# BARTER IN INTERNATIONAL TRADE: A RATIONALE

Erwin AMANN
Dalia MARIN

Forschungsbericht/
Research Memorandum Nr. 257

October 1989

## ABSTRACT

Barter is a trade practice in which goods are accepted as payment for other goods. The paper provides a rationale for why it might be efficient for agents to use barter rather than a traditional cash transaction in international trade. More specifically, the paper argues, that barter can be viewed as an exchange in international trade which represents a rational response to market distortions. Thus, barter can be understood as a second–best outcome in the presence of market imperfections. The welfare gains due to the reduction of these distortions might outweigh the losses due to higher transaction costs when the advantages of money–mediated exchange are circumvented.

## 1. INTRODUCTION

In the last ten years countertrade has become a growing phenomenon in international trade. Estimates vary between 5% and 40% of world trade (see OECD 1985, IMF 1984 and Business International 1984). Countertrade can be described as a trade practice which involves some sort of reciprocity. Goods and services are accepted as either full or partial payment for other goods and services. Among countertrade transactions three main forms of contracts can be distinguished: barter, counterpurchase, and buy-back. The contracts differ from each other in terms of two features of the transaction. First, the temporal incidence of the exchange of the two sets of goods. Second, the economic and/or technical relation of the types of products exchanged. Barter is basically a spot transaction in which the two sets of goods are exchanged at more or less the same time while counterpurchase and buy-back are long term in nature in which both sides of the transaction are separated temporally with contract lenght of typically one to five years for counterpurchase and five to ten years for buy-back. In barter and counterpurchase transactions there is no technical association between the original products sold and those bought back, while in the case of buy-back the original sale consists of machinery or a complete plant and the repurchase is some fraction of the output produced by the equipment. In contrast to barter in which no money is used in the transaction, counterpurchase and buy-back involve two linked but financially separate transactions since each commodity flow is payed in foreign exchange.

Countertrade has often been viewed as an irrational trade device since the countries involved are seen to considerably restrict their trading opportunities. Instead of selling their exports to the highest bidder and, with the proceeds, buy their imports in whatever market they choose, the advantages of money-mediated exchange are seen to be circumvented by returning to an ancient and inefficient form of exchange (see OECD 1983). Therefore, countertrade is seen by official bodies of the west to represent a threat to the multilaterial world trading system as well as to the economic welfare of the countries concerned. Its proponents, in turn, argue that countertrade is a necessary vehicle to facilitate the development process in many countries and thus is seen to eventually lead to increased world trade.

There are two popular explanation for the occurence of countertrade. One is that countertrade is seen as a way of overcoming the constraint on development imposed by a shortage of hard-currency thereby increasing imports above what they would otherwise have been. High interest payment on foreign debt and reduced export prospects due to recession and protectionism are seen to have contributed to the shortage of hard currency in the countries imposing countertrade. However, in order for countertrade to be effective in overcoming foreign-exchange shortages, it must lead to an increased supply or decreased demand for hard currency for a given amount of imports. Barter eases the need for foreign–exchange since no foreign–exchange is used in the transaction which simultaneously reduces demand and supply for hard currency. However, it does not create additional foreign–exchange and therefore, cannot be effective in easening the foreign–exchange constraint in the countries concerned. Counterpurchase and buy–back, in turn, do not even help to reduce the need for foreign–exchange, since these forms of countertrade involve two linked but financially separate transactions (see Banks 1983). The other frequent explanation is that countertrade is seen as a way of promoting a country's exports by committing the western exporter to take the country's products in return which is seen to help the producing country to win market shares at the expense of other countries. Countertrade is seen to stimulate exports because the countries imposing it (usually the CPE's and the LDC's) are seen to have a comparative disadvantage in marketing their exports which countertrade helps to overcome. However, if these countries were to have a comparative disadvantage in marketing their exports, why don't they purchase marketing services from western trading companies for cash? Why are these countries taking recourse to countertrade in order to stimulate exports when other least costly policies with the same outcome are available? At face value, countertrade seems to be a rather inefficient means of marketing a country's exports. Both explanations seem, therefore, to have only limited explanatory power.

This paper focusses on barter as the most puzzling form of countertrade since virtually no money is used in the transaction.[1)] Although barter is the less frequent form of countertrade, still 9 per cent of countertrade with centrally planned economies (CPE's) and 26 per cent of countertrade with developing countries LDC's take the form of barter (see Marin 1988). The paper provides a rationale of why it might be efficient for the LDC's and the CPE's to use barter as an export promoting policy. More specifically, the paper argues that barter can be viewed as a mutually beneficial form of contract in international trade which represents a rational response to market distortions on western markets. Barter contracts can, therefore, be understood as corrections of these distortions and thus as a second best outcome. The welfare gains due to the reduction of these distortions might outweigh the losses due to higher transaction costs which arise when the advantages of money–mediated exchange are circumvented.

The paper is in four sections. In section 2 the basic model is worked out which shows why agents might prefer barter to a traditional cash transaction. Section 3 then looks at the bargaining over the contract conditions and explores the factors determining the gains from barter trade and its distribution among the bargaining agents. Furthermore, the section analyzes how the bargaining

---

1) For the other forms of countertrade see Amann/Marin (1989).

outcome will be modified when the bargaining period is extended. In the appendix the proofs on the existence of the equilibria in the one and multiperiod game under incomplete information are shown. Finally, section 4 summarizes the arguments and discusses some welfare implications of this form of trade.

## 2. THE MODEL

The model consists of two players: a firms X in a western industrial country which produces the good $G_X$ and wants to sell the product in a CPE or in a LDC, and a party M (a firm or a Foreign Trade Organization) which buys $G_X$ and wants to oblige X to accept its products $G_M$ as payment for $G_X$. In other words, in order to get entry into M's market, X has to commit himself of buying and marketing M's product. Assuming that both X and M are risk neutral, M's utility function is given by

$$(2.1) \qquad V_M = \max \{-p_X G_X + (p_M - c_M) G_M \, , \; -p_X^c G_X\}$$

where $p_X^c$ is the cash price for X's product $G_X$, $p_X$ is the barter price for $G_X$, $p_M$ is the barter price for M's product $G_M$ which is produced with marginal costs $c_M$. M's utility of doing barter relative to buying in cash will be the greater the lower the barter price $p_X$ relative to the cash price $p_X^c$ and the higher the price–cost margin on $G_M$. Note that M has the outside option of buying an identical good $G_X$ for cash from somebody else than X, while he is dependent on the barter agreement for selling his product on western markets. It is assumed that M is faced with an informational and marketing barrier to entry in western markets which prevents him from exporting his product in a traditional cash transaction. This entry barrier arises because M lacks the information on the market conditions for his product which X is supposed to possess.

X's utility, in turn, is given by

$$(2.2) \qquad U_X = \max \{ (p_X - c_X) G_X + (p_M^* - p_M) G_M \, , \, 0 \}$$

where $c_X$ is X's marginal costs, and $p_M^*$ is the price at which X can sell M's product on the world market. X's utility of doing barter increases with the price–cost margin on $G_X$ and with the world market price $p_M^*$ that X gets when selling M's product relative to the barter price $p_M$ that X has to pay to M for the purchase of $G_M$. It is assumed here that X has no outside option of selling his product to M for cash which is supposed to capture the entry barrier that X faces in M's market. Thus, the barter deal can be viewed as an exchange of entry into each others market.

Firm X is assumed to be able to help M overcoming the entry barrier to the western market since he is supposed to have private information on the world market price $p_M*$ while M's knowlegde over $p_M*$ is incomplete (his beliefs about $p_M*$ are represented by a probability distribution $F(p_M* \leq x) = e^{-1/x^2}$ with density $f(p_M* = x) = 2/x^3 \; e^{-1/x^2}$). This asymmetry in information between X and M puts M in the position to make X's entry into his market contingent on his own entry into X's market.

Furthermore, it is assumed that $p_X G_X = p_M G_M$ i.e. the compensation ratio is 100 per cent which means that X commits himself of buying goods of equal value as his original export sale.[2)]

Given the profit functions (2.1) and (2.2) there will be gains from barter trading to be split between the two parties X and M if

$$(2.3) \qquad \frac{p_X^c}{c_M} - \frac{c_X}{p_M*} \geq 0$$

$p_X^c/c_M$ represents the marginal terms of trade at which M will still be ready to agree to the barter deal. This terms of trade has the feature that X gets the cash price for his product whereas M's price equals his marginal costs. $c_X/p_M*$, in turn, is the marginal terms of trade at which X will still find it profitable to accept the agreement. At this terms of trade X's price equals his marginal costs while M gets the cash world market price for his product. Thus, in order for trading to take place the agreed upon barter terms of trade $p_X/p_M$ has to lie in the interval $[p_X^c/c_M, c_X/p_M*]$ which leaves a net surplus to both X and M.

From the condition for gains from barter trade (2.3) it can be seen why M would prefer to do barter rather than to use a traditional cash transaction with the involvment of a western trading house. Condition (2.3) implies that there will be gains from barter trade only if X has some monopoly power ($p_X^c > c_X$) and/ or if M produces a competitive product ($c_M < p_M*$). Barter becomes an attractive option to M if his product is not competitive on the world market ($c_M > p_M*$) for whatever reason. One possible reason for $p_M* < c_M$ would be that goods from CPE's and LDC's have a lack of a reputation or even a bad reputation among western consumers so that they can be sold only at a discount while they are, in fact, competitive products.[3)] When M's product is not competitive on the world market he can use barter to absorb some of X's profit

---

2) Most barter transactions have this feature, whereas in the other forms of countertrade the size of the compensation ratio is part of the agreement and thus subject to negotiations.

3) There is some empirical evidence supporting this see Marin (1988).

margin in order to subsidize the export of his product into the western market. X will agree to the bargain since the transaction provides him with entry into M's market and leaves a net surplus to him. When $p_M* < c_M$ holds, M would not find a western trading house with knowledge over $p_M*$ which would be ready to provide him with the marketing services for cash at the price $p_M = c_M$. Thus, M has the alternative of selling his product via a trading house for cash with a net loss or to export his product via barter with a net surplus. If the reason for $p_M* < c_M$ is a reputational barrier to entry then the rationale for using barter to overcome the entry barrier will eventually disappear as western consumers learn about the true nature of the product.[4] M will, however, also want to use barter when his product is competitive on western markets, since barter puts him in the position to force the western firm X to sell its product at a more competitive price thus constraining X in exploiting his monpoly power in M's market. Thus, the model implies that barter would not make any sense for the CPE's and LDC's in the absence of any distortions on western markets.

## 3. THE BARGAINING

In the last section the interval has been defined within which the agreed upon barter terms of trade $p_X/p_M$ has to lie in order for barter to take place. This section discusses the factors on which it will depend where in the range of feasible terms of trades the actual bargaining outcome will be located determining how the gains from trade are devided between X and M.

As $p_X G_X = p_M G_M$ holds, the payoff functions (2.1) and (2.2) can be reduced by a linear transformation to the following form

(3.1) $$U_X \tau = \mu\tau - c_X$$

(3.2) $$V_M = k - \mu$$

where $\mu$ stands for the barter terms of trade $p_X/p_M$, $\tau = p_M*$ characterizes the western firm of type $X^\tau$ that faces the world market price $p_M*$ and $k = p_X^c/c_M$ is M's marginal terms of trade at which he will still accept the barter agreement.

4) In a personal interview with one of the authors western countertraders confirmed this by complaining that once a countertrade good sells well on western markets it disappears from the countertrade shopping list.

The bargaining is modeled as a finite game under incomplete information. In each period player M is supposed to make an offer of some $\mu$ which X can accept (a) or reject (r). If there is no agreement before or in period T the outside option (no barter) is adopted. In the reduced form this means that both players payoff becomes zero. Defined in this way, the game captures two features of barter transactions. First, M is considered to make always the offer which is supposed to reflect that M is very often a powerful Foreign Trade Organization which controls foreign trade in many of the CPE's and LDC's. Second, the players bargain over the terms of trade at which both commodity flows are exchanged rather than sequentially over each side of the transaction which is supposed to capture the one contract feature of barter transactions[5].

Two questions will be analyzed in the remaining section. First, how are different sizes of X's market power (X's price-cost margin $p_X^c/c_X$ on western markets) on the one hand and different levels of M's competitiveness (M's marginal costs $c_M$) on the other affecting the bargaining outcome. More specifically, does a greater degree of X's monopoly power and/or M's competitiveness increase (decrease) M's ability to shift the terms of trade in his favour? Second, how is the bargaining outcome modified upon increasing the number of bargaining periods T i.e. which of the two players is gaining from an increased bargaining period?

### 3.1 One Period Game

The main features of the one period game are captured by Figure 1.

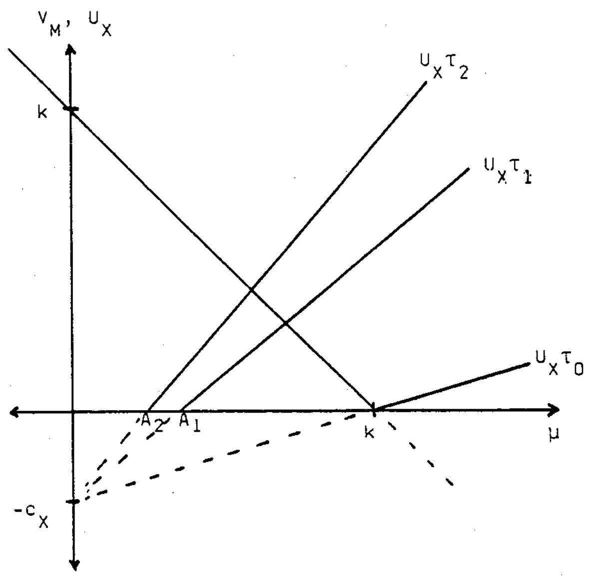


Figure 1

5) In contrast to barter, in the other forms of countertrade two contracts are signed in which each side of the transaction is specified separately.

It shows the payoffs of player M and of the different types of player $X^{\tau}$ depending on the terms of trade agreed on. M's payoff is a declining function of $\mu$, whereas X's payoff increases with $\mu$. The point k represents M's marginal terms of trade at which his payoff is zero and X's payoff is at the maximum (he gets all the gains from barter trade). The points $A^1$ and $A^2$, in turn, are X's marginal terms of trade (depending on which world market price $p_M{}^*$ he faces) at which his payoff is zero and at which those of M is at the maximum. The distance between the A's and k define the range of possible terms of trades at which an agreement is feasible, while beyond these points the outside option is adopted since either X's or M's payoff would become negative as indicated by the dashed lines.

It can be seen from equation (3.1) and Figure 1, respectively that the best-response for player $X^{\tau}$ is given by

$$BR(X^{\tau}) = X^{\tau} = \begin{cases} \text{(a) if} & \mu \geq c_X/\tau \\ \text{(r) if} & \mu \leq c_X/\tau \end{cases}$$

Let $\tau^*(\mu)$ be the marginal type that is indifferent between (a) and (r) then the unique equilibrium response for any player

$$X^{\tau}\ (\tau > \tau^*) \text{ is } X^{\tau} = \text{(a)}$$

and

$$X^{\tau}\ (\tau < \tau^*) \text{ is } X^{\tau} = \text{(r)}$$

respectively. This gives the expected payoff with $F(x \geq \tau) = e^{-1/\tau}$ for player M

(3.3) $$E\,V_M(\mu) = (k - \mu)\ \{1 - F(\tau^*)\} = (k - \mu)\ \{1 - e^{-\mu/c_x}\}$$

M's equilibrium strategy $\mu^*$ is thus obtained by

(3.4) $$\mu^* = \arg\max\ (k - \mu)\ \{1 - e^{-\mu/c_x}\}$$

The first and the second order conditions become

(3.5) $$e^{-\mu/c_x} - 1 + (k-\mu)/c_X\ e^{-\mu/c_x} = 0$$

(3.6) $\quad -1/c_X\, e^{-\mu/c_X} - 1/c_X < 0$

Knowing X's best response to his offer, M will choose his $\mu*$ in such a way as to maximize his expected payoff. Although M will try hard to make an offer that X will accept (he will maximize his payoff and the probability of X's acceptance) since any agreement has a higher expected payoff to him than the outside option of no barter, there is still some probability that no agreement will be reached. As M can only make one offer, this might turn out to be such that X facing a certain $p_M*$ might not find it profitable to agree to it.

THEOREM 1: The bargaining game $\Gamma_{T=1}$ has a unique set of payoff equivalent subgame perfect equilibria.

PROOF: see Appendix

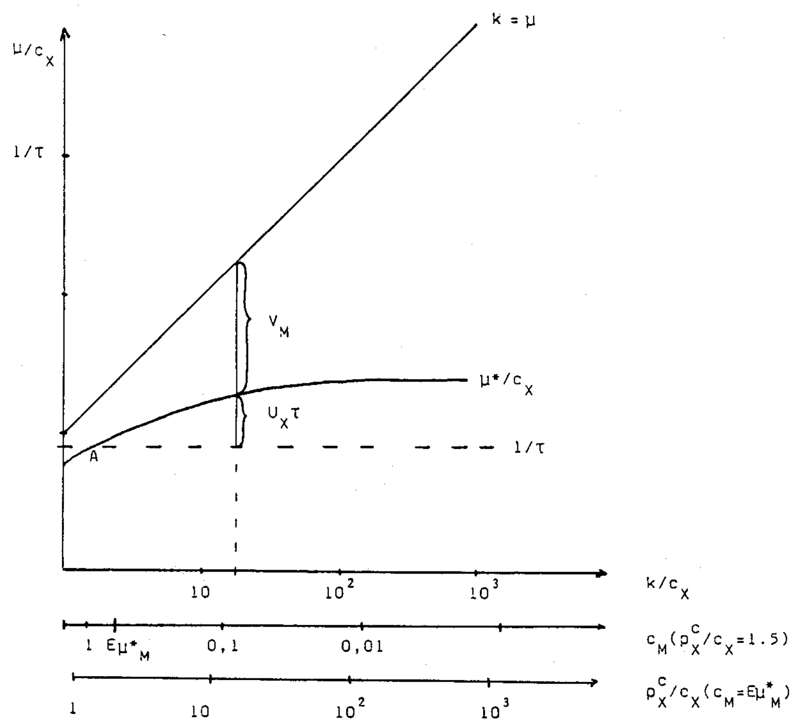


Figure 2

Figure 2 shows how changes in X's monopoly power and changes in M's competitiveness are affecting the bargaining outcome. The vertical axis gives the agreed upon terms of trade divided by X's marginal costs (which equals $1/\tau$) while on the horizontal axis $k/c_X$ is measured which is an increasing function of X's price-cost margin $p_X^c/c_X$ and a declining function of M's marginal costs $c_M$. At the $k=\mu$-line M's payoff is zero. For a given western firm of type $X^\tau$ (as drawn by the horizontal line $1/\tau$), the gains from barter trade can be seen by the distance between the $1/\tau$-line and the $k=\mu$–line whereas the $\mu^*/c_X$–curve shows how the gains are split between X and M. The higher X's price–cost margin the greater will be the gains from trade and the more favourable will the bargaining outcome be for M. At point A the western firm of type $X^{\tau}$ is indifferent between accepting and rejecting M's offer while M gets the whole gains from trade. As X's market power increases, both X and M gain from the increased gains from trade up to the point where only M can improve his relative bargaining outcome. The intuition behind this result is that when X has a very high profit margin, M will know that he will not increase the probability of X's acceptance by offering a higher more favourable $\mu$ to X (the $\mu^*/c_X$–curve becomes flat) which weakens X's relative bargaining position. In other words, a high profit margin signals to M that he can make a more unfavourable offer which X is going to accept with the same probability as a more favourable one no matter how low the world market price $p_M^*$ might be.[6] Thus, X's market strenght puts him in a weak position in the bargaining with M. An increase in M's competitiveness (a decrease in his marginal costs) works in a similar way. The more competitive M's product on the world market, the more likely will it be that X will accept a lower and less favourable terms of trade offer, thereby improving M's bargaining outcome. In this case, however, the stronger M's market position, the stronger his bargaining position. Thus, by improving his bargaining position, barter creates an incentive for M to increase his competitiveness and makes it more unlikely that M will use barter just for selling a not competitive product without any uncerlying comparative advantage.

### 3.2 Multiperiod Game

The picture changes somewhat when the bargaining period is extended to two periods. Now M has two chances to make an offer of $\mu$ and X has to decide whether he should accept (reject) M's offer in the first or in the second period. When X rejects M's offer in the first period, this reveals to M information on the distribution of $p_M^*$ (or on the types $X^{\tau}$), which helps him to make a more informed offer in the second period.

Having full knowledge over M's equilibrium strategy $\mu_T$, $\mu_{T-1}$ X's strategy in the last period T is the same as in the one period game. He will accept M's offer if $\mu \geq c_X/\tau$. In the first period T–1, player $X^{\tau}$'s best–response will be

6) When the compensation ratio is less than 100 per cent as is often the case in the other forms of countertrade, a sufficiently high profit margin makes X to accept the barter deal even when $p_M^*=0$. When the profit margin is sufficiently high, X can afford to throw M's good away with a net profit. Countertrade deals with a discount of 100 per cent have this feature, but they are not occuring frequently see Marin (1988).

$$BR(X^{\tau}) = X^{\tau} = \begin{cases} (a) \text{ if } & U_X\tau(\mu_{T-1}) = (\mu_{T-1}\tau - c_X) \geq \delta U_X\tau(\mu_T) = \delta(\mu_T\tau - c_X) \\ (r) \text{ if } & \leq \end{cases}$$

He will agree to the today offer $\mu_{T-1}$ if his utility of accepting M's offer today will be greater than the discounted utility of accepting (rejecting) tomorrow. The marginal type $\tau_{T-1}$ that is indifferent between accepting today or tomorrow is defined by

$$\tau_{T-1} = \frac{(1-\delta)c_X}{\mu_{T-1} - \delta\mu_T} \qquad (\mu_{T-1} > \delta\mu_T)$$

so that the equilibrium response for any player

$$X^{\tau}_{T-1}\ (\tau > \tau_{T-1}) \quad \text{is} \quad X^{\tau}_{T-1} = (a)$$

and

$$X^{\tau}_{T-1}\ (\tau < \tau_{T-1}) \quad \text{is} \quad X^{\tau}_{T-1} = (r)$$

respectively which gives the expected payoff for player M in the last period

(3.7) $$E\,V_M^{\ T} = (k-\mu_T)\ \{F(\tau_{T-1}) - F(c_X/\mu_T)\}$$

and in the first period

(3.8) $$E\,V_M = (k-\mu_{T-1})\ \{1-F(\tau_{T-1})\} + \delta\ (k-\mu_T)\ \{F\ (\tau_{T-1}) - F\ (\tau_T)\}$$

M's optimal action $\mu_T$ $(\mu_{T-1})$ is thus determined by the first order conditions

$$\frac{\delta EV_M^{\ T}}{\delta\mu_T} = 0 \quad \text{and} \quad \frac{\delta EV_M}{\delta\mu_{T-1}} = 0$$

THEOREM 2:

The bargaining game $\Gamma_{T=2}$ has a unique set of payoff equivalent sequential equilibria.

PROOF: in the Appendix

Figure 3 illustrates the decision problem from X's perspective in the two period game. On the horizontal axis the different types of player X are given, while the vertical axis shows the payoffs of X and M, depending on which type player X is (whether he faces a high or low $p_M$*) and depending on wether X agrees to the barter deal in the first or the second period. Given M's offers $\mu_{T-1}$, $\mu_T$ there are two marginal types of player X. The marginal type $\tau_{T-1}$ who is indifferent between accepting M's offer in the first T−1 or the second period T. He is defined by the point where the two payoff functions for the periods T and T−1 intersect. The other marginal type is $\tau_T$ who is indifferent between accepting and rejecting M's offer in the second period. He is defined by the point where the payoff function for the second period $\delta\ U_X(\mu_T)$ intersects with the horizontal axis. The strong dark line indicates the equilibrium and defines the intervals in which agreement will (or will not) be reached in the first or second period. Types of player X facing a favourable world market price $p_M$* for M's product will be located in the interval $\tau_{T-1}$, $\infty$ and thus will accept M's offer in the first period, and types of X who are located in the interval $\tau_T$, $\tau_{T-1}$ will agree in the second period, while X–types between 0, $\tau_T$ will reject M's offer. Note that M's payoff does not depend on which world market prics $p_M$* X will get when selling M's product, since M always gets the absolut amount k−$\mu$ of the gains from barter trade. M, nevertheless, needs to take $p_M$* into account, since it decides on the probability of X's acceptance for which M does care. M's payoff does, however, depend on the period in which it comes to an agreement. M's payoff will be lower in the second period T because of two reasons. One is that if X rejects in the first period, M's offer in the second period will need to be more favourable to X in order to make him accept. The second reason is that if M prefers an agreement today to one tomorrow (his time preferences are such that the discount $\delta < 1$) then this will be reflected in a lower utility in the second period.

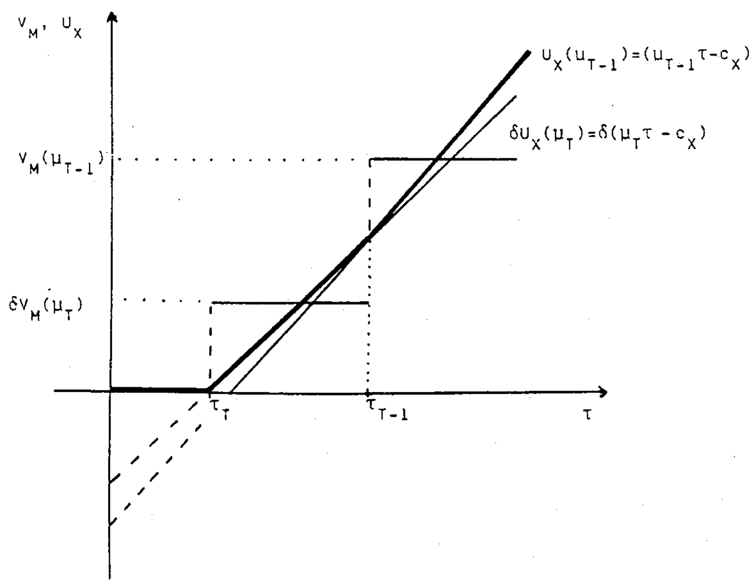


Figure 3

Figure 4 compares the bargaining outcome in the one period game with that of the two period game from M's perspective. It shows the density distribution of the types of player X facing a certain $p_M$* (or the density distribution that M has over $p_M$*) $f(x=\tau)$. The area between $\tau_{T-1}$ to $\infty$ gives the probability of an agreement in the first period, the area between $\tau_T$ to $\tau_{T-1}$ measures the probability of X's acceptance of M's offer in the second period, whereas the area between $\tau^*$ to $\infty$ is the probability that X will accept the terms of trade offered by M in the one period game. As can be seen from the Figure the probability of a barter agreement increases with the number of bargaining periods. The reason for the increased probability is that by making two offers of $\mu_{T-1}$, $\mu$ M reveals information on the distribution of X-types $\tau$ he is faced with. After X's acception (rejection) of M's offer in the first period, M decides on his optimal $\mu_T$ in the second period on the basis of the constrained information set $(0, \tau_{T-1}]$ instead of $(0,\infty)$ of the distribution. The price that M pays for the increased probability of X's acceptance in the two period game is, however, that M will need to offer to X a more favourable terms of trade compared to the one period game (namely $\mu_T$ instead of $\mu^*$).

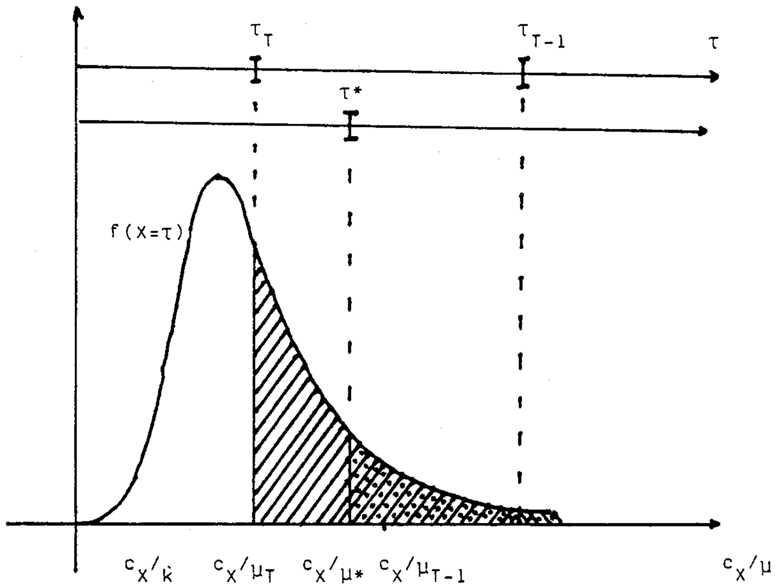


Figure 4

## 3.3 Interpreting the Results

We have shown that barter can be interpreted as a second-best outcome when market distortions are present. In the model described in section 2 the market distortion is reflected in the monopoly power of the western firm X which the agent M (from the CPE or the LDC) wants to constraint by using barter. There is an alternative way in which the model can be interpreted which might explain the high frequency of barter trade in LDC's and OPEC countries. Suppose the market distortion takes the form of the agent M being a member of an international cartel (like

OPEC or the International Bauxite Association) and/or of joining an International Commodity Agreement (which exist i.e. for coffee, cocoa, rubber, sugar etc.), then M might want to undercut the cartel price (the price agreement) when he is faced with surplus capacity. One way of doing it without violating against the cartel regulations is to use barter. The lack of transparency in barter makes it a vehicle for hidden price cuts. M sells his good at the official price and takes an overpriced good from X. In this case it is the existence of market impediments on M's side which M wants to circumvent that provides the rationale for barter.[7)]

## 4. SUMMARY AND CONCLUSIONS

This paper has developed a simple game theoretical model explaining international barter. It turns out that barter makes only sense in the presence of some market distortions. Barter allows to shift some of the monopoly profit away from the western firm to the CPE's and the LDC's who, in turn, use the profit gain to subsidize their exports. This explains why it might be efficient for these countries to use barter rather than a traditional cash transaction. One possible bargaining outcome migh take the form of the western firm selling its product at a lower than the usual cash export price which, in turn, allows the CPE's or the LDC's to export their products below marginal costs. The import of more competitively priced goods will make consumers in the countries imposing countertrade better off. Whether the export subsidy as well will increase welfare in these countries will depend on i) whether the product that is subsidized through barter has an underlying comparative advantage and ii) whether the CPE's and LDC's face a reputational barrier to entry on western markets due to western consumers having incomplete information on the quality of the goods from these countries. Then the bad reputation of goods coming from the LDC's or CPE's will change among western consumers only after having some experience with them. Under these circumstances the barter induced export subsidy migh be welfare improving.[8)]

Thus barter might be defended on two grounds: On the import side (from the perspective of the LDC's and the CPE's) it might lead to more competitive import prices thereby increasing consumer welfare[9)]. On the export side barter works like an export subsidy for which there might be a case due to an infant industry argument for protectionism when the LDC's and the CPE's face a reputational barrier to entry in western markets.

---

7) Market specialist estimate that 10 to 20 per cent of OPEC's oil exports were bartered in 1984 see Banks (1983).

8) For the conditions under which an export subsidy might be welfare improving in face of a reputational barrier to entry see Grossman/Horn (1988) and Mayer (1984).

9) Barter does not always lead to more competitive import prices since there are bargaining outcomes possible in which the barter export price $p_X$ might be above the cash export price $p_X^c$.

## 5. Appendix

THEOREM 1. *The bargaining game $\Gamma_{T=1}$ has a unique set of payoff equivalent sequential equilibria.*

Remark 1: The only feature that is not uniquely determined is the strategy of the type $X^\tau$ that is indifferent between $(a)$ and $(r)$ . Since this set is of measure zero and the probability distribution has no atoms, the expected payoff for player $M$ remains unchanged.

PROOF: Since there is only one negotiation period the decision problem for player $X$ reduces to wether accepting the offer or choosing the outside option leads to a higher payoff:

$$\begin{aligned} BR(X^\tau) = x^\tau = & \quad (a) \quad \text{if} \quad U_{X^\tau} = \rho\tau - c_x \leq 0 \\ = & \quad (r) \quad \text{if} \quad \rho\tau - c_x \geq 0 \end{aligned}$$

This gives an expected payoff for player $M$

$$V_M(\rho) = (k - \rho)\{1 - F(c_x/\rho)\}$$

The first order condition together with $F(z) = e^{-\frac{1}{z^2}}$

$$2\frac{\rho(k-\rho)}{c_x^2}e^{-(\frac{\rho}{c_x})^2} - \{1 - e^{-(\frac{\rho}{c_x})^2}\} = 0 \tag{5.1}$$

respectively the second order condition

$$\{4(\frac{\rho}{c_x})^3 - 4(\frac{\rho}{c_x})^2\frac{k}{c_x} + 2\frac{k}{c_x} - 6\frac{\rho}{c_x}\}e^{-(\frac{\rho}{c_x})^2/c_x} = P_3 e^{-(\frac{\rho}{c_x})^2/c_x} < 0$$

determine the equilibrium strategy of player $M$. The polinomial $P_3$ has a uniqe zero in $(0, k)$ . This gives a unique maximum $\bar{\rho}$ for the left hand side (LHS) of equation (5.1) in this interval. The LHS is positive in $(0, \bar{\rho}]$ and negative for $\rho = k$. By the mean-value-Theorem this proves existence. Monitonicity of the LHS on $(\bar{\rho}, k)$ and the fact that SOC does not hold for $\rho = 0$ proves uniqueness.

THEOREM 2. *The bargaining game $\Gamma_{T=2}$ has a unique convex set of payoff equivalent sequential equilibria.*

PROOF: The payoff for player $X^\tau$ in equilibrium is:

$$U_{X^\tau} = \begin{cases} \rho_{T-1}\tau - c_x & \text{if} \quad x^\tau_{T-1} = (a) \\ \delta(\rho_T - c_x) & \text{if} \quad x^\tau_{T-1} = (r) \quad x^\tau_T = (a) \\ 0 & \text{if} \quad x^\tau_{T-1} \quad = \quad x^\tau_T = (r) \end{cases}$$

Defining $\tau_T = c_x/\rho_T$ resp. $\tau_{T-1} = \frac{(1-\delta)c_x}{\rho_{T-1}-\delta\rho_T}$ as in the proof of Theorem 1:

$$BR_t(X^\tau) = x^\tau_t = \begin{array}{ll} (a) & \text{if} \quad \tau > \tau_t \\ (r) & \text{if} \quad \tau < \tau_t \end{array}$$

This determines the equilibrium action $\rho_T$ of player $M$ in the last period:

(5.2)
$$\frac{2\rho_T(k-\rho_T)}{c_x^2} e^{-(\rho_T/c_x)^2} - \{F(\tau_{T-1}) - F(\tau_T)\} =$$
$$\frac{2\rho_T(k-\rho_T)}{c_x^2} e^{-(\rho_T/c_x)^2} - \{1 - F(\tau_T)\} + \{1 - F(\tau_{T-1})\} = 0$$

Since (5.2) has a unique solution in [0,k], and it fulfilles the second order condition, increasing $\{1-F(\tau_{T-1})\}$ resp. decreasing $\tau_{T-1}$ increases the equilibrium action $\rho_T$. This gives a unique rest point $\rho_T(\rho_{T-1})$.

Thus the equilibrium strategy in the first period is determined by:

(5.4) $$\rho_{T-1} = argmax(k - \rho_{T-1})\{1 - F(\tau_{T-1})\} + \\ + \delta(k - \rho_T)\{F(\tau_{T-1}) - F(\tau_T)\}$$

under the condition (5.2):

(5.3) $$\rho_{T-1} = \delta\rho_T + (1-\delta)c_x\sqrt{(\frac{\rho_t}{c_x})^2 - ln\frac{2\rho_T(k-\rho_T)}{c_x^2} + 1}$$

The expected payoff reformulates to

(5.5)

$$(1-\delta)(k-c_x)\sqrt{(\frac{\rho_t}{c_x})^2 - ln\frac{2\rho_T(k-\rho_T)}{c_x^2} + 1}\{1-e^{-(\frac{\rho_t}{c_x})^2 - ln\frac{2\rho_T(k-\rho_T)}{c_x^2}+1}\}+$$

$$+\delta(k-\rho_T)\{1-e^{-(\frac{\rho_T}{c_x})^2}\}$$

respectively with $y \doteq c_x\sqrt{(\frac{\rho_t}{c_x})^2 - ln\frac{2\rho_T(k-\rho_T)}{c_x^2} + 1}$

$$((5.6)) \qquad (1-\delta)(k-y)(1-e^{-(y/c_x)^2}) + \delta(k-\rho_T)(1-e^{-(\rho_T/c_x)^2})$$

The same argument as in the proof of Theorem 1 completes the proof.

## REFERENCES


AMANN, E. and MARIN, D. (1989), Long term Contracts in International Trade, mimeo

BANKS, G. (1983), The Economics and Politics of Countertrade, The World Economy 2, 159–182

GROSSMAN, G. M. and HORN, H. (1988), Infant–Industry Protection Reconsidered: The Case of Informational Barriers to Entry, Quarterly Journal of Economics, 4, 767–787

MARIN, D. (1988), Assessing Countertrade, Report to the European Community, DG I, Florence

MAYER, W. (1984), The Infant–Export Industry Argument, Canadian Journal of Economics, 12, 249–69

deMIRAMON, J. (1985), Countertrade: An Illusionary Solution, OECD Observer

OECD (1981), East–West Trade: Recent Developments in Countertrade, Paris