.2	0.2	−0.6	−0.4	−0.7	−0.7	−0.8	−0.8
	(0.02)	(0.26)	(0.40)	(0.47)	(0.36)	(0.90)	(0.59)	(0.52)	(0.00)	(0.17)	(0.01)	(0.01)	(0.01)	(0.02)
REGION		1.8	2.0	1.9		−1.8	−2.0	−2.0		−9.6				
		(0.00)	(0.00)	(0.00)		(0.00)	(0.00)	(0.00)		(0.65)				
REPEAT			−0.4	−0.7			0.1	−0.0			1.5	1.5	1.5	1.6
			(0.40)	(0.14)			(0.86)	(0.96)			(0.00)	(0.00)	(0.00)	(0.00)
ln *TECHIMP*			−1.6	−1.4			1.3	1.2			1.0	0.9	0.5	0.6
			(0.02)	(0.06)			(0.06)	(0.13)			(0.13)	(0.22)	(0.51)	(0.47)
ln *EXPORT*			0.3	0.4			−0.1	−0.2				0.2		−0.2
			(0.58)	(0.44)			(0.83)	(0.65)				(0.61)		(0.76)
RISK				0.3				−0.3					0.4	0.4
				(0.42)				(0.49)					(0.02)	(0.02)
COMPETE				0.3				−1.5					−1.3	−1.3
				(0.50)				(0.01)					(0.02)	(0.02)
Intercept	−3.1	−0.85	1.8	2.3	0.8	0.5	−4.2	−4.8	2.1	−7.9	−0.8	−0.9	1.0	1.1
	(0.00)	(0.35)	(0.41)	(0.41)	(0.23)	(0.53)	(0.08)	(0.10)	(0.00)	(0.71)	(0.78)	(0.76)	(0.73)	(0.72)
−2 LL	206.6	190.4	166.5	157.9	187.1	171.9	156.9	146.1	178.4	146.7	151.0	150.8	132.4	132.2
% correct	82.3	84.9	86.2	86.4	58.8	66.2	69.5	68.3	58.8	70.6	70.8	65.4	70.6	70.6
N	226	226	217	206	136	136	128	126	136	136	130	130	126	126

Notes: Logit regressions. Numbers in brackets are *p*-values.
BASIC Dummy variable equal to 1 when export good is a basic good or chemical product and equal to 0 otherwise
CONSUM Dummy variable equal to 1 when export good is consumer good and equal to 0 if it is a basic good or chemicals
INVEST Dummy variable equal to 1 when export good is investment good and equal to 0 if it is a basic good or chemicals
ln *DEBT* Log of debt to GDP ratio of LDC or EE country in 1987
REGION Dummy variable equal to 1 when trade partner is located in LDC country, and equal to 0 if he is located in EE country
REPEAT Dummy variable equal to 1 when LDC or EE country imported from developed country firm on a regular basis and 0 otherwise
ln *TECHIMP* Log of share of technology imports in total imports of EE or LDC country in 1987, UN, Financial Statistics
ln *EXPORT* Log of exports to GDP ratio of LDC or EE country in1987
RISK Dummy variable equal to 1 when parties agreed on a fixed price over contract duration and equal to 0 otherwise
COMPETE Dummy variable equal to 1 when there are only a small number of suppliers for the barter good worldwide and equal to 0 otherwise

REGION is a dummy variable equal to 1 if the debtor country is a developing country and equal to 0 if it is an Eastern European country. *REGION* is positive and significant for basic goods, negative and significant for consumer goods, and insignificant for investment goods. In accordance with comparative advantage, developing countries use basic goods, while Eastern Europe uses consumer goods to collateralise future payments. Including this regional dummy reduces the significance of the *DEBT* coefficient in the equations for basic goods and for consumer goods. This suggests that the choice of basic goods relative to consumer goods is driven more by comparative advantage than by the incentive problems of debt repayment. The reverse picture emerges for investment goods. The regional dummy is insignificant. We therefore exclude *REGION* for the remaining specifications for investment goods. The significant effect of debt in the investment choice equations suggests that investment goods are used as means of payment only when the country has a creditworthiness problem. Comparative advantage does not seem to affect the choice. The negative coefficient of *DEBT*, however, suggests that investment goods will be an effective collateral only when the creditworthiness problem is mild.

In specifications (3), (7) and (11), we include three more variables that may affect the choice of collateral goods. To control for reputation effects, we include *REPEAT* as a proxy for whether the parties know each other from previous interactions. *REPEAT* measures the frequency of *A*'s exporting activity to *B*. The underlying presumption is that, if *A* has exported to *B* regularly in the past, she is more likely to continue to do so in the future than if she trades with *B* for the first time. One might expect that problematic goods like investment goods are more likely to be chosen if *B* has an incentive to maintain a reputation for high product quality. This is confirmed by Table 4, where *REPEAT* has a positive and significant coefficient in specifications (11)–(14), while it appears insignificant in the other specifications.

As a proxy for *B*'s export opportunities in case of default, we use the export ratio of *B*'s country *EXPORT*. A high export ratio suggests that the country is well integrated into the world market indicating that *B*'s outside option to barter is good. This should make it more important to choose goods of high collateral value, like basic and consumer goods. However, *EXPORT* turns out not to be significant in any of the specifications.

Finally, we include *TECHIMP* as a proxy for *B*'s benefit from importing good 1. *TECHIMP* is the ratio of technology imports over total imports in *B*'s country. A large share of technology imports indicates that *B* depends essentially on *A*'s imports and that it will be particularly difficult for *B* to find substitutes. *B* will be more reluctant to cheat on *A*, because *A* can punish by excluding *B* from future imports. Thus, a high ratio of technology imports makes it less important to choose high value collateral goods like basic or consumer goods. This is supported for basic goods, where the coefficient is significant and negative. For consumer goods and for investment goods, however, *TECHIMP* has either the wrong sign or is insignificant. An alternative interpretation is that the variable *TECHIMP* reflects comparative advantage rather than *A*'s punishment potential in case of *B*'s default on payment. Countries are more likely to export consumer goods rather than basic goods if they have access to more advanced technology.

In the literature, some complementary explanations for the export pattern of bartering countries have been proposed. Amann and Marin (1994) have argued that barter can serve in addition as an insurance mechanism if export revenues are stochastic. In principle, developing countries could eliminate all the risk from their foreign exchange earnings by selling their products forward and thus having a guaranteed price over the period for which the futures market is open. However, futures contracts exist only for a narrow range of commodities. Barter trade allows forward selling of goods for which no organised futures market exists, i.e. in particular for consumer and investment goods.

Another potential explanation for the dominance of consumer and technology goods among barter exports is that barter offsets inefficiencies due to imperfect competition.

To control for these other possible explanations for the export pattern in barter, we have included the variables *RISK* and *COMPETE*. *RISK* is a dummy variable of value 1 when the parties agreed on a fixed price for the barter good over the duration of the contract. RISK captures the insurance motivation for barter. This variable has no explanatory power for the choice of basic or consumer goods. Its coefficient is positive and significant for investment goods. *COMPETE* is a dummy of value 1 when there are only a small number of suppliers for the barter good worldwide. The variable is supposed to capture market power reasons for the choice of barter good. It is insignificant for the choice of basic goods and it significantly affects the choice of consumer and investment goods. However, consumer and investment goods tend to be used as means of payment when market power is low, as the negative sign of the coefficient on *COMPETE* indicates.

Finally, Marin and Schnitzer (1995) explain why technology dominates among the barter imports to Eastern European and developing countries. They show that barter trade can induce an efficient technology transfer, by using the barter good as a hostage for *A*'s technology. They show further that this effect is easier to achieve if the hostage good is a differentiated good for which markets are difficult to establish. Accordingly, they predict why differentiated goods like consumer and investment goods dominate among barter exports from Eastern European and developing countries when these countries have a large share of technology imports. This proves to be of some relevance since *TECHIMP* positively affects the likelihood that consumer goods are used as means of payment and negatively the likelihood of the choice of basic goods.[23]

Let us turn again to the actual pattern of specialisation of barter trade described in the introduction. Among barter exports from developing countries and Eastern Europe, consumer goods (32%) and investment goods (35%) dominate. How can we explain this pattern given the results of Table 4? The table predicts that investment goods will be used to collateralise future payments only when the country's creditworthiness is not too bad. Consumer goods instead are equally good collaterals as basic goods and therefore can be used as substitutes for them.

[23] Caves and Marin (1992) find evidence that barter allows Western exporters to price discriminate. However, this does not lead to a clear prediction of which type of barter goods are used for the transaction.

Our theory predicts that countries that differ in their creditworthiness will show a different pattern of barter trade. More specifically, countries with lower creditworthiness will use higher value collateral goods as means of payment in barter. Thus, the large share of investment good exports in our sample let us expect that the problem of creditworthiness, though present, is not too severe among the countries represented in the sample. This is indeed what we find in the data. The debt-to-GDP ratios of the countries in the sample vary widely, ranging from 5% to 327%. However, because of the dominance of Eastern Europe in the sample, in particular the former Soviet Union and former Czechoslovakia, we have a relatively larger number of barter deals with countries that were not too severely indebted in 1987. Of the barter deals, 86.2% of the sample are with Eastern Europe and 13.8% as with developing countries. Eastern Europe, with an average debt-to-GDP ratio of 33.8 in 1987, was substantially more creditworthy than the developing countries with an average debt-to-GDP ratio of 76.6. Eastern Europe has thus used investment goods as means of payment in barter because it could 'afford' to use 'bad money' with low collateral value. Investment goods provided collateral of sufficient value compared to the gains from defaulting. Consumer goods turn out to be 'good money' and qualify as collateral for countries with low creditworthiness. Thus, developing countries with low creditworthiness use predominantly the most liquid goods, basic goods, as means of payment in barter. The large share of investment good exports among barter can be explained by the dominance of Eastern Europe in the sample, a region whose creditworthiness problem has not been too severe during the 1980s.

3. Conclusions

In this paper, we have shown that barter can be an efficient institution that mitigates the incentive problems of highly indebted countries. Goods, rather than money, may be used as a medium of exchange in international trade with highly indebted countries because of their superior credit enforcement properties. The reason why goods are better collateral than money is that they are less anonymous and therefore property rights on goods are easier to define and enforce than property rights on the future export returns of a country. Since the creditor in the developed country can label the goods as belonging to her, the debtor in the developing country or Eastern Europe cannot use these goods for other purposes than paying back his debt. Thus, goods function like 'special purpose money'. However, payment in goods introduces new incentive problems due to informational asymmetries. The debtor has an incentive to pay with low quality goods which makes goods less liquid than money. We rank goods with respect to their anonymity and liquidity – with respect to the severity of the incentive problems. This ranking of commodity money implies that the severity of the incentive problem of debt repayment varies with the type of medium of exchange used as payment in barter. We do indeed find that the larger the debtor's incentive problem in the credit relationship, the more likely it is that a collateral good is used as payment which ranks high on the liquidity scale and low on the anonymity

scale, i.e. the more likely it is that basic goods and the less likely it is that investment goods are used to collateralise future payments.

Our analysis suggests that some forms of international trade cannot be understood without the analysis of contracts and institutions. The pattern of specialisation in barter trade differs significantly from that in conventional trade. We introduce incentives as an additional determinant of the pattern of trade in barter. Thus, we can give an institutional explanation for why investment goods and consumer goods dominate among barter exports from Eastern Europe which complements the explanation given by comparative advantage. These goods are the appropriate medium of exchange for countries whose problem of creditworthiness is not too severe.

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Appendix

Proof of Proposition 1

To prove the necessity of this condition, note first that (3) together with (4) require

$$c_2 + \hat{\pi}(v_2 - c_2) - \min(p_1, a) \;\leq\; p_2 - p_1 \;\leq\; v_2 - c_1 \tag{9}$$

which implies condition (5).

Next, we have to show that, if (5) is satisfied, we can find prices such that (2), (3) and (4) hold. Rewriting (2), (3) and (4) gives

$$A \;\equiv\; -a \;\leq p_2 - p_1 \tag{10}$$

$$B \;\equiv\; c_2 + \hat{\pi}(v_2 - c_2) - \min(p_1, a) \;\leq p_2 - p_1 \tag{11}$$

$$p_2 - p_1 \leq\; v_2 - c_1 \;\equiv\; C \tag{12}$$

These conditions can only be fulfilled simultaneously if $A \leq C$ and $B \leq C$. Note that $A < C$ by assumption. Given condition (6), $B \leq C$ can be satisfied by choosing $p_1 \geq a$. *QED*

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