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Dalia Marin and Monika Schnitzer

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Centre for Economic Policy Research
25-28 Old Burlington Street
London W1X 1LB
Tel: (44 71) 734 9110

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ABSTRACT

Tying Trade Flows: A Theory of Countertrade*

A countertrade contract ties an export to an import. Usually, countertrade is seen as a form of bilateralism and reciprocity and thus as an inefficient form of international exchange. In this paper we argue that there are circumstances where the tying of two technologically unrelated trade flows may be efficiency enhancing. We show that countertrade can be seen as an efficient institution that solves moral hazard problems and restores creditworthiness of countries with large outstanding debt. We test the implications of our model using a sample of 230 countertrade contacts.

JEL classification: D23, F13, F34, L14
Keywords: countertrade, double moral hazard problem, sovereign debt, technology transfer, creditworthiness

Dalia Marin
Department of Economics
Humboldt Universität zu Berlin
Spandauer Str. 1
D-10178 Berlin
GERMANY
Tel: (49 30) 2468 373

Monika Schnitzer
Department of Economics
Universität Bonn
Adenauerallee 24
D-53113 Bonn
GERMANY
Tel: (49 228) 739 246

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NON-TECHNICAL SUMMARY

In a countertrade agreement an export is tied to an import. Typically, a firm in a developed country (DC) exports to an East European (EE) or developing country (LDC) and commits itself (in a second contract) to import goods from this country in return. According to most estimates, countertrade accounts for 10–20% of world trade. Traditionally, countertrade is seen as a form of bilateralism and reciprocity and thus, as an inefficient form of international exchange. In this paper we argue that there are circumstances where tying an export to an import may yield efficiency gains. Countertrade can be an efficient institution that solves contractual problems which otherwise would prevent the realization of gains from trade.

Even though most experts agree that countertrade accounts for a large and rapidly growing proportion of international trade, it is quite difficult to get reliable data on the exact volume and features of these transactions. In order to obtain data on the specific features of countertrade agreements we carried out a survey among countertrading companies located in Austria (some produce in Austria, but most are trading companies or subsidiaries of multinationals). Our sample contains information on 230 countertrade contracts signed by firms from OECD countries and trade organizations in EE or LDCs in 1984–8. In Section 2 of the paper we report four stylized facts on countertrade.

Fact 1: *Counterpurchase is the dominant form of countertrade.*

Fact 2: *Countertrade is more frequently employed by countries with high outstanding debt.*

Fact 3: *In countertrade transactions, DC firms tend to specialize in the export of technology related and investment goods, while the imports from EE or LDCs are mainly consumption goods and basic materials.*

Fact 4: *The degree to which the two trade flows are tied together varies considerably.*

Motivated by fact 2, the most common explanation of countertrade suggested in the descriptive literature is that countertrade helps countries to overcome financial constraints imposed by a shortage of foreign exchange. It is seen as a way to finance imports without the use of hard currency. The only form of countertrade that actually avoids the use of hard currency, however, is barter – a spot transaction where the two trade flows occur simultaneously and no foreign exchange is used. But surprisingly, barter accounts for only a small proportion of total countertrade. Fact 1 indicates that by far the dominant form is

counterpurchase. In counterpurchase agreements the two transactions are carried out sequentially and each flow is paid for in foreign exchange.

The questions raised by these facts are: Why is countertrade mostly used by countries with high outstanding debt? Why does the trade pattern differ significantly from that in untied trade? And what drives the extent to which the two trade flows are tied together?

In Sections 3 and 4 of the paper we develop a theory of countertrade which suggests that counterpurchase agreements are chosen to mitigate contractual hazards and incentive problems that arise in technology trade and in imperfect capital markets. One major implication of this theory is that the degree to which the two trade flows are tied together is an important instrument for controlling the incentives of the parties involved in the trade. We identify the following double moral hazard problem prevalent in this type of trade. On the one hand there is a DC firm seeking to export plant, machinery, know how, or other investment goods to an LDC or EE country. These are complex and sophisticated products, and it is often difficult to specify all aspects of the quality of these goods in a complete contingent contract. Thus the DC firm may be tempted to undersupply quality and blame adverse circumstances in the LDC or EE country for unsatisfactory performance. On the other hand, the LDC or EE country often lacks creditworthiness due to large outstanding debt which may make it impossible to finance the deal with a simple loan from an international bank. Thus, the DC firm cannot be sure that the LDC or EE country is actually going to pay for the export.

How can tying two transactions mitigate these moral hazard problems? In our model the second deal (the import from the LDC/EE) serves as a 'hostage' (in the language of Williamson (1983)) that deters cheating on quality and defaulting on the payment in the original export. The import has to be profitable to both the DC firm and the LDC/EE country, and the contract is designed such that the second deal becomes sufficiently less profitable for either party that does not fulfill its obligations in the first transaction. We show that this contractual arrangement makes the DC firm internalize the externality its quality decision has on the LDC/EE country. Furthermore, the subsequent import creates a deal specific collateral which gives the LDC/EE country an incentive to fulfill its financial obligations. This way, the tying of trade flows secures efficient technology spillovers from developed countries to Eastern Europe/LDCs and restores creditworthiness of countries with large outstanding debt.

Note that without the subsequent import the gains from trade of the technology export could not have been realized. Thus, even if the second deal could be carried out more efficiently with a third party, e.g. a trading company specialized in marketing imports from LDC/EE countries, it may still be optimal to link the two transactions in a countertrade arrangement. We show, however, that it is possible to renegotiate the subsequent import such that the technology exporting

DC firm markets the import through a specialized trading company, without affecting the incentives in the first transaction.

In Section 5 we test several implications of our theory. Traditionally, countertrade is seen as a means to overcome the shortage of foreign exchange and the credit constraint of highly indebted countries (which is certainly true for barter). Our theory, however, suggests that there may be additional reasons which motivate counterpurchase agreements. If counterpurchase serves different functions than barter, this should be reflected in the variables that explain the choice between barter and counterpurchase. Furthermore, our model predicts that the extent to which the two trade flows are tied together will be chosen such as to provide optimal incentives to both parties involved in the countertrade deal. The empirical data on actual countertrade transactions are consistent with our hypotheses.

In Section 6 we conclude that countertrade might play an important role in transition economies in Eastern Europe. It may mitigate two serious problems these countries face. First, their creditworthiness is poor and in some cases further deteriorating. One example is Russia. In recent years Russia experienced a sharp increase in countertrade in its trade with the West. This fits well the story of our model since the increasing importance of countertrade went hand in hand with a significant deterioration of Russia's creditworthiness. Second, there is only modest incoming direct foreign investment due to the high political uncertainty in the transition period. Thus, the amount to which foreign resources can be used to invest and promote growth and development in these countries is restricted. Under these circumstances, countertrade may play an important role in facilitating trade and financing imports of technology from developed countries.

1. Introduction

In a countertrade agreement an export is tied to an import. Typically, a firm in a developed country (DC-firm) exports to an Eastern European (EE) or a developing country (LDC) and commits itself (in a second contract) to import goods from this country in return. A western bank is often involved that finances both transactions. According to most estimates countertrade accounts for 10 to 20 percent of world trade.[1] The phenomenon has become sufficiently important to be negotiated in the Uruguay Round.[2] Traditionally, countertrade is seen as a form of bilateralism and reciprocity and, thus, as an inefficient form of international exchange. In this paper we argue that there are circumstances where tying an export to an import may yield efficiency gains. Countertrade can be an efficient institution that solves contractual problems which otherwise would prevent the realization of gains from trade.

Three forms of countertrade can be distinguished: barter, counterpurchase, and buyback. Barter is a spot transaction where the two trade flows occur simultaneously and no foreign exchange is used. The export is paid for with the import. In counterpurchase and buyback arrangements, in contrast, the two transactions are carried out sequentially and each flow is paid for in foreign exchange. With buyback there is also a technological relationship between the original export and the subsequent import, one flow consisting of plants and/or machinery and the other of output produced with this equipment.

One of the most frequent explanations of countertrade suggested in the descriptive literature is that this arrangement helps countries to overcome financial constraints imposed by a shortage of foreign exchange. It is seen as a way to finance imports without the use of hard currency.[3] However, the only form of countertrade that actually avoids the use of hard currency is barter, and barter accounts for only a small proportion of total countertrade. Surprisingly, by far the dominant form is counterpurchase (See Table 1 in Section 2).

Our explanation of countertrade focuses on counterpurchase and on how such an

[1] See Hammond (1990), and OECD (1981, 1985).

[2] Countertrade is discussed under the heading "Trade Related Investment Measures (TRIMS)" in the GATT negotiations (Guisinger, 1987). For the different political views on countertrade see OECD (1985).

[3] See, e.g., OECD (1981, 1985).

agreement can mitigate contractual hazards and incentive problems that arise in technology trade and in imperfect capital markets. We identify the following double moral hazard problem prevalent in this type of trade. On the one hand there is a DC firm which wants to export a plant, machinery, know how, or other investment goods to an LDC or EE country. These are complex and sophisticated products, and it is often difficult to specify all aspects of the quality of these goods in a complete contingent contract. Thus, the DC firm may be tempted to undersupply quality and blame adverse circumstances in the LDC or EE country for unsatisfactory performance. On the other hand, the LDC or EE country often lacks creditworthiness due to large outstanding debt which may make it impossible to finance the deal with a simple loan from an international bank. Thus, the DC firm cannot be sure that the LDC or EE country is actually going to pay for the export.

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Note that without the subsequent import the gains from trade of the technology export could not have been realized. Thus, even if the second deal could be carried out more efficiently with a third party, e.g. a trading company specialized on marketing imports from LDC/EE countries, it may still be optimal to link the two transactions in a countertrade arrangement. We show, however, that it is possible to renegotiate the subsequent import such that the technology exporting DC firm markets the import through a specialized trading company, without affecting the incentives in the first transaction.

Based on a sample of 230 countertrade contracts which have been signed between DC-firms and EE and LDC in the period between 1984 and 1988 we test several im-

plications of our theory. The data support our hypothesis that countertrade is chosen to secure technology transfer to developing countries and Eastern Europe and to restore creditworthiness of countries with large outstanding debt.

Until recently, the analysis of contracts and institutions that govern trade has been neglected in trade theory which focuses on endowments, technologies, preferences, and the nature of competition in international markets as determinants of trade. A notable exception is Greif, Milgrom and Weingast (1991) who analyse merchand gilds in the middle ages as an efficiency enhancing institution to deal with moral hazard problems in "international" trade. To our knowledge the only paper so far that focuses on countertrade as a way to mitigate incentive problems is Chan and Hoy (1991). They consider a DC firm supplying a plant (or some technology) to an LDC firm. There is a "moral hazard in teams" problem (Holmström, 1982) in that the quality of the output produced with this plant is affected by the effort supplied by both, the DC firm and the LDC firm. Chan and Hoy show that a buyback arrangement, where the DC company is paid partially with the output produced by the plant, can mitigate the moral hazard problem. Note, that here the technological relation between the two goods is essential. The DC firm spends more effort in setting up the plant in order to improve the quality of the output it is paid with. Thus, Chan and Hoy explain only buyback arrangements. In contrast, our approach does not require any technological relationship between the two trade flows and can explain the dominant form of countertrade: counterpurchase.

There is a small theoretical literature on countertrade which deals with other possible explanations for this phenomenon. Caves and Marin (1992) suggest that countertrade may be used by DC companies as an instrument of price discrimination which leads to lower prices for customers in LDCs or EE. Ellingsen (1991) considers a strategic setting in which countertrade facilitates profit shifting from competitors to the countertrading firm. Here, countertrade increases the market distortion associated with non-competitive pricing. Ellingsen and Stole (1992) see government mandated countertrade as a strategic commitment for buyers not to purchase unless there are reciprocal sales. This can reduce sellers' incentives to exploit their market power and thus lead to a net trade increase in imperfectly competitive markets. Amann and Marin (1993) suggest that countertrade provides a mechanism for risk sharing between parties. Countertrade offers insurance

against random fluctuations of market conditions when no future markets for the good of the LDC/EE country exists.

The paper is also related to the recent literature on debt. Both the corporate debt and the sovereign debt literature deal with the question of how to enforce the repayment of a loan. Bolton and Scharfstein (1990) show in a two period model that a firm will not default on its debt if the availability of a second loan is made contingent on the repayment of the first one. The "reputation theory" of sovereign lending suggests that a country will not repudiate its loan if otherwise it risks not to receive additional loans in the future. In our model, the introduction of a second profitable deal which serves as a collateral guarantees that the debtor will fulfill his financial obligations. Thus, the two trading partners do not have to rely on reputation effects to guarantee that the creditor gets a sufficiently high return on his lending.

The paper is organized as follows. In Section 2 we present some stylized facts that a theory of countertrade needs to address. Section 3 introduces the model. In Section 4 we show under what conditions countertrade can solve the moral hazard problems described in Section 3. Section 5 derives testable predictions from the model which are then put to an econometric test. Finally, Section 6 concludes and discusses the relevance of the model for Eastern European economies in transition. Some of the proofs and more detailed information on the data are gathered in an Appendix.

2. Some Stylized Facts

Even though most experts agree that countertrade accounts for a large and rapidly growing proportion of international trade, it is quite difficult to get reliable data on the exact volume and features of these transactions. Countertrade does not show up in the official trade statistics. It is hard to measure, because (in case of barter) there are often no prices attached to the trade flows and (in case of buyback and counterpurchase) the trade flows occur in different periods. Furthermore, governments have an incentive to play down the role of countertrade because it is regarded as a potential trade barrier by the GATT.

In order to obtain data on the specific features of countertrade transactions we carried out a survey among countertrading companies located in Austria. Some of these firms are

producing in Austria, but most are trading companies or subsidiaries of multinationals. Our sample contains information on 230 countertrade contracts signed by firms from OECD countries and trade organizations in EE or LDCs in 1984 - 1988.[4] All statistics presented in this paper are based on the number of contracts, rather than trade volume, as the unit of analysis.

To motivate the characteristics of our model, we report in this section four stylized facts on countertrade. These facts, in so far as they are available, are a common feature of most empirical studies on the subject.

Fact 1 *Counterpurchase is the dominant form of countertrade.*

This has been reported by many studies and is confirmed by Table 1.[5] In our sample, counterpurchase accounts for more than three quarters of total countertrade.

Table 1: Contract Forms

Barter	26 (11.3)
Counterpurchase	176 (76.5)
Buyback	28 (12.2)
Countertrade	230 (100.0)

Source: Data sample of 230 countertrade contracts.

Fact 2 *Countertrade is more frequently employed by countries with high outstanding debt.*

[4] For more details on this data set see Marin (1990) and Appendix B.

[5] See e.g. Jones and Jagoe (1988) and OECD (1981, 1985).

Table 2: Indebtedness of Countertrading Countries*)

in percent

	Eastern Europe	LDCs	Total
severely indebted (SICs)	32.2	22.6	30.9
moderately indebted (MICs)	25.6	29.0	26.1
other countries (OCs)	42.2	48.4	43.0
Total	[86.5]	[13.5]	100.0

*) Classification follows the World Bank definition, numbers are column percentages except for numbers in [ ] brackets which are row percentages.

SICs: Poland, Bulgaria, Brazil, Ecuador, Argentina, Nicaragua, Philippines, Zambia, Hungary, Togo

MICs: former Soviet Union, Indonesia, former Yugoslawia, Egypt, Algeria, Syria, Zimbabwe

OCs: former Czechoslovakia, East Germany, Albania, Cuba, Malaysia, China, Korea, Israel, Iran, Cyprus, South Africa, Romania, India

Source: Data Sample of 230 Countertrade Contracts

All theories which explain countertrade as a device to overcome financial and credit constraints rely on this observation. It is supported by our data reported in Table 2. Almost 60 % of all contracts have been with a country classified by the World Bank as either severely or moderately indebted.

Fact 3 *In countertrade transactions, DC firms tend to specialize on the export of technology related and investment goods, while the imports from EE or LDCs are mainly consumption goods and basic materials.*

In our sample more than 70 % of OECD exports to EE and LDCs were technology

related (plant and equipment, investment and technical goods). OECD firms imported from these regions mainly consumption goods (32 %) and basic materials (18 %). Note that this pattern of specialization differs significantly from that in untied trade with these regions. In untied trade only 30 - 40 % of OECD exports to EE are technology related and around 15 % of OECD imports are consumer goods, whereas basic materials account for about 25 % of total imports.[6]

Table 3: Pattern of Trade

in percent

	exports to LDCs/PCPEs	imports from LDCs/PCPEs
plant and equipment	14.3	0.0
investment and technical goods	56.6	35.5
chemicals	8.8	8.2
consumption goods	8.8	31.9
basic materials	3.6	18.4
luxury goods[1])	4.0	0.0
services[2])	4.0	6.0
Total	100.0	100.0

[1]) includes toys, cosmetics.

[2]) includes among exports: know how, patents, and licenses;
among imports: labor services and freight.

Source: Data Sample of 230 Countertrade Contracts

Fact 4 *The tying of trade flows as measured by the compensation ratio varies considerably.*

The compensation ratio is the value of repurchase by the DC-firm as a percentage of its export value to EE or an LDC. A compensation ratio of 100 % means that the DC-firm

[6]For the pattern of specialization in untied East-West trade see COMECON Data Bank, Vienna, Institute of Comparative Economic Studies, various years.

Table 4: Tying Features

compensation ratio*)	Eastern Europe	LDCs	Total
2 - 99 %	106	7	113
	(53.3)	(22.6)	(49.1)
100 %	62	22	84
	(31.2)	(71.0)	(36.5)
101 - 400 %	31	2	33
	(15.6)	(6.5)	(14.3)
Total	199	31	230
	[86.5]	[13.5]	(100.0)

*) value of repurchases by DC firm as a percentage of its value to EE or LDC firm.
Numbers without brackets are absolute number of cases; numbers in ( ) brackets are column percentages, numbers in [ ] brackets are row percentages.
Source: Data Sample of 230 Countertrade Contracts.

makes an import of equal value to its original export. In our sample the compensation ratio varied between 2 % and 400 %. A compensation ratio of 100 % clearly is a prominent number. However, as is appararent from Table 4, if the export value does not match the import value exactly, "loose" tying dominates. In almost 50 % the value of the import was smaller than the value of the OECD firm's export.

These facts raise the following questions. First, why is countertrade mostly used by countries with high outstanding debt? Second, why is the proportion of technology related goods in countertrade exports of OECD firms so predominant? And third, what drives the extent to which the two trade flows are tied together, i.e., the compensation ratio? The following model addresses these questions.

3. The Model

3.1. The Double Moral Hazard Problem

Consider two parties, A and B, where A (she) is a company in a developed country (DC) and B (he) is a trade organization in Eastern Europe (EE) or a developing country (LDC). A wants to export a technology, like a turnkey factory, machinery, or some other investment good, to B. This technology, in the following called "good 1" or the "export", can be produced at different quality levels q. Quality is observed by both parties, but good 1 is sufficiently complex that at least some aspects of quality cannot be verified to an outsider like the courts, and thus cannot be specified unambiguously in a contract. For simplicity we assume that there are only two different quality levels $q \in \{\underline{q}, \overline{q}\}$, $\underline{q} < \overline{q}$, where $\underline{q}$ ($\overline{q}$) stands for low (high) quality, respectively.[7] Quality is measured in terms of the cost firm A has to incur to produce it. B's valuation, v_1, of good 1 is a function of q, with $\overline{v}_1 \equiv v_1(\overline{q}) > v_1(\underline{q}) \equiv \underline{v}_1$. It can be thought of as the profit B can generate with good 1 including spillover effects this technology may have on other industries in the LDC or EE country.

We rule out the possibility that the level of quality can be deduced from A's production cost or B's profits. Both parties can shift accounting costs and profits between different divisions and activities, such that it is impossible for the courts to infer q from accounting data. To make the problem interesting, we impose:

Assumption 1 $\overline{v}_1 - \overline{q} > \underline{v}_1 - \underline{q}$ *and* $\overline{v}_1 - \overline{q} > 0$.

Thus, producing high quality is efficient and there are gains from trade. However, there is a genuine moral hazard problem in that firm A has an incentive to cheat on quality.

To make matters worse, there is often a second moral hazard problem in North-South or East-West trade. Many LDCs and EE countries face a foreign exchange shortage. Typically, they do not have the liquidity to pay for good 1 in cash at the date of delivery. In principle, the transaction could be financed with a credit, either from a commercial

[7] All our results can be generalized to the case of a continuous quality variable. See Footnote 14.

bank or from firm A directly, which has to be paid back out of B's profits, v_1, generated with good 1. If this credit could be guaranteed by the government of B's country, there would be no problem. Often, however, these countries are also credit constrained which is due to the sovereign debt problem. B's government cannot be forced by the courts in A's country to repay his debt. He has to voluntarily meet this obligation, either for reputational reasons in order to get further credit in the future, or because he wants to avoid the international trade sanctions which may be triggered by the default on a loan. If an LDC or EE country is highly indebted already, the gains from default on existing debt may outweigh the expected future losses, and western banks will be reluctant to offer additional credit.[8]

In our model there is no difference whether B gets a credit from A or from a commercial bank. For simplicity, we assume that any credit is provided by A directly. We want to allow for the possibility that A can enforce at least some repayment up to an amount $\underline{v}_1 + s$, $s \geq 0$. Recall that $\underline{v}_1$ is the smallest revenue B can ever make if the technology trade takes place. Thus, we see $\underline{v}_1$ as the verifiable part of B's revenues, payment of which can be enforced by A through the courts in B's country. Furthermore, B's country may have some assets abroad which can be used as a collateral. The more severely indebted B's country, the smaller is s, the assets A can seize in case of default.[9]

Assumption 2 *B is credit constrained on international capital markets, and A can enforce payments only up to an amount $\underline{v}_1 + s < \overline{q}$.*

That is, payment of $\underline{v}_1 + s$ is insufficient to cover A's cost to produce high quality. Hence, there is a second moral hazard problem in that B has to be induced to pay for the transaction.

Considered in isolation, the outcome of this double moral hazard problem must be inefficient. It is neither possible to induce A to deliver high quality, nor to get B to pay more than $\underline{v}_1 + s < \overline{q}$. Thus, if at all, only the inferior quality good may be traded.

[8] See Eaton (1992).

[9] In an alternative version of the model we assumed that not even $\underline{v}_1$ can be enforced. In this case countertrade still works. However, the set of parameters under which countertrade implements an efficient allocation (see Theorem 1) is reduced.

3.2. Creating a Hostage

How can a countertrade arrangement help to overcome the double moral hazard problem? The idea is to find a second transaction which is potentially profitable for both parties and which serves as a hostage: The countertrade contract is designed such that the gains from the second trade are lost if either party cheates in the preceding technology trade. We are going to show that this can be done even if there is no technological relationship between the two goods.

To fix ideas, suppose that the parties find a second transaction to be carried out after $v_1(q)$ has been realized and B has paid p_1 for good 1. This time B is supposed to deliver one unit of another good, in the following called "good 2" or "import", to firm A. Good 2 will typically be a standardized consumption good, the quality of which can more easily be verified and controlled through a contract. Furthermore, let us assume that A (a large company in a western country) is neither liquidity nor credit constrained, and that the courts in A's country will enforce the payment for good 2. Thus, there are no contractual hazards in this second deal.

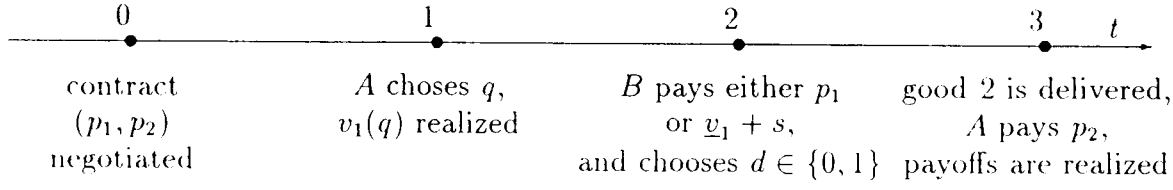
Let v_2 denote A's valuation for good 2 and p_2 denote the price A agreed to pay. In order to produce good 2, B has to incur investment and/or production cost $c > 0$ (in hard currency), for example to buy machinery or inputs on the world market. B can finance this cost with his profits $v_1(q) - p_1$ from the first transaction or with another loan from firm A. Note, that A can use p_2 as a collateral. If B does not repay his debt, A can withhold the outstanding amount from p_2.

In addition to the payoff $p_2 - c$, B receives a nonverifiable benefit $b > 0$ if the second trade takes place. The idea is that B learns how to market the good on the world market, that he acquires information about consumers' tastes or about the production technology, or that there is a good will effect: consumers learn about the quality of B's good which makes it more profitable to sell other goods later on. The second transaction is interesting only if there are gains from trade:

Assumption 3 $v_2 + b - c > 0$.[10]

[10]Note that although the trade is efficient it may still be the case that $v_2 < c$, i.e., good 2 cannot be sold at a price which covers its cost. In this case the trade is mainly motivated by the spillover benefit b.

How does the design of the second transaction affect the incentives in the preceding technology trade? First, it generates an additional collateral for firm A. If B does not fully pay p_1, A can withhold the difference from her payment p_2 for good 2. Second, B's ability to finance the production cost c depends on the quality level of good 1. Suppose A cheates on quality and deliveres $\underline{q}$, then B's profit is reduced to $\underline{v}_1 - p_1 < \overline{v}_1 - p_1$. If p_1 and p_2 are chosen appropriately, B will be unable to pay for c, and the second trade is lost.[11,12] A might be willing to renegotiate and offer additional money to B in order to rescue the gains from the second transaction. However, cheating on quality was inefficient. Therefore, A will have to put in more money now than she gained from cheating on quality in the previous transaction. This way, A can in fact be made residual claimant for her own quality decision.



FIGUR 1: Time Structure.

The sequence of events is summarized in Figure 1. A and B negotiate prices p_1 and p_2 at date 0. At date 1 A chooses the quality level q which determines B's profit $v_1(q)$. At date 2 B chooses whether or not to pay p_1. If he does not meet his obligation, A enforces $\underline{v}_1 + s$, and A may deduct the outstanding payment from p_2 if the second transaction

[11] B will face such a financial constraint when A delivers low quality only when the deal is sufficiently large. As our data suggest the deals have been large enough to make the Foreign Trade Organisations (FTO) in Eastern Europe face this constraint. In 1985 the average countertrade deal with Czechoslovakia had a share of 16 percent of total imports of the former CSSR. This means that in 1985 a typical countertrade deal with CSSR made up 79 percent of the trade value of a typical FTO (assuming that CSSR's trade was governed by 5 FTOs in 1985). Similar calculations for Hungary and Poland make the typical countertrade deal 33.8 percent and 54.8 percent, respectively, of the average trade value of the typical FTO.

[12] In the corporate debt literature there is an interesting parallel to our use of a financial constraint as an incentive device. Hart (1992) considers a manager whose action has an externality on outside investors. The manager might not want to liquidate the firm when it would be profitable to do so. The optimal debt repayment schedule is designed such that the manager faces a financial constraint and is forced to come to the capital market for additional funds. This way, he can be induced to liquidate the firm when it is in the interest of outside investors to do so.

takes place. Furthermore, B can invest c and produce good 2. This decision is denoted by $d \in \{0,1\}$. If $d = 1$, then, at date 3, good 2 is delivered and A has to pay p_2, otherwise there is no trade and no payment.

All payments are measured in date 3 money. The utility functions of A and B are given by

$$U_A = p_1 - q + d \cdot [v_2 - p_2] \,, \tag{1}$$

$$U_B = v_1(q) - p_1 + d \cdot [p_2 - c + b] \,, \tag{2}$$

respectively.

4. Countertrade as an Efficient Institution

Given Assumptions 1 and 3, the first best requires that A chooses $q = \overline{q}$ at date 1 and B choses $d = 1$ at date 2. In this section we are going to ask under what conditions on the parameters of the model there exists a countertrade contract (p_1, p_2) which implements the first best. We say that a contract implements the first best, if (given p_1 and p_2) there is a unique subgame perfect equilibrium outcome in which A choses high quality, B pays p_1, and the second transaction takes place. Furthermore, both parties have to agree to countertrade voluntarily.

We proceed in two steps. In Section 4.1. we consider the case of no renegotiation. That is, A cannot increase her payment p_2 in case she delivered low quality in order to rescue the second deal. Nor can B turn to a third party and carry out the second transaction without A. In Section 4.2. we allow for renegotiation and relax these assumptions.

4.1. No Renegotiation

Note first that there is an upper bound on the payment p_1 player B is going to make in equilibrium. In order to enforce p_1, A can seize $\underline{v}_1 + s$, and, if the second deal takes place, A can retain the payment p_2. Thus the highest payment that can be enforced is $\underline{v}_1 + s + p_2$, and it is a strictly dominated strategy for player B to pay more. Hence, p_1

must satisfy[13]

$$p_1 \;<\; p_2 + \underline{v}_1 + s \;. \tag{3}$$

Next, we want to induce B to pay p_1 and choose $d = 1$ if A delivered high quality at date 1. Note, that if B wants to choose $d = 0$, then it is clearly optimal to pay p_1 if and only if $p_1 \leq \underline{v}_1 + s$. Furthermore, if (3) holds and B chooses $d = 1$, then he cannot avoid p_1 because A can use $p_2 + \underline{v}_1 + s$ as a collateral. Therefore, if the incentive constraint

$$\overline{v}_1 - p_1 + p_2 + b - c \;>\; \overline{v}_1 - \min\{p_1, \underline{v}_1 + s\} \tag{4}$$

holds, then B strictly prefers to pay p_1 and produce good 2, rather than to default on p_1 and forgo the second deal.

On the other hand, we want B to choose $d = 0$ if A delivered low quality. Note that there is no technological relationship between goods 1 and 2. Thus, if (4) is satisfied for $v_1 = \overline{v}_1$ then it must also hold for $v_1 = \underline{v}_1$. However, A's quality decision has an impact on B's financial constraint. B can ask A for a loan in order to finance his investment and production cost c. But this loan cannot exceed $p_2 + s$ because this is the highest amount B can be forced to pay back at date 3.[14] Thus, if we want B to be able to finance the second transaction if and only if he received high quality, we have to choose p_1 and p_2 such that[15]

$$\overline{v}_1 - p_1 + p_2 + s \;\geq\; c \;. \tag{5}$$

$$\underline{v}_1 - p_1 + p_2 + s \;<\; c \;. \tag{6}$$

Now consider the problem to induce A to produce high quality. If (4), (5) and (6) are met, then the second transaction will take place if and only if $q = \overline{q}$. Thus, A will strictly prefer to deliver high quality if

$$p_1 - \overline{q} + v_2 - p_2 \;>\; \min\{p_1, \underline{v}_1 + s\} - \underline{q} \;. \tag{7}$$

[13]Rewriting condition 3 as $p_2 > p_1 - (\underline{v}_1 + s)$ highlights the similarity with the condition for debt repayment in the sovereign debt literature. The debtor will meet his debt service obligations only if he expects to receive a net resource transfer from creditors if he repays. See Eaton (1992).

[14]Note that b cannot be used as a collateral, because it is an unverifiable, spillover benefit, which cannot be seized by A.

[15]If q is a continuous variable and q^* denotes the efficient quality level, then (5) and (6) have to be replaced by a condition which requires that B can finance c if and only if q^* is delivered.

Finally, both parties have to participate voluntarily in the countertrade transaction. A's and B's participation constraints are given by

$$p_1 - \overline{q} + v_2 - p_2 \geq 0 , \tag{8}$$

$$\overline{v}_1 - p_1 + p_2 + b - c \geq 0 , \tag{9}$$

respectively.

To summarize: If for a given pair of prices (p_1, p_2) conditions (3) to (7) are satisfied, then there is a unique subgame perfect equilibrium in which A choses high quality, B pays p_1, and the second trade takes place. Furthermore, if (8) and (9) hold, then both parties benefit from the countertrade transaction. This proves:

Proposition 1 *If there exist prices (p_1, p_2) satisfying (3) - (9), then a countertrade contract (p_1, p_2) implements the first best.*

The question is, of course, whether such a pair of prices (p_1, p_2) exists. Theorem 1 gives necessary and sufficient conditions for the existence of an efficient countertrade contract.

Theorem 1 *There exists a countertrade contract (p_1, p_2) which implements the first best if and only if the following conditions hold:*

(i) $v_2 + b - c > \overline{q} - \underline{q}$,

(ii) $v_2 - \overline{q} + \overline{v}_1 + s \geq c$,

(iii) $v_2 > \overline{q} - \underline{v}_1 - s$,

(iv) $\underline{v}_1 + s + v_2 + b - c > \overline{q}$.

The first part of the proof of Theorem 1 shows where these conditions come from and how they can be interpreted.

Proof: Note first that given Assumptions 1 and 2 condition (9) is implied by (4) and can be ignored. The first part of the proof is to show that (3) to (8) imply (i) to (iv):

- Consider (4) and (7), the incentive constraints for B and A, respectively. They imply that

$$c - b - \min\{p_1, \underline{v}_1 + s\} \; < \; p_2 - p_1 \; < v_2 - \overline{q} + \underline{q} - \min\{p_1, \underline{v}_1 + s\} \; , \qquad (10)$$

which in turn implies

(i) $$v_2 + b - c \; > \; \overline{q} - \underline{q} \; .$$

That is, the gains from trade from the second transaction have to be larger than $A's$ gains from cheating on quality in the technology trade.

- Condition (5) requires that $\overline{v}_1 - p_1 + p_2 + s \geq c$, i.e., B has to be able to finance the second deal if A delivered high quality. Together with A's participation constraint (8), which puts an upper bound on the net payment from A to B by imposing that $p_2 - p_1 \leq v_2 - \overline{q}$ this implies

(ii) $$v_2 - \overline{q} + \overline{v}_1 + s \; \geq \; c$$

saying that A's maximum transfer to B $(v_2 - \overline{q})$ plus B's own funds $(\overline{v}_1 + s)$ must be sufficient to finance c.

Next, condition (3) requires that $p_1 - p_2 < \underline{v}_1 + s$, otherwise p_1 cannot be enforced. On the other hand, (8) requires that $p_1 - p_2 \geq \overline{q} - v_2$ to make it worthwhile for A to participate. This implies

(iii) $$v_2 \; > \; \overline{q} - \underline{v}_1 - s \; ,$$

i.e., A's valuation of good 2 must be big enough to compensate her for the cost of producing high quality that are not covered by B's minimum payment $\underline{v}_1 + s$.

- Finally, B's incentive constraint (4) puts a lower bound on $p_2 - p_1$, which is A's net transfer to B, while A's participation constraint (8) imposes an upper bound on this term:

$$c - b - \min\{p_1, \underline{v}_1 + s\} \; \leq \; p_2 - p_1 \; < \; v_2 - \overline{q} \; . \qquad (11)$$

or

$$\min\{p_1, \underline{v}_1 + s\} \; > c - b - v_2 + \overline{q} \; , \qquad (12)$$

which implies in particular

(iv) $$\underline{v}_1 + s + v_2 + b - c > \overline{q} .$$

This condition says that B's minimum payment ($\underline{v}_1 + s$) plus the surplus from the second transaction (given by $v_2 + b - c$, which is the highest amount A can receive from the second transaction without violating B's incentive constraint) have to be big enough to cover A's production cost $\overline{q}$.

The second part of the proof, showing that (i) to (vi) imply (3) to (8) is relegated to the Appendix. *Q.E.D.*

Note first that the set of parameters satisfying (i) to (iv) is not empty. As an example, choose $v_2 > \overline{q}$, $c < \underline{q}$ and $\underline{v}_1 + s > c - b$, then (i) to (iv) hold. But, of course, countertrade is not always an efficient remedy to solve the underlying incentive problems. Considering (i) to (iv) again, it is easy to see that these conditions are less likely to be satisfied if the incentive for A to cheat on quality, measured by $\overline{q} - \underline{q}$, is very big, and the minimum payment that can be enforced from B ($\underline{v}_1 + s$) is very small. Thus, the incentive problems may not be too severe. On the other hand, countertrade is more likely to be an efficient institution the higher the gains from the second trade, i.e., the bigger $v_2 + b$ and the smaller c. All this is quite intuitive. Countertrade is supposed to solve the double moral hazard problem by introducing a hostage which is lost if either party cheates in the first transaction. For this construction to work it has to be the case that the hostage is sufficiently valuable as compared to the gains from cheating.

What can we say about the prices p_1 and p_2 which implement the first best? If conditions (i) - (iv) are met, there exists a continuum of price pairs (p_1, p_2) satisfying (3) - (9). Note, however, that for any such price pair with $p_1 \geq \underline{v}_1 + s$, there exists another price pair (p_1', p_2') which also implements the first best, where $p_1' \leq \underline{v}_1 + s$, $p_2' = p_2 - (p_1 - p_1')$ and where

$$c - b \leq p_2' \leq v_2 - (\overline{q} - \underline{q}) . \qquad (13)$$

This price pair has a natural interpretation: B is asked to pay for the first loan what can be enforced anyway and A is compensated for her costs in transaction 1 (mainly) through the second transaction. As condition (13) shows p_2' has to be chosen such that the second

deal is sufficiently attractive to both A and B, i.e., their incentive constraints (4) and (7) have to be satisfied.

4.2. Renegotiation and Third Parties

An important question is whether a countertrade contract still achieves the first best, when A and B cannot commit not to renegotiate the initial contract. An opportunity for an ex post Pareto improvement arises off the equilibrium path. Suppose A delivered low quality in the first transaction. We have chosen p_1 and p_2 such that B is not able to finance the second deal in this case. However, A could offer to raise p_2, i.e., put in additional money, in order to rescue the gains from trade from the second transaction. B can finance the production cost c for the second good if p_2 is increased by Δ such that

$$\underline{v}_1 - p_1 + p_2 + s + \Delta \geq c \tag{14}$$

Furthermore, B has to voluntarily accept this offer. If he does so, his final payoff is given by

$$\underline{v}_1 - p_1 + p_2 + \Delta - c + b \; . \tag{15}$$

If he rejects he will only pay $\min\{p_1, \underline{v}_1 + s\}$ for good 1 and gets

$$\underline{v}_1 - \min\{p_1, \underline{v}_1 + s\} \; . \tag{16}$$

Thus, B's participation constraint requires that

$$\Delta \; \geq \; p_1 - p_2 + c - b - \min\{p_1, \underline{v}_1 + s\} \; . \tag{17}$$

A succesful renegotion offer has to satisfy both, (14) and (17):

$$\begin{aligned} \Delta \; &\geq \; p_1 - p_2 + c + \max\{-b - \min\{p_1, \underline{v}_1 + s\}, -\underline{v}_1 - s\} \\ &= \; p_1 - p_2 + c - \min\{\min\{p_1 + b, \underline{v}_1 + s + b\}, \underline{v}_1 + s\} \\ &= \; p_1 - p_2 + c - \min\{p_1 + b, \underline{v}_1 + s\} \; = \; \underline{\Delta} \; . \end{aligned} \tag{18}$$

Recall, that (4) and (6) imply that $p_1 > \underline{v}_1 + s - b$. Therefore,

$$\underline{\Delta} \; = \; p_1 - p_2 + c - \underline{v}_1 - s \tag{19}$$

If we want to make sure that A strictly prefers to deliver high quality and stick to the old contract, rather than cheating on quality in the first transaction and putting in the minimum amount $\underline{\Delta}$, the following renegotiation constraint has to be satisfied:

$$\begin{aligned} p_1 - \overline{q} + v_2 - p_2 &> p_1 - \underline{q} + v_2 - p_2 - \underline{\Delta} \\ &= p_1 - \underline{q} + v_2 - p_2 - (p_1 - p_2 + c - \underline{v}_1 - s) \\ &= v_2 - \underline{q} + \underline{v}_1 + s - c \,, \end{aligned} \tag{20}$$

or, equivalently,

$$\underline{v}_1 - p_1 + p_2 + s < c - \overline{q} + \underline{q} \,. \tag{21}$$

Note that this condition implies (6). The contract (p_1, p_2) is "renegotiation proof" if the possibility of mutually beneficial renegotiation does not offset the equilibrium, i.e., if it satisfies condition (21).

Theorem 2 *Suppose A and B can renegotiate after A has chosen q but before B decides on d. A countertrade contract (p_1, p_2) which implements the first best and which is renegotiation proof exists, if and only if in addition to (i)-(iv) the following conditions are met:*

(v) $c > \overline{q} - \underline{q}$,

(vi) $b > \overline{q} - \underline{q}$.

Proof: Let us first show that (v) and (vi) are implied by (3)-(8) and (21):

- The renegotiation constraint puts a lower bound on the net payment from B to A: $p_1 - p_2 > \overline{q} - \underline{q} + \underline{v}_1 + s - c$. Together with (3) we have

$$\overline{q} - \underline{q} + \underline{v}_1 + s - c \;<\; p_1 - p_2 \;<\; \underline{v}_1 + s \,. \tag{22}$$

This implies

(v) $$c > \overline{q} - \underline{q} \,,$$

i.e., A's gains from cheating in the first transaction have to be smaller than the total cost to produce good 2.

- Condition (4), the incentive constraint of B, imposes an upper bound on B's net payment to A: $p_1 - p_2 < \min\{p_1, \underline{v}_1 + s\} + b - c$. Together with the renegotiation constraint (21) this implies that

$$\overline{q} - \underline{q} + \underline{v}_1 + s - c < p_1 - p_2 < \min\{p_1, \underline{v}_1 + s\} + b - c \,, \qquad (23)$$

which in turn implies

(vi) $$b > \overline{q} - \underline{q} \,.$$

Again, A's incentive to cheat on quality may not be too big.

The second part of the proof, showing that (i) - (vi) imply (3) - (8) and (21) is relegated to the Appendix. *Q.E.D.*

As conditions (v) and (vi) of Theorem 2 indicate, to implement the first best quality level $A's$ incentive problem may not be too severe.[16]

There may also be the possibility to renegotiate by including a third party into the contract. Suppose there is another firm in a developed country, called C, which is specialized on marketing good 2. Suppose C is more efficient than A in carrying out the second transaction, i.e., C's valuation for good 2 is $v_2 + \epsilon$, $\epsilon > 0$. Then there is scope for a Pareto improvement by including C into the countertrade contract. Note that A owns good 2. Thus she can sell it to C for a price p_2', such that $v_2 \leq p_2' \leq v_2 + \epsilon$. B's utility is unaffected by this transaction and his permission is not required. The following theorem shows that this form of renegotiation does not offset the efficient equilibrium and actually increases the scope for countertrade:

Theorem 3 *Suppose there exists an efficient countertrade contract (p_1, p_2). Renegotiation with a third party C, whose valuation for good 2 is $v_2 + \epsilon$, $\epsilon > 0$, does not offset the efficient equilibrium induced by (p_1, p_2). Furthermore, the existence of such a third party relaxes conditions (i) - (vi) and thus increases the set of parameters under which countertrade implements the first best.*

[16] If quality is a continuous variable and if conditions v and vi are violated for the efficient quality level q^*, then it may still be possible to implement a second best quality level q, $q^* > q > \underline{q}$.

Proof: Suppose A sells good 2 to C at a price $p_2' = v_2 + \epsilon'$, $0 \leq \epsilon' \leq \epsilon$. Replacing v_2 by $v_2 + \epsilon'$ in conditions (3) - (8) and (21) relaxes these conditions. Thus, choosing high quality, paying p_1 and delivering good 2 is still an equilibrium.

Considering (i) - (vi), v_2 appears on the left hand side of (i) - (iv) and is irrelevant for (v) and (vi). Thus, increasing v_2 by ϵ' relaxes these conditions. *Q.E.D.*

Theorem 3 shows that the main disadvantage usually associated with countertrade, namely that there has to be a double coincident of needs, is not really a problem, since the parties can include a third party into the contract. In fact, this is frequently done in reality. In our empirical investigation we found that most firms in developed countries that countertrade with LDC or EE countries have a division specialized in finding an appropriate buyer for the goods imported from these countries.

It is essential, however, that A's permission for this form of renegotiation is required. If B could bypass A and sell to C directly, the efficient equilibrium would be offset. B would have no incentive to repay p_1. Instead, he would take his profit from the first transaction and turn to C. Note, however, that the second deal serves as a collateral for the first one, and that the countertrade contract promises good 2 to A. If B breaches this contract and tries to sell good 2 to C, then A can use the courts in C's country to seize good 2 as soon as it is delivered. We assume that the probability of success of this legal action is sufficiently high to make a separate deal between B and C unprofitable.

5. Theoretical Predictions and Empirical Evidence

In this section we discuss some testable predictions from our theoretical model, look for proxies for the variables we would like to measure, and estimate whether or not the derived predictions are consistent with the data on actual countertrade contracts in our sample.

5.1. Counterpurchase versus Barter

The most common explanation for countertrade is based on the observation that it tends to occur with highly indebted countries. According to this view, countertrade is a means to overcome the shortage of foreign exchange and the credit constraint of these countries.

While this is certainly true for barter, our theory suggests that there may be additional reasons which motivate counterpurchase agreements. In a barter contract, the value of the import is chosen such as to provide sufficient payment for the value of the DC firm's export. If counterpurchase were just another form of barter and motivated only by financial constraints then we would expect that both counterpurchase and barter contracts show a similar pattern of compensation ratios (value of export relative to value of import). If, however, counterpurchase is driven by other incentive problems as well, then this should be reflected by a different pattern of compensation ratios.

Hypothesis 1 *Counterpurchase contracts show a pattern of compensation ratios which differs significantly from that of barter contracts.*

We examine this hypothesis with an analysis of variance (ANOVA) of the pattern of compensation ratios and with the Kolmogorov-Smirnov test, which asks whether the sample of barter contracts and the sample of counterpurchase contracts are drawn from the same distribution. Table 5 shows the mean and standard deviation of compensation ratios in barter, counterpurchase and buyback contracts. The significance levels of both tests show that the distributions of compensation ratios are not the same, which is consistent with our model.

If counterpurchase serves different functions than barter, then this should be reflected in the variables that explain the choice between barter and counterpurchase. We would expect parties to agree on a barter contract when the only contractual problem is the financial constraint of the LDC or EE country. On the other hand, our model predicts that counterpurchase will be chosen if the LDC or EE firm wants to make sure that the DC firm provides efficient quality. This leads to our second hypothesis.

Hypothesis 2 *The contract will be counterpurchase rather than barter when there is a problem to induce the DC firm to deliver high quality technology goods.*

Table 6 presents the results of testing Hypothesis 2 using the choice between counterpurchase versus barter as the independent variable. We estimate the effect of contract

Table 5: Pattern of Compensation Ratios

	mean	standard deviation	number of cases
total countertrade	71.4	51.44	230
barter	107.4	28.77	26
counterpurchase	61.2	45.31	176
buyback	101.8	74.04	28
ANOVA	F=16.75	marginal significance .000	
Kolmogorov-Smirnov Test of barter versus counterpurchase	K-S Z = 2.6	2-tailed p= .000	

characteristics on the choice of contractual form by using a Logit specification. Consider first the results presented in column (1) of the Table. A's incentive to cheat on quality is proxied by the variable XCLASS. It is assumed here that the incentive problems are more prevalent when the DC firm delivers a whole factory or a technology rather than other types of goods. We measure B's creditworthiness with the variable DEBT. This is supposed to reflect the fact that the larger a country's outstanding debt the lower its creditworthiness.

XCLASS proved to be consistently positive and significant, independent of the specification. This suggests that the presence of technology increases the probability that the contract form will be counterpurchase relative to barter. The empirical support for the importance of DEBT for contract choice is less strong. The coefficients have a negative (though statistically insignificant) sign indicating that the parties will sign a barter agreement rather than counterpurchase when EE/LDC's debt problems are severe. This may be related to the fact, that if a country is too much indebted (if s is very small in our model), then counterpurchase may fail to implement an efficient allocation, while simple barter may still be feasible, depending on how easily a country's goods can be made to cash.

Table 6

Choosing counterpurchase versus barter: dependent variable CPURCH

	(1)	(2)	(3)
XCLASS	[11.9]	[13.3]	[17.8]
	(.002)	(.001)	(.000)
factory	2.12	2.24	2.6
	(.052)	(.041)	(.02)
machinery	1.45	1.67	2.2
	(.001)	(.001)	(.000)
DEBT	[4.14]	[3.63]	[2.61]
	(.127)	(.162)	(.271)
severly	-.72	-.68	-.74
	(.22)	(.24)	(.22)
moderately	-1.14	-1.08	-.92
	(.04)	(.057)	(.12)
HOME		-.76	-1.09
		(.127)	(.040)
XPOS			[8.9]
			(.012)
leading producer			-1.31
			(.047)
significant middle enterprise			-2.59
			(.003)
intercept	1.62	1.73	2.67
	(.001)	(.001)	(.000)
N	202	202	202
-2LL	138.2	135.9	125.4
% correct	87.1 %	87.1 %	87.0 %

Logit regressions, numbers in [ ] are Wald statistics and in ( ) p-values. A p-value smaller than .05 indicates rejection of the null at the 5 percent level.

In order to test for whether the difficulty of selling the import reduces the likelihood of barter as compared to counterpurchase, we included the variable HOME in the regression. HOME indicates that A sold the imported goods on her local market rather than in a third country. This variable is supposed to capture how easily A could sell B's goods.[17] To control for other factors, which may determine the contract choice but which lie outside our model, we introduced the variable XPOS. This controls for cases where barter was chosen so that A could effectively price discriminate between different export markets (see Caves and Marin (1992)). The results are shown in specification (3) of Table 6. The coefficients for both variables have the expected negative sign and are statistically significant at the 1 percent level. All equations correctly predict about 87 percent of the contract choices.

5.2. Counterpurchase and Compensation Ratios

Our model predicts that the extent to which the two trade flows are tied together - as measured by the compensation ratio - will be chosen such as to provide optimal incentives to both parties involved in the countertrade deal. Recall that the compensation ratio is given by the ratio of the import value to the export value, i.e., the price ratio p_2/p_1 (since quantities are fixed and normalized to 1). The model does not allow for point predictions of p_1 and p_2. However, counterpurchase implements an efficient allocation only if $p_2 - p_1$ can be chosen in an intervall the bounds of which are given by constraints (3) to (8) (and (21)). Suppose the upper bound of this interval is reduced because of a change in the exogenous variables of the model. If $p_2 - p_1$ was close enough to the upper bound, it will have to go down as well. This could be achieved by reducing p_2, by increasing p_1, or by a combination of both, all of which leads to a decrease of the compensation ratio p_2/p_1. Similarly, if a change in the exogenous variables leads to an increase of the lower bound for $p_2 - p_1$ we would expect the compensation ratio to go up. This observation leads to the following hypotheses.

[17] It is assumed here that selling abroad requires A to get more involved in the marketing of B's goods, making them less than perfect substitutes for cash. This view gets support from personal interviews with countertrade specialists who often argued that they agreed to the deal when they already had a customer for B's goods.

Hypothesis 3 *The greater A's incentive to cheat on quality the lower will be the compensation ratio.*

Let $(\overline{q} - \underline{q})$ capture A's incentive to cheat on quality. Consider conditions (3) - (8) which are conveniently expressed in terms of $p_2 - p_1$ in Appendix A. An increase in $(\overline{q} - \underline{q})$ reduces the right hand side of (7) and leaves all other constraints unaffected. (If (6) is replaced by (21) in order to guarantee renegotiation proofness, the right hand side of (21) is also reduced.) Thus, $p_2 - p_1$ is restricted to be smaller, which potentially decreases p_2/p_1. Intuitively, when A's incentive to cheat on quality increases, the contract needs to give A a larger profit in transaction 2 in order to make sure that A wants to carry out the second deal. This calls for a lower net transfer to B.

Hypothesis 4 *The lower B's creditworthiness the larger will be the compensation ratio.*

In the model, s stands for the assets A can seize in case of B's default. A decrease in s increases the left hand side of (3) and (5) as well as the right hand side of (6). Hence, lower creditworthiness is associated with a higher $p_2 - p_1$ and a higher compensation ratio. Intuitively, the smaller the contractable collateral the larger the collateral generated by the second deal needs to be in order to restore B's creditworthiness.

Hypothesis 5 *The smaller B's unverifiable benefit from carrying out the second transaction (his "reputation" gain b) the higher will be the compensation ratio.*

A decrease in b increases the left hand side of (4) and does not affect any other constraint. Thus, $p_2 - p_1$ has to be bigger which increases the compensation ratio. The reason is, that the smaller the spillover benefit on B's future transactions, the higher must be A's net transfer to B in order not to violate B's incentive to carry out the second deal.

Hypothesis 6 *The smaller A's profit from marketing good 2 the smaller will be the compensation ratio.*

A reduction of v_2 decreases the right hand sides of (7) and (8) and forces $p_2 - p_1$ (and thus the compensation ratio) to become smaller. A lower valuation of the second good makes it more difficult to satisfy A's incentive and participation constraints, and thus require a lower net transfer from A to B.

The results presented in Table 7 test for incentive effects that might drive the compensation ratio in counterpurchase contracts (excluding barter and buyback) as posed in hypotheses 3 to 6. Our theory predicts that in order for counterpurchase to provide optimal incentives we need both moral hazard problems to be present. Specification (1) and (2) test whether "quality cheating" and "loan cheating" independently and interactively explain the tying of the trade flows. As expected, the dummy variable XCLASS*DEBT which indicates the presence of both incentive problems is significant. The negative and significant coefficients on XCLASS in specification (1) and (2) are consistent with our hypothesis 3. When the developed country firm delivered technology, the contracts were designed with lower compensation ratios to increase the technology seller's stake in the second deal.

Hypothesis 4 predicts the compensation ratio to increase with the size of outstanding debt. Turning to the results in Table 7, the dummy variable DEBT, capturing B's creditworthiness, has the expected positive sign but becomes significant at conventional levels only when other variables which are relevant for the deal are included in the regression. These variables are MDIF and MPOS measuring B's and A's benefits, respectively, of carrying out the second transaction. MDIF is supposed to capture the gain in good will b that B has from carrying out the second deal. We proxy this gain with whether or not good 2 is differentiated. The idea is that when B as a new entrant on A's market sells differentiated goods he has to convince consumers about the quality of his products. Consumers learn the quality of these goods by using them. Therefore, when good 2 is differentiated, sales on A's market generate an informational externality about the quality of good 2 thereby contributing to B's future profits. In specification (3) of Table 7 the dummy MDIF is included in the regression to expose hypothesis 5 to a statistical test. The hypothesis states a smaller compensation ratio when B's good is differentiated. The results are consistent with our prediction and the inclusion of MDIF improves the overall statistical properties of the regression.

Table 7

Determining the degree of tying: dependent variable ln(COMP)

	(1)	(2)	(3)	(4)	(5)
XCLASS	-1.13	-.92[a]	-.73[a]	-.70[a]	-.77[a]
	(6.71)	(4.62)	(3.48)	(3.39)	(3.94)
DEBT	.08	.24	.34[b]	.25	
	(.49)	(1.32)	(1.88)	(1.41)	
XCLASS*DEBT		-.35[b]	-.47[a]	-.45[a]	-.46[a]
		(1.93)	(2.49)	(2.43)	(2.60)
MDIF			-.38[a]	-.39[a]	-.42[a]
			(2.57)	(2.67)	(2.84)
MPOS				.58[a]	.54[a]
				(2.71)	(2.55)
DEBT*TIME					.52[b]
					(2.09)
intercept	4.53[a]	4.48[a]	4.58[a]	4.58[a]	4.58[a]
	(28.9)	(28.4)	(28.3)	(28.7)	(29.6)
F	23.0[a]	16.8[a]	14.2[a]	13.6[a]	14.30[a]
Adjusted R^2	.20	.21	.24	.28	.29

Ordinary least square regressions of 176 observations. Numbers in brackets are t-values. Levels of significance: a = 1 percent, b = 5 percent.

Consider finally specifications (4) and (5) of Table 7 examining hypothesis 6. We proxy the profitability with which firm A can sell good 2 with the dummy variable MPOS. It is assumed here that if the market for good 2 is highly concentrated, then A's profit from marketing good 2 will be bigger. The estimated coefficient on MPOS is consistent with the hypothesis that a higher profitability of marketing good 2 tends to increase the compensation ratio. However, the inclusion of MPOS makes DEBT lose its statistical significance which suggests that the two variables are correlated. In order to avoid biased estimates due to multicollinearity, we constructed the dummy variable DEBT*TIME which selects those contracts only in which B had a severe outstanding debt and in which B received a loan that extended over one year. The idea is that the longer the period for which a loan is granted, the more uncertain is the future and thus the more serious is the creditworthiness problem. A look at specification (5) of Table 7 indeed confirmes that the replacement of DEBT by DEBT*TIME improves the statistically properties of the regression without changing the qualitative results.

6. Summary and Conclusions

This paper offers a theory of countertrade which is able to explain the stylized features of the data. We have shown that countertrade can be an efficient institution to mitigate incentive problems which are prevelant in East-West and North-South trade. The introduction of a second transaction serves as a hostage which induces both trading partners to fulfill their contractual obligations. If the DC firm delivers poor quality or if the EE or LDC company defaults on its payment the second transaction is jeopardized. This way, the tying of trade flows secures efficient technology spillovers from developed countries to Eastern Europe/LDCs and restores creditworthiness of countries with large outstanding debt. The empirical data on actual countertrade transactions seem to be consistent with the implications of our model.

Our model suggests that countertrade might play an important role in transition economies in Eastern Europe. It may mitigate two serious problems these countries face. First, their creditworthiness is poor and in some cases further deteriorating.[18] Second,

[18]In recent years Russia experienced a sharp increase in countertrade in its trade with the West. This

there is only modest direct foreign investment due to the high political uncertainty in the transition period. Thus, the amount to which foreign resources can be used to invest and promote growth and development in these countries is restricted. Under these circumstances, countertrade may become an even more important remedy to facilitate trade and finance imports of technology from developed countries.

fits well the story of our model since the increasing importance of countertrade went hand in hand with a significant deterioration of Russia's creditworthiness.

Appendix A

Proof of Theorem 1:

We have to show that if (i)-(iv) hold, then there exist (p_1, p_2) satisfying (3)-(8). Note, that if $p_1 \geq \underline{v}_1 + s$, then only the difference $p_2 - p_1$ matters in conditions (3)-(8), and we are free to fix the absolute value of p_1 as we like. For example, we can set $p_1 = \underline{v}_1 + s$. Thus, without loss of generality, we can restrict attention to prices $p_1 \leq \underline{v}_1 + s$. Rewriting conditions (3)-(8) and substituting $p_1 = \min\{p_1, \underline{v}_1 + s\}$ we get:

$$A \equiv -\underline{v}_1 - s < p_2 - p_1 \tag{3}$$

$$B \equiv c - b - p_1 < p_2 - p_1 \tag{4}$$

$$C \equiv c - \overline{v}_1 - s \leq p_2 - p_1 \tag{5}$$

$$p_2 - p_1 < c - \underline{v}_1 - s \equiv D \tag{6}$$

$$p_2 - p_1 < v_2 - \overline{q} + \underline{q} - p_1 \equiv E \tag{7}$$

$$p_2 - p_1 \leq v_2 - \overline{q} \equiv F \tag{8}$$

These conditions impose some restrictions on the choice of p_1. Upper bounds on p_1 are imposed by (4) and (6):

$$p_1 > \underline{v}_1 + s - b \equiv G\,, \tag{9}$$

and by (4) and (8):

$$p_1 > c - b - v_2 + \overline{q} \equiv H\,. \tag{10}$$

Lower bounds on p_1 are imposed by (3) and (7):

$$p_1 < v_2 - \overline{q} + \underline{q} + \underline{v}_1 + s \equiv I \tag{11}$$

and (5) and (7):

$$p_1 < v_2 - \overline{q} + \underline{q} - c + \overline{v}_1 + s \equiv J \tag{12}$$

We can find a p_1 within these bounds if and only if $G < I$, $G < J$, $H < I$, and $H < J$.

$G < I$ is implied by (i), $G < J$ is implied by Assumptions 1 and 3, $H < I$ is implied by (i) and (iii), and $H < J$ follows from (i) and (ii).

Pick any p_1 satisfying (9)-(12). There exists a p_2 such that (p_1, p_2) satisfy (3)-(8) if $A < D$, $A < E$, $A < F$, $B < D$, $B < E$, $B < F$, $C < D$, $C < E$, and $C < F$.

By the choice of p_1, we know already that $A < E$, $B < D$, $B < F$, and $C < E$. $A < D$ is trivially satisfied. $A < F$ is equivalent to (iii), and $B < E$ is equivalent to (i). $C < D$ follows from $\overline{v}_1 > \underline{v}_1$. Finally, $C < F$ is implied by (ii). *Q.E.D.*

Proof of Theorem 2:

We have to show that if (i) - (iv) hold, then there exist (p_1, p_2) satisfying (3)-(8) and (21). Recall that (21) implies (6). The proof follows the lines of the proof of Theorem 1, where (6) is replaced by (21):

$$p_2 - p_1 \;<\; c - \underline{v}_1 - s - \overline{q} + \underline{q} \;\equiv\; D' \tag{21}$$

This tightens the upper bound imposed on p_1. (4) and (21) impose:

$$p_1 > \underline{v}_1 + s - b \;\equiv\; G' \,. \tag{13}$$

Note that $G' < I$ is implied by (i) and (v), and $G' < J$ is implied by (i) and Assumption 1. Thus, we can find a p_1 satisfying (10) - (12) and (13).

Pick any such p_1. There exists a p_2 such that (p_1, p_2) satisfy $A < D'$, $A < E$, $A < F$, $B < D'$, $B < E$, $B < F$, $C < D'$, $C < E$, and $C < F$. By choice of p_1, $B < D'$. $A < D'$ is equivalent to (v), while $C < D'$ is implied by Assumption 1. The other inequalities have been checked in the proof of Theorem 1 already. *Q.E.D.*

Appendix B

THE DATA

We approached companies engaged in countertrade who have a division located in Austria. These are either firms producing in Austria, or subsidiaries of multinational enterprises with their own inhouse countertrade division located in Austria, or other firms in OECD countries which use an international trading firm in Vienna to carry out the countertrade transaction. Thirty 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. Each firm was asked to provide information on about 40 aspects of each countertrade transaction.

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. The deals included in our sample are mostly very large in size, ranging from US $ 8400 to US $ 635 million with a mean of US $ 11.1 million.

DEFINITION OF VARIABLES

XCLASS	type of product exported to EE or LDC. A dummy variable set equal to one if the product is plant or machinery. XCLASS is used also as a categorical variable with (1): factory, (2): machinery, and (3): others.
DEBT	A dummy variable set equal to one if the country has been classified as severly indebted by the World Bank in 1987. DEBT is used also as a categorical variable with (1): severly indebted, (2): moderately indebted, (3): other country.
XCLASS*DEBT	A dummy variable set equal to one if the country has been classified as severly indebted and if the export to EE/LDC is technology.
MDIF	A dummy variable set equal to one if the imported good from EE/LDC is differentiated in design or quality or both.
MPOS	A dummy variable set equal to one if EE/LDC is leading producer with the good exported to developed country. MPOS is used also as a categorical variable with (1): leading producer, (2) significant middle enterprise, (3): follower firm.
HOME	A dummy variable set equal to one if the developed country firm sold EE/LDC's product on the local market.

XPOS — market power of DC firm; categorical variable with (1): leading producer, (2): significant middle enterprise, (3): follower firm.

DEBT*TIME — A dummy variable set equal to one if the contract extended over one year and if the country was classified by the World Bank as severly indebted.

COMP — compensation ratio. Continuous variable running from 2 to 400. Value of import from EE/LDC in percent of export values to EE/LDC.

CPURCH — A dummy variable set equal to one if the contract is counterpurchase and zero if the contract is barter.

Table B1: Form of Contract

		Counterpurchase [87.1]	Barter [12.9]
1. Pattern of exports to EE and LDCs			
technology, know how	72.1	92.4	7.6
others	27.9	73.2	26.8
statistical significance: 1%			
2. Indebtedness			
severly indebted	28.7	84.5	15.5
moderately indebted	30.2	82.0	18.0
other countries	41.1	92.8	7.2
statistical significance: n.s.			

Chi-square test performed, N=202 excluding buyback contracts; numbers are row percentages except for numbers in [ ] brackets which are column percentages.

Table B2: Tying of Trade Flows

	compensation ratio		
	< 100 % [49.1]	100 % [36.5]	> 100 % [14.3]
1. Trade Pattern			
Exports to EE and LDCs			
technology and know how	59.0	32.9	8.1
others	19.6	46.4	33.9
statistical significance: 1%			
Imports from EE and LDCs			
homogenous products	39.8	48.1	12.0
differentiated products	55.2	27.6	17.2
statistical significance: 1%			
2. Indebtedness			
severly indebted	39.2	33.8	27.0
moderately indebted	47.8	50.7	27.6
other countries	58.6	27.6	13.8
statistical significance: 1%			
3. Competitive conditions for exports from EE and LDCs			
leading producer	25.0	50.0	25.0
significant middle exporter	36.4	45.5	18.2
follower firm	55.8	32.7	11.5
statistical significance: 1%			
4. Contract form			
barter	7.7	69.2	23.1
counterpurchase	59.1	29.5	11.4
buyback	25.0	50.0	25.0
statistical significance: 1%			

Numbers are row percentages except for numbers in [ ] brackets which are column percentages. N=230.

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