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by

Georgi Trofimov

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Postadress
Box 5501
114 85 Stockholm

Gatuadress
Industrihuset
Storgatan 19

Telefon
08-783 80 00
Telefax
08-661 79 69

Bankgiro
446-9995

Postgiro
19 15 92-5

TRADE AND MONETARY POLICY IN A PURE EXCHANGE MODEL OF INTERNATIONAL TRADE[1]

Georgi Trofimov

IUI, Box 5501, S-11485
Stockholm, Sweden;
The Market Economy Institute
Russian Academy of Science, Krasikova st.32, 117418,
Moscow, Russia.

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ABSTRACT: Optimal trade and monetary policy is studied under imperfect competition of trading firms. The economy exercises monopoly market power in international trade. Economic authorities use price control on exports and monetary interventions to maximize the welfare of households. The optimal policy is equivalent to maximization of net nominal trade of the country by means of terms of trade control. The "law of one price" is fulfilled in a modified form, in terms of reservation-purchasing price ratios. Under optimal trade and monetary policy the exchange rate does not depend on currency for which the exported good is traded.

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1. Introduction.

Optimal trade and monetary policy is studied for a (home) country large enough to exercise monopoly power in the world market. The country is completely specialized and able to follow independent monetary policy using a managed floating exchange rate regime. Its citizens are endowed with a real asset - a tradable non-consumer good which is exchanged for a consumer good produced outside the country. The trade between the country and the rest of the world is intermediated by oligopolistic foreign trading firms. They use currency exchange for transaction purposes, while households trade in the currency market in order to adjust their holdings of nominal assets. Both parties face financial constraints that determine their trade in the currency exchange and liquidity positions in other markets.

The government and the monetary authority keep control over the price of the real asset and the nominal exchange rate. They agree on the welfare-maximizing trade and monetary policy and act as a Stackelberg leader with respect to both trading firms and households. Both economic authorities are able to precommit themselves to an optimal pricing rule and monetary intervention. The main purpose of the paper is to describe optimal policy and to examine welfare implications of the open-doors regime, when all artificial (e.g. institutional and informational) barriers to trade are removed.

As it is shown, optimal trade and monetary policy can be implemented through two simple rules. According to the first rule, the government should maximize the nominal volume of export and to the second - the central bank has to maintain the zero balance of payments. Both policies are implemented separately and economic authorities do not have to coordinate their actions.

It turns out that welfare-maximizing trade and monetary policy are equivalent to a specific trade policy rule, stating that *net nominal trade* of the country is maximized by means of terms of trade control, given the floating exchange rate regime. (We mean by net nominal trade of the country the nominal volumes of exports and imports less the monopoly surplus of trading firms.) This result spreads the terms of trade argument for a tariff to the case of perfectly coordinated trade and monetary policy.

The "law of one price" does not hold in the usual sense, but it is fulfilled in modified form, in terms of reservation-purchasing price ratios. Purchasing power parity, however, holds in the limit case of perfect competition, when the number of trading firms tends to infinity. Competition of trading firms is beneficial for both domestic households and the world market. The latter gains, because the foreign asset price in this case is twice lower to the level, when there is no trade.

Finally, it does not matter under the optimal trade and monetary policy, whether the real asset is traded in domestic or in foreign currency. The optimal exchange rate as well as the welfare of consumers and profits of trading firms are not influenced by a pattern of trade in the domestic market.

These conclusions differ from the earlier research on issues of international trade in imperfectly competitive markets, for example, by Dixit [1984], Brander and Spencer [1985], Helpman and Krugman [1985, 1989], Eaton and Grossman [1986], Venables [1985]. All of them deal with the non-monetary exchange in a two-country world and focus on the issues of protecting domestic producers against foreign competitors. (They justify profit-shifting trade policies distorting terms of trade.) Naturally, these aspects are ignored in our model of pure (international) exchange.

Our paper is closer to the one of Dornbusch [1987] concerning to some extent monetary issues. It examines the influence of exogenous movements of the nominal exchange rate on domestic prices in the two-country oligopolistic trade models. However, it does not explain the exchange rate determination and does not deal with policy issues.

They are examined in detail in the international finance literature that, in particular, studies the behavior of international financial markets in the general equilibrium framework. The widely used dynamic models are of two-country two-good and two-currency type with financial constraints faced by households related to the goods and financial markets, such as in Lucas [1982], Svensson [1985], Helpman and Razin [1985], Grilli and Roubini [1992]. The model of household behavior in our paper is similar to those in the referred papers, because it also incorporates cash-in-advance constraints in different types of markets. However, there is no trade policy in those models, and market environment there is competitive implying the purchasing power parity.

Thus, the model presented here is based to a large extent on two branches of international economics: international trade and trade policy under oligopoly, and international finance. It is quite reasonable to involve both of them in the analysis, once the issues of optimal trade and monetary policy are examined.

The paper is organized as follows. The next section presents the model of a trading firm and examines a Cournot oligopoly situation in the foreign trade markets. Section 3 deals with household behavior. Optimal trade and monetary policy is analyzed in Section 4. The question about foreign currency trade in the domestic asset market is discussed in Section 5.

2. Competition of trading firms.

Consider a two-product exchange between a country and the rest of the world. The domestic economy is endowed with a large stock of real asset traded as a good in the world market. It can be a natural resource, for example, a raw material or any kind of fabricated good accumulated in inventories. It is not consumed by domestic households either because it is a non-consumer good or by the reason of satiation. A consumer good (in what follows called also as good) is imported from abroad and is not produced inside the country. The economy is large in the sense, that the export of the asset influences world prices, although the foreign market for the good is not sensitive to the import. It means that the purchasing price of the good is given exogenously.

The foreign trade is intermediated by profit maximizing foreign trading firms. They act during one trading period in the following sequencing. First, they buy the consumer good abroad and bring it to the domestic market. It is assumed, that money firms dispose at the beginning of trade is just enough to make purchases in foreign currency. They, nevertheless, use currency exchange operations in the second stage in order to be in a liquid position (in terms of domestic money) required for the asset purchases. (For a time being it is assumed, that the asset is sold to trading firms for home currency.) Finally, trading firms buy the asset in the domestic market and sell it in the world market.

Trading firms are supposed to be identical, because of the perfect information about prices and the absence of any price discrimination in the domestic market for the asset. In what follows the notation is used: p, p′ - the purchasing and the sale price of the asset; π, π' - the sale and the purchasing price of the good; x - the quantity of asset exported by an individual firm; y - the quantity of good imported by a firm; λ - the nominal exchange rate of foreign currency (a price of it in terms of home money).

A trading firm solves the problem:

$$\max_{x,y,\mu} p'x - \pi'y + (\pi y - px)/\lambda \tag{1}$$

$$\text{subject to} \quad px \le \pi y + \mu, \tag{2}$$

$$y \ge 0, \tag{3}$$

where μ is its demand for home (foreign) currency, if $\mu \ge 0$ ($\mu \le 0$). The net trade profit (1) is the sum of gains from trade in the domestic markets denominated in foreign money. The cash-in-advance constraint (2) relates to trading operations in the domestic markets: asset purchases px must be met by good sales πy plus home currency acquired in the currency exchange μ. The constraint (3) forbids export of the consumer good.

In what follows we deal with competition among trading firms in the world asset market, in the domestic market for good and in the currency exchange. The purchasing market price of the consumer good is not influenced by the trading firms. The purchasing asset price, as well as the nominal exchange rate, are supposed to be under the control of the economic authorities and are not influenced by trading firms too.

Consider a Cournot-type oligopoly of n trading firms in the domestic good market and the foreign market for the asset. Demand functions for the asset and the good are linear in corresponding prices. The world market-clearing asset price is:

$$p' = p_r - a_1 X, \tag{4}$$

where p_r is the *reservation* world market price for the asset and a_1 is the parameter specifying the slope of the inverse demand function, $X = nx$. The domestic market-clearing price for the consumer good is a linear function of total import $Y = ny$:

$$\pi = \pi_r - a_2 Y, \tag{5}$$

where π_r , a_2 - parameters similar to p_r , a_1. Parameter π_r is referred to as the reservation price of the consumer good.

Given the exchange rate λ and the purchasing price p, trading firms solve the problem (1) - (3) under the conditions (4) - (5), being perfectly informed about the markets and competing in the Cournot sense.

Suppose the exchange rate belongs to the interval that ensures profitability of the foreign trade:

Assumption 1.

$$\lambda > p/p_r , \tag{i}$$

$$\lambda < \pi_r / \pi'. \qquad (ii)$$

Proposition 1. *Equilibrium export and import flows are:*

$$x^* = (p_r - p/\lambda)/a_1(n+1) \qquad (6)$$

$$y^* = (\pi_r - \pi'\lambda)/a_2(n+1) \qquad (7)$$

Proof. The cash-in-advance constraint (2) turns into equality in equilibrium. Solving (1) subject to the market-clearing conditions (4),(5) we directly obtain (6) and (7). □

The home currency demand is determined as a residual: $\mu^* = \pi y^* - px^*$. In what follows we use the notation X^*, Y^* for the corresponsing variables in the Cournot-Nash equilibrium.

The profitability assumption can be formulated equivalently, once the trading firms act as Cournot oligopolists. Define the exchange rate for the asset as a price ratio $e_1 = p/p'$, and the exchange rate for the consumer good in the similar way as $e_2 = \pi/\pi'$. The following proposition demonstrates a link between these rates and the nominal exchange rate.

Proposition 2. *The nominal exchange rate is higher than the exchange rate for the asset and lower than the exchange rate for the consumer good:*

$$e_1 < \lambda < e_2.$$

Proof follows immediately from the calculation of sale-purchasing price indeces relying on (4)-(7). The exchange rate for the asset is the harmonic average of the nominal exchange rate and the price index p_r/p:

$$e_1 = (\lambda^{-1}n/(n+1) + (p_r/p)/(n+1))^{-1}. \qquad (8)$$

This and (i) imply, that $e_1 < \lambda$. The exchange rate of the consumer good is the arithmetical average of the exchange rate and the price index π_r/π':

$$e_2 = \lambda n/(n+1) + (\pi_r/\pi')/(n+1). \qquad (9)$$

Therefore, and because of (ii) $e_2 > \lambda$. □

In the case of our model the deviation of "real" exchange rates e_1 and e_2 from the nominal exchange rate λ is explained by the imperfectness of competition among trading firms and the profitability conditions (i)-(ii). The market prices of both the asset and the good are higher than they are in the case of perfect competition of trading firms, i.e. when n tends to infinity. For example, if there is a monopoly situation (n = 1), the market prices are: $p' = (p_r + p/\lambda)/2$ and $\pi = (\pi_r + \pi'\lambda)/2$, while they are notably lower under perfect competition: $p' = p/\lambda$ and $\pi = \pi'\lambda$. In other words, if the number of trading firms increases, both rates e_1 and e_2 converge to the nominal exchange rate, as it is seen from (8)-(9). Thus, the "law of one price" and the purchasing power parity hold as a limit case in our model.

3. The model of household behavior.

Households own the stock of the real domestic asset and are allowed to sell it to trading firms. They are also endowed with initial stocks of domestic and foreign money serving as a medium of exchange. They act as competitive price-takers in the good market and in the foreign exchange. Households face a budget constraint given the nominal volume of export and a set of cash-in-advance constraints. The latter are related to home currency spending in the domestic market for good and to purchases of domestic and foreign interest-bearing safe assets (indexed bonds).

Households choose consumption and nominal assets holdings. They maximize a composite utility that is a sum of direct consumption utility and indirect utility measuring their nominal asset position at the end of trade.

Both these utilities are denominated in home currency. At the beginning of the trade period households buy consumer goods, then exchange currencies and sell the real asset to trading firms. Domestic and foreign money holdings are converted into domestic and foreign bonds when the trade is over. Interest rates on both monetary assets are supposed to be equalized and normalized to zero (to reduce the notations). The stock of the real asset is sufficiently large and not incorporated in the (indirect) utility.

In line with the above linear specification of demand function (5) we assume that the consumption utility is $u(c) = c(\pi_r - a_2c/2)$ and defined for $c \leq \pi_r/a_2$. The indirect utility of nominal assets holding is given by an additive function $v(B_1) + B_2$, where B_1 and B_2 are the foreign and the domestic asset holdings. The function $v(B_1)$ indicates the preferences of households: it shows how much of the domestic asset is required to substitute a holding of the foreign asset. It is a monotonously increasing, differentiable and concave function defined for $B_1 \geq 0$, satisfying Inada conditions:

Assumption 2. $v'(0) = \infty$, $v'(\infty) = 0$.

According to this Assumption there always exists an interval of profitable holdings of the foreign asset, where $v(B_1) - \lambda B_1 \geq 0$. The foreign and domestic assets in a sense complement each other from a household's view, because their marginal rate of substitution changes from zero to infinity on all isoquants of $v(B_1) + B_2$. One can also interprete $v(B_1)$ as the expected revenue from the future resale of the foreign asset and, correspondingly, $v'(B_1)$ as the expected exchange rate.

Thus, households solve the problem:

$$\max_{c,M_1,M_2,B_1,B_2} u(c) + v(B_1) + B_2 \tag{10}$$

$$\text{s.t. } \pi c + \lambda \Delta M_1 + \Delta M_2 = pX \tag{11}$$

$$\pi c \leq M_{02}, \tag{12}$$

$$B_1 \leq M_1, \tag{13}$$

$$B_2 \leq M_2, \tag{14}$$

where M_{01} and M_1 - initial and final (before nominal asset purchases) foreign currency holdings, M_{02} and M_2 - initial and final (in the same sense) stocks of home currency; $\Delta M_1 = M_1 - M_{01}$ and $\Delta M_2 = M_2 - M_{02}$ - the household demand for foreign and home currency, correspondingly (the former increament is acquired in the currency exchange, while the latter is a residual). The budget constraint (11) relates to the markets for good and currency. The cash-in-advance constraint (12) bounds consumer expenditures by the initial stock of home currency. The cash-in-advance constraints (13), (14) bound nominal assets purchases by the stocks of corresponding currencies.

The problem (10)-(14) is decomposed into two subproblems. Since (12) holds as equality in equilibrium, the item πc disappears from the budget constraint, and households choose consumption separately from asset holdings. The optimal consumption then satisfies:

$$u'(c) = \pi \nu, \tag{15}$$

where ν is a Lagrange multiplier for (12) normalized to unity (utility function u(c) is denominated in home money and its parameters π_r and a_2 are supposed to be normalized in such a way that $\nu = 1$).

Inasmuch as the constraints (13)-(14) are also binding, the money holdings are the solution to the reduced problem:

$$\max_{M_1,M_2} v(M_1) + M_2 \tag{16}$$

$$\text{s.t. } \lambda\Delta M_1 + M_2 = pX, \tag{17}$$

implying the first-order condition (due to Assumption 2):

$$v'(M_1) = \lambda. \tag{18}$$

This condition is understood as the interest arbitrage relationship: it says that purchases of foreign currency (converted then in foreign bonds) must equalize expected and current exchange rates.

The separate choice of consumption and asset holdings in our model is due to the specific form of household's objective function (10) and the cash-in-advance constraint (12).

4. Trade and monetary policy.

The government has control over the price of the real asset p, while the monetary authority manages the exchange rate λ through foreign-exchange operations. They agree upon maximization of the households' welfare $W(\lambda,p) = u(Y^*) + v(M_1) + pX^* - \lambda\Delta M_1$ less the foreign currency purchases by the monetary authority denominated in home money, provided that the foreign trade markets and the currency exchange are in equilibrium:

$$\max_{p,\lambda,m} W(\lambda, p) - \lambda m \tag{19}$$

$$\text{s.t. } z(\lambda, p) = \Delta M_1 + m, \tag{20}$$

where $z(\lambda, p) = n\mu^*/\lambda$ is the supply of foreign currecy by trading firms, m is the monetary intervention (the foreign currency purchases by the monetary authority). We assume that foreign exchange reserves of the central bank are sufficiently large.

The optimal policy (p^*, λ^*, m^*) is characterized in the following Theorem.

Theorem 1. The optimal asset price maximizes the total volume of sales pX^*: $p^* = p_r\lambda^*/2$. The optimal exchange rate is $\lambda^* = \pi_r/2\pi'$. The optimal intervention provides total demand for foreign currency opposite the quantity supplied by trading firms as $D = \Delta M_1 + m^* = (p_r^2/4a_1 - \pi\pi'/a_2)n/(n+1)$.

Proof: in Appendix.

The government maximizes total volume of export, because there is no quantity constraint on the export of the real asset. The optimal price is the half of the world market reservation price evaluated in home currency through the optimal exchange rate. Optimal policy implies the profitability of export, i.e. Assumption 1(i) is fulfilled.

Note that the optimal exchange rate λ^* does not depend on the reservation price of the asset and the number of trading firms. It is determined by the preferences of domestic consumers (and implicitly - by the initial stock of home money M_{01} held by them), on the one hand, and by the competitiveness of foreign markets for the consumer good, on the other hand. The higher nominal price domestic consumers are ready to pay for the imported good and the cheaper it is abroad, the higher is the (nominal) exchange rate of foreign currency. Theorem 1 implies the profitability of import or that Assumption 1(ii) holds under the optimal policy.

Both households' demand for foreign currency and the central bank intervention depend on the evaluation of the foreign exchange $v(M_1)$ by households. However, their total currency demand D does not depend on it.

As a result, the optimal exchange rate is also independent from the indirect utility of the foreign asset.

Theorem 1 makes it possible to determine the balance of payments: *B* $= (pX^* - \pi Y^*)/\lambda^* - D$ and the sign of the trade balance $T = (pX^* - \pi Y^*)/\lambda^*$ denominated in foreign money through the optimal exchange rate.

Corollary. The balance of payments B *is equal to zero under the optimal policy. The trade balance* T *is positive, if and only if* $p_r \geq p_m = \pi_r(2a_1/a_2)^{1/2}[(2+n/\lambda^*)/(n+1)]^{1/2}$.

Proof. Under the optimal policy the trade balance surplus is:

$$T = (p_r/2)X^* - (\pi/\lambda^*)Y^* = [(p_r^2/4)/a_1 - (\pi/\lambda^*)(\pi_r - \lambda^*\pi')/a_2]n/(n+1)$$
$$= [(p_r^2/4)/a_1 - \pi\pi'/a_2]n/(n+1) = D.$$

From (5),(7) $\pi = (\pi_r + n\pi'\lambda^*)/(n+1)$ implying that $T > 0$, if and only if $p_r > p_m$. □

In other words, currency purchases by the central bank and households coincide with the trade balance $T = z(\lambda^*, p^*)$. The sign of the trade balance depends, among other parameters, on a level of the asset reservation price. The Corollary demonstrates the influence of the world market for the asset on the distribution of "roles" in the currency market. If the former is favourable, i.e. p_r is higher than the threshold price p_m, then trading firms supply the latter with foreign currency. In the opposite situation, i.e. under unfavourable world market, they acquire foreign exchange. (One can see that the threshold price is decreasing with respect to the number of trading firms if $\lambda^* > 1/2$ and vice versa.) Note, that their is no trade in the currency market between households and the monetary authority, on the one hand, and trading firms, on the other hand, if the reservation price of the asset is just at the threshold level $p_r = p_m$, since $D = z(\lambda^*, p^*) = 0$.

Theorem 1 and Corollary imply two simple rules of trade and monetary policy. According to the first rule, the government should maximize the nominal volume of export pX^* and to the second - the central bank has to maintain the zero balance of payments. Both policies are conducted in a separate way and economic authorities need not to coordinate their actions.

Under the optimal trade and monetary policy the "law of one price" is fulfilled in a modified form:

$$\lambda^* = \pi_r/2\pi' = 2p^*/p_r. \qquad (21)$$

In other words, the exchange rate is half of the reservation-purchasing price ratio for the good and the doubled reciprocal of the same ratio for the asset.

The left-hand part of (21) is equivalent to the condition of the nominal import inflow $\pi'Y^*$ maximization by means of tariff regulation. Suppose for a while that given the floating exchange rate regime, the government is able to influence purchasing price of the imported good π' (for example, through tariffs). Suppose it maximizes by some reason the nominal inflow of import. Then it must set the purchasing price at the level $\pi' = \pi_r/2\lambda^*$, where λ^* is an exchange rate providing the zero balance of payments.

Hence, the optimal trade and monetary policy is equivalent to a specific trade policy rule, provided the government controls both export and import purchasing prices and the monetary authority does not intervene in the currency exchange. According to this rule the nominal volume of export pX^* and the nominal inflow of import $\pi'Y^*$ are maximized through the terms of trade control. The nominal inflow of import denominated in home currency is equal to the nominal volume of import less the monopoly surplus obtained by trading firms from import operations: $\lambda^*\pi'Y^* = \pi Y^* - (\pi-\pi'\lambda^*)Y^*$. Thus, the sum $pX^* + \lambda^*\pi'Y^*$ means *net nominal trade* of the country. As a result we can formulate

Theorem 2. Optimal trade and monetary policy is equivalent (in the above sense) to a trade policy maximizing net nominal trade of the country by means of terms of trade regulation.

This statement can be viewed as a practical guide for a welfare-maximizing trade policy.

Up to this point we have considered the competition of a finite number of trading firms. It is now reasonable to extend the analysis to the case of perfect competition. When the number of trading firms n goes to infinity, the world market asset price p' tends to the domestic optimal price denominated in foreign currency $p^*/\lambda^* = p_r/2$. At the same time the domestic good price π converges to the purchasing price denominated in home money $\lambda^*\pi'$ (as is seen from (5), (7)) and the nominal volume of import πY^* converges to the nominal inflow of import $\lambda^*\pi'Y^*$. Consequently, the optimal policy under perfect competition provides the same outcome, as if both nominal export and import volumes are maximized through the terms of trade control given the floating exchange rate regime.

It can be shown that optimal welfare $W(\lambda^*, p^*)$ increases with new entry into the sphere of foreign trade (as n goes up).

Proposition 3. Optimal welfare of households $W(n) = W(\lambda^*, p^*)$ is the increasing (bounded) function of the number of trading firms.

Proof. Differentiating the optimal welfare function $W(n)$ gives: $W'(n) = u'(Y^*)dY^*/dn + d(p^*X^*)/dn + (v'(M_1) - \lambda)dM_1/dn = u'(Y^*)dY^*/dn + d(p^*X^*)/dn$ (because of (18)). The nominal export grows with n: $d(p^*X^*)/dn = d[(p_r^2/4a_1)n/(n+1)]/dn > 0$. Similarly, import grows as n increases: $dY^*/dn > 0$. Hence, optimal welfare is a growing function of the number of trading firms. □

One can also easily show, that individual and total profits of incumbent trading firms are declining (and vanishing in the limit) with the degree of competition. Therefore it is in interests of the domestic country, not of the trading firms to remove all artifficial barriers to entry into the sphere of foreign trade.[2] It is also beneficial for the world market, because the world price of the asset declines converging to the optimal price (denominated in foreign currency) as the number of trading firms increases. The foreign asset price in the case of perfect competition is twice lower ($p_r/2$) to the level when there is no trade.

5. Should households be allowed to trade in foreign currency?

In this section we deviate from the main subject and consider a particular problem which may be interesting with relation to the phenomenon known as "dollarization". Suppose it is allowed for residents of the country to use foreign currency as a medium of exchange. Would households gain or loose from this, given that trade and monetary policy is welfare-optimizing?

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[2] "Rivalry is the life of trade and the death of the trader" (E. Hubbard).

To answer this question consider a particular situation, when households trade the real asset for foreign currency. But at the same time they use home currency to buy consumer goods, so the two currencies are circulating in parallel in the domestic markets.

Consider, first, the above model of a trading firm in a slightly modified form. Let the real asset price p'' be set in terms of foreign currency. It is assumed (as above) that trading firms have enough money to make purchases in foreign currency. At the same time they do not need any home currency for the asset purchases when they have sold consumer goods. Therefore they use currency exchange to convert (in advance) in foreign currency all the revenue obtained in the good market. Trading firms, thus, maximize net profits in a similar way to (1)-(3) facing another financial constraint:

$$\max_{x,y,\mu} (p' - p'')x + (\pi/\lambda - \pi')y \tag{22}$$

$$\pi y + \mu \geq 0 \tag{23}$$

$$y \geq 0 \tag{24}$$

Let the profitability conditions similar to those in Assumption 1 hold with (i') stating, that $p'' < p_r$, instead of (i). It means, that the asset price must simply be less than the world market reservation price. Equilibrium trade flows are the same as in the above model:

$$x^* = (p_r - p'')/a_1(n+1)$$

$$y^* = (\pi_r - \lambda\pi')/a_2(n+1).$$

Households and the central bank also somewhat change their actions in the currency market. This is so, because the household budget constraint (17) in the subproblem (16)-(17) modifies to

$$\lambda(\Delta M_1 - p''X^*) + M_2 = 0 \tag{25}$$

and the equilibrium condition (20) in the policy problem (19)-(20) now looks as

$$z(\lambda) + \Delta M_1 + m = p''X^*. \tag{26}$$

where $z(\lambda) = - n\mu^*/\lambda = - n(\pi/\lambda)y^*$ is the demand for foreign currency by trading firms. The economic authorities maximize the modified welfare function $W_1(\lambda,p'') - \lambda m = u(Y^*) + v(M_1) - \lambda(\Delta M_1 - p''X^* - m)$ subject to (26).

Proposition 4. If the real asset is traded for foreign currency, the monetary authority provides the supply of foreign currency as $S = -D = \pi\pi' n/a_2(n+1)$ opposite the quantity demanded by trading firms.

Proof of this proposition actually replicates the proof of Theorem 1 and is left for a reader.

Thus, in the modified model trading firms always buy foreign currency. The description of the currency market is summarized by an equilibrium equation:

$$S = z(\lambda), \tag{27}$$

that directly implies the main result of this Section.

Theorem 3. If the real asset is sold for foreign currency, the optimal exchange rate will be $\lambda^* = \pi_r/2\pi'$.

In other words, optimal exchange rate is identical to the one in the case when the real asset is traded for home currency. Note, that this takes place only under the optimal policy of economic authorities. It implies the optimal intervention prescribed by Proposition 4 and the asset price setting at the half of the reservation price level $p^{**} = p_r/2$, that is equivalent to the optimal pricing rule, obtained above.

As a result welfare of households will not be influenced, if the asset is traded for the foreign currency and (of course) the government and the monetary authority follow the optimal policy rules. Trading firms of both types will also neither loose, nor gain from this.

6. Concluding comments.

The paper examined the optimal trade and monetary policy in a market characterized by imperfect competition among trading firms operating as intermediators in international exchange. The highly-stylized model of foreign trade proposed here deals with a situation peculiar for an economy, endowed with a large stock of (real) assets traded in world markets. This may be also the case when a nation possesses some exclusive opportunities in the international trade (the natural monopoly and so on). The imperfection of competition among trading firms is explained by institutional and informational barriers that make entry into the sphere of the foreign trade difficult.

We implicitly assumed perfect coordination among economic authorities responsible for trade and monetary policy: they agree about the objectives of macroeconomic policy and jointly solve the above welfare-maximization problem. Of course, this assumption could be easily criticized as unrealistic. However, as is demonstrated, optimal trade and monetary policy does not actually require a unification of efforts of these authorities. They can act separately, once they follow the simple rules of optimal policy: maximization of the nominal export volume for the trade authority and maintenance the zero balance of payments for the monetary authority. Note, that the first rule is a reasonable inference under the assumption that the stock of the real asset is large and its reduction is not counted in the welfare function. Otherwise optimal domestic asset price must be higher than the sales-maximizing level.

We have also shown, that the optimal policy is equivalent to maximization of net nominal trade of the country under the floating exchange rate regime. It means that the best way the large economy can exercise its monopoly power is to use trade policy to increase nominal export and import volumes less the monopoly surplus obtained by intermediating firms. The open doors policy is preferable for both the domestic country and the world market but it is undesirable for incumbent trading firms.

As it turns out, the optimal exchange rate does not depend on currency which the asset is sold for to trading firms. As a consequence, the households' welfare and profits of trading firms do not change, if the government permits trades in the foreign currency.

Appendix.

Proof of Theorem 1.

Inserting (20) into (19) and differentiating the latter with respect to p we obtain

$$v'(B_1)\partial z(\lambda,p)/\partial p + \partial(pX^*)/\partial p - \lambda\partial z(\lambda,p)/\partial p = 0, \tag{A1}$$

which is equivalent due to (19) to

$$\partial(pX^*)/\partial p = 0 \text{ or } \partial(p(p_r - p/\lambda^*))/\partial p = 0.$$

Thus, the optimal asset price provides the maximization of sales and is equal to

$$p^* = p_r\lambda^*/2. \tag{A2}$$

The first-order condition for λ is obtained in a similar way:

$$u'(Y^*)\partial Y^*/\partial\lambda + p\partial X^*/\partial\lambda - z(\lambda,p) = 0. \tag{A3}$$

Taking into account (15) and (20) we have

$$\pi\partial Y^*/\partial\lambda + p\partial X^*/\partial\lambda = D. \tag{A4}$$

Taking the derivatives in (A4) and using (A2) yields

$$D = (p_r^2/4a_1 - \pi\pi'/a_2)n/(n+1). \tag{A5}$$

To find the optimal exchange rate, consider the equilibrium condition (20) as an equation on λ:

$$z(\lambda, p^*) = D. \tag{A6}$$

Since $\mu^* = px^* - \pi y^* = px^* - (\pi_r + n\pi'\lambda)y^*/(n+1)$ from (5), (7), then one can see from (6), (7) and (A5), that (A6) is a square equation:

$$n^2(2\pi'\lambda - \pi_r)\pi'\lambda + n(2\pi'\lambda - \pi_r)\pi_r = 0,$$

having a unique positive root $\lambda^* = \pi_r/2\pi'$.

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