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Creating Creditworthiness through Reciprocal Trade

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Abstract

The paper investigates how barter can be used to finance imports and restore the creditworthiness of highly indebted countries when reputation as an enforcement mechanism for credit repayment does not work. The authors argue that payments in goods can be used to collateralize a trade credit and thus improve the creditor's incentives to pursue defaulting debtors. Furthermore, it is shown that barter is particularly advantageous if export revenues of the debtor country are stochastic, even in the absence of risk aversion. The predictions of the model are consistent with data on actual barter contracts.

1. Introduction

With the collapse of the socialist system in eastern Europe, many experts expected barter trade to vanish as well, as a relic of the old system of centralized planning. But the recent economic and financial crisis in Russia has seen barter trade come back with a vengeance.[1] Southeast Asia seems to be having a similar experience.

Barter is a reciprocal form of trade in which an import is paid with an offsetting export, either simultaneously or at some later date. The term "barter" is used with different meanings, sometimes as a term that refers to countertrade transactions in general, sometimes in a more specific sense. In a more general sense, barter (or "countertrade") denotes transactions in which a party from an industrialized country supplies goods, services, or technology to a second party in an eastern European or developing country, and in which, in return, the first party purchases from the second party an agreed amount of goods, services, or technology. The distinctive feature of this form of trade is the existence of a link between the two transactions, the import and the subsequent export. This form of trade takes a variety of forms, called "barter" in the strict sense of the word, "counterpurchase," and "buyback". Barter in the strict sense of the word avoids the use of cash altogether; i.e., the export serves directly as a payment in goods. Other forms of barter, like counterpurchase or buyback, link an import and an export, specifying cash payments for both transactions.[2] All three forms are frequently observed in international trade.

In this paper we argue that barter in its general sense can be seen as a possibility to restore the creditworthiness of highly indebted countries by collateralizing trade credits. Furthermore, we show that barter is particularly advantageous in the case of uncertain export revenues. Both features together may account for the recent rise in barter trade.

In the early 1980s, when the international debt crisis led to a dramatic decline in private lending to developing and eastern European countries, highly indebted

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countries found it increasingly difficult to finance their imports. Thus, unconventional forms of trade and trade financing experienced a resurgence, including barter trade.[3] Hammond (1989) estimated that 10–20% of total world trade were governed by barter agreements in the 1980s. More recent estimates suggest that international barter has not declined.[4]

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 collateralized in the same way as domestic debt (Eaton, 1990). Creditors who finance exports to foreign firms or trade organizations 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).

In a seminal paper, Eaton and Gersovitz (1981) have shown how "reputation effects" can sustain sovereign lending. But, as Bulow and Rogoff (1989a) point out, reputation effects alone cannot sustain any positive repayment if the debtor can switch to "cash-in-advance" contracts after repudiation. Kletzer and Wright (1990) show 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.

In this paper we argue that barter has important advantages over reputation as an enforcement mechanism for credit repayment. The main difference between reputation and barter is that barter can be used to collateralize a trade credit. In our paper we compare the rights associated with a barter contract and a credit contract and explain how barter enables the creditor to recover a larger fraction of the outstanding debt. As we will see, in case of barter in the strict sense, the contract specifies goods with which to pay the import which means that the creditor can establish property rights on these goods. If cash payments are specified, as in the case of counterpurchase or buyback, the payments for import and export can be offset against each other and the export goods can serve as a collateral for the cash payment to be made for the import.

This way of establishing seniority rights for the creditor through barter contracts offers a more viable alternative to sustain international lending to highly indebted countries. To make this point we use a simple dynamic model in which creditors and debtors interact repeatedly. This allows us to compare the enforcement mechanisms discussed by the sovereign debt literature, such as "reputation" effects and the threat of trade sanctions, with those if trade credits are "collateralized" through barter agreements.

Another important advantage of barter becomes apparent in the case of uncertain export revenues. If export revenues are stochastic, a debtor may occasionally find himself unable to repay fully, owing to liquidity constraints. To fulfill his debt obligations, he may therefore be obliged to pay more when revenues are particularly high. Thus, when export revenues are low, repudiation may occur owing to liquidity problems; and when export revenues are high, repudiation is attractive because the payment which is due is rather high. In the case of barter, instead, the payment is in goods and thus contingent on the uncertain export prospects. This avoids negative or positive surprises on the debtor's side and hence prevents repudiation due to high or low export revenue realizations. This is why barter makes it easier to prevent repudiation in the case of stochastic export revenues.

The empirical analysis of our paper 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.[5] 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.[6] An important advantage of our micro dataset 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 the necessary size of the collateral as well as on the optimal choice of commodity money.

In this paper we focus on solving the creditworthiness problem but barter can also serve other functions. 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 Marin and Schnitzer (2001), we introduce incentive problems to explain the trade pattern of international barter. A more general discussion of how barter can be used to solve economic incentive problems in international trade can be found in Marin and Schnitzer (1998). Hennart (1989) and Mirus and Yeung (1986, 1993) are early papers that interpret countertrade, and in particular buyback as a solution to transactional difficulties that arise from information asymmetries and hold-up problems due to transaction-specific investments. Ellingson (1998) discusses barter as a screening device in the case of uncertain financial resources of the buyer. The key assumption in this paper is that the debtor's liquidity is private information and that the debtor can prove his financial constraint by making part of the payment in kind.

In section 2 we study a repeated credit relationship to identify how much sovereign lending can be sustained by reputation effects alone. In section 3 we introduce barter in this dynamic framework and show under what conditions barter can relax the credit constraint of highly indebted countries. In section 4 we derive empirical implications of our analysis and use our data sample to test these predictions. Section 5 concludes.

2. The Problem of Credit Enforcement

We consider a simple trade and credit relationship between two trade partners, called A and B. Think of A (she) as a firm in an industrialized country, and B (he) as a firm or a trade organization in an eastern European (EE) or a developing (LDC) country. The trade partner in the East wants to buy some import goods from A, but does not have the foreign exchange necessary to pay for these imports. The question we examine in this section is to what extent reputational concerns can sustain international lending if A and B are engaged in a long-term relationship where B intends to buy import goods on a credit basis not just once, but repeatedly. As Eaton and Gersovitz (1981) have shown, the threat of exclusion from credit markets provides an incentive for a country to repay its debt. If countries intend to borrow not just once but repeatedly, they are interested in maintaining a reputation for being good creditors. However, the amount of potential credits that can be sustained with such reputational concerns is limited.

To study this question more formally, consider the following setup. 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 the form of a supplier credit. B's willingness to pay for good 1 is v_1 and A's production cost is c_1, with $v_1 > c_1$. In period 2, B can produce one unit of good 2 and sell it on the world market. This generates foreign exchange revenues of value v_2. To save on notation, but without loss of generality, we normalize production cost of good 2 to zero. Both parties A and B have a common discount factor $\delta = 1/(1 + r)$, where $r > 0$ is the world interest rate per period. 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., $v_2 \geq (1/\delta)c_1$. 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 $(1/\delta)p_1$ in period 2 ($(1/\delta)p_1 \leq v_2$).

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.[7] 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, $(1/\delta)p_1 \leq a$. 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 $(1/\delta)p_1$. Thus, we say that B is "creditworthy" if and only if

$$a \geq \frac{1}{\delta} c_1. \tag{1}$$

If instead $a < (1/\delta)c_1$ we say that B faces a credit constraint because there exists no p_1 such that $p_1 \geq c_1$ and $(1/\delta)p_1 \leq a$ are satisfied simultaneously. In the following we will 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. The idea is that A threatens that she will never again deliver good 1 if B repudiates once. Thus B would lose his discounted payoff from all future purchases of good 1. However, as Bulow and Rogoff (1989a) point out, reputational concerns alone cannot enforce repayment if B can switch to "cash-in-advance" contracts. In this case B can take the foreign exchange revenues that were destined for credit repayment and use them for importing goods instead. The problem is that even if everybody believes that B will not repay any debt in the future, A and A's competitors cannot commit not to deal with B if he offers to pay cash in advance. But A may have other possibilities to punish B and to recover some of her money. In particular, A may try to track down B's future exports and imports and take legal action in order to confiscate these goods or the payments associated with them.[8] For instance, A may have goods seized that are shipped by B to A's country but not paid yet, or goods that are destined for B and paid but not yet shipped.

To make this point more formally consider the following dynamic framework which is an infinitely repeated version of the credit relationship just described. In each period, starting with period 1, B wants to buy one unit of good 1 at some fixed price p_1 from A. Suppose that p_1 is the spot market price for good 1 and that there are other sellers in developed countries offering this good at the same price. Furthermore, starting with period 2, B can produce one unit of good 2 each period and sell it on the world market at price v_2. Again we assume $v_1 \geq p_1 \geq c_1$, and $\delta v_2 \geq p_1$.

The question is whether there exists a self-enforcing "implicit agreement" between A and B (which cannot be enforced by the courts), saying that in each period A gives a trade credit to B in order to finance the purchase of good 1, and B repays $(1/\delta)p_1$ out of his revenues v_2 one period later. An implicit contract is a subgame-perfect equilibrium of the repeated game; i.e., it has to be optimal for each party to stick to the terms of the agreement on and off the equilibrium path. Abreu (1988) has shown that a path of behavior can be sustained as a subgame-perfect equilibrium if and only if it can be sustained with the threat of the worst possible punishment equilibrium for each player. In our context, the crucial question is to determine the worst possible punishment equilibrium for firm B. The worst that can happen to B in case of default is that A seizes his assets a and refuses to trade with B in the future. B has the option to switch to other suppliers of good 1. While they may not be willing to offer a trade credit to B, they will not refuse to deliver good 1 if B pays cash in advance. However, given the possibility of legal action by A described above, the expected gains from trade of future exports and imports are reduced. Let π, $0 \le \pi \le 1$, denote the probability with which B can cheat on A without being interfered with. This implies that his expected revenues from selling good 2 to a third party are πv_2. Thus B's payoff in case of default is given by[9]

$$v_1 - \delta a + \delta(v_2 + \pi(v_1 - p_1)) + \sum_{t=2}^{\infty} \delta^t(\pi(v_2 + v_1 - p_1)). \tag{2}$$

Note that B can default only after the export in the second period has been carried out, since the revenue v_2 from this export was supposed to be used to repay $(1/\delta)p_1$. Hence, A's punishment can affect the import in the second period at the earliest.

If B sticks to the terms of the implicit agreement, his payoff is

$$v_1 + \sum_{t=1}^{\infty} \delta^t \left[v_1 - \frac{1}{\delta} p_1 + v_2 \right]. \tag{3}$$

Comparing (2) with (3), B will repay his debt in every period if and only if

$$v_1 + \frac{\delta\left[v_1 - \frac{1}{\delta} p_1 + v_2 \right]}{1-\delta} \ge v_1 - \delta a + \delta(v_2 + \pi(v_1 - p_1)) + \sum_{t=2}^{\infty} \delta^t \pi(v_2 + v_1 - p_1), \tag{4}$$

which is equivalent to

$$\frac{1}{\delta} p_1 \le \frac{1}{1-\pi\delta}[(1-\pi)v_1 + (1-\delta)a + \delta(1-\pi)v_2]. \tag{5}$$

On the other hand, A is willing to participate in the transaction if and only if $p_1 \ge c_1$. The following proposition summarizes this discussion.

PROPOSITION 1. *B's creditworthiness can be restored through a repeated credit relationship if and only if*

$$\frac{1}{1-\pi\delta}[(1-\pi)v_1 + \delta(1-\pi)v_2 + (1-\delta)a] \ge \frac{c_1}{\delta}. \tag{6}$$

Note that if $\pi = 1$ (i.e., if A cannot affect B's gains from future international trade) we are back to the case considered above where the repetition of the credit relationship did not improve B's creditworthiness as compared to a one-shot relationship.

3. Advantages of Payment in Goods

Using Barter Goods as Collaterals

In the following section we want to ask whether B's creditworthiness can be improved if B turns to barter trade. As we have seen above, all forms of barter share the common feature that the export can be used to collateralize the import credit. Either, as in case of barter in the strict sense, the use of money is avoided altogether, or as in case of counterpurchase or buyback, the two monetary payments are offset against each other and the export goods are used as a collateral to secure this transaction. Thus, as we will discuss in more detail in the following subsection, the crucial feature is that the importing firm commits to deliver goods to the western supplier.

To see what difference this makes for B's creditworthiness problem, let us assume again 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 as a payment in kind.[10] The problem is of course that with a barter contract a new incentive problem arises. Since B cannot be forced to produce and deliver good 2 to A, he must be induced to do so voluntarily. This corresponds to the problem to induce B to pay $(1/\delta)p_1$ 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 any more. 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 no longer free to use good 2 as he wants to. If he refuses to deliver to A he may not be able to sell good 2 at all. A can use the courts in her own country (or in other industrialized countries) to enforce her claim and seize good 2 when it is shipped to some third party. 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, the potential surplus from selling good 2 on the world market, v_2, is reduced to $\hat{\pi}v_2$, $0 \leq \hat{\pi} \leq 1$.

To make this more precise suppose that A and B agree to repeat the following barter deal infinitely often. In every period A delivers one unit of good 1, starting in period 1, and B delivers one unit of good 2, starting with one period delay. If B sticks to the barter agreement his payoff is

$$v_1 + \sum_{t=1}^{\infty} \delta^t v_1. \tag{7}$$

What is the worst possible punishment if B deviates in period 2, refuses to deliver good 2 to A, and switches to cash-in-advance contracts thereafter? Again, A can seize B's assets a and try to confiscate some of B's future trades. This is modeled by assuming that B's future gains from exporting good 2 (if he defaulted on the barter deal) are reduced to $\hat{\pi}v_2$. We argue below that it is sensible to assume that $\hat{\pi} \leq \pi$. Thus, B's payoff in case of default is

$$v_1 - \delta a + \sum_{t=1}^{\infty} \delta^t [\pi(v_1 - p_1) + \hat{\pi} v_2]. \tag{8}$$

Note that B's incentive to deviate depends on the price p_1 he has to pay if he switches to another supplier of good 1. Let us consider the case where B's incentive to deviate is maximal, that is where $p_1 = c_1$.[11]

Substituting $p_1 = c_1$ in (8) and comparing this expression to (7), B will not deviate from the barter agreement if and only if

$$(1 - \delta)a \geq \hat{\pi} v_2 - (1 - \pi) v_1 - \pi c_1. \tag{9}$$

On the other hand, A is willing to participate in the barter agreement if and only if

$$\sum_{t=0}^{\infty} \delta^t c_1 \leq \sum_{t=1}^{\infty} \delta^t v_2. \tag{10}$$

The following proposition (proved in the Appendix) shows under what conditions a barter contract can achieve efficiency.

PROPOSITION 2. *Suppose that B is not creditworthy. Then there exists a barter agreement which restores B's creditworthiness and implements the efficient allocation if and only if*

$$\frac{1}{1 - \delta\pi}[(1 - \pi) v_1 + (1 - \hat{\pi}) v_2 + (1 - \delta) a] \geq \frac{c_1}{\delta}. \tag{11}$$

Condition (11) shows that the moral hazard problem of debt repayment can be solved only if the problem of creditworthiness is not too severe (i.e., a is not too small) and if the deal-specific collateral v_2 is sufficiently large.

Let us compare barter, the promise on goods, to a credit arrangement, the promise on cash. Comparing the left-hand sides of (11) and (6), we find that barter is advantageous if

$$(1 - \hat{\pi}) v_2 > \delta (1 - \pi) v_2. \tag{12}$$

Thus, barter outperforms a simple credit arrangement if $\hat{\pi} < \pi$; i.e., if a claim on good 2 is easier to enforce than a claim on cash. In the following subsection we discuss why this seems to be realistic. Note also that since A has a property right on the export good produced by B in period 2, she can affect B's export payoff in period 2 already. The less frequently the transaction is repeated (i.e., the smaller δ) the more likely this is to play a role.

Establishing Seniority Rights through Barter

Why should A be more successful to interfere with B's exports if she has a barter contract; i.e., why should $\hat{\pi}$ be smaller than π? To see this we have to look in more detail at the legal consequences of collateralizing a trade credit with barter.

As we have explained above, in barter in the strict sense no monetary payments are made at all for the import—the import is paid for with goods. In counterpurchase and buyback, the trade partners may agree that both import and export are paid for with foreign exchange. But the monetary payments can be set off against each other. The crucial feature, however, is that in both cases the barter goods serve as collateral.[12]

Quite generally, it appears that it is easier to seize physical goods than cash since cash, or financial transactions in general, are much easier to hide than physical goods. So if goods are used as payment or as collateral, this is one good reason we should expect $\hat{\pi}$ to be smaller than π.

But more importantly, using barter goods as collateral means that A's expected payoff from legal action is higher. Note that A's success in pursuing B hinges on the effort A spends on tracking down B's exports and on taking legal action against B. Since this effort depends on A's payoff should she succeed in laying her hands on good 2 in case of B's default her incentive is larger, the larger her payoff in case of success. The point is that with barter as a collateral good, 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 whereas in the case of barter goods specified as collateral goods A has the advantage of having seniority rights. Thus, a property right on the barter good gives A a larger return than a claim on cash.

To see this consider A's payoff in case of default if she has no barter contract. In this case all returns from legal action are shared with other creditors. Suppose for notational simplicity that there are n other creditors who all have a claim of equal size. Then her payoff in case of default is

$$-c_1 + a + \sum_{t=1}^{\infty} \delta^t \frac{1-\pi}{n}(v_1 - p_1) + \sum_{t=2}^{\infty} \delta^t \frac{1-\pi}{n} v_2. \tag{13}$$

In contrast, in the case of barter, A's property rights on good 2 give A seniority rights on the collateral good. Thus, A does not have to share the revenues from tracking down good 2 with any other creditor who has purely financial claims but no property right on good 2. This means the maximum expected payoff in case of default is

$$-c_1 + a + \sum_{t=1}^{\infty} \delta^t \left[\frac{1-\pi}{n}(v_1 - p_1) + (1-\hat{\pi})v_2 \right]. \tag{14}$$

Comparing these two expressions reveals that A's default payoff in case of barter is strictly higher than with a credit relationship since

$$\sum_{t=1}^{\infty} \delta^t (1-\hat{\pi})v_2 > \sum_{t=2}^{\infty} \delta^t \frac{1-\pi}{n} v_2 \tag{15}$$

for all $\hat{\pi} \leq \pi$.

Thus, A has a larger incentive to spend effort on tracking down good 2 with a barter contract, which in turn results in $\hat{\pi} < \pi$.

Barter in the Case of Uncertain Export Revenues

So far we have assumed that all economic variables are deterministic, in particular future world market prices and export revenues. However, one of the problems of developing countries is that their export revenues depend mainly on commodities with huge fluctuations of world market prices. These fluctuations in world market prices for commodities make these countries suffer large fluctuations in export revenues. As a consequence, these countries can find themselves in the situation where they are not able to satisfy their debt obligations even though they may be willing to do so.

Of course, one way of dealing with this problem is to condition the debt repayments that are due in each period on the export revenues realized in this period. This means that in periods of low world market prices and thus low export revenues, only low repayments have to be made. In periods of high export revenues, instead, high repayments are required in order to compensate for the low repayments in periods with low revenues.

In this subsection we study the question how stochastic export revenues affect the problem of enforcing debt repayment. As we will see, stochastic revenues make it more difficult for the reputation mechanism of credit repayment to work. Thus, stochastic revenues further restrict the credit limit for indebted countries. We ask how barter can help to overcome these problems related to revenue uncertainty and to extend the credit limit.

Consider again the solution suggested above: contingent debt repayments that are high if revenues are high and low if revenues are low. This solution has two problems. First of all it gives the debtor country an incentive to misrepresent its export revenues, claiming they are low because only low prices could be realized. Secondly, and more importantly, it implies that the debtor's incentive to repudiate his debt is particularly high in periods when high revenues have been realized because then high payments are due. Since these high repayments in good times have to compensate for the low repayments in bad times they need to be larger than the necessary repayment if export revenues were nonstochastic and always large enough to cover the credit cost. This in turn implies that stochastic export revenues make it more difficult to ensure that the debtor has always the right incentive to make his repayments.

To illustrate this point by way of an example, consider the following extension of the infinite-horizon model introduced above. This time, B's future export revenues v_2 are subject to uncertainty. This uncertainty can arise from fluctuations in the demand for the export good, in prices or in exchange rates. Now suppose that in each period, v_2 takes a high value $\bar{v}_2$ with probability q and a low value $\underline{v}_2$ with probability $1 - q$. The distribution of revenues in each period is assumed to be i.i.d. The expected value of export revenues in each period is thus $v_2^e = (1 - q)\underline{v}_2 + q\bar{v}_2$. A and B are assumed to be risk-neutral.

Consider first the case where A and B are engaged in a repeated credit relationship, without payment in goods. Suppose that $\underline{v}_2 < p_1$; i.e., B cannot pay p_1 in periods with low revenue realizations even if he is willing to do so. This implies that the two parties have to agree on two different prices, $\underline{p}_1$ and $\bar{p}_1$, to be paid in periods with low revenues and in periods with high revenues, respectively. Of course, this requires that A can observe the realization of v_2, since otherwise payments cannot be contingent on revenue realizations. Since both parties are risk-neutral, A is willing to accept these prices if the expected payment $p_1^e = (1 - q)\underline{p}_1 + q\bar{p}_1$ covers her production cost and if she can be sure that B will pay these prices as specified.

Consider now the case where export revenues $\bar{v}_2$ have been realized so that B has to pay $\bar{p}_1$, where $\bar{p}_1 > p_1^e > \underline{p}_1$. In this case B's payoff from defaulting is higher than if he were to pay p_1^e or $\underline{p}_1$ for that matter. This means his incentive to default is larger than in the case of nonstochastic revenues. This makes it more difficult to sustain a credit relationship with a reputation mechanism.

By resorting to barter trade the trade partners can overcome both problems. Barter means that the debtor pays with goods rather than cash. This puts the creditor in a better position *vis-à-vis* the debtor when it comes to judging the value of these export goods. She cannot be deceived about the value because she realizes the sales and the revenues herself. On the other hand, the debtor has to deliver the goods before knowing how much these goods are in fact worth in each particular period. This has

the advantage that the incentive to deliver the goods as promised is affected only by their expected value, not by low or, in particular, high realizations. This means, the incentive to deviate is not different in the case of stochastic export revenues as compared to deterministic revenues, provided the expected value of revenues is the same in both cases. Thus, barter alleviates the credit repayment problem because it forces the debtor to make his payment in terms of goods before the uncertainty about their value is resolved. This avoids the temptation to cheat on payment when the realized value of the goods destined for payment is high.[13] Of course, at the time of the delivery, B may have already some information about the value of good 2. But it is reasonable to assume that not all uncertainty is resolved at that moment. In the case of cash payments the problem is that the amount due does in fact have to condition on the realized revenues. Since the debtor is more tempted to deviate when a high payment is due, the credit limit without barter is lower than if barter is used.

4. 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 or not the derived predictions are consistent with data on actual barter contracts.

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. Thirty percent of the western firms of the sample are based in the European Community and 62.7% in other industrialized countries including Austria, Sweden, Japan, and the USA. Each firm was asked for information on about 40 aspects of each barter trade.

Owing to Austria's geographic proximity to eastern Europe, East–West barter accounts for more than four-fifths of all deals in our sample. The deals in our sample are mostly very large in size, ranging from US$8,400 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.[14]

In section 3 we demonstrated that barter can be sustained only if equation (11) is satisfied. Rearranging this expression shows that this is possible only if the value of the collateral is sufficiently large:

$$v_2 \geq \frac{c_1}{\delta} - v_1 + \pi(v_1 - c_1) - (1-\delta)a + \hat{\pi}(v_2 - c_2). \tag{16}$$

On the left-hand side we have the value of the collateral created by the barter contract. This collateral has to cover at least A's production costs c_1/δ, respectively, as well as B's payoff from defaulting and selling good 2 to a third party, $\hat{\pi}(v_2 - c_2)$, and buying good 1 from a third party on a cash-in-advance basis in the future, $\pi(v_1 - c_1)$. The collateral can be smaller the more A can punish B when he defaults. This is captured by the terms v_1 and $(1 - \delta)a$. The larger the right-hand side of condition (16), the larger the value of the collateral needs to be in order to overcome B's credit constraint.

From this condition we can derive a number of hypotheses on how the value of the collateral needs to be chosen for a given credit cheating problem.

We measure the value of the collateral by the value of B's exports to A. The required value of the collateral will be influenced by the size of the original trade credit which A gives to B. To control for size effects we normalize the value of the collateral (export

value) by dividing it through by the value of the trade credit (import value). Hence, we use what the traders call the "compensation ratio" (the ratio of the export value to the import value, from the point of view of B) of each barter trade as the measure of the value of the collateral provided by the barter contract. The following hypotheses report how the value of the collateral relative to the trade credit has to be chosen in response to different exogenous parameters.

HYPOTHESIS 1: *Restoring Creditworthiness. The lower B's creditworthiness, the larger will be the value of the collateral relative to the trade credit.*

In the model, B's creditworthiness increases with the assets held by B abroad which can be seized in case of default. Note that a reduction of a has a positive impact on the right-hand side of (16). Intuitively, the smaller the collateral B can provide via a, the larger the collateral generated through barter has to be in order to restore B's creditworthiness.

HYPOTHESIS 2: *Creating a Collateral. The better B's export opportunities in case of default, the larger will be the value of the collateral relative to the trade credit.*

In our model B's export opportunities in case of default are captured by the term $\hat{\pi}(v_2 - c_2)$. The larger $\hat{\pi}$, the larger the left-hand side has to be to satisfy condition (16). We argue that the more B is integrated into the world market, the less dependent he is on A as a customer and the easier it is for him to find alternative venues to sell good 2. Similarly, the more standardized the goods delivered by B, the more difficult it is for A to label them as her own property and the more easily B can sell them to some third party in case of default.

HYPOTHESIS 3: *Using Reputation. The value of the collateral relative to the trade credit can be, the smaller the more frequently the barter transaction takes place.*

The more frequently the transaction takes place, the larger will be δ and thus the smaller will be the right-hand side of (16). To see this, consider the derivative of the right-hand side with respect to δ, which yields

$$-\frac{c_1}{\delta^2} + a < 0, \quad \text{since } a < \frac{c_1}{\delta} < \frac{c_1}{\delta^2}. \tag{17}$$

HYPOTHESIS 4: *Using Trade Sanctions. The less B depends on his imports, the larger will be the value of the collateral relative to the trade credit.*

B's benefit from importing good 1 is given by v_1 in the model. A reduction of v_1 increases the right-hand side of (16) which calls for a higher value of the collateral. The point is that the smaller v_1, the less B has to lose if he is (partially) cut off from future imports.

HYPOTHESIS 5: *Dealing with Export Revenue Risk. The value of collateral relative to the trade credit should be unaffected by the export revenue uncertainty.*

As we have argued in section 3, barter avoids that B is exposed to export revenue uncertainty. Thus, the collateral need not condition on the uncertainty.

In order to test Hypotheses 1 to 5 we use the following variables. As a proxy for creditworthiness we use 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. As a proxy for how frequently the barter transaction takes place we use the variable *REPEAT*, which measures how frequently A and B have interacted with each other in the past. The underlying presumption is that if A and B have traded regularly with each other in the past, they are more likely to continue to do so in the future. As a proxy for B's export opportunities in case of default we use a country-specific and a deal-specific variable. As a country-specific variable 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. The deal-specific variable we use is *BASICM*. This is a dummy variable which takes the value 1 if the good that is exported from B to A in the relevant barter deal is basic material, agricultural goods, raw material, or oil. These are very standardized goods which are easy to market for B and which are difficult to label as A's property. As a proxy of B's benefit from importing good 1 we use *TECHIMP* which 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 to find substitutes. Finally, we have included *RISK*, 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.

Table 1 presents the results of testing Hypotheses 1 to 5. *DEBT* has a positive and significant coefficient for all specifications, confirming Hypothesis 1. The barter contract is indeed furnished with a larger deal-specific collateral when the country lacks creditworthiness. *EXPORT* and *BASICM* both show the expected positive and highly significant coefficient, which supports Hypothesis 2. The predicted negative and significant sign on *REPEAT* suggests that the barter contract requires a smaller deal-specific collateral when B does not want to lose his reputation as a good debtor as has been suggested by Hypothesis 3 and the sovereign debt literature. *TECHIMP* has the expected negative (but less significant) coefficient, confirming Hypothesis 4. When A's punishment potential in case of B's default is weak because B can easily trade with someone else, then the barter contract needs to create a larger collateral in order to restore B's creditworthiness. Finally, as stated in Hypothesis 5, *RISK* has no significant effect on the value of collateral chosen. All specifications explain up to 23% of the variation of the data on the compensation ratio.

5. Conclusions

In this paper we have shown that barter can be used to mitigate the creditworthiness problem of highly indebted countries. Barter allows collateralization of a trade credit and thus proves to be a superior enforcement mechanism compared with reputation. Furthermore, we show that payment in goods is advantageous if export prices are very volatile. The point is that in the case of barter not all uncertainty about prices is resolved at the date of delivery and hence the creditors are less tempted to refrain from fulfilling the contract when there is a favorable price development. This may explain why barter is frequently used by highly indebted emerging market and transition economies whose export revenues are often subject to high uncertainty.

Table 1. Value of Collateral

	Dependent variable ln *COMP*				
	(1)	*(2)*	*(3)*	*(4)*	*(5)*
ln *DEBT*	0.38[a]	0.35[a]	0.36[a]	0.24[a]	0.25[a]
	(4.77)	(4.33)	(4.36)	(2.60)	(2.65)
ln *EXPORT*	0.22[c]	0.25[c]	0.32[a]	0.56[a]	0.57[a]
	(1.67)	(1.88)	(2.41)	(3.94)	(3.92)
BASICM		0.30[c]	0.34[b]	0.22	0.19
		(1.73)	(1.95)	(1.23)	(1.09)
REPEAT			–0.38[a]	–0.46[a]	–0.48[a]
			(3.00)	(2.86)	(2.90)
ln *TECHIMP*				–0.89[a]	–0.87[a]
				(3.64)	(3.52)
RISK					–0.06
					(0.41)
Intercept	1.93[a]	1.88[a]	1.52[a]	4.24[a]	4.21[a]
	(4.57)	(4.45)	(3.54)	(4.59)	(4.51)
F	16.9[a]	12.3[a]	11.8[a]	13.2[a]	11.0[a]
Adjusted R^2	0.13	0.13	0.18	0.23	0.23
Number of observations	224	223	205	201	197

Note: Ordinary least square regressions of 230 observations. Numbers in brackets are *t*-values. Levels of significance: a = 1%, b = 5%, c = 10%.
Survey of 230 barter deals, *World Debt Tables* 1987, *UN Financial Statistics* 1987.

DEBT	Debt-to-GDP ratio in 1987 of EE/LDC country
COMP	Compensation ratio: export value in percent of import value
EXPORT	Export-to-GDP ratio in 1987 of EE/LDC country
TECHIMP	Share of technology imports in total imports in 1987 of EE/LDC country
BASICM	Type of good exported from EE/LDC country: basic goods or chemical product
REPEAT	Industrialized country firm and EE/LDC country have interacted repeatedly
RISK	Fixed price contract

Appendix

Proof of Proposition 2

To see that (11) is necessary for restoring B's creditworthiness, note first that (10) is equivalent to

$$0 \le v_2 - \frac{1}{\delta} c_1 \tag{A1}$$

and (9) is equivalent to

$$(1-\hat{\pi})(v_2 - c_2) + (1-\pi)v_1 + \pi c_1 - (1-\delta)a \ge v_2. \tag{A2}$$

Thus, both conditions can be fulfilled simultaneously only if

$$(1-\hat{\pi})(v_2 - c_2) + (1-\pi)v_1 + \pi c_1 - (1-\delta)a \ge \frac{1}{\delta} c_1, \tag{A3}$$

which is equivalent to (11).

To see that (11) is also sufficient, recall first that condition (A1) (which is equivalent to (10)) is satisfied by assumption. Thus, as long as (11) is fulfilled the only possible problem that can arise is that condition (9) is violated, so that

$$(1-\hat{\pi})(v_2-c_2)+(1-\pi)v_1+\pi c_1-(1-\delta)a\le v_2. \tag{A4}$$

If this were the case then A could induce B to deliver good 2 by making a monetary side payment s conditional on B's delivery such that

$$(1-\hat{\pi})(v_2-c_2)+(1-\pi)v_1+\pi c_1-(1-\delta)a+s\ge v_2. \tag{A5}$$

As long as (11) holds it is possible to find a side payment s such that (A5) and (A1) are both satisfied, so that

$$(1-\hat{\pi})(v_2-c_2)+(1-\pi)v_1+\pi c_1-(1-\delta)a\ge v_2-s\ge\frac{1}{\delta}c_1. \tag{A6}$$

This proves Proposition 2.

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Notes

1. For a theoretical discussion of financing transition economies in eastern Europe, see Holmström (1996).
2. In the case of a buyback agreement, there is a technological relationship between the import and the subsequent export. For example, the import is a machine and the export is output produced with this machine. In counterpurchase, import and export are not technologically linked. Throughout this paper, we will use the term "barter" in its widest sense, including all forms of countertrade, unless otherwise stated.
3. 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 (1989) 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.
4. See Fischer (1996), Fantapi (1994), and Jalloh (1990).
5. 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.
6. 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.
7. This sovereign debt problem arises in particular if B's country is highly indebted already, and if B is a state-owned trade organization or has close relations to the government. In this case, the state authorities have no incentive to enforce credit repayment. For a survey of 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.
8. An extensive discussion of the legal aspects of these actions can be found in Bulow and Rogoff (1989b).
9. Period 2 is the first period in which a payment is due. Since the problem is completely stationary, it suffices to show that it is not profitable to deviate in this period.
10. Or, if monetary payments are agreed on, as a delivery to generate an offsetting payment.
11. If there is a supplier different from A with production cost smaller than c_1, B should have dealt with him in the first place.
12. The "Legal Guide on International Countertrade Transactions," prepared by the United Nations 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. *"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. . . ."* (UNCITRAL, 1993, p. 158). That goods from barter transactions are in fact frequently used as a collateral has been reported, for example, by Welt (1984, p. 61), by Verzariu (1985, p. 111), and by Barkas (1987, p. 80).

13. Note that the same effect holds also for barter transactions where monetary payments are specified for both import and export, since the value of these payments is fixed in advance and the payments are offset against each other. Hence the importing country faces no uncertainty about her export revenues.

14. For more details on this dataset, see Marin (1990) and Marin and Schnitzer (1995).