Current Research Journal of Economic Theory 1(1): 1-4, 2009
ISSN: 2042-485X

Submitted Date: June 24, 2009 Accepted Date: July 18, 2009 Published Date: November 10, 2009

The Dynamics of Trade Creation and Trade Diversion Effects Under International Economic Integration

R.T. Dalimov
Business Administration, Economics Department, National University of Uzbekistan, Uzbekistan, 100174

Abstract: The research develops dynamic tool to the analysis of trade creation and trade diversion effects under economic integration based on the model developed for interregional flow of the goods between member states of the union and the rest of the world. It is based on Navier-Stoxes equation usually applied to gas and liquid flux. Relation obtained in the article directly links intra- and inter-regional spatial dynamics of prices and outputs, with the former causing the flow of the goods. Analysis has shown that interregional flow of the goods as well as trade creation and trade diversion effects are correctly described by one-dimensional Navier-Stoxes equation, with the method itself complementing static analysis of Viner's trade creation and diversion effects.

Key words: Efficiency of economic union, economic integration, trade creation and trade diversion effects, Navier-Stoxes equation, interregional flow of the goods and spatial dynamics of the output

INTRODUCTION

Trade creation and trade diversion effects were firstly introduced by Viner (1950) staying a corner stone in classic theory of international economic integration up-to-date. Both of them are due to economic unification of states changing direction of the goods from one to the other state supplying the goods to third considered country. They both seem to provide better pricing due to cancellation of tariffs. They differ at the point when trade creation provides real net improvement of the price while trade diversion comes at the moment when trade from cheapest supplier state is diverted to the state inside the union which became cheaper only due to the decrease of tariffs but actually is more expensive compared with the rest of the world.

In practice, the combinations of trade creation and trade diversion effects of different commodities usually observed. Efficiency of international economic integration is defined on the basis of an outcome between the trade creation and trade diversion effects: when the former prevail an economic union is treated as efficient one, and vice versa.

Viner's trade creation and trade diversion effects briefly considered in present article have been studied statically (El-Agraa, 1998; Jovanovich, 1998; Robson, 1998), since it provides generally sufficient information for defining the direction of the flow of the goods after the creation of economic union. Within this approach economic reasoning (the difference of prices in member states) is served as a basis to clarify where and from where the flow of the goods will be directed. At the same time, the static analysis is not capable to be implemented in a real situation when prices in neighboring states rapidly change consequently requiring development of a different approach, dynamic at its origin and possibly simple in practice.

Present article provides solution to this problem by developing at first the dynamics of the regional flow of the goods based on Navier-Stoxes equation implemented in physics for the flux of a liquid or a gas. Deductions are further used for a case of customs union and interregional trade. The final part of the article obtains expressions for the dynamics of the trade creation and trade diversion effects.

Distinctive point in the given modelling approach is a vision of the flow of the goods directed by the prices margin as similar to the flux of liquid or gas directed by the spatial difference of pressures. This way the modelling constitutes a tool which one may use under circumstances of changing price environment and internal consumption within a state before the goods pass the border of neighboring member state after economic union has been created.

Finally, price changes in this case are not given externally versus flow of the goods, but rather directly linked with the spatial dynamics of the goods thus providing a tool in analysis and forecasting respective economic policies (common external tariffs level on the border of the union, national specialization and competitive price setting of sectors in member states) and scenarios prior the creation of economic unions.

MATERIALS AND METHODS

Main material for the research was the static analysis of trade creation and trade diversion effects which is still a corner stone for the theory of international economic integration. The study was conducted within the premises of Business Administration Unit at Economics Department of the National University of Uzbekistan in 2009. The methods implemented in the article, besides Navier-Stoxes equation, include analysis of ordinary differential equations. The research was funded by the

National grant of the Republic of Uzbekistan OT-F7-082 "Modelling International Economic Integration".

Viner's model: We start by considering the classic case of three states *A*, *B* and *C*, where B and C compete to supply similar goods to country A (El-Agraa, 1998; Jovanovich, 1998).

Assume that price of the goods in C is comparatively less: $P_C < P_B$ (Fig. 1a). Under equal common external tariff of the state *A* towards the goods imported from *B* and *C* the price of the goods from these states after crossing the border of the country A is respectively equal to P_C (1+τ) and P_B (1+τ), maintaining a competitive advantage of the country C. Hence, the goods are imported to country A from C.

In case of the creation of a customs union between A and B (Fig. 1b) due to termination of tariff barriers between them the price of the goods from B becomes less than from C, i.e. $P_B < P_C$ (1+τ). Respectively, the country B is selected. In this case we described the trade diversion effect. Trade creation would be in case of the creation of the customs union between *A* and *C*.

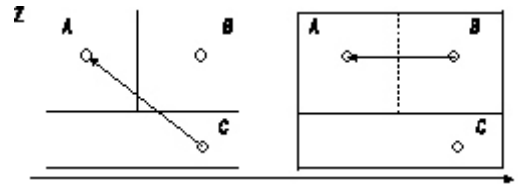
Dynamic model: Navier-Stokes equation: Mathematical description of the dynamics of the flux of a liquid or a gas is given by Navier-Stokes equation (Acheson, 1990).

$$\rho\left[\frac{\partial \vec{v}}{\partial t} + \vec{v}.\nabla\,\vec{v}\right] = -\nabla p + \nabla . T + f \qquad (1)$$

where $\vec{v}$ – the flux velocity, ρ – its density, *p* – pressure, *T* – tensor of pressure, *f* represents various forces acting on the flux. One may see a difference of pressure present in the equation (1) in the form of gradient, $\nabla p = gradp \equiv \left[\frac{\partial}{\partial x} + \frac{\partial}{\partial y} + \frac{\partial}{\partial z}\right]p$ defining the direction of the flux.

Remarkably, physical flows are due to differences of a pressure (either in a liquid or a gas), while flows in economy are stimulated by the price level. Hence, it seems reasonable to adapt the equations from physics describing the dynamics of flows, and use instead of pressure and velocity of a liquid (gas) the price and velocity of the output respectively.

The output of similar goods produced in B and C (denoted as *Q*) plays the role of the density ρin (1). Velocity of the goods flow may be denoted as unit vector $\vec{q}$. Remarkably, the change of the velocity of the goods flow under regional trade takes place along only one coordinate, for instance, from country B to country C. In this case the first term of an equation (1) becomes equal to $Q\left[\frac{\partial q}{\partial t} + q.\frac{\partial q}{\partial x}\right]$.



(a) (b)

Fig: 1. Trade flower between states A, B, C
(a) Prior to creation of customs union
(b) after economic integration of A and B

The intraregional flow of goods is stimulated by disparity of the cost of the goods and market price, while in case of interregional trade it is driven by positive interregional disparities of prices $PA - P_B$; $P_A - P_C$. Consequently, we have to consider spatial changes of the velocities along only two axes, e.g. *x* and *z*. On the other hand, prices within a region quite rapidly equalize due to the law of one price under economic integration. Then in case of trade between two economically separate states we have to account for changes along only one axis, for instance, *x* leading to the following price gradient:

$$\nabla P = \frac{\partial P}{\partial x} \qquad (2)$$

Remarkably, physical flux moves towards less pressure while flow of the goods is directed towards higher prices; this way the demand is satisfied. Hence, instead of pressure gradient in (1) one may use positive gradient of price in case of exports, and negative price gradient in imports stimulated by the least difference of prices between country-importer and country-supplier.

Considering the tensor of "pressure" accounting in hydrodynamics non-homogeneously distributed pressure of a flux, due to the abovementioned reasons it will be equal to nil since in rough approximation the price gradient (acting as a pressure for the flow of goods) is defined only at the border of trading states. More exact analysis of any interregional flow of the goods has to consider intraregional consumption, i.e. when part of the goods exported does not reach the border of its main importing state.

Role of the force *f* may be played by various regional economic policies such as subsidies, non-tariff barriers etc. terminated in circumstance of free competition, i.e. when *f* = 0. According to the second best theory, international economic integration stands as a second best choice stimulating trade after the freedom of trade, present under free competition. Hence, we may consider a case with *f* = 0, simplifying our mathematical analysis.

Summating all of the above, we obtain the following fundamental equation for interregional flow of the goods:

$$Q\left[\frac{\partial q}{\partial t}+q.\frac{\partial q}{\partial x}\right]=\pm\frac{\partial P}{\partial x} \qquad (3)$$

Customs union: Economic efficiency of the country A is defined by the least price, i.e. when $\tau = 0$ which takes place in international economic integration having a law of one price, i.e. $\frac{\partial P}{\partial x}=0$. Respectively under economic integration we have the following dynamic equation for the flow of goods:

$$Q\left[\frac{\partial q}{\partial t}+q.\frac{\partial q}{\partial x}\right]=0 \qquad (4)$$

i.e.

$$\frac{\partial q}{\partial t}+q.\frac{\partial q}{\partial x}=0\ . \qquad (4)$$

Its solution may be found using Fourier substitution $q = q_x(x)q_t(t) = q_x q_t$ which leads to the following:

$$\frac{\partial q_t}{\partial t}=-q_t^2\frac{\partial q_x}{\partial x} \qquad (5)$$

Regrouping shows that independent variables have to be equal to constant magnitude ψ:

$$\frac{\frac{\partial q_t}{\partial t}}{q_t^2}=-\frac{\partial q_x}{\partial x}=\psi \qquad (6)$$

It leads to the following:

$$\begin{cases} q_x=-\psi x, \\ q_t=-\dfrac{1}{\psi t} \end{cases} \qquad (7)$$

Using definition $q = q_x(x)q_t(t) = q_x q_t$ we finally obtain:

$$q=\frac{x}{t} \qquad (8)$$

Expression (8) has a form of velocity, while the function q by definition was introduced as velocity of the output's flow.

Interregional trade: Now one may attempt to solve equation (3) assuming constant value of the output, i.e. some fixed quantity of the goods:

$$Q\frac{\partial q}{\partial t}=Q\left[\frac{1}{Q}.\frac{\partial P}{\partial x}-q.\frac{\partial q}{\partial x}\right] \qquad (9)$$

i.e.

$$\frac{\partial q}{\partial t}=-\frac{\partial}{\partial x}\left[\frac{q^2}{2}-\frac{P}{Q}\right] \qquad (10)$$

By introducing a new variable $\frac{q^{-2}}{2}=\frac{q^2}{2}-\frac{p}{Q}, i.e.\ q^{-2}=q^2-\frac{2p}{Q}$, i.e., taking to attention that economically $P<<Q$ and using first term of McLoren series ($\frac{P}{Q}<<1$), we obtain:

$$\bar{q}=\sqrt{q^2-\frac{2P}{Q}}\approx q-\frac{2P}{Q} \qquad (11)$$

Under temporarily constant price $\frac{\partial \bar{q}}{\partial t}=\frac{\partial q}{\partial t}$ producing the following:

$$\frac{\partial \bar{q}}{\partial t}=-\frac{\partial \bar{q}^2}{\partial x} \qquad (12)$$

Solution of a given equation is similar to the one in (8): $\bar{q}=\frac{x}{t}$. Consequently, we obtain the following:

$$\bar{q}=\frac{x}{t}\approx q-\frac{2P}{Q} \qquad (13)$$

It leads to obvious expression for the velocity of the flow of the goods:

$$q=\frac{x}{t}+\frac{2P}{Q} \qquad (14)$$

Hence, the higher is price the more is velocity of the flow of the goods. Indeed, high sales price stimulates trade, i.e. the flow of the goods. At the same time, the more is a quantity of the goods (output Q) the less is velocity of the flow of the goods. It is also economically true since larger quantity of similar goods leads to saturation of the market, decrease of price and consequent fall of the flow of the goods.

Trade creation and trade diversion effects: We are interested to find an influence of the price difference between countries B and C on the flow of the goods entering country A. In this case we have two different equations (Fig. 1):

$$\left\{ Q\left[\frac{\partial q}{\partial t} + q.\frac{\partial q}{\partial x}\right] = -\frac{\partial P}{\partial x} \right.$$ for the flow of the goods from B;(15)

$$Q\left[\frac{\partial q}{\partial t} + q.\frac{\partial q}{\partial z}\right] = -\frac{\partial P}{\partial z}$$ for the flow of the goods from C(16)

where is a flow of similar goods into country from the other two states.

Price of the goods from country B entering in country is equal to P_B (1+τ). Similar discussion for the region C leads to the following:

$$\begin{cases} \dfrac{\partial P}{\partial x} = P_B(1+\tau) - P_B = P_B\tau & (17) \\ \dfrac{\partial P}{\partial x} = P_C(1+\tau) - P_C = P_C\tau & (18) \end{cases}$$

Using (17) and (18) one may compare the flows of the goods from countries B and C by deducting (16) from (15):

$$Qq.\left[\frac{\partial q}{\partial x} - \frac{\partial q}{\partial z}\right] = \tau\left[P_C - P_B\right] \qquad (19)$$

Depending on the prices in supplying states there could be three different scenarios:

1) $P_B = P_C$: right side in (19) is equal to zero suggesting an equality between spatial derivatives on x and z coordinates , with each of them standing for different direction from B and C. Hence, it suggests equality of the flow of the goods from states B and C to country ;
2) $P_B > P_C$: right side in (19) is negative, i.e. the flow of the goods on the border of and B states is less then the one from country C. In case of economic integration the goods from country B become cheaper due to zero tariffs leading to reorientation of the flow of the exported goods from country C to country B which becomes supplier to country. In this case we have described trade diversion effect.
3) $P_B < P_C$: the goods enter the state A from the state B prior and after economic integration of these two states, with the trade creation effect observed in this case.

RESULTS AND DISCUSSION

All results obtained in the article have analytic origin just to show how complex Navier-Stoxes equation may be solved and used for economic analysis. In practice prices spatially differ due to transportation costs, as well as there many other barriers such as non-tariffs economic policy, tariff regulation etc which may have complicated the analysis conducted.

In the article we were able to define fundamental relation (3) between explicitly linked spatial dynamics of prices and output for three different cases: intra- and inter-regional flow of the goods; customs union. Introducing simplification regarding internal consumption of the goods within a state where goods originate (produced) we were able to obtain analytic results for the abovementioned cases.

Finally, by considering the price changes due to tariffs on the border of states it was demonstrated that Navier-Stoxes equation correctly describes the dynamics of trade creation and trade diversion effects under economic integration. This result develops and complements the static case of their analysis when in order to define the direction of the flow of the goods one had to use economic reasoning, namely price differences in neighboring states.

Now one has an equation where the parameters of the flow of the goods (both its quantity and velocity) are directly linked to the price difference, i.e. a spatial gradient providing a tool to take into account exact situation with prices on the border of states. At the same time, if price across the border of considered states is the same, conclusions of the dynamic model are identical to the results of original Viner's model. Among ways to develop the model it seems to be taking into account a tensor of spatial dynamics of the output which was neglected in the article.

CONCLUSION

The study discusses Navier-Stoxes equation usually applied to the dynamics of the flux of liquid and gas, here implemented to the interregional dynamics of the flow of the goods. Analysis was conducted on the cases of international economic integration, interregional trade showing ability of one-dimensional Navier-Stoxes equation to correctly describe the interregional flow of the goods, as well as trade creation and trade diversion effects. Interregional price difference was used in the modelling as a stimulating factor for the dynamics of the goods flow while in Navier-Stoxes equation this role is played by pressure pushing liquid or gas to area with less pressure.

REFERENCES

Viner, J., 1950. The Customs Union Issue. Carnegie Endowment for International Peace, pp: 41-55; ASIN: B000OFGCS0.

El-Agraa, A.M., 1998. The European Union: History, Institutions, Economics and Policies. Prentice Hall, 621 p., ISBN 0139162631.

Jovanovic, M.N., 1998. International Economic Integration. Routledge; 2nd Edn., pp: 472, ISBN 0415164516.

Robson, P., 1998. The Economics of International Integration. Routledge; 4th Edn., pp: 333, ISBN 0415148774.

Acheson, D.J., 1990. Elementary Fluid Dynamics. Oxford Applied Mathematics and Computing Science Series. Oxford University Press, pp: 408, ISBN: 0198596790.