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ON THE RELEVANCE OF GRAVITY MODEL IN THE NEW INSTITUTIONAL ENVIRONMENT

Abstract

International trade enables economies to gain specific advantages of trade. Theory of international trade is anchored on several key concepts. The first is the concept of comparative advantage. The size of international trade is frequently measured with the use of the gravity model. According to this model, countries trade with each other based on the size of their GDP and population. Another motivation supporting trade is the cultural affinity, institutional support and physical proximity. Deteriorating influence on the extent of mutual trade is traditionally expressed by increased geographical distance and trade impediments. In this paper we discuss the general validity of the model, taking in consideration new communication technology and new ways of transport and quality of institutions. We also discuss the issue of barriers to trade and we especially focus on the existing non-tariff barriers that are inhibiting the trade and we investigate how they can be included in to gravity model.

Key words: gravity model, globalization, impediments to trade, nontariff barriers, institutional factors

1   INTRODUCTION

International trade enables economies to gain a specific advantage of trade. Theory of international trade is anchored on several key concepts. The first is the concept of comparative advantage, which represents the general motivation for trading. The size of international trade is traditionally measured with the use of the gravity model. According to this model, countries trade with each other based on the size of their GDP and population. Another motivation supporting trade is the cultural affinity institutional support and physical proximity. Institutional factors and support of trade also play an important role. Diminishing influence on the extent of mutual trade is traditionally expressed by increased geographical

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distance and trade impediments (tariffs, quotas and invisible barriers).

Traditional theories of international trade used to argue in favour of free trade without barriers claiming that the countries involved will benefit from trade due to their comparative advantage identified by Ricardo (1817) and discussed lately by Krugman, Melitz and Obstfeld (2017), Baldwin and Wyplosz (2006), Mankiw (2020). As we can observe as measured by GDP per capita and openness of economy so called comparative advantage this is mainly an advantage for more advanced industrial economies. Situation of poorer nations with "no comparative advantage" was traditionally very different Alvarez-Cuadrado, Amodio and Poschke (2020), Tucker (2020), Pender, Hazell and Garrett (2020), and Khemani.

In this paper we discuss the general validity of the model, taking in consideration new communication technology and new ways of transport. This paper is structured as follows: The first part provides the introduction to the problem of international trade in the second part we discuss the basic concepts comparative advantage as the major motivation of trade. The third part provides details of the logistics of international trade - applications of gravity model with extensions to economics. The fourth part discusses trade impediments and barriers of trade including invisible non-tariff barriers. Part five discusses the findings and highlights contributions of this paper to current stream of literature.

2 COMPARATIVE ADVANTAGE

International trade is linked with negotiations: either support or neglect by state institutions and with special arrangements related to transaction and with transportation of goods and products to destinations. If the object of trading concerns services, which became practicable only with the rise and the worldwide spread of internet services since the break of 1980s and 1990s, when the address www was first introduced. Nowadays many services can be provided also on-line, especially those which do not require any shipment of physical items. This is how the new technology and globalization modifies the traditional way of trading. Another alteration is brought by multinational companies where the production is organized through production chain and can span several continents (for example in electro technic engineering or in machinery). These arrangements require transportation of physical goods, materials or semi-products. The production does not take place on one spot. Organization was developed for the reasons or extensive mass production and economies of scale.

2.1 Factors generating comparative advantage

Comparative advantages are results of several factors - natural conditions, disposability of natural resources and production factors. Countries with more

advanced technology and traditional industrial background will be better equipped and reach better prosperity through international trade than countries without natural or capital resources and necessary technology equipment. Countries that have abundant resources or abundance in particular production factor are better equipped for international trade Leamer (1984) and Markusen and Venables (1986).

However, one must not forget that the majority of productions factors including technology and information basis is nowadays movable due to advanced technology (MacGregor Pelikánová, 2019) and cheap transportation costs. Furthermore, large production chains nowadays create more comparative advantage due to savings from increased efficiency through the effects of scale. Multinational corporations are able to achieve gains from scale due to better organization of production and better logistics and additional savings from cutting off so called non value adding activities through activity based costing systems. This concept was originally brought by Cooper and Kaplan (1991) and lately developed by Özcan (2020), Xu, Niu and Cai (2020) or Castro-Santos, Diaz-Casas and Brage (2020). Modularity is one of the most important quality attributes during system development. Its concepts are commonly used in disciplines of information technology courses, mainly in subjects as software project, software architecture, and others (Hosťovecký, Novák,Horváthová, 2017), (Rubáček, 2017) and Rubáček, Jindřichovská, Horvathova and Abrhám (2020)

With the arrival of then new concepts by Heckscher-Ohlin the importance of "traditional comparative advantage" born by natural conditions and local traditions is fading as all production factors become movable to different locations. In 1920s Eli Heckscher and Berthold Ohlin claimed that the comparative advantage is born by different relatively abundant production factors in different countries. The authors were referring to new technology and new organization of production see Jones (1956) and Samuelson, (1971), Batra (1975) and later Dornbusch, Fischer, and Samuelson (1977) and further development of theory by Helpman (1981), Leamer (1984) and Brecher and Choudhri (1993), and more recently e.g. Cheong, Kwak and Tang (2015) and furthermore Sun (2020) and Tai (2020). Białek-Jaworska and Gabryelczyk (2016) propose framework for internationalization of biotech sector thanks to networking in projects and partnering with global pharmaceutical companies.

3   GRAVITY MODEL

When looking at the logistic of international trade it becomes apparent that big nations trade with each other its can be understood as application of the so called gravity model (see e.g. Krugman, Melitz and Obsfield, 2017). To investigate this relationship, we will use the gravity model. The gravity model

in economics comes from Newton's "Law of Universal Gravitation" which was proposed in 1687. It states that every two particles in the universe attract each other. The formulation of the law is as follows:

$$F_{ij} = G * (M_i M_j / D_{ii})$$

Where:
Fij is the attractive force,
Mi and Mj are the masses, and
Dij is the distance between the two objects, e.g. Ugurlu and Jindrichovska (2019).

In economics:
Fij is usually representing the country export or import or another measure expressing the international trade flow. It can be also FDI or eventually the measure of openness   which is the sum of country export and import as a proportion of country GDP.
Mi and Mj are the masses, in economics are usually represented by Gross Domestic product of respective countries.
Dij distance between countries can be found in CEPII (the French Centre d'Etudes Prospectives et d'Informations Internationales).

The gravity equation to model the size of bilateral trade flows between any two countries was firstly presented, in 1962, by Jan Tinbergen. The gravity equation can be also augmented by further factors which have impact on the trade. There can be both positive impart promoting the trade and on the other negative impact inhibiting the trade.

3.1 Augmented gravity model

Gravity model has been extended into economics. The model is frequently estimated in logarithmic form. The model can include dummy variables according to investigated features Boarder dummy (board), membership of the country in particular trading block e.g. the EU (Tblock), existence of non-tariff measures (NTM), other institutional factors.

$$\ln EXP_{ij} = \alpha + \beta_1 \ln GDP_i + \beta_2 \ln GDP_j + \beta_3 \ln D + \beta_4 Board + \beta_5 TBlock + \beta_6 NTM + ..$$

Alternatively, this model can be estimated for ln IMP as dependent variable.
Number of dummy variables depends on the context and it should not be too many to avoid over-specification of the model. Augmented gravity models

were tested e.g. by Martínez-Zarzoso and Nowak-Lehmann (2003), Batra (2006) and recently by Yadav (2020). The last author was also questioning the relevance of distance in today's age.

4   INSTITUTIONAL FACTORS

Speaking about theoretical framework of institutional theory we need to refer to the concept of isomorphism coined by DiMaggio and Powell in 1983. The authors discussed the coercive, normative and mimetic isomorphism identified in behaviour of economic agents. Coercive isomorphism signifies the imitation or respect of the world institutions governing the discipline, whereas normative isomorphism refers to imitation of professional organizations. Lastly, the mimetic isomorphism refers to such behaviour that enables the country to attract investments from abroad to support the local economy DiMaggio and Powell (1983) and (1991).

Institutional factors are included in the model in various ways. Inhibiting institutional factors will have negative coefficients and supportive coefficients positive coefficient, depending on the object of research.

Supporting factors may include features like cultural affinity or common language or common cultural or legal background and common history. Furthermore we need to include official measures supporting trade stemming or the various degree of economic integration.

Depending on the phases of economic integration starting with the Free trade zone, followed by Customs union and Common market to Economic and Monetary union.

> The first degree of integration is *Zone of free trade*, which removes or reduces trade barriers in the form of tariffs and quotas. Another removal of limits is exercised in the zone.
> The next step of economic integration is *Customs union*, which takes over trade benefits and simplifies the free trade area and adds unification of external customs policy by creating a so-called single customs tariff.
> Further step is the *Common market*, which takes advantage of the customs union by adding the free movement of persons, capital and services in addition to the free movement of goods. In this s stage of economic integration in addition to the above all discriminatory barriers to trade are removed in the framework of the free movement of goods.
> The highest form of integration is *Economic and Monetary Union*, which is the most profound and complex stage of economic integration. In monetary unions there is no requirement of common economic policy, whereas economic and monetary union includes monetary, monetary and fiscal policy). Within a monetary union, it is possible to choose between an incomplete and a complete union, i.e. between the mutual fixation of the exchange rate and the common currency - for example the euro

Source: Own elaboration according to Lisbon Treaty (2007)

Contrary to economic integration supporting the trade, there are opposing factors which reduce the trade. There are either natural factors like national

boarders or artificially imposed factors. The basic classification of opposing forces is trade barriers - tariffs and quotas and non-tariff barriers

Negative effect of boarders was discussed for example by Chen (2004), Begum (2020) or Javed, Rehman, Nabi, Razzaq, Saqib, Bakhsh and Luqman (2020) and Jámbor and Gál (2020).

As long as it concerns institutional barriers to trade it must be highlighted that whatever measure is instituted it has always impacting both potential parties to trade. Like recent embargoes against Russia or China, where Russian cannot benefit from the purchase of the prohibited articles or machinery and the selling partner loses financial benefit from unexecuted transaction.

4.1 Barriers to trade

Barriers to trade, trading blocks, including invisible barriers and trade wars serve as the means of protectionism. Traditional ways of protectionism include:
1) Customs duties - a tax imposed on imports
2) Import quotas - quantitative restrictions on the amount of imports
3) Non-tariff barriers – e.g. health, quality certificates and norms.

Nontariff measures currently exceeds the importance of customs (historically it was the opposite. For more detail see "International Classification of Non-tariff Measures" at the link listed in references.

Table 1 Classification of non-tariff measures by chapter

Classification of non-tariff measures by chapter

Imports	Technical measures	A	Sanitary and phytosanitary measures
		B	Technical barriers to trade
		C	Pre-shipment inspection and other formalities
	Non-technical measures	D	Contingent trade-protective measures
		E	Non-automatic import licensing, quotas, prohibitions, quantity-control measures and other restrictions not including sanitary and phytosanitary measures or measures relating to technical barriers to trade
		F	Price-control measures, including additional taxes and charges
		G	Finance measures
		H	Measures affecting competition
		I	Trade-related investment measures
		J	Distribution restrictions
		K	Restrictions on post-sales services
		L	Subsidies and other forms of support
		M	Government procurement restrictions
		N	Intellectual property
		O	Rules of origin
Exports		P	Export-related measures

Source: International Classification of Non-tariff Measures, 2019, p. 7.

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Briefly, the above factors can be classified as

1. Paratarif measures:
Including customs surcharges, additional taxes and surcharges, internal taxes imposed on imports, compulsory customs valuation of imports, tariff quotas, price control, and import authorization in connection with export performance.

2. Financial arrangements:
Representing administrative fixing of prices or exchange rates, price limits, anti-dumping measures, countervailing duties, prepayment requirement, concurrent exchange rates, foreign exchange restrictions, and import deposits.

3. Automatic licensing measures:
Comprising automatic licenses and import monitoring

4. Quantitative measures:
Embracing quotas, import bans (safeguards), export restrictions, other types of licenses.

5. Monopolistic measures:
Involving so called one import organization, compulsory use of national services, etc.

6. Technical, sanitaria phytosanitary measures:
Representing technical regulation, e.g. GOST, CCC certificates, health and other inspections, and the like, and on the other hand also

7. Production and export control measures:
Consisting of subsidies, export bans and export taxation.

Testing nontariff barriers is more technical as it is more straight-forward to construct the model for particular sector or industry then a general model for whole economy. This is mainly because of great heterogeneity of factors entering the research question. In food industry we have for example research by Chevassus-Lozza, Latouche, Majkovič and Unguru (2008) and further more Roman, Mocanu and Hoinaru (2019) analysing the borders in agri-food exports. Nontariff measures were also subject of research book by Beghin (2013) and Daniel, Hoinaru, Mocanu and Roman (2019).

Białek-Jaworska and Gabryelczyk (2016) highlighted the role of intellectual property trade barriers in internationalization of biotechnology services. Foreign patents are required for biotech firms when they aim to enter the global market due to the international competitiveness of their R&D outcomes.

Large specialized exporters are more likely to extend trade credit and provide more trade credit than some non-exporters do. On contrary, small specialized exporters are less likely to extend trade credit due to their aversion to currency risk and the risk of debt collection from foreign clients (Białek-Jaworska, Nehrebecka, 2016).

Recent publications include Webb, Strutt, Gibson and Walmsley (2020) who concentrated on supply chains in ASEAN and Marks (2020) summarizing the Non-Tariff Measures in Asia and Pacific, whilst Herman (2020) concentrated on the costs on nontariff trade.

5 CONCLUSION

This paper concentrated on the role of distance and institutional factors in international trade. From the analysis performed it seems that the geographical distance between trading partners is shortening. The main impression of shortening distance gives the use of new communication technology as well as the impact of new organization of work in modern cost-saving supply chains. Cooper and Kaplan (1991) and Castro-Santos, Diaz-Casas and Brage (2020). It seems that new technology can overcome the physical distance Batra (2006). Nevertheless, when we analyse the scientific papers on international trade we find that the coefficient on distance is still very significant. Sometimes the distance even „lengthens" because of new administrative burdens that are artificially instituted between trading countries DiMaggio and Powell (1983), Beghin (2013), Khemani (2020) and Webb, Strutt, Gibson and Walmsley (2020).

As we have established in this research, the geographical distance still plays significant role in the international trade in spite of new ways of communication and new ways of organization of work Ugurlu and Jindrichovska (2019) and Jindřichovská, Ugurlu and Thalassinos (2020). This is true especially in those industrial segments where the physical component of work needs shipment across countries or continents. Furthermore, disregarding cost-savings we can observe that due to the more complex organization of work and supply chains spanning across continents the production process often becomes so complex that it requires even more logistics and transportation then when the whole production is exercised at one place Begum (2020).

To conclude, these days the physical distance does not matter too much due to concurrent flow of information, however, sometimes the distance becomes even longer due to various artificial barriers Xu, Niu and Cai (2020), Jámbor and Gál (2020) and Herman (2020). And this is a topic worth attention in further research.

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