WORKING PAPER NO 10
ECONOMOPOULOS FUND

MULTILATERAL BARTER EXCHANGE SYSTEM WITH CREDIT LEVERAGE OPTION

BY

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Introduction

We propose an electronic exchange system desired to promote multilateral trade of goods in a business to business (B2B) market. The goal is to **partly overcome substantial liquidity shortage and excessive inventory levels by utilizing on information technology to match multilateral trading needs not served by the monetary medium of payment**. First, we formulate the mechanics of aggregate exchange as a set of bilateral transactions that link buyers and sellers into a closed network throughout time. Second, we then restructure the network via regrouping bilateral transactions into **multilateral barter trades, suppressing the required circulating liquidity and its cost to only a fraction of its original level**. Third, the remaining settlement requirements can be covered by the **issue and circulation of system designed credit units within this electronic market which is based on a customer specific leverage of cash deposits.** Fourth**, these cash deposits act as collateral insurance against probable malpractices and protection against fraud, default and quality mismatches of trades of participating customers**. Fifth, the proposed system **communicates with existing barter exchange systems** in order to enlarge the market potential of the orders entered in the proposed system. Sixth, the proposed system tends to **control prices and this reduces price variation** as transactions are settled with a series of product swaps rather than monetary exchange.

Financial benefits for the system authority arise from managing the cash pool created by **subscription** and **order fees**, **interest** from cash deposits and **commercial advertisements**.

Alternative Electronic Systems

There are a large number of web-based "barter" exchange systems serving millions of customers internationally. Modern barter is perceived as trade without the use of national currency or other monetary medium of exchange. Multilateral bartering is based on the exchange of IOUs (I Owe U) issued by the system, usually referred to as barter-credits, barter-units, barter-dollars or credit-units. They are essentially a form of e-tokens and e-coupons. In large B2B exchange markets where taxation issues emerge they are units of a legal private currency accepted by the members of the barter network. These barter systems are based on **trust** and are **not able to secure internally with collateral against fraud, default and quality mismatches** except via price quote variation and ex post system access denial.

Here is a list of such barter exchange sites:

- Ormita Commerce Network (http://www.ormita.com/)
- National TradeBanc (http://naionaltradebanc.com)
- Biz 2 Biz Commerce (http://www.biz2bizcommerce.com/)
- Community Cretits.com www.communitycredits.com,
- Barter Your Way http://www.barteryourway.com/

A smaller number of barter exchanges promote traditional barter in the form of goods and services swap. The most popular such site is the non-commercial U-Exchange (http://www.u-exchange.com/). These barter swap systems **cannot handle multilateral trades, no credit is extended and no means of collateral against fraud, default and quality mismatches** is provided except price quote variation and ex post system access denial.

The system we propose does accommodate modern barter, but also promotes historic barter to its multilateral exchange version due to advanced information exchange and communication facilitated by today's enhanced technology. Traders can always exchange goods for barter-units through bilateral transactions, but they can also trade through multilateral transactions where they buy from one trader and sell to another. Furthermore, they are able to protect their deals with required cash deposits and settle their trades with system credit units whose leverage is based on these cash deposits that are not cleared fully by multilateral barter. They can also connect with other available barter exchange computer systems to search for trades with members of these systems. Finally, the system minimizes price variation encountered with monetary exchange since it clears and settles deals with a series of closed product and service swaps.

Trading networks and multiparty deals

Market activity formulation

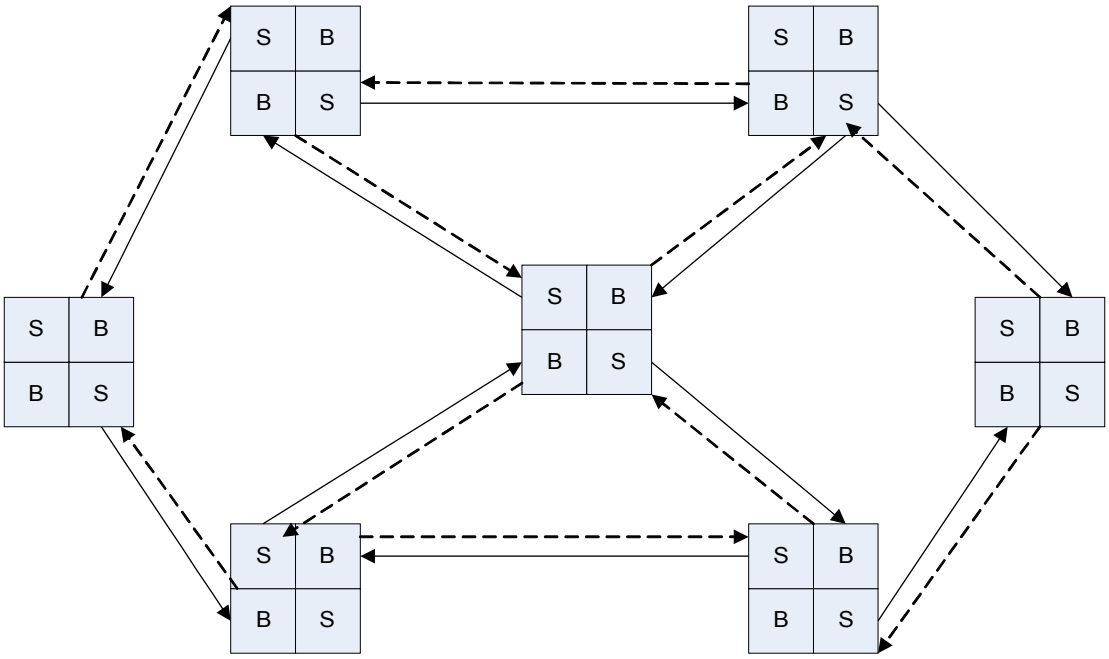
Trades involve opposing counterparties and pricing variation is the outcome of the transaction process. A unit with a long position seeks to buy from a counterparty making an effort by varying the duration search which brings a decreasing **discount** on the spot price. A unit with short position seeks to sell from a counterparty making an effort by varying the duration search which brings a decreasing **premium** on the spot price. When the trade is consummated and the duration is positive and equalized the interaction involved from the transaction of opposing counterparties brings a discount which at the maximum is equal to the product of the squared duration and trade. When the trade is at corner solutions where only the party that has the lowest transaction cost searches and the other sells at spot, the result is either the max premium if the seller searches or the max discount if the buyer searches. Otherwise, the trader that searches more because he has the lowest transaction cost has the advantage receiving either a net discount (buyer) or a net premium (seller) from the spot price. This idea can give an alternative formula of price variation if we include a duration cost factor to get present values for reasons of ex ante comparisons and decision making.

Notice that in the presence of a computer system that processes electronically and simultaneously virtual searches and communicates trade information, the duration

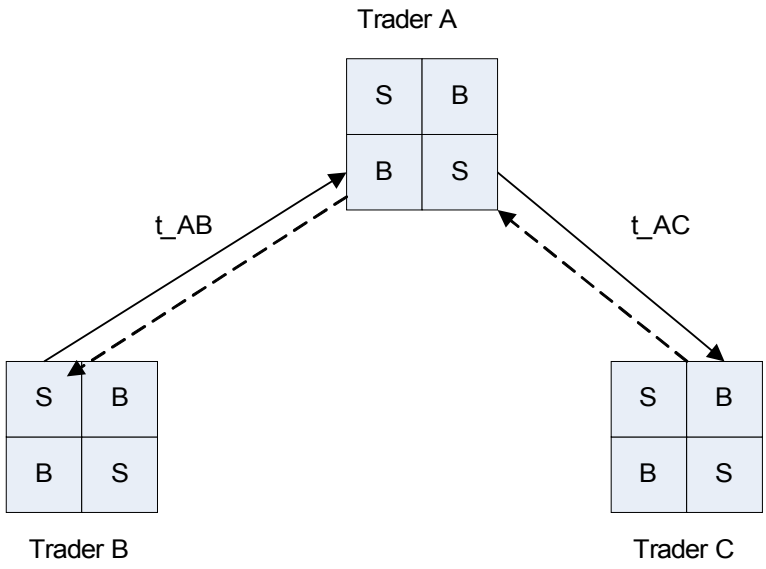
cost and the discount factor are minimized to the level required by imperfection conditions (asymmetry, heterogeneity, dispersion, disintegration) of products and services that distort their trade.

We view market participants as the trade carriers of supply and demand for **duration** of the **transaction sequence of search, negotiation, clearance and settlement**. The core mechanism for performing trading is the transaction, a bilateral exchange of goods and finance for monetary media of exchange. A fragment of market activity can be projected into a network of counterparty nodes connected via transaction arrows. We are interested to facilitate activities whose nodes are all interconnected as coincidence either directly or through other nodes, while most counterparties take both sides of variable trade. The latter is the key feature to our exchange system. This means that ideally, counterparties are able to simultaneously exchange information, negotiate, clear and settle trade in similar time/space duration and variable content (quality, quantity). We first elaborate the idea at its cell level and then expand it to larger market scale.

What follows is a typical graphical representation for the kind of market activity that takes place in a monetary market economy. Each bilateral transaction is represented by a double arrow; the bold component represents the exchange of asset, while it's dashed counterparty the exchange of cash/credit. Assets are directed from short position (sell) to long (buy), while the opposite is true for cash. For reasons of simplicity we assume only three (3) traders in this example.



Consider the simple case of a trader A buying an asset from trader B and selling another asset to trader C over a period of time. Theoretically, if there is duration horizon (space, time) coincidence all transactions can be executed with pure barter exchange. In reality, there is no such coincidence of economic relations and this requires exchange with a monetary medium that accounts, clears and settles the transactions.



In this case of asymptotic trades that require horizon duration search, there are two distinct possibilities:

- After appropriate horizon duration search, Trader A carried the purchase towards trader B first (t_AB < t_AC). This implies sufficient cash and horizon duration was available to trader A at the beginning of the period, facilitating the buy action.

- After an appropriate but not the same duration horizon of the previous case, Trader A sold his own asset for cash to trader C first and then performed the buy from trader B using this cash (t_AB > t_AC). This is a typical scenario under conditions of liquidity and credit shortage to trader A. Despite demand meeting supply, limited liquidity/credit constraining trader A delays transactions and slows activity down. Notice that this sale duration horizon has an opportunity cost that can be compared with the cash cost of the direct trade in the previous case.

Multiparty trading

Our ultimate target here is to introduce a mechanism that allows traders that have assets/products/services for offer to settle directly their buy orders and cover up for any liquidity and /or credit shortage, reduce the sale opportunity cost and provide collateral in order to settle the deal. In the presence of excess demand order by a buyer we want the buyer's asset that is effectively used as collateral to be complemented with system provided liquidity as credit leverage is required for his buy trade to be accomplished.

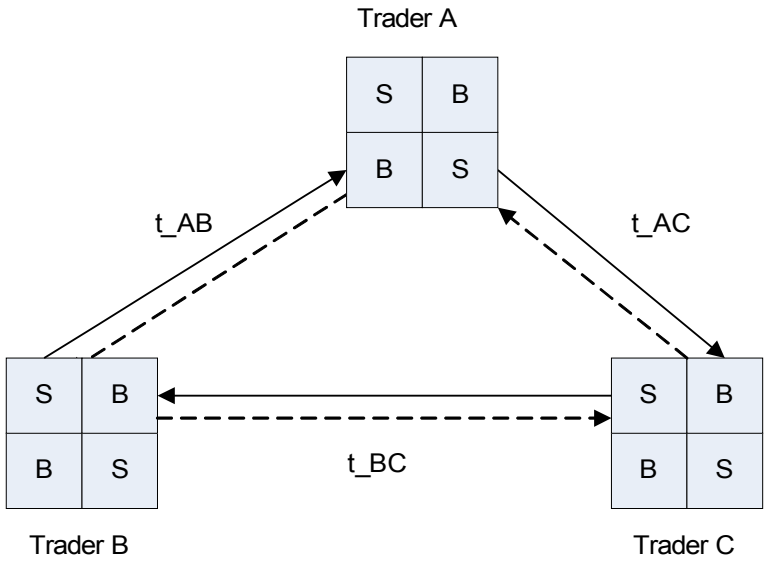
In a conventional approach a buyer would use assets as collateral of equal or more value on a loan deal providing him with cash to carry out the buy order. This approach simply tackles the problem by injecting the ex ante missing liquidity from additional resources. It would not really promote the deal with less cash; it would simply introduce extra counterparties as intermediaries (lenders) and bilateral credit transactions (borrowing/lending) in the activity subject to a cost. Furthermore, it does not close the transaction if there is a remaining balance between the buy and the sale value including the loan cost.

Although we do not exclude credit from transaction activity, our computerized system processes the information required to facilitate these trades, minimizing liquidity requirements at a limited cost. All counterparties, three traders in this case, become members of the ***same*** **multiparty deal**. The corresponding market activity in the case of this system is not a set of asymptotic bilateral transactions with considerable price and terms negotiation. Instead it is realized as one **multilateral transaction coordinated to involve a) simultaneous bilateral exchange of assets within a limited search horizon and negotiation; b) system injected as required credit at limited cost without external intermediation**. **The computerized system has the comparative advantage of a) minimizing negotiation and price variation since the trade is a simultaneous multilateral deal and b) generating the information that determines and provides electronically the adequate credit required to settle the multiparty transaction**. This adequate credit covered with **deposit collateral** is necessary and sufficient to close discrepancies in time, space and content of bilateral transactions.

In real life all traders are in the position of trader A, limited in their trades by **problems of search/negotiation coordination, incomplete information and liquidity shortage**. One very realistic case would be that traders are in a difficult financial position during periods of recession and banking crisis. In this case *all* members of the multiparty deal are coordinated by the system to join at both sides of trades with the rest of the counterparties.

The size of such trade networks relates to the diversity of the content (quantity, quality) and the time/space horizon over the range of products traded in the market. A trivial peer to peer network consists of two traders, each interested in the other's quantity and quality of product subject to an appropriate horizon cost. This is close to an original barter exchange, up to the product value difference which still needs to be covered by cash or credit leverage.

The simplest non-trivial local area case involves three traders:



In real markets that have been facilitated by the circulation of traditional forms of monetary exchange media, it is extremely unlikely that such cases of small networks can be created. In national B2B markets one would expect such networks to involve dozens or even hundreds of traders. It is the ultimate purpose of this project to provide market participants with an electronic system that enables them to search, find, connect with each other and coordinate their transactions in order to create such networks.

Exchange System and Trading Mechanics

We now can explain the main process architecture. First, the system is allowed to generate trade/credit units used to account and settle transactions which are accepted by system participants.

Deal creation process

Potential traders can access the computer (web-based) system and perform their electronic market search by paying a small subscription fee. They can navigate manually and/or setup a criteria-based automated search with a possible electronic notification. They can then place their own composite buy-sell orders which can be detected and accessed by other traders.

As soon as matches are found for the buy or sell part of the order, the negotiation process begins. Prices are expressed in a popular currency or, equivalently, in system (trade/credit) units of fixed rate to such currency. As soon as negotiations are terminated, counterparties can proceed to the next stage of "Engagement". This consists of the generation of a formal bilateral contract that binds the parties between them and the system authority. At this stage point the traders have to place an order deposit in cash or system trade units equal to a percentage of the exchange value of the contract which is determined by the credit worthiness of the trader. This varies by the experience of past trades and serves as an insurance premium against potential malpractice by the trader in the event he fails to meet his trade obligation or make subsequent trades that repay any extended credit.

A trader must engage to at least two bilateral agreements, since he/she takes both trade sides. The total deposit should not need to exceed a predetermined fraction of the most expensive value among the bilateral transactions or equal any value gap between his demand and sale order. Hence, there is always a possibility that a trader may place a deposit only at the process of his/her first engagement.

When a trader engages into bilateral agreements across all assets assigned to the order, he/she enters into a state of "Pending Allocation". As soon as a bilateral transaction network cycle closes, the multilateral agreement has been cleared and the multi-party deal can move towards settlement. The order status of the participating traders moves into "Pending Confirmation".

Each trader order consists of both a buy and a sell side whose values can be expected to differ. If the sell value is higher then it fully covers the buy cost and there is no need for additional cash or system credit. In the opposite case, the traders account must have sufficient balance to cover fully or partially the difference. Borrowing cash or system credit units is an option. The credit level is determined by the trader's credibility and system activity. If the trader has sufficient funds or system credit to cover her part of the deal, she can proceed to the next stage of "Pending Global Confirmation". When every participant has moved to such stage, the deal has been confirmed and status switches to "Pending Settlement".

When a trader confirms a deal he acquires the legal obligation to complete the settlement according to the rules specified by the parties and the system authority. The assets under trade must be rigorously specified since any dispute may end up in a court of law.

Reaching to such a multiparty agreement can take considerable time for reasons associated to the original levels of supply and demand, the diversity of products involved and, of course, the negotiations. The system employs a number of tools to help traders avoid wasting their time waiting, but also support the creation of a potential deal throughout its formation process.

As far as helping traders gain a picture of the electronic market options and their potential for completion, the system allows them to view the status of unclosed trade network deals of other counterparties before they chose to engage with them. They

can even try "pre-engage" with them and see the prospects when their two unclosed network cycles get joined. If they realize that the chances of reaching a multiparty deal are higher with a counterparty offering a possibly lower offer/higher bid price, they may opt for this trade. Given that time delay has a cost, the complicated nature of multiparty deals changes significantly the behavior of traders. They can even e-connect with other electronic systems to find trading partners and close deals with them.

Furthermore, the system is designed to discourage traders from dumping bilateral agreements on the way to a deal formation. New orders are placed all the time and it is likely that some of them will attract traders already invoked into an agreement. Although one can not expect the agreement to be pending for ever (the network may never close), a minimum duration must be required as part of the bilateral agreement. Breaking it outside a withdrawal period implies an effective penalty equal to the order deposit. Whoever exits the agreement beyond this period and prior to its expiration is not allowed to engage the order again. If both parties want to exit, then they share the penalty by having half of their deposit returned.

Settlement

As soon as all parties confirm the deal the traders' accounts are credited or debited, while the delivery process initiates straight away. If all traders receive their assets and are happy with them, then full settlement has been accomplished. In any other case the deal outcome is partial settlement.

Full settlement failure is down to two reasons:

- One or more traders failed to deliver the assets to the counter party at the demand side of their bilateral agreement.
- One or more traders are not satisfied with the assets they have received.

In all cases counterparties have the option to resolve their disputes directly or use the system for corrective financial transactions, but they can always do it privately outside the system. Should this fail, any party can make use of the legal aspect of the agreement and take the case to court.

Any member, who does not receive her asset or rejects it with probable cause, can claim compensation from the system authority. Her deposit can be leveraged to the compensation amount. The leverage level depends on the agreed value of the failed trade activity. A highly credible member will receive a cash/credit amount very close to the value of the undeliverable asset. In case the member wins further compensation in court, she must return the original amount to the system authority.

Fees

The system charges a) **subscription fees** and b) **trade fees** as a percent of trade value which are paid by the required cash deposit in the account of the member trader. Furthermore, the system receives **credit interest** from lending cash to settle any uncovered balances that require monetary payment rather than credit units and pays **deposit interest**. The system also charges **fees for commercial ads/banners** displayed by the system interfaces of transaction.

The Theoretical Model

Economopoulos (2011) presents a theoretical framework that discusses the trade process and the market mechanism in the general context of the orientation process of transaction occurrences. A trade transaction $f(X^*)_{IJ}$ engages a market mechanism with forces of clearance $f(X)_{IJ}$ and settlement $f(X^*)_{IJ}$, where $(X)_{IJ}$ is the amount of the trade for good (I=1,….k) under terms (J=1,….m) in any of the settlement unit and $(x)_{IJ}$ refers to the corresponding change or deviation in trade as an outcome of the market mechanism. A trade clearance as exchange, production, investment or transfer occurs with means of barter, credit, equity and pools of resources and funds and a trade settlement of the above sequences occurs with terms of payment of funds, debt finance, barter units, revenue, equity and resource shares. However, these forces of clearance and settlement face a number of problems that distort the market mechanism beyond the marginal propensity to trade or trade change slope and they must be addressed if trade methods and the resulting agreements are to be optimal.

The first problem of distortion is the result of frictions and imperfections that materialize during the process of trade contact among discrete counterparties and each transaction structure is subject to imperfections of heterogeneity, asymmetry,

dispersion and non integration. These frictions and imperfections block the completion of the process and the remainder term (trade burden) needs to be covered by market access so the mechanism can clear and settle the trade effectively. Mathematically, this trade burden cover or market access equilibrium can be shown to be approximately equal to one half of the squared deviation or change in trade [1/2 $(x_{ID}^*)^2$], assuming linearity at this point [$f''(X_{ID}) = 1$]. However, if we allow for complexity interactions, the attempt to cover the exposure to the trade burden is constrained by entropy of this attempt, allowing only a partial access and curvature at this point. This partial access, using the Lagrange approximation of the remainder term, can be expressed asymptotically as a continuous logarithmic share of the burden and the access entropy is maximized at the value which is equal to the burden estimate minus the partial access of this trade by the market counterparties. After some algebraic manipulations, the partial access factor can be expressed as equal to [$(\delta + \delta^2/2 + \delta/3! + ...)(x_{ID}^*)^2/2$], where ($\delta$) is the entropy parameter. Furthermore, this must be multiplied by the intensity of trade interaction which can be expressed by the ratio of the number of trade incidents relative to the population of trade trials $(n/N)_{ID}$. Thus the market mechanism must be automated in order to minimize the entropy effect upon trades.

The second problem of distortion is the float shortfall that results from the asynchronous incidence of the clearance and settlement processes of trade occurrences. This is dependent on a number of factors as follows; first, on the horizon (t) of the trade burden allowed to be covered by the market mechanism. The larger is the horizon of the market mechanism, the smaller the float which tends asymptotically to zero. Assuming the settlement process variance or squared deviation/change of trade $(x_{ID}^*)^2$, is the default steady state of this transaction, the float depends on additional parameters; (α), the adaptive/learning coefficient of generation during each trade point of the clearance path process and (β), the smoothing coefficient of allocation at each trade point of the clearance path process of the transaction.

Furthermore, the float shortfall is multiplied by the intensity measure of trade interaction which as mentioned earlier is equal to the ratio of the number of trade incidents relative to the population of trade trials $(n/N)_{ID}$. In summary, we specify the float as an adaptive/learning exponential smoothing process of the non synchronicity

between the clearance and settlement forces of the market mechanism of the trade. Again, the market mechanism must be automated in order to minimize the asynchronous incidence of the forces operating trade transactions.

Third problem of distortion facing the market mechanism is the uncertainty and convention factors introduced by the trade search activity ($Y(n/N)_{\text{Ɪ}}$). This means that an additional term of the trade burden needs to be covered which expresses the protection against ignorance of trade decision options and the organization against conservation of trade practices. This is mainly exhibited as a function of a switch factor of interaction among traders (θ) that shocks the trade process and the intensity measure or market efficiency of trade interaction $(n/N)_{\text{Ɪ}}$. This relationship can be specified as a Bernoulli process in order to make the effect linear. Notice that (θ) values outside a certain bifurcation range bring instability and multiple equilibria of trade agreements. As the intensity measure increases, this trade effect is reduced, so if the market mechanism is automated, raising incidents of trade, and trade search activity is minimized, the uncertainty/convention factors are reduced and shock effects from (θ) tend to lose significance.

$(Y(n/N))_{\text{Ɪ}}$ is a general solution to a differential equation that presents an expression factor of a shift of deviation of the trade adjustment. This shift is a non-increasing function of (n/N) only and is independent of other aspects of the trade adjustment. The differential equation of the adjustment factor is of the general form $[dY_{\text{Ɪ}}/d(n/N)_{\text{Ɪ}} = h_{\text{Ɪ}}(Y, (n/N))]$ and takes a specific non-linear form $[dY/d(n/N) + RY = TY^{\kappa+1}]_{\text{Ɪ}}$, where R, T are functions of (n/N). This equation is referred as a Bernoulli equation and can always be reduced to a corresponding linear differential equation and solved accordingly. If $(\kappa+1=2, \kappa=1)]$ and assuming (R=T=(n/N)), then the equation becomes, $[dY/d(n/N) + (n/N)Y = (n/N)Y^2]_{\text{Ɪ}}$. The general solution of the uncertainty/convention effect is equal to $[Y(n/N)_{\text{Ɪ}} = \{(\theta(1+ (n/N)^2 + (n/N)^4/2)+....)_{\text{Ɪ}} + 1\}^{-1}]$.

Finally, we must allow the possibility of disturbance from random/stochastic processes that can be expressed as a normal geometric motion sequence which can be explicitly modeled as the square root of the trade burden cover or market access $(x_{\text{Ɪ}}^*)^{1/2}$ of the settlement process times the square root of the intensity measure of trade interaction $((n/N)_{\text{Ɪ}})^{1/2}$, or $[(x^*)^{1/2}(n/N)^{1/2}]_{\text{Ɪ}}$.

The expression of the polynomial function of the trade transaction f(X*) is equal to,

$F(X^*)_{IJ} = [\ X^* + f'\ (X^*)(x^*) - (\delta+\delta^2/2 +\ldots)(x^*)^2/2 + (\alpha + \beta)^t/2(x^2 - (x^*)^2)]\ (n/N) + \{(x^*)(n/N)\}^{1/2} + \{(\theta(1 + (n/N)^2 +(n/N)^4/2+\ldots) +1\}^{-1}]_{IJ}$.

This trade expression for product (I) under terms (J) must be minimized by automating the market mechanism with the appropriate utilization of information flows recorded in accounts by the mechanism with the exception of the random/stochastic component that corresponds to the random error of the mechanism that can only be hedged by a cash/credit balance. Notice that as (n/N) rises reflecting more market efficiency, the uncertainty/convention effect disappears but the other terms get larger.

Notice that the market mechanism corresponds to a community mechanism that overlaps or disjoins the boundaries of private transactions as traders are also members of this community mechanism. A community develops institutions whose authority regulates trade mechanism transactions by supplying public goods with common traits that facilitate the conversion of trade across products and terms of payment by sharing value as units of account, deposit and transaction settlement; they accomplish this service at a minimum cost as units of reserve and velocity of settlement. On the other hand, the clearance process is established when private goods with proprietary traits trade at price terms of conversion and technical efficiency of substitution.

The private initiative of trade clearance as expressed in markets is engaged either by price variation or elasticity of substitution. This is regulated by the settlement authority exercised either by velocity variation of payment terms or reserves variation of the common currency or unit of trade due to credit creation to finance payment. Trade clearance as traders compete and partner with price variation must involve a fixed stock of payment units whose velocity slope of circulation adjusts accordingly in order to cover the price variation. On the other hand, trade clearance as traders compete and partner with technical efficiency of substitution must involve a variable stock of reserves to cover credit variation required by this substitution and product differentiation. The community mechanism reaction function matches at the

equilibrium trade slope or marginal propensity to trade [f′(X*)(x*)], and stabilizes the terms of clearance with the terms of settlement.

When, the stock of reserves is given (i.e., gold), the velocity slope (f′(V)) is equal to the price slope (f′(P)) and when the velocity of circulation for the units of settlement remains fixed, the reserves slope (f′(R)) which stabilizes the credit creation slope is equal to the substitution or output productivity slope (f′(a)), so [f′(X*)(x*) = {f′(V) + f′(R)}(x*)].

As explained in Economopoulos (2011) private traders with comparative advantage seek to limit public regulation of the market mechanism (liberalization) and this means that the community reaction function is terminated and the propensity to trade is satiated. The equilibrium trade slope tends to zero, the velocity slope equals the opposite of the reserves slope and the output slope equals the opposite of the price slope in order for settlement and clearance to balance; and if the market mechanism functions optimally the trade amount is fixed at (X*), a higher level of output with the minimum (P), gaining externalities of output. Notice that deregulation destabilizes the market mechanism as trade change required to equilibrate the trade transaction clearance is denied, in the event that any of the distortion factors analyzed above materializes. In this case, the settlement function does not adjust to balance clearance accordingly.

On the other hand, private traders with comparative power seek to "capture" regulation and enforce the limited market access effect which restricts market trade and allow for the float shortfall to happen, so f(X*) corresponds to a higher (P) collecting a rent premium equal to the sum of the partial market access effect and the float shortfall with a higher velocity slope for a given reserves and credit level and this destabilizes the market mechanism. If the market efficiency (n/N) rises, comparative advantage and comparative power of traders is reduced and this causes deregulation and "capture"/lobby pressures to be terminated.

The model can be enhanced further if we realize that each trade for product (I) and Terms (J) triggers a series of trades for this product subject to the same terms. Assuming the same propensity to trade or [$f(X_{IJ}^*) - (X_{IJ}^*)$], across each derived trade, we have a geometric series of trades which is equal to [{1- $((f(X_{IJ}^*) - (X_{IJ}^*))^n$/

$1 - ((f(X_{IJ}^*) - (X_{IJ}))\} X_{IJ}^*]$, where (n) is the number of incidents of trade, and as n-→infinity the nominator converges to unity. This model can be generalized further if we allow for the trade of all goods (I) under all terms (J) which is not done here although an appropriate computer system can do this subject to the proper algorithm.