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ABSTRACT

Creating Creditworthiness through Reciprocal Trade*

In the aftermath of the international debt crisis of the 1980s reciprocal trade arrangements experienced a resurgence. This paper examines how countertrade can help highly indebted countries to finance imports if they are not able to use standard credit arrangements. It compares the credit enforcement mechanisms discussed by the sovereign debt literature with those available under countertrade agreements and shows under what conditions countertrade can increase the debt capacity of highly indebted countries. The implications of our model for the design of optimal countertrade contracts are consistent with empirical evidence from a data set of 230 countertrade transactions.

JEL Classification: F13, F34, L14
Keywords: countertrade, sovereign debt, creditworthiness

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NON-TECHNICAL SUMMARY

In the aftermath of the international debt crisis of the 1980s unconventional forms of trade and finance experienced a resurgence. In particular, countertrade (a reciprocal form of trade in which an exporter commits himself to making an offsetting import) has been rising, reaching 10–20% of world trade.

In this paper we show that countertrade can be used to finance an import of an East European or developing country from a developed country even if this deal cannot be financed with a traditional credit arrangement due to the sovereign debt problem. The basic idea is that the import (from the perspective of the exporter in the developed country) is used as collateral. When economies are short of 'collaterizable' assets which serve to secure lenders funds, future exports can serve as such collateral. If the East European or developing country repudiates on its debt, the creditor in the developed country has a priority right on the good he is supposed to import. We argue that priority rights on goods are easier to enforce than priority rights on the future cash flow of the export returns of a country. The 'anonymity' of money as a general medium of exchange turns out to be a disadvantage for enforcing priority rights. The debtor can use the future cash flow of his export returns for other purposes than for repayment of his debt. By giving property rights on specific goods, reciprocal trade removes this anonymity. The collateral goods can be viewed as 'special purpose money' which only the creditor can be paid with. Thus, a reciprocal arrangement may have two advantages. First, in case of default the creditor will be able to recover a larger fraction of the outstanding debt. Second, perhaps less obviously, if the creditor has priority rights on specific goods, he has a stronger incentive to track down these goods and to establish his claims as compared to a situation where he has no priority rights but has to share the benefits from his legal actions with many other creditors. Hence, with a countertrade contract the debtor is more likely to suffer in case of default from his goods being seized when he tries to sell them. This effect makes repudiation less attractive.

In order to show that countertrade can increase the debt capacity of a country, we explicitly relate our model to the sovereign debt literature. In particular, we develop a simple dynamic model in which creditors and debtor 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 'collaterized' through

countertrade agreements. In the sovereign debt literature it is shown that reputation effects alone cannot sustain any positive repayment if the debtor can switch to 'cash-in-advance' contracts after repudiation. The problem posed 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. Seniority rights on cash are notoriously difficult to enforce, however. Our paper shows that countertrade which gives seniority rights on export goods offers a more viable alternative to sustain sovereign lending of highly indebted countries.

In the second part of the paper we confront our theory with data on actual countertrade contracts. We use survey data of 230 contracts signed by developed country firms which use Austria as their basis for countertrade transactions. From our model we derive several hypotheses of the factors that drive the value of the collateral generated by countertrade agreements relative to the value of the trade credit (export value). The collateral will need to be the larger relative to the export, (i) the lower the creditworthiness of the developing or East European country (LDC/EE), (ii) if the developed country firm signs the agreement with the LDC/EE only once rather than repeatedly, (iii) the better LDC/EE's export opportunities, and (iv) the less the LDC/EE depends on its imports. In the empirical test of these hypotheses all hypotheses are not rejected at conventional levels of significance.

The value of the collateral is determined by its profitability and its liquidity. The more symmetric is the information about future returns of an asset, the more liquid the asset is and the better it can serve as collateral. We measure the liquidity of the collateral by the type of collateral goods and by the type of countertrade contract. When the import consists of basic goods or agricultural products which are often traded on an exchange, information on their prospective returns can be readily obtained from the market. In the buyback form of countertrade contract the developed country firm controls, to some extent, the collateral goods it is paid with, since it provides the technology with which these goods are produced. In the buyback contract, therefore, the collateral provided to the exporter is 'safer' and more liquid compared to the counterpurchase form of countertrade. We expect the liquidity of the collateral to be the higher the less creditworthy the LDC/EE and this is indeed confirmed by the data.

1. Introduction

Starting in the early eighties, 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, skeptical 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 countertrade transactions.[2] Countertrade is a reciprocal form of trade in which an exporter commits himself to make an offsetting import, which may be carried out simultaneously or at some later date. Estimates are that about 10 to 20 percent of total world trade are governed by countertrade agreements (Hammond, 1989).

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, 1991). 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 this paper we show that a countertrade transaction can be used to finance an import of an Eastern European or developing country from a developed country even if this deal cannot be financed with a traditional credit arrangement due to the sovereign debt problem. The basic idea is that the second deal is used as a collateral. If the Eastern European or developing country repudiates on its debt, the creditor in the developed

[1] See e.g. Sachs (1989). Gooptu and Soledad (1992) emphasize that commercial banks are reluctant to provide new loans unless they are insured by the creditor's governments.

[2] Bussard (1987, p. 17) reports that the number of countries engaged in countertrade rose from 27 in 1979 to 88 in 1984. Likewise, the number of countertrade 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 co-movement of debt problems and countertrade can be found in the late nineteenth century and in the depression of the 1930s.

country has a priority right on the goods earmarked by the countertrade contract for the second deal. We argue that priority rights on goods are much easier to define and to enforce than priority rights on the future cash flow of the export returns of a country. The "anonymity" of money turns out to be a disadvantage in so far as enforcing priority rights is concerned. By giving property rights on specific goods, countertrade removes this anonymity. Thus, a countertrade arrangement may have two advantages. First, in case of default the creditor will be able to recover a larger fraction of the outstanding debt. Second, perhaps less obviously, if the creditor has priority rights on specific goods, he has a stronger incentive to track down these goods and to establish his claims as compared to a situation where he has no priority rights but has to share the benefits from his legal actions with many other creditors. Hence, with a countertrade contract the debtor is more likely to suffer in case of default from his goods being seized when he tries to sell them. This effect makes repudiation less attractive.

In order to show that countertrade can increase the debt capacity of a country, we explicitly relate our model to the sovereign debt literature. In particular, we develop 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 countertrade agreements.

In a seminal paper, Eaton and Gersovitz (1981) have shown how "reputation effects" can sustain sovereign lending. But, as Bulow and Rogoff (1989a) pointed 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. Our paper shows that countertrade which gives seniority rights on export goods offers a more viable alternative to sustain sovereign lending of highly indebted countries.

Even though the descriptive literature frequently refers to countertrade as a possibility to overcome import constraints imposed by a foreign exchange shortage and low creditworthiness no theoretical foundation for this interpretation has been offered so far.

In a companion paper (Marin and Schnitzer 1995) we provide a first assessment of how countertrade can help to finance imports by using countertrade goods as a collateral for trade credits. However, the main focus of this earlier paper is on incentive problems related to technology transfer from developed to developing countries, while the role of countertrade as a financial instrument has not been fully developed. In particular, it uses a static framework which does not allow for reputation effects and cash-in-advance contracts, and there is no explicit comparison of countertrade with the enforcement mechanisms discussed by the sovereign debt literature.

In the second part of this paper we confront our theory with data on actual countertrade contracts. The most important difficulty encountered by empirical studies on reciprocal trade is that countertrade is not documented in official trade statistics. Hence data on the characteristics of actual countertrade contracts are very difficult to obtain.[3] This is why we have carried out a survey among companies that are engaged in reciprocal trade and that use Austria as their basis for countertrade transactions. Our sample consists of 230 contracts, signed between 1984 and 1988. Almost all previous empirical studies on countertrade use macro data and test (on the basis of relatively few observations) how debt ratios of various countries affect the estimated volume of countertrade in these respective countries.[4] 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 countertrade contracts, on the basis of a (comparatively) large number of observations.

The paper is organized as follows. In Section 2 we present a static model to introduce the creditworthiness problem. In Section 3 we develop a dynamic framework and compare countertrade to enforcement mechanisms discussed by the sovereign debt literature. In Section 4 we derive empirical implications of our theory and use our data sample to test these predictions. Section 5 concludes.

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

[4]For example, Casson and Chukujama (1990) report evidence (based on 35 observations) that countries with higher debt ratios are more strongly engaged in countertrade. 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 countertrade activities.

2. Credit enforcement in a static framework

2.1 A simple credit relationship

Consider two parties, A (she), a firm in a developed country, and B (he), a firm or a trade organization in an Eastern European (EE) or a less developed (LD) country. B wants to buy one unit of good 1 from A in period 1 but can pay for it only one period later. For simplicity, 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. 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 at cost c_2 and sell it on the world market. This generates foreign exchange revenues of value v_2. Both parties A and B have a common discount factor $\delta = \frac{1}{1+r}$, where $r > 0$ is the world interest rate per period.

Assumption 1 *B's revenues v_2 in period 2 are sufficient to pay for A's production cost c_1 in period 1, i.e.*

$$v_2 \geq \frac{1}{\delta} c_1 \tag{1}$$

Thus, a price p_1 can be found such that p_1 covers A's production cost ($p_1 \geq c_1$) and such that B is able to pay $\frac{1}{\delta} p_1$ in period 2 ($\frac{1}{\delta} p_1 \leq v_2$).

A common problem with this kind of transaction between a developed country and an EE or LD country is, however, 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. This is called the sovereign debt problem.[5] 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, $\frac{1}{\delta} p_1 \leq a$. Note that A is willing to deliver good 1 on

[5] This 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. For a recent survey on the large literature on the sovereign debt problem see Eaton and Fernandez (1994). In the following we consider the extreme case where A cannot count on her claim being enforced in B's country at all.

a credit basis only if $c_1 \leq p_1$ and if B will indeed pay $\frac{1}{\delta}p_1$. Thus, we can say that B is "creditworthy" if and only if

$$a \geq \frac{1}{\delta}c_1 \,. \tag{2}$$

If instead $a < \frac{1}{\delta}c_1$ we say that B faces a credit constraint because there exists no p_1 such that $p_1 \geq c_1$ and $\frac{1}{\delta}p_1 \leq a$ are satisfied simultaneously. In the following we will focus on cases where B is not creditworthy in the sense defined above.

2.2 A countertrade arrangement

How can a countertrade agreement help B to overcome his credit constraint if $a < \frac{1}{\delta}c_1$? Suppose that instead of selling good 2 on the world market B agrees to a countertrade contract which promises to sell good 2 to A for 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 new collateral, A's payment p_2. If B delivers good 2 and if

$$\frac{1}{\delta}p_1 \leq p_2 + a \tag{3}$$

then B's payment $\frac{1}{\delta}p_1$ can be enforced. The point is that A can withhold $\frac{1}{\delta}p_1$ from her own payment p_2 in addition to seizing assets a.[6] Without loss of generality we can restrict attention to prices p_1 and p_2 that satisfy (3) since a higher p_1 will not be paid anyway.

But with a countertrade contract, 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 $\frac{1}{\delta}p_1$ in a simple credit arrangement. There is an advantage of a countertrade 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 countertrade, 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 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

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

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, $v_2 - c_2$, is reduced to $\hat{\pi}(v_2 - c_2)$, $0 \leq \hat{\pi} < 1$. If the probability that A manages to seize good 2 is sufficiently high, 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 sequence of events is summarized in Figure 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 or not 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 in order to seize assets a and to track down good 2. If instead $d = 1$, B delivers and A pays $p_2 - \frac{1}{\delta}p_1$ if $p_2 - \frac{1}{\delta}p_1 \geq 0$ and receives $\min\left\{a, \frac{1}{\delta}p_1 - p_2\right\}$ if $p_2 - \frac{1}{\delta}p_1 < 0$.

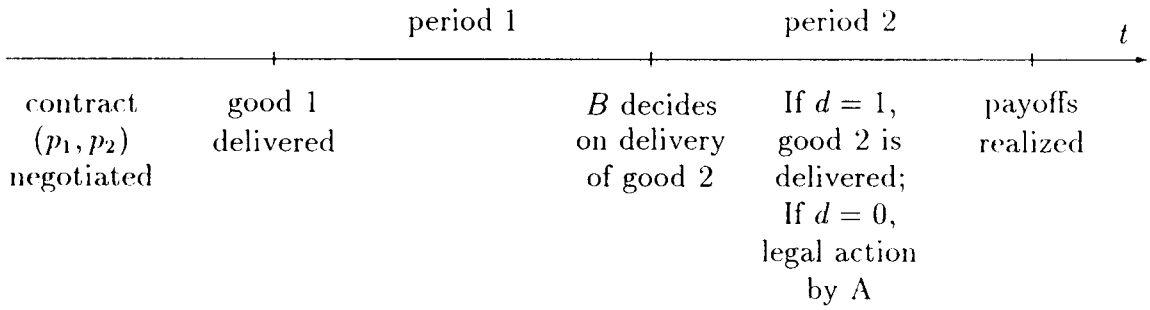

FIGURE 1: The time structure

To ensure that B voluntarily delivers good 2 in period 2 and A delivers good 1 on a credit basis in period 1, p_1 and p_2 have to satisfy, in addition to (3), two more conditions. First, B delivers good 2 if and only if

$$p_2 - c_2 - \frac{1}{\delta}p_1 \geq \hat{\pi}(v_2 - c_2) - \min\left\{\frac{1}{\delta}p_1, a\right\} . \tag{4}$$

Second, A is willing to sign the countertrade contract and to deliver good 1 in period 0 if

and only if she believes that B will deliver good 2 and

$$-c_1 + \delta(\frac{1}{\delta}p_1 + v_2 - p_2) \geq 0 . \tag{5}$$

Note that (4) implies that B's participation constraint is satisfied as well since

$$v_1 + \delta(-\frac{1}{\delta}p_1 + p_2 - c_2) \geq v_1 - \delta \min\left\{\frac{1}{\delta}p_1, a\right\} \geq 0 \tag{6}$$

where the first inequality follows from B's incentive constraint (4) and the second inequality from $v_1 > c_1 > \delta a$, i.e., the fact that B lacks creditworthiness.

A countertrade contract (p_1, p_2) induces a game to be played by A and B. We say that (p_1, p_2) implements the efficient allocation if there exists a subgame perfect equilibrium of this game such that (i) $p_2 + a$ suffices as a full collateral for $\frac{1}{\delta}p_1$, (ii) B is willing to deliver good 2 voluntarily, and (iii) A is willing to deliver good 1, i.e. if (3), (4) and (5) hold. If these conditions are satisfied a countertrade contract overcomes B's credit constraint. The following proposition states for which parameter conditions a countertrade contract (p_1, p_2) can implement the efficient allocation.

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

$$(1 - \hat{\pi})(v_2 - c_2) + a \geq \frac{1}{\delta}c_1 . \tag{7}$$

Proof: To prove the necessity of this condition note first that (4) together with (5) require

$$c_2 + \hat{\pi}(v_2 - c_2) - \min\left\{\frac{1}{\delta}p_1, a\right\} \leq p_2 - \frac{1}{\delta}p_1 \leq v_2 - \frac{1}{\delta}c_1 , \tag{8}$$

which implies condition (7).

Next we have to show that if (7) is satisfied we can find prices such that (3), (4) and (5) hold. Rewriting (3), (4) and (5) we get:

$$A \equiv -a \leq p_2 - \tfrac{1}{\delta}p_1 \tag{9}$$

$$B \equiv c_2 + \hat{\pi}(v_2 - c_2) - \min\left\{\frac{1}{\delta}p_1, a\right\} \leq p_2 - \tfrac{1}{\delta}p_1 \tag{10}$$

$$p_2 - \tfrac{1}{\delta}p_1 \leq v_2 - \frac{1}{\delta}c_1 \equiv C \tag{11}$$

These conditions can only be fulfilled simultaneously if $A \leq C$ and $B \leq C$. Note that $A < C$ by assumption. Given condition (7), $B \leq C$ can be satisfied by choosing $\frac{1}{\delta} p_1 \geq a$. *Q.E.D.*

Comparing condition (7) of Proposition 1 with condition (2) shows that countertrade relaxes B's credit constraint by an amount of $(1 - \hat{\pi})(v_2 - c_2)$. In both equations (2) and (7) the left hand side measures the financial loss B has to incur if he repudiates. With a countertrade contract B does not only lose 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 countertrade contract be used to improve B's creditworthiness. This has natural implications for the optimal choice of import goods that will be discussed and tested in Section 4.

Critics of countertrade arrangements argue that reciprocal trade is inefficient because it requires a double coincidence of needs. Being the best producer for good 1 does not imply that A is also the consumer with the highest valuation for good 2. In general there will be other firms around whose willingness to pay for good 2 is higher. Indeed, it is frequently observed that the countertrading firm in the developed country does not use good 2 itself but resells it to some third party C (e.g. a specialized trading company). Suppose that this involves some additional transaction costs $\Delta > 0$ which would not have to be incurred if B sold to C directly. The following Corollary shows that a countertrade transaction may still be efficient because without it the gains from trade of good 1 cannot be realized.

Corollary 1 *Suppose that the surplus of the second transaction if B traded directly with some third party C is $v_2 + \Delta - c_2$, $\Delta > 0$. If condition (7) of Proposition 1 holds, a countertrade arrangement with A is still efficient if $\delta a < c_1$ and $v_1 - c_1 \geq \Delta$.*

Proof: The first transaction cannot be financed with a simple credit because B is credit constrained ($a < \frac{1}{\delta} c_1$). Hence, only the surplus $v_2 - c_2$ from the second deal can be realized. On the other hand, given that condition (7) holds, a countertrade contract can restore B's creditworthiness, and the first deal can be financed. In this case, total surplus

$v_1 - c_1 + v_2 - c_2 - \Delta$ can be realized which is at least as much as $v_2 - c_2$ given that $v_1 - c_1 \geq \Delta$. *Q.E.D.*

3. Credit enforcement in a dynamic framework

3.1 A repeated credit relationship

A natural question is whether countertrade and the transaction costs associated with it can be avoided 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 this case implicit ways of credit enforcement through "reputation equilibria" may take the place of explicit countertrade contracts. 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) pointed 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.

To make this point more formally consider the following dynamic framework which is an infinitely repeated version of the static model of Section 2. In each period, starting with period 1, B wants to buy one unit of good 1 at some fixed price $\overline{p}_1$ from A. Suppose that $\overline{p}_1$ 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 at cost c_2 each period and sell it on the world market at price v_2. Again we assume $v_1 \geq \overline{p}_1 \geq c_1$, $v_2 > c_2$ and $\delta v_2 \geq \overline{p}_1$.

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 $\frac{1}{\delta}\overline{p}_1$ 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. However, 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. Thus, if B defaults in period 2 his payoff is given by[7]

$$v_1 - \delta a + \sum_{t=1}^{\infty} \delta^t (v_2 - c_2 + v_1 - \overline{p}_1) \ . \tag{12}$$

On the other hand, if B sticks to the terms of the implicit agreement, his payoff is

$$v_1 + \sum_{t=1}^{\infty} \delta^t [v_1 - \frac{1}{\delta}\overline{p}_1 + v_2 - c_2] \ . \tag{13}$$

Thus, B will repay if and only if

$$v_1 - \delta a + \frac{\delta[v_2 - c_2 + v_1 - \overline{p}_1]}{1-\delta} \ \leq \ v_1 + \frac{\delta[v_1 - \frac{1}{\delta}\overline{p}_1 + v_2 - c_2]}{1-\delta} \tag{14}$$

which is equivalent to

$$\frac{1}{\delta}\overline{p}_1 \ \leq \ a \tag{15}$$

Note that A will participate in this transaction only if $\overline{p}_1$ covers at least her production cost c_1. Hence, the efficient allocation can be achieved through a repeated credit relationship only if

$$a \geq \ \frac{1}{\delta} c_1 \tag{16}$$

The conclusion is that a repetition of the credit relationship does not improve B's creditworthiness over that in a one-shot relationship if B can costlessly switch to cash-in-advance contracts.[8]

The argument given above is oversimplistic in that it assumes that the only feasible punishment A can inflict on B in case of default is to seize the assets a that B holds

[7]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.

[8]This conclusion holds much more generally. Bulow and Rogoff (1989a) consider a non-stationary environment and allow for uncertainty and risk aversion. They use an arbitrage argument showing that without further punishments (such as seizing assets a in this example) reputation equilibria cannot be used to enforce the repayment of any positive level of debt.

abroad. 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.[9] 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. We model this in the same way as we did in the case of a one-shot countertrade transaction in Section 2.2: Given the possibility of legal action by A, the expected gains from trade of future exports and imports are reduced by a factor π, $0 \leq \pi \leq 1$. Thus B's payoff in case of default is given by

$$v_1 - \delta a + \delta\left(v_2 - c_2 + \pi(v_1 - \overline{p}_1)\right) + \sum_{t=2}^{\infty} \delta^t(\pi(v_2 - c_2 + v_1 - \overline{p}_1)) \ . \tag{17}$$

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 $\frac{1}{\delta}\overline{p}_1$. Hence, A's punishment can affect the import in the second period at the earliest.[10]

Comparing (17) to (13) B will repay his debt in every period if and only if

$$\begin{aligned} & v_1 + \frac{\delta[v_1 - \frac{1}{\delta}\overline{p}_1 + v_2 - c_2]}{1-\delta} \\ & \quad \geq \ v_1 - \delta a + \delta\left(v_2 - c_2 + \pi(v_1 - \overline{p}_1)\right) + \sum_{t=2}^{\infty} \delta^t \pi(v_2 - c_2 + v_1 - \overline{p}_1) \ , \end{aligned} \tag{18}$$

which is equivalent to

$$\frac{1}{\delta}\overline{p}_1 \ \leq \ \frac{1}{1-\pi\delta}\left[(1-\pi)v_1 + (1-\delta)a + \delta(1-\pi)(v_2 - c_2)\right] \tag{19}$$

On the other hand, A is willing to participate in the transaction if and only if $\overline{p}_1 \geq c_1$. The following proposition summarizes this discussion.

Proposition 2 *B's creditworthiness can be restored through a repeated credit relationship if and only if*

$$\frac{1}{1-\pi\delta}\left[(1-\pi)v_1 + \delta(1-\pi)(v_2 - c_2) + (1-\delta)a\right] \ \geq \ \frac{c_1}{\delta} \ . \tag{20}$$

[9] An extensive discussion of the legal aspects of these actions can be found in Bulow and Rogoff (1989b).

[10] This is the reason why we could not consider punishments of B through trade sanctions triggered by A in the one-shot model of a simple trade credit in Section 2.1. Default occurs only after the second deal is completed, and then the world ends. In contrast, with a countertrade transaction this punishment is possible even in the one-shot case. The reason is that A observes B's default before the second deal is completed.

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.

3.2 A repeated countertrade arrangement

Let us now consider a repeated countertrade transaction. Of course, if B's credit worthiness can be restored through a countertrade contract in the one-shot transaction already, it can also be restored if the transaction takes place repeatedly. In this section it will be shown that the set of parameter values for which the efficient allocation can be implemented through repeated countertrade is strictly larger as compared to a one-shot countertrade deal and also as compared to a repeated credit arrangement.

Suppose that A and B agree to repeat the following countertrade 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. When good 2 is delivered A pays p_2, withholding B's payment $\frac{1}{\delta}p_1$. If $p_2 < \frac{1}{\delta}p_1$, B has to pay the difference when delivering good 2. If B sticks to the countertrade agreement his payoff is

$$v_1 + \sum_{t=1}^{\infty} \delta^t (p_2 - c_2 - \frac{1}{\delta}p_1 + v_1) \tag{21}$$

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. There are two important differences to a repeated credit arrangement, however, both of which arise from the fact that A has a claim on B's goods, not just on B's money. First, under a countertrade arrangement B's deviation is detected *before* he realizes his export revenues, namely as soon as he refuses to deliver good 2 to A. Hence, A can try to confiscate B's export already in period 2. Second, and more importantly, the fact that good 2 is used as a collateral for A implies that if she manages to seize good 2 (now or in some future period), she reaps the full benefit of this action. On the other hand, under a repeated credit arrangement good 2 is not used as a collateral. Thus, if A manages to seize it, she may have to share the benefit with potential other creditors of B. Hence, A's incentive to track down B's future exports are stronger if countertrade is used.[11] This is modelled by assuming that B's future gains

[11] Of course, the same effect could be achieved if A could be given seniority rights on B's return streams

from exporting good 2 (if he defaulted on the countertrade deal) are reduced to $\hat{\pi}(v_2 - c_2)$, with $\hat{\pi} \leq \pi$. Thus, B's payoff in case of default is

$$v_1 - \delta a + \sum_{t=1}^{\infty} \delta^t \left[\pi(v_1 - \overline{p}_1) + \hat{\pi}(v_2 - c_2)\right] \tag{22}$$

Note that B's incentive to deviate depends on the price $\overline{p}_1$ 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 $\overline{p}_1 = c_1$.[12]

Substituting $\overline{p}_1 = c_1$ in (22) and comparing this expression to (21), B will not deviate from the countertrade agreement if and only if

$$p_2 - \frac{1}{\delta} p_1 \;\geq\; \hat{\pi} v_2 + (1 - \hat{\pi}) c_2 - (1 - \pi) v_1 - \pi c_1 - (1 - \delta) a \; . \tag{23}$$

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

$$\sum_{t=0}^{\infty} \delta^t c_1 \leq \sum_{t=1}^{\infty} \delta^t (v_2 - p_2 + \frac{1}{\delta} p_1) \; . \tag{24}$$

This discussion is summarized in the following proposition.

Proposition 3 *Suppose that B is not creditworthy. Then there exists a repeated countertrade agreement (p_1, p_2) which restores B's creditworthiness and implements the efficient allocation if and only if*

$$\frac{1}{1 - \delta\pi} \left[(1 - \pi) v_1 + (1 - \hat{\pi})[v_2 - c_2] + (1 - \delta) a\right] \;\geq\; \frac{c_1}{\delta} \tag{25}$$

Proof: (24) is equivalent to

$$p_2 - \frac{1}{\delta} p_1 \leq v_2 - \frac{1}{\delta} c_1 \; . \tag{26}$$

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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 e.g. Krugman (1992)). An example for the ineffectiveness of seniority rules in case of financial assets is described in Bulow and Rogoff (1988). They 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.

[12] 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 already.

Thus, a contract (p_1, p_2) satisfying (23) and (24) can be found if and only if

$$\hat{\pi}v_2 + (1-\hat{\pi})c_2 - (1-\pi)v_1 - \pi c_1 - (1-\delta)a \leq v_2 - \frac{1}{\delta}c_1 \tag{27}$$

which is equivalent to (25). *Q.E.D.*

Let us compare the case of a one-shot countertrade transaction characterized by Proposition 1 to the case of repeated countertrade.

Corollary 2 *For all* $0 < \delta < 1$ *and all* $0 \leq \hat{\pi} < 1$, $\hat{\pi} \leq \pi \leq 1$, *the set of parameters under which the efficient allocation can be implemented is strictly larger if the countertrade transaction is repeated as compared to a one-shot countertrade transaction.*

Proof: We have to show that the left hand side of (25) is always larger than the left hand side of (7). This is the case if

$$\frac{1-\pi}{1-\delta\pi}v_1 + \frac{1-\hat{\pi}}{1-\delta\pi}(v_2 - c_2) + \frac{1-\delta}{1-\delta\pi}a \;>\; (1-\hat{\pi})(v_2 - c_2) + a \;, \tag{28}$$

which is equivalent to

$$(1-\pi)(v_1 - \delta a) + \delta\pi(1-\hat{\pi})(v_2 - c_2) > 0 \;. \tag{29}$$

Note that this is guaranteed by the assumptions that $\hat{\pi} < 1$ and $v_1 > c_1 > \delta a$. *Q.E.D.*

The intuition for this result is straightforward. Repeating the countertrade deal increases the punishment potential that can be used to induce B to repay. If B deviates he loses $(1-\hat{\pi})(v_2 - c_2)$ not only once but in all future periods. Furthermore, his future gains from trade with good 1 may also be affected.

Let us now compare the case of repeated countertrade to the case of a simple repeated credit arrangement. Comparing the left hand sides of (25) and (20), it is obvious that

$$(1-\hat{\pi})(v_2 - c_2) \;>\; \delta(1-\pi)(v_2 - c_2) \;, \tag{30}$$

which proves the following corollary.

Corollary 3 *For all* $0 < \delta < 1$ *and all* $0 \leq \hat{\pi} < 1$, $\hat{\pi} \leq \pi \leq 1$ *the set of parameters under which the efficient allocation can be implemented is strictly larger if the countertrade transaction is repeated as compared to a repeated credit arrangement.*

Again, the intuition is simple. There are two reasons why a deviation of B can be punished more severely if the parties engage in countertrade: First, in a countertrade transaction a deviation by B is detected as soon as he refuses to deliver good 2, so A can try to seize good 2 already in the period of the deviation. Thus, there is no δ on the left hand side of (30). Second, since good 2 is used explicitly as a collateral in the countertrade contract, A's claim on good 2 has priority over the claims of all other potential creditors which increases A's incentives to track down good 2. Hence, B's future benefits from exporting good 2 after a deviation are reduced by $(1 - \hat{\pi})(v_2 - c_2) \geq (1 - \pi)(v_2 - c_2)$.

4. Theoretical predictions and empirical evidence

In this section we discuss several predictions of our model and contrast them with actual data from our sample of countertrade contracts.

4.1 Contract design

In a countertrade contract parties have to specify payments p_1 and p_2 such that both A's participation and B's incentive constraint are satisfied. More specifically, our analysis of the static framework restricts A's net payment in period 2, $p_2 - \frac{1}{\delta}p_1$, to the following range

$$\hat{\pi}v_2 + (1 - \hat{\pi})c_2 - a \leq p_2 - \frac{1}{\delta}p_1 \leq v_2 - \frac{c_1}{\delta} , \tag{31}$$

whereas in case of repeated countertrade the range of A's feasible net payment per period is given by

$$\hat{\pi}v_2 + (1 - \hat{\pi})c_2 - (1 - \pi)v_1 - \pi c_1 - (1 - \delta)a \leq p_2 - \frac{1}{\delta}p_1 \leq v_2 - \frac{c_1}{\delta} . \tag{32}$$

A change in the exogenous variables has an impact on the upper and lower bounds specified by these two conditions and thus on the range of feasible net payments. Hence, an

interesting test for our theory is to look how changes in the exogenous variables affect net payments in actual contracts. However, the countertrade contracts in our sample vary considerably in size, which affects A's absolute net payment to B. To control for size effects we normalize A's net payment by dividing import value minus export value through the respective export value. Hence, we can use the "compensation ratio" (import value over export value) of each countertrade transaction as a proxy for the net payment of the firm in the developed country.

The following hypotheses report how the parties have to design the countertrade contract by choosing an appropriate compensation ratio in response to different exogenous parameters.

Hypothesis 1 *The lower B's creditworthiness, the larger will be the compensation ratio.*

In the model, B's creditworthiness increases with a, the assets hold by B abroad which can be seized in case of default. Note that a reduction of a has a positive impact on the lower bound of A's net payment in both (31) and (32). Intuitively, the smaller the collateral B can provide via a, the larger the collateral generated through countertrade has to be. As a proxy for creditworthiness we use DEBT/GNP, a continuous variable reported by 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.

Hypothesis 2 *The compensation ratio will be larger in a one-shot countertrade transaction as compared to a repeated countertrade arrangement.*

A comparison of constraints (31) and (32) shows that the lower bound for A's net payment is strictly larger if countertrade is a one-shot transaction since $(1-\pi)v_1 + \pi c_1 \geq c_1 > \delta a$. The repetition of countertrade generates an additional collateral which reduces the need for a high compensation ratio. As a proxy for whether or not countertrade is repeated we consider REPEAT, a dummy variable set equal to one if A exports good 1 to B on a regular basis and zero if she exports to B for the first time. 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.

Hypothesis 3 *The more A discounts future payments the smaller will be the compensation ratio.*

A reduction of δ lowers the upper bound of both (31) and (32) and at the same time relaxes the lower bound of (32). A natural interpretation of δ is that a smaller value of δ represents a longer time lag between original export and import. But the longer A has to wait for B's payment and delivery the more she has to be compensated for her waiting, i.e. the smaller has to be the compensation ratio. As a proxy for this effect we use TIME, a continuous variable which measures the duration of a single countertrade contract and thus the length of time A has to wait for B's delivery.

Hypothesis 4 *The better B's export opportunities the larger will be the compensation ratio.*

In our model B's export opportunities are captured by the variable v_2. It affects the compensation ratio in two ways. First, if v_2 is high, then $\hat{\pi} v_2$ is high, i.e., B's payoff in case of default. This calls for a higher collateral, and, indeed, an increase in $\hat{\pi} v_2$ increases the lower bounds of (31) and (32). Second, the better B's export opportunities, the less difficult it is for A to sell good 2 on the world market. Thus, her willingness to pay for good 2 is high which is reflected in an increase of the upper bounds of (31) and (32). Both effects go in the same direction and tend to increase the compensation ratio. As proxies for B's export opportunities we use a country and a deal-specific variable. EXPORT is a continuous variable measuring the export ratio of B's country. A high export ratio indicates that the country has interesting goods to offer and is successfully selling them on the world market. This should increase A's willingness to pay for good 2 in a countertrade transaction. BASICM is a dummy variable that takes the value one if the good that is exported from B to A in the relevant countertrade is basic material, agricultural goods, raw material or oil. Marketing these goods is relatively easy which again should raise A's willingness to pay.

Hypothesis 5 *The less important the import good for B the larger will be the compensation ratio.*

B's benefit from importing good 1 is given by v_1 in the model. A reduction of v_1 increases the lower bound of (32) which calls for a higher compensation ratio. The point is that the smaller v_1, the less B has to lose if he is (partially) cut off from future imports. Our proxy for this variable is TECHIMP, a continuous variable which measures the ratio of technology imports over total imports in B's country. The idea is that B will find it particularly difficult to find substitutes for Western technology imports.

Table 1 presents the results of testing hypotheses (1) to (5). DEBT has a positive coefficient for all specifications, confirming Hypothesis 1, and is significant at the 1 percent level. Similarly, REPEAT and TIME both have the negative sign predicted by Hypotheses 2 and 3 and are significant at the 1 percent level in almost all specifications. Hypothesis 4 is tested in specifications (2) and (3). Both EXPORT and BASICM show the expected positive coefficient and are significant at the 1 and 5 percent level, respectively. Finally, specification (4) tests Hypothesis 5. As predicted, TECHIMP has a negative sign. However, it is significant only at the 9 percent level.

4.2 Choice of countertrade goods

To determine the optimal countertrade prices we have taken the goods to be traded as given. However, Propositions 1 and 3 indicate that B's creditworthiness can be restored only if the surplus $v_2 - c_2$ that is generated through the sale of good 2 is sufficiently high. This has natural implications for the selection of import goods.

Hypothesis 6 *The lower B's creditworthiness the more profitable will be the import goods chosen for countertrade.*

The smaller a, the amount of assets that can be seized in case of default, the lower B's creditworthiness and the larger $v_2 - c_2$ has to be for conditions (7) and (25) to be satisfied. Table 2 performs an analysis of variance (ANOVA) and shows how the DEBT/GNP ratio (a continuous proxy for B's creditworthiness) varies with the profitability of the import good which is measured by the market position of the import good producer. If the countertrade deal involves a leading producer of the import good, then the average debt ratio is significantly higher as compared to the cases where the import good is sold by a producer in a weaker market position. This is consistent with Hypothesis 6 which claims

Table 1 - Creating Creditworthiness
Dependent variable lnCOMP

	(1)	(2)	(3)	(4)
lnDEBT	0.43[a]	0.38[a]	0.35[a]	0.30[a]
	(5.51)	(4.59)	(4.19)	(3.07)
REPEAT	- 0.38[a]	- 0.43[a]	- 0.43[a]	- 0.45[a]
	(2.68)	(3.01)	(3.06)	(3.16)
lnTIME	- 0.18[a]	- 0.18[a]	- 0.18[a]	- 0.14[b]
	(2.46)	(2.54)	(2.63)	(1.92)
lnEXPORT		0.35[a]	0.41[a]	0.48[a]
		(2.50)	(3.00)	(3.26)
BASICM			0.38[b]	0.36[b]
			(2.39)	(2.21)
lnTECHIMP				- 0.50
				(1.69)
intercept	2.78[a]	1.81[a]	1.65[a]	3.27[a]
	(7.79)	(3.58)	(3.34)	(2.99)
F	16.8[a]	14.8[a]	14.4[a]	12.1[a]
Adjusted R^2	0.20	0.23	0.27	0.28

Ordinary least square regressions of 230 observations. Numbers in brackets are t-values. Levels of significance: a = 1 percent, b = 5 percent.

that in a highly indebted country only very profitable import goods can be used to restore B's creditworthiness.

Table 2 - Creditworthiness and profitability of collateral goods

cline2-4	DEBT/GNP		
	mean	standard deviation	number of cases
market position of collateral good producer:			
leading producer	58.31	56.85	31
significant middle enterprise	37.77	27.73	31
follower firm	35.46	34.07	155
total	39.05	37.37	217
ANOVA	F=4.85	marginal significance	0.008

Table 3 compares the DEBT/GNP ratios for different categories of import goods. Interestingly, the average debt ratio is highest for basic materials and lowest for technology and investment goods. This is again consistent with Hypothesis 6 which says that in highly indebted countries the countertrade contract should use import goods that can easily and profitably be sold. In contrast, goods that developing and Eastern European countries find notoriously difficult to sell (because of entry barriers and reputation problems) can be chosen only if the debt problem is less severe.

Table 3 - Creditworthiness and marketability of collateral goods

	DEBT/GNP		
	mean	standard deviation	number of cases
categories of collateral goods:			
Investment and technology goods	28.75	24.08	75
Services	42.76	30.41	10
Chemical Products	41.38	30.41	21
Consumption goods	39.04	28.97	75
Basic materials	56.32	59.66	40
total	39.07	37.74	221
ANOVA	F=3.71	marginal significance	0.006

4.3 Choice of contract form

Three main forms of countertrade can be distinguished: barter, buyback and counterpurchase. In barter, the export is paid directly with the import, i.e. no foreign exchange is used, and the two trade flows occur more or less simultaneously. In buyback and counterpurchase, instead, there is often a considerable time lag between export and import. In buyback, the export is a machine or a production plant and the import is output produced with this equipment. In contrast, in counterpurchase there is no technological link between the export and the import good.

The three forms differ with respect to how tightly the two trade flows are linked and how "safe" the collateral provided to the exporter in the developed country is. In a barter transaction, the exporter takes almost no risk since the two trade flows occur more or

less at the same time, i.e., no credit has to be given. This is different with buyback and counterpurchase. In buyback, however, the exporter has the advantage that he controls, to some extend, the import good he is paid with since he provides the technology with which these goods are produced. This leaves counterpurchase as the losest form of tying.

Hypothesis 7 *The lower B's creditworthiness the more tightly the two trade flows will be linked.*

Table 4 - Creditworthiness and type of countertrade contract

	DEBT/GNP		
	mean	standard deviation	number of cases
type of contract:			
Barter	50.28	49.92	23
Basic materials	62.14	64.22	5
Others	46.98	46.92	18
Buyback	46.17	28.77	27
Basic materials	46.20	31.37	12
Others	46.14	27.63	15
Counterpurchase	36.44	36.91	171
Basic materials	44.22	32.83	45
Others	33.66	38.00	126
total	39.07	37.74	221
ANOVA	F=1.92	marginal significance 0.148	

Even though we have not explicitly modelled the three different contract forms, our preceding analysis suggests that the less creditworthy B is the more A should protect her credit by choosing safe forms of countertrade. Table 4 shows that the average debt ratios

are indeed decreasing as we go from barter to buyback and to counterpurchase, but the relationship is not very strong, as the marginal significance level shows. An interesting observation is that in case of buyback the debt ratios do not differ for basic materials and other goods. This is in contrast to our previous observation that in general basic materials are correlated with relatively high debt ratios. One possible explanation is that goods that are produced with A's technology are always easy to sell by A, simply because A partly controls their production. In this case the type of good may be irrelevant.

5. Conclusions

This paper develops a theory of countertrade in which countertrade is an efficiency enhancing arrangement in international trade to mitigate the sovereign debt problem. The implications and predictions of our model on the design of optimal countertrade contracts are consistent with the empirical evidence offered by a large data set with detailed information on the characteristics of 230 actual countertrade contracts.

In particular, we have shown that a countertrade transaction can be used to finance an import of an Eastern European or developing country from a developed country even if this deal cannot be financed with a traditional credit arrangement. In this sense countertrade increases the creditworthiness of the EE or LD country. However, our analysis is partial in that it neglects repercussions of countertrade transactions on B's other credit relations. If some of B's future exports are earmarked for countertrade the return stream that can be used to repay previous creditors is reduced. Anticipating this, creditors may be more reluctant to lend to B in the first place. Hence, the possibility of countertrade may reduce the maximum amount of unsecured debt B can obtain. A formal analysis of this effect in a model of multiple creditors is beyond the scope of this paper but an important topic for future research. This effect may be one of the reasons why the International Monetary Fund, the World Bank and the GATT are traditionally hostile to countertrade.

Data-Appendix

Our sample covers 230 contracts, signed by firms that use Austria as their basis for countertrade transactions. Some of the respondents produce in Austria, others are subsidiaries of multinational enterprises with their own inhouse countertrade division located in Austria, still others are firms in OECD countries which use an international trading firm in Vienna to carry out the countertrade transaction. 30% percent of the western firms of the sample are based in the EEC and 62.7 percent in other industrialized countries including Austria, Sweden, Japan, and the USA.

The countertrade partner was a state agency in EE or an LDC (85.2 percent of the cases), a state-owned enterprise (9.1 percent), or a private firm (5.7 percent). Due to Austria's geographic proximity with EE, North-South countertrade is underrepresented in the sample. Only 5.7 percent of the transactions took place with Africa, 3 percent with Asia, 2.6 percent with South America, and 2.2 percent with China. In contrast, our data on East-West countertrade can be considered to represent the parent population of East-West countertrade since the sample covers a sufficiently large number of cases in all former CMEA member countries involved in countertrade. More specifically, 14.8 percent of the transactions are with the former Soviet Union, 24.8 percent with the former Czechoslovakia, 14.3 percent with Hungary, 7 percent with Poland, 4.3 percent with Rumania, 6.5 percent with East Germany and Bulgaria, respectively, 6.1 percent with the former Yugoslavia, and .9 percent with Albania.

DEFINITION OF VARIABLES

COMP Compensation ratio: value of import from EE/LDC in percent of export values to EE/LDC. A continuous variable running from 2 percent to 400 percent.

DEBT Total debt stocks in percent of GNP. A continuous variable running from 4.5 percent to 326 percent. Source: World Bank, World Debt Tables, various years.

REPEAT A dummy variable set equal to 1 if developed country firm exported to developing/Eastern European trade partner on a regular basis and 0 if it did so for the first time.

TIME Duration of countertrade contract until delivery of developing country/Eastern European trade partner is completed. A continuous variable running from 0 to 120 months (or no termination point).

EXPORT Eastern European or developing country's total exports in percent of GNP. A continuous variable running from 4.2 percent to 63.9 percent. Source: International Monetary Fund, International Financial Statistic, and Vienna Institute for Comparative Economic Studies, Comecon Data, various years.

TECHIMP Share of Eastern European or developing country's technology imports in percent of total imports. A continuous variable running from 11.6 percent to 45.4 percent. Source: International Monetary Fund, International Financial Statistic, and Vienna Institute for Comparative Economic Studies, Comecon Data, various years.

BASICM A dummy variable that takes the value 1 if the good that was exported from developing or Eastern European trade partner to developed country firm was basic materials, agricultural goods, raw material or oil.

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