Agricultural Labour Productivity and the Intensity of Agri-food Trade in Selected Regional Trade Agreements

Agnieszka Baer-Nawrocka and Agnieszka Sapa
Poznan University of Life Sciences

baer-nawrocka@up.poznan.pl
agnieszka.sapa@ui.poznan.pl

Selected paper prepared for presentation at the International Agricultural Trade Research Consortium’s (IATRC’s) 2013 Symposium: Productivity and Its Impacts on Global Trade, June 2-4, 2013, Seville, Spain
Agricultural labour productivity and the intensity of agri-food trade in selected regional trade agreements

by
Agnieszka Baer-Nawrocka, Agnieszka Sapa

May 2013

Correspondence regarding this paper should be addressed to:
Agnieszka Baer-Nawrocka, PhD
Department of Economics and Economic Policy in Agribusiness
Faculty of Economics and Social Sciences
Poznan University of Life Sciences
Ul. Wojska Polskiego 28
60-637 Poznan
E-mail address: baer-nawrocka@up.poznan.pl

Agnieszka Sapa, PhD
Department of Macroeconomics and Food Economy
Faculty of Economics
Poznan University of Economics
Al. Niepodleglosci 10
61-875 Poznan
E-mail address: agnieszka.sapa@ue.poznan.pl
Abstract

A characteristic feature of contemporary world economy is the development of regional trade groupings in quantitative and qualitative aspects. The groupings have been formed for many years, but the intensification of this process has been particularly evident since the mid-90’s of previous century. One of the reason for formation of such groups is improving economic efficiency and welfare in the integrating countries. Regional trading blocs and the liberalization of trade flows among members may result in the intensification of intra-regional trade and the process of convergence, which can also reveals in relation to agricultural productivity increase. This in turn affects the growth of farmers' income and improve the international competitiveness of agriculture, which is especially important for the developing countries. The main aim of this paper is to answer the question whether within regional trade groupings convergence of agricultural productivity occurs, and whether this process is accompanied by increase in the intensity of intra-regional agri-food trade. In addition, authors try to find if the obtained results are related to the level of development of the member countries of the selected regional trading blocs. Topic of this paper comprise part of regional development economics, which is based on classical economics and is related to the international trade theory with the convergence concept (J. Tinbergen). According to this concept, formulated in the 40’s of the twentieth century, a result of free trade between developed and developing countries will level out economic wealth. To achieve such a state, active participation in the global economy and appropriate capital per worker in the developing countries is needed. Trade liberalization within a regional trading groups may be reflected into an increase in the productivity of production factors, including agriculture, although the empirical studies carried out do not give conclusive results.

The analyzed groups are represented by North-North relations (EFTA), North – South relations (NAFTA) and South - South relations (MERCOSUR, EAC, CAN and CACM). Agricultural productivity will be measured by labor productivity in agriculture, although it doesn’t quite reflect the productivity of agriculture, but it is very important in the process of food production and the creation of agricultural income. For each regional trade agreement the coefficient σ convergence has been calculated and the convergence process has been evaluated. In order to verify σ convergence, the standard deviation of the log of agriculture value added per worker has been used. The analysis is based on data derived from World Development Indicators database and covers the period 1980-2010. Changes in the agri-food flows are measured by some indices: shares of intra-regional trade, intra-regional trade intensity index and symmetrical introversion trade indicator. Agri-food products are adopted
in accordance with the SITC classification. Trade data come from the World Integrated Trade Solution database. On the basis of the conducted analyses it cannot be clearly stated that membership in regional trade agreement means the existence of the processes of convergence of agricultural labour productivity among countries constituting a particular grouping. What is more, in the analysed groupings it is difficult to indicate unambiguous similarities within agri-food trade, that accompany the identified convergence/divergence process or the development level of the member countries.
1. Introduction

Apart from socio-economic system, economic policy and the possibility of influencing the international economic environment, the most important factors determining the competitive capacity of the economy and its sectors include the size, quality and structure of productive resources and efficiency of its use [Misala 2001]. In this context, the agricultural sector is particularly important. Most economists and agricultural economists agree with the thesis that the development of agriculture and the increase in its productivity, including productivity of labour, are positively correlated with economic growth of the country, expressed in GDP per capita. But the direction of this relation is still a contentious issue. In the theories which try to explain this problem there are two ways of thinking. The first of these proves that agriculture generates an surplus that goes to other sectors and creates conditions for the development of the entire economy, and remains one of the main leading forces of economic growth at the same time. The arguments presented in the second trend advocate the idea that the well-developed non-agricultural sectors through the utilization of labour surplus and the transfer of new technologies contribute to the growth of agricultural productivity. It is unquestionable fact that the increase in agricultural productivity plays a key role in improving the economic situation in the agricultural sector and in solving problem of the world food security. According to Hedaey et al. (2010) almost half increase of total factor productivity in agriculture is determined by growth in the productivity of labour resources. What is more, the effective use of production factors, including labour, decides about the competitiveness of agriculture at international level [Poczta et al. 2012]. It is especially important when we think about deepening of globalization process.

So, on the one hand, in each country the productivity of production factors (including labour) in agriculture determines its competitive ability and level of participation in the global economy. On the other hand, the liberalization of agri-food trade can be important impulse for agricultural development and determining the quantity, quality and efficient utilization of production factors in agriculture. And trade liberalization can be done according to the unilateral approach or the reciprocal approach. The reciprocal approach means that trade is making free through multilateral trade negotiations under the auspices of the GATT / WTO or through forming regional trade agreements [Bhagwati 2003]. Unprecedented proliferation of regional trade agreements is the main feature of contemporary world economy and international relations. For example on 10 January 2013 there were 546 regional trade agreements (counting goods, services and accession separately) notified by the GATT/WTO (of these 354 were in force). Why do countries became members of such regional groupings
so eagerly? Countries create or associate to the existing groupings because of economic and non-economic reasons\(^1\) [Whalley 1996]. One of the economic reason is improvement of the economic efficiency (also in agriculture) and welfare in integrating countries, but achievement of that goal is determined by structural, technological and economic factors\(^2\) [Misala 2001]. So, building the regional trade groupings can be important in the context of agriculture, especially, in developing countries. For these countries the relatively considerable share of agriculture in their GDP, high share of agri-food trade in their total trade flows and their small presence in the global agri-food market are characteristic. So the agricultural sector can have positive contribution to economic development and improvement of the world food security [World Bank 2008]. Regional trading groups formation and the liberalization of trade flows that is connected with this process, may result in the intensification of intra-regional and extra-regional trade flows (trade creation effect, trade diversion effect). Integration of member countries of selected regional trading group can be accompanied also by the process of convergence, which can also reveals in relation to agricultural productivity increase. This in turn affects the growth of farmers' income and improve the international competitiveness of agriculture.

The main aim of this paper is to answer the question whether convergence of agricultural productivity within the regional trade groupings occurs, and whether this process is accompanied by increase in the intensity of intra-regional agri-food trade\(^3\). In addition, authors try to find if the obtained results are connected with the level of development of the member countries of selected regional trading blocs. Hence, the analysis consists of three parts. The first part of the study is devoted to the assessment of the convergence/divergence process in the productivity of agriculture in selected regional trade groupings. The second part is the analysis of regional trade interdependences in relation to total and agri-food products. The last part of work – conclusions – is an attempt to recognize the relations between identified convergence/divergence process and intra-regional trade changes in the agricultural sector and the level of development of the countries constituting trade groupings.

---

\(^1\) Among non-economic reasons there are: political goals (to ensure peace, security, political stability, respect for democracy and human rights), ideological, humanitarian and cultural objectives.


\(^3\) The part of studies included in this paper was published in: Baer-Nawrocka A., Sapa A. (2013). The empirical analysis of convergence in agriculture have been proposed by, inter alia, Soares and Ronco (2000), Liu et al. (2008), Alexiadis (2010) Esposti (2011).
2. Methodical approach

The concept of convergence covers the problem of assessment of the scale and the reasons for inter-regional differences as well. This concept is used in many scientific fields, inter alia, biological, economic, humanistic or technical ones. Despite the fact that convergence has a different significance in each of these fields, their common denominator is identifying convergence with the process of becoming similar to each other. In social sciences this concept usually refers to categories such as GDP per capita, level of household income, indicators referring to labour market, the level of technological advance, and the capacity to create innovations, etc. The process of divergence, which is opposite to convergence, is identified with a multidirectional, divergent development that causes the lack of cohesion in the level of regional development [Fiedor, Kociszewski 2010].

The concept of convergence emphasized economic historians, such as Kuznets (1955), Gerschenkron (1962) and Gomulka (1986). They all note that backward countries tend to grow faster than rich countries. This conception derives from the standard neoclassical theory, as this is formulated by Solow (1956). In neoclassical growth models regions will converge towards a common ‘steady-state’ if the growth rate of technology, investment and labour force are identical across regions. The growth rate per capita tends to be inversely related to the starting level of output or income per capita – the poor economies grow faster than rich ones. This concept describes also J. Tinbergen which is considered to be the progenitor of convergence theory in economic sciences. Tinbergen noted that economic cooperation between developed and developing countries (on certain conditions such as an active participation in the global economy or possessing the capital that enables the initiation of economic growth) will lead to the equalization of living conditions in those countries [Fiedor, Kociszewski 2010]. Early theories of regional development are based on neoclassical theories of international trade and economic growth. Those theories emphasized that over time, the disparities in labour cost and in other factors will be decreasing between the regions and they will exhibit a tendency to converge. There are differences between national and regional economies, since the latter are far more open than national economies within which they are situated. Regional economies are usually more developed than national economies, since there is a duty-free, inter-regional and international trade as well as similar culture and customs. The great majority of theories derived from the understanding of tendencies in home economies may be increasingly applied to the regions in countries located in regional trade groupings [Łaźniewska et al. 2011].
In the following years there was a dynamic development of research on convergence, which is reflected in numerous interpretations of this concept [Sala-i-Martin 1996, Boldrin, Canova 2001]. The analysis of the literature on convergence shows that there are two basic concepts: beta (β) convergence and sigma (σ) convergence. The first concept assumes that the countries with lower initial income level are characterized by faster growth pace than richer countries, which in turn leads to the equalization of income level per capita among economies analysed. Beta convergence can be divided into unconditional (absolute) or conditional convergence. Absolute beta convergence assumes that all economies aim for the same income level per capita, whereas the idea of conditional beta convergence is that each economy strives for its own prosperity that depends on its internal characteristics. Sigma convergence, on the other hand, indicates scattering (dispersion) of the examined characteristic in the group of economies analysed (countries, regions). Depending on the direction of sigma convergence indicators changing the convergence or the divergence process can be identify in the considered period. In this paper in order to verify σ convergence, the standard deviation of the log of agriculture value added per worker has been used. It is described by the formula [Fiedor, Kociszewski 2010]:

\[
\sigma(t) = \sqrt{\frac{1}{n} \sum_{i=1}^{n} (\log y_i(t) - \bar{y}(t))^2}
\]

where:

\[
\bar{y}(t) = \frac{1}{n} \sum_{i=1}^{n} \log y_i(t)
\]

σ(t) – dispersion of agriculture value added per worker in the group of all regional trade agreements in the year t
y_i(t) – agriculture value added per worker in the regional trade agreement i in the period t
\bar{y}(t) – average agriculture value added per worker in the period t

The decreasing value of coefficient σ in the period considered indicates reducing disproportions in the level of characteristics analyzed, so there is convergence process. In the opposite situation, when sigma indicator increases, the divergence occurs [Barro, Sala-i-Martin 1992; Malaga 2004].
In order to assess changes of number of the employed in agriculture and agriculture value added per worker observed in particular countries, the formula to calculate the average pace of changes on the basis of all values of characteristic has been applied [Wysocki, Lira 2003].

With regard to the regional trading blocs, they are the results of the implementation of preferential trade agreements. Such agreements are concluded in accordance with the requirements of the World Trade Organization as an exception to the most-favoured-nation (MFN). Within these emerging groupings trade is arranged on preferential bases and is discriminating against the third countries at the same time. The creation of such international integrating groupings are accompanied by changes in trade flows within the groups and between the groupings and the third countries (trade creation effect, trade diversion effect)\(^4\). To evaluate those effects, inter alia, the descriptive methods are used, among them indicators of regional trade interdependence can be calculated. Those indicators make possible to assess if the established regional trading grouping is accompanied by greater intensification of trade among the members of the group as compared to the trade flows between that trade group and the rest of the world. In the conducted survey the indicators describing regional trade interdependence were calculated. These indicators, however, do not estimate trade effects of international integration and do not indicate the reasons of distribution of trade flows. In this study three indicators were calculated: intra-regional trade share, intra-regional trade intensity index and symmetrical introversion trade index. The first two measures are often used in the analysis of international integrating groupings, although they have some limitations of interpretation in the context of time series analysis and comparison of groupings. The indicator that is rather free of some restrictions is symmetrical introversion trade index which can be interpreted as the \textit{ex-post} trade diversion effect [Iapadre 2004].

The intra-regional trade share (trade means export plus import) is defined as the ratio of trade among the countries (members of groupings) to the overall trade of these countries. It allows to specify how relatively important is intra-regional trade in relation to the total trade of the members of the grouping [Cheong 2010, Iapadre 2004]. The mathematical formula of this index is:

\[
S_i = \frac{t_{ii}}{t_i}
\]

\(S_i\) = intra-regional trade share of region \(i\)

\(t_{ii}\) = intra-regional trade of region \(i\)

\(t_i\) = total trade of region \(i\)

\(^4\) The basic theory of the customs union have been formulated by J. Viner in the 1950s. His analysis related to the static effects of a preferential trade liberalization within the customs union: trade creation effect and trade diversion effect. J. Viner was a leader for further research on the effects of regional integrating groupings, resulting in numerous publications.
The intra-regional trade share index is very often used for evaluation of regional trade concentration, although its worth for analysis of comparison of selected international groupings is limited. Firstly, the value of the index depends on the number of members and their economies size. Secondly, the interpretation problem is connected with the concept called geographic neutrality. Thirdly, the intra-regional trade share is biased by pro-cyclical distortion [dell’Aquila, Sarker, Meilke 1999; Cheong 2010; Iapadre 2004].

The intra-regional trade intensity index is the measure which partly allows to avoid the mention above interpretation problems in the context of dynamic analysis of trade flows of international integrating groups. The simplest form of this index can be describe as the ratio of the intra-regional trade share of the group to the share of trade of this group in the world trade. Its mathematical formula is:

\[ I_i = \frac{t_{ii}}{t_i} \]

\[ I_i = \text{intra-regional trade intensity index of region } i \]
\[ t_{ii} = \text{intra-regional trade of region } i \]
\[ t_i = \text{total trade of region } i \]
\[ T = \text{world trade} \]

That measure is also called relative intra-regional trade intensity index because the intra-regional trade is estimated in relation to the share of group trade in the world trade [Cheong 2010]. That is why that index is also considered as alternative to the revealed comparative advantages of Balassa interpretation to indicate specialization of trade direction. If the intra-regional trade intensity index is greater than one it means that grouping trade is specialized - trade is relatively more oriented towards grouping members than towards third countries. Increase in that index means the weight of grouping for trade flows grows more (decreases less) than the weight of the world economy [Iapadre 2004].

- The indicator is equal one when the intra-regional share of grouping is equal to the share of grouping trade in the world trade. Such a situation means that the trade of the group members is geographically neutral.
- If the indicator has a value above one it means that the grouping trade is more oriented towards grouping members.
- If the indicator is less than one (and greater than zero), this means that trade flows are more oriented towards the third countries.

---

5 The geographic neutrality is defined as lack of preferential direction of trade flows of country or group of countries.
Intra-regional trade intensity index has interpretation problems that can be referred to three areas. First, the range variability of the index depends on the size of the grouping. The second problem is related to the asymmetry of the range variation. The third problem is connected with possible sign concordance between the changes of complementary indicators (intra-regional trade indicator and extra-regional trade indicator are complementary indicators) [Iapadre 2004]. The alternative measure to trade flows intensity which allows to avoid such interpretation problems is symmetrical trade introversion index.

Symmetrical trade introversion index measures the relative intensity of intra-regional trading versus trading with the third countries. The introversion trade indicator shows, in clear way, if intra-regional trade intensity grows more or less than extra-regional trade intensity [Iapadre 2004]. The mathematical formula of this index is following:

\[SJ_i = \frac{[HI_i - HE_i]}{[HI_i + HE_i]}\]

\[HI_i = \frac{(t_{ii} / t_i)}{(t_{ir} / t_r)}\]

\[HE_i = \frac{[1 - (t_{ii} / t_i)]}{[1 - (t_{ir} / t_r)]}\]

- \(t_{ii}\) = intra-regional trade of region \(i\)
- \(t_i\) = total trade of region \(i\)
- \(t_{ir}\) = extra-regional trade of region \(i\)
- \(t_r\) = total trade of the rest of the world

- The index is independent of the size of the region and symmetrical around zero while its range is \([-1, 1]\).
- The introversion trade indicator is equal to zero when trade of grouping is geographically neutral.
- If the indicator is greater than zero it means that trade flows are inwards oriented.
- If the indicator is less than zero the region’s trade has an extra-regional bias.

Trade introversion index rises (falls) when the intensity of intra-regional trade of grouping is growing faster (slower) than the intensity of extra-regional trade of that grouping. This indicator can be also interpreted as an ex-post measure of trade diversion effect.

The member countries of six regional trade agreements representing North - North trade relations (EFTA), North – South trade relations (NAFTA) and South - South trade relations

---

6 The range of variation of the index is not symmetrical around its neutrality threshold – when the index takes the value of one. To avoid problems connected with range variability and range asymmetry some other indexes are calculated: homogeneous index of intra-regional trade intensity and symmetrical index of intra-regional trade intensity. See more: [Iapadre 2004].
are analysed. The analysis is based on data: agriculture value added per worker, employment in agriculture derived from World Development Indicators (WDI) database and time series of trade data derived from World Integrated Trade Solution (WITS) database. The SITC classification was used where agri-food products are defined as: SITC (0+1+2-27-28+4). Time range of analysis covers the period 1980-2010.

3. Labour productivity in agriculture

Data on the average labour productivity in particular countries among analysed trade associations in the period from 1980-2010 are presented in table 1 and figure 1 shows sigma coefficient which has been calculated on this basis. The growth of sigma coefficient can be noticed among groupings such as NAFTA and EAC, which indicates the growth of spatial discrepancies between the countries of these groupings in terms of labour productivity in agriculture. In case of NAFTA it is caused by growing differences in labour productivity between Canada, the USA and Mexico. The growth of labour productivity occurred in all above-mentioned countries, but it was far more considerable in Canada and the USA than in Mexico. It was caused not only by the growth of agricultural value added but also by decreasing number of the employed in Canadian and American agriculture (table 2). It led to growing differences in labour productivity when compared to agriculture in Mexico, where the number of people employed increased. In the 80’s agriculture value added per worker in Mexican agriculture was eight times lower than in Canadian and American agriculture, whereas in years 2000-2010 this difference was fourteen times bigger. Therefore, it can be stated that in that case the process of divergence occurred. At the same time, labour productivity levels in Canadian and American agriculture show the catching up trend that may indicate the process of convergence. Productivity of labour in these countries is one of the highest among all the analyzed countries. It is determined by the agrarian structure which is dominated by large-scale farms with a high degree of relations with the market and a high level of mechanization of agriculture.

7 Throughout analysed period the membership of each grouping is fixed in order to avoid distortion caused by accession. CACM (Central American Common Market) includes: Costa Rica, El Salvador, Guatemala, Honduras and Nicaragua. CAN (Andean Community) embraces Bolivia, Colombia, Ecuador and Peru. EAC (East African Community) includes: Burundi, Kenya, Uganda, Tanzania and Rwanda. EFTA (European Free Trade Association) members are: Iceland, Liechtenstein, Norway, Switzerland, but in all calculations we take EFTA without Lichtenstein. MERCOSUR (Mercado Comun del Cono Sur) members are: Argentina, Brazil, Paraguay, Uruguay. NAFTA (North American Free Trade Agreement) includes: Canada, Mexico and United State.

8 For EAC the calculation of trade relations are based on time series data only within 1997-2010 because of the lack of adequate data in WITS database.
The process of \textit{sigma} divergence in terms of labour productivity in agriculture is especially visible from the mid 90’s in the countries forming EAC. In these countries labour productivity is extremely low when compared to countries from other analysed groupings. What is more, there is just a slight growth in labour productivity in the period concerned or its decline in case of Kenya and Burundi. In the majority of these countries, the increase in agricultural value added was accompanied by an increase in the number of worker employed in agricultural sector that is reflected in a positive rate of change. A very low labour productivity is determined by a large share of employment in agriculture of these countries, low capital endowment of agricultural workers as well as difficult natural conditions. That is the basic reason for the lack of competitiveness in the global agri-food market, and as the long-term forecasts show such situation will be maintained for these countries in the future [FAO 2012].

Although the convergence processes are limited, they can be noticed in EFTA and MERCOSUR groupings. EFTA consists of high developed countries, with high GDP \textit{per capita} and well developed agricultural sector. In the period concerned, labour productivity was increasing among the countries constituting both groupings. Among the EFTA members that growth was more determined by a decrease in the number of agriculture employees rather than by an increase in agricultural value added (except Switzerland). Reducing the labour force involved in the production process, along with a decrease in the number of farms marked the main path of growth in agricultural income of these countries. Among the MERCOSUR countries, on the other hand, an increase in agricultural value added was larger
but it was usually accompanied (except in Brazil) by a slightly increasing involvement of labour force in the production process. In case of both groupings it can be stated that countries with a relatively lower agricultural labour productivity in a particular grouping are gradually becoming similar to countries with a higher productivity of labour factor in agriculture. Thus, it can be concluded that there was the beta convergence tendency in terms of agricultural labour productivity among the countries of EFTA and MERCOSUR in the time considered.

Table 1.
Annual average of agriculture value added per worker and its changes in selected regional trade agreements in 1980-2010 (constant 2000 USD; %)

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>CACM</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Costa Rica</td>
<td>2 498.8</td>
<td>3 581.0</td>
<td>4 820.7</td>
<td>193</td>
</tr>
<tr>
<td>El Salvador</td>
<td>1 765.9</td>
<td>1 792.1</td>
<td>2 274.8</td>
<td>129</td>
</tr>
<tr>
<td>Guatemala</td>
<td>2 213.8</td>
<td>2 592.0</td>
<td>2 780.2</td>
<td>126</td>
</tr>
<tr>
<td>Honduras</td>
<td>1 008.8</td>
<td>1 279.7</td>
<td>1 754.1</td>
<td>174</td>
</tr>
<tr>
<td>Nicaragua</td>
<td>1 532.8</td>
<td>2 251.6</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CAN</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bolivia</td>
<td>679.3</td>
<td>719.4</td>
<td>721.8</td>
<td>106</td>
</tr>
<tr>
<td>Colombia</td>
<td>2 463.9</td>
<td>2 764.7</td>
<td>2 662.5</td>
<td>108</td>
</tr>
<tr>
<td>Ecuador</td>
<td>1 769.0</td>
<td>1 395.0</td>
<td>1 735.1</td>
<td>98</td>
</tr>
<tr>
<td>Peru</td>
<td>990.6</td>
<td>997.0</td>
<td>1 382.8</td>
<td>140</td>
</tr>
<tr>
<td>EAC</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Burundi</td>
<td>164.7</td>
<td>146.9</td>
<td>102.7</td>
<td>62</td>
</tr>
<tr>
<td>Kenya</td>
<td>399.9</td>
<td>348.1</td>
<td>354.7</td>
<td>89</td>
</tr>
<tr>
<td>Uganda</td>
<td>202.1</td>
<td>191.8</td>
<td>212.3</td>
<td>105</td>
</tr>
<tr>
<td>Tanzania</td>
<td>.</td>
<td>220.8</td>
<td>265.1</td>
<td></td>
</tr>
<tr>
<td>Rwanda</td>
<td>186.1</td>
<td>195.9</td>
<td>211.1</td>
<td>113</td>
</tr>
<tr>
<td>EFTA</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Iceland</td>
<td>44 201.2</td>
<td>47 711.4</td>
<td>54 442.8</td>
<td>123</td>
</tr>
<tr>
<td>Norway</td>
<td>14 535.8</td>
<td>24 134.1</td>
<td>35 425.7</td>
<td>244</td>
</tr>
<tr>
<td>Switzerland</td>
<td>22 232.5</td>
<td>19 484.3</td>
<td>23 121.4</td>
<td>104</td>
</tr>
<tr>
<td>MERCOSUR</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Argentina</td>
<td>6 633.2</td>
<td>7 933.0</td>
<td>10 476.1</td>
<td>158</td>
</tr>
<tr>
<td>Brazil</td>
<td>1 325.5</td>
<td>1 863.5</td>
<td>3 214.3</td>
<td>242</td>
</tr>
<tr>
<td>Paraguay</td>
<td>1 389.5</td>
<td>1 749.6</td>
<td>2 105.6</td>
<td>152</td>
</tr>
<tr>
<td>Uruguay</td>
<td>5 348.3</td>
<td>6 601.7</td>
<td>7 931.1</td>
<td>148</td>
</tr>
<tr>
<td>NAFTA</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Canada</td>
<td>18 990.5</td>
<td>32 741.0</td>
<td>44 312.9</td>
<td>233</td>
</tr>
<tr>
<td>Mexico</td>
<td>2 225.4</td>
<td>2 333.8</td>
<td>2 920.9</td>
<td>131</td>
</tr>
<tr>
<td>United States</td>
<td>15 813.2</td>
<td>23 185.6</td>
<td>42 652.5</td>
<td>270</td>
</tr>
</tbody>
</table>

Source: own calculations based on World Development Indicators database.
Table 2. Changes of agriculture value added and employment* in agricultural sector in selected regional trade agreements in 1980-2010 (%)

<table>
<thead>
<tr>
<th>Regional trade agreements</th>
<th>Agricultural value added</th>
<th>Employment in agricultural sector</th>
</tr>
</thead>
<tbody>
<tr>
<td>CACM</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Costa Rica</td>
<td>0.02</td>
<td>0.04</td>
</tr>
<tr>
<td>El Salvador</td>
<td>-0.03</td>
<td>0.01</td>
</tr>
<tr>
<td>Guatemala</td>
<td>0.00</td>
<td>0.02</td>
</tr>
<tr>
<td>Honduras</td>
<td>0.02</td>
<td>0.02</td>
</tr>
<tr>
<td>Nicaragua</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CAN</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bolivia</td>
<td>0.00</td>
<td>0.03</td>
</tr>
<tr>
<td>Colombia</td>
<td>0.02</td>
<td>-0.02</td>
</tr>
<tr>
<td>Ecuador</td>
<td>0.03</td>
<td>-0.07</td>
</tr>
<tr>
<td>Peru</td>
<td>0.03</td>
<td>0.03</td>
</tr>
<tr>
<td>EAC</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Burundi</td>
<td>0.03</td>
<td>-0.01</td>
</tr>
<tr>
<td>Kenya</td>
<td>0.03</td>
<td>0.00</td>
</tr>
<tr>
<td>Uganda</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tanzania</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rwanda</td>
<td>0.01</td>
<td>0.00</td>
</tr>
<tr>
<td>EFTA</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Iceland</td>
<td>0.01</td>
<td>-0.01</td>
</tr>
<tr>
<td>Norway</td>
<td>0.01</td>
<td>0.04</td>
</tr>
<tr>
<td>Switzerland</td>
<td>-0.03</td>
<td>-0.02</td>
</tr>
<tr>
<td>MERCOSUR</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Argentina</td>
<td>0.01</td>
<td>0.03</td>
</tr>
<tr>
<td>Brazil</td>
<td>0.03</td>
<td>0.02</td>
</tr>
<tr>
<td>Paraguay</td>
<td>0.03</td>
<td>0.03</td>
</tr>
<tr>
<td>Uruguay</td>
<td>-0.01</td>
<td>0.04</td>
</tr>
<tr>
<td>NAFTA</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Canada</td>
<td>0.02</td>
<td>0.00</td>
</tr>
<tr>
<td>Mexico</td>
<td>0.01</td>
<td>0.01</td>
</tr>
<tr>
<td>United States</td>
<td>0.04</td>
<td>0.02</td>
</tr>
</tbody>
</table>

Employment by sections and divisions-employed in agriculture, hunting and forestry.
Source: own calculations based on World Development Indicators database.

In the CACM and CAN countries, in turn, there were no considerable changes in the convergence indicator level, which shows that disproportions in agricultural labour productivity between these countries are not increasing nor decreasing. Thus, the tendency to maintain differentiations was stable in the time considered. In the majority of countries that belong to these regional trade agreements there was an increase in agricultural value added per worker, although greater changes in this matter occurred in the CACM countries. In these
countries, a gradual decline in the share of agriculture in GDP can be noted along with simultaneous an increase in GDP per capita [WDI 2013]. The increase in productivity in the agricultural sector, therefore, is accompanied by the economic development. Despite this, agriculture in these countries is still characterized by a low labour productivity. It should be also noted that the number of people employed in agricultural sector increased in the period considered (positive rate of change). Quite considerable growth in labour force potential occurred especially in agriculture of the CAN countries – in extreme cases this growth reached 50-60% when compared to the beginning of the time considered.

4. Regional trade interdependences

In the analyzed groupings the share of intra-regional total and agri-food trade was at the highest level in the case of NAFTA (figures 2 and 3). It is understandable taking into account the limitations of index values interpretation associated with the size economies of the member countries. The share has increased significantly in the 80’s and 90’s relatively from 34% (27%) to approximately 50% at the beginning of the twenty-first century. And then the index value came down by 5 percentage points for total trade and 6 percentage points for agri-food products. In the case of MERCOSUR, the share of intra-regional total and agri-food trade was increasing continuously up to level of 24% and 26% in 1998. In subsequent years, a steady decline of the ratio was observed. It decreased adequately to 17% and 12%, although these shares remained at the same level in 2004-2010. What is more, at the end of the first decade of the twenty-first century, the share of intra-regional agri-food trade balanced at the same level as in the early 80’s. As in the case of MERCOSUR, the shares of intra-regional trade increased steadily from the mid-80’s for the CACM and CAN countries. In CACM, unlike other groups, the share of intra-regional agri-food trade increased much more when compared to total trade, respectively, about 20 and 7 pp. CACM is also the only group in which the share of intra-regional agri-food trade was greater than the share of intra-regional total trade (since the mid-90’s). In the CAN countries the share of intra-regional trade developed at the similar level both for total trade and agri-food trade. The indicators balanced from 3-4% in the second half of the 80’s to 8-11% in 2001-2010. In the case of the EAC countries the share of intra-regional trade ratio was shaped in a horizontal corridor ranged from 12% to 19% in the case of total trade and from 11% to 17% for the agri-food products.

---

9 Such a relatively low share of intra-regional trade in the case of MERCOSUR is connected to, inter alia, the obligation to pay additional duties within the grouping despite it is the custom union and Common Custom Tariff was established [Korinek, Melatos 2009].
The lowest share of intra-regional trade index was observed in the EFTA countries. During analysed 30 years, only 1% of total trade and 2% of agri-food trade of his group had intra-regional nature.

Fig 2. Share of intra-regional total trade in the selected regional trade agreements in 1980-2010 (%)
Source: own elaboration based on World Integrated Trade Solution database.

Fig 3. Share of intra-regional agri-food trade in the selected regional trade agreements in 1980-2010 (%)
Source: own elaboration based on World Integrated Trade Solution database.

Intra-regional trade intensity index for groups: CACM, CAN, EAC, MERCOSUR and NAFTA take values greater than one, both for total trade and agri-food trade in the period concerned (figures 4 and 5). So it can be said that the trade of these groupings is
geographically specialized (in this case regionally), because trade flows, both total and agri-food, are more oriented towards member countries than the third countries. In the case of NAFTA the relative importance of the member countries in the trade relations steadily increased both for total and agri-food trade. What is more, the intensity indicant was higher for agri-food products from the 90’s to the end of the period considered. The relative importance of intra-regional agri-food trade also systematically increased in CACM and CAN, whereas intra-regional trade intensity for total trade was almost stable for the CACM countries and decreasing for the CAN members.

![Intra-regional trade intensity index for total trade of the selected regional trade agreements in 1980-2010](image1)

*Fig. 4. Intra-regional trade intensity index for total trade of the selected regional trade agreements in 1980-2010 Source: own elaboration based on World Integrated Trade Solution database.*

![Intra-regional trade intensity index for agri-food trade of the selected regional trade agreements in 1980-2010](image2)

*Fig. 5. Intra-regional trade intensity index for agri-food trade of the selected regional trade agreements in 1980-2010 Source: own elaboration based on World Integrated Trade Solution database.*

In the EAC countries, the intensity of intra-regional agri-food trade accepted values relatively unchanged while the importance of member countries in the intra-regional total trade systematically declined in the first decade in the 21st century. The trade intensity indicator
changed differently in MERCOSUR. By the end of the 90’s, the importance of intra-regional trade systematically increased. For example, the importance of intra-regional total (agri-food) trade was 15 (6.5) times higher than the share of total (agri-food) trade of grouping in the world total (agri-food) trade. Since then a continuous decline in the relative importance of intra-regional trade has been observed - these ratios decreased relatively to 9 and 2.5.

Only in the case of EFTA the intensity index was below 1 for total trade in the period considered. With regard to the agri-food trade, it was more biased towards the member states since the early 90’s, although the values of intensity were very close to the neutrality threshold.

![Fig. 6. Introversion index for total trade of the selected regional trade agreements in 1980-2010](source-own_elaboration_based_on_world_integrated_trade_solution_database.png)

![Fig. 7. Introversion index for agri-food trade of the selected regional trade agreements in 1980-2010](source-own_elaboration_based_on_world_integrated_trade_solution_database.png)
In terms of the intra-regional trade introversion index, it was observed that both total trade and agri-food trade were inward oriented in the CACM, CAN, EAC, MERCOSUR and NAFTA countries (figures 5 and 6). In these groupings the introversion indices developed between (0, 1). In the case of CACM, NAFTA and CAN the intra-regional trade introversion indices were increasing significantly (stabilization in recent years), that means that the intensity of intra-regional agri-food trade increased faster than the intensity of extra-regional agri-food trade. Similar tendencies occurred for total trade of NAFTA and CAN. In the CACM members the introversion index for total trade balanced almost at the same level during the time concerned. It can be also noticed that the introversion indices are almost unchanged for the EAC countries. Thus, it can be concluded that the pace of changes of intra-regional trade intensity was the same as the extra-regional trade intensity (for total and agri-food trade). In the case of MERCOSUR, after period of growth and stability, there was a systematic decrease of trade introversion index during 2000-2010. Such a tendency was particularly evident in terms of agri-food trade, what implies that the intensity of intra-regional trade grew more slowly than extra-regional trade.

Trade relations of EFTA had quite different nature. Throughout the time considered, the values of the introversion indices were below zero, that allows to conclude that trade flows were more biased towards outside of the groupings than towards the member countries. Since the 90’s the intensity of intra-regional agri-food trade increased faster than extra-regional agri-food trade, that the values of introversion index validated. Simultaneously the values of this index were very close to zero, which may indicate that agri-food trade of EFTA was almost geographically neutral.

5. Conclusions
On the basis of the conducted analyses it cannot be clearly stated that membership in regional trade agreement means the existence of the processes of convergence of agricultural labour productivity among countries constituting a particular grouping. What is more, in the analysed groupings it is difficult to indicate unambiguous similarities within agri-food trade, that accompany the identified convergence/divergence process or the development level of the member countries.

The tendencies to eliminate spatial disparities between countries in terms of labour productivity, expressed as agricultural value added per worker, were noticeable only in relation to EFTA (high developed countries of North-North relations) and MERCOSUR (developing countries of South-South relations). What is more, beta convergence is also
visible in case of both groupings, which is reflected in a faster growth in agricultural labour productivity in countries with lower initial level of this factor. At the same time, in both these groupings the geographical specialization takes place. The agri-food trade was relatively more oriented towards the member states than towards the countries outside of the groupings. Whereas:

- in the case of MERCOSUR, the intra-regional agri-food trade intensity grew faster than extra-regional agri-food trade intensity only by the end of the 90’s. Then the rest of the world became more important. The decrease of intra-regional trade introversion indicator (intra-regional trade intensity grew slower than extra-regional trade intensity) accompanied the custom union that was established in 1991. The observed improvement in agricultural labour productivity resulted in an increase in the competitiveness of the agri-food products in the world market. It was reflected by near double growth of agri-food export share of MERCOSUR in the world agri-food export (from 5% at the beginning of the 90’s to almost 9% in 2010). At the same time the share of agri-food export in total export of MERCOSUR accounted for about 40%. Simultaneously Brazil had the largest share in total agri-food export and extra-regional agri-food export of MERCOSUR (respectively 58% and 61% in the period 1980-2010). It was also Brazil for which there was the greatest increase in agricultural labour productivity during the period concerned.

- the trade situation was somewhat different in the EFTA countries. During the period considered total trade of EFTA was relatively more oriented towards third countries. But intra-regional agri-food trade intensity was greater when compared to extra-regional agri-food trade intensity only from the 90’s. At the same time, taking into account values of intra-regional trade intensity index and introversion trade index, it can be concluded that agri-food trade of EFTA was almost geographically neutral. The interpretation of these results is limited, however, due to the fact that since the establishment of EFTA (1960) the number of member countries significantly has changed. EFTA consists of high developed countries with a very low share of agriculture in GDP and a relatively small share of agri-food exports in its total exports.

Strengthening the spatial disparities between countries in terms of agricultural labour productivity occurred in the NAFTA and EAC countries.

- The agricultural labour productivity increased in all NAFTA countries, however, the pace of this process varied from country to country, thus disproportions in labour productivity in agriculture within this grouping were increasing (mainly between Canada, the USA and Mexico) so the divergence process occurred. This process was accompanied by a
systematic increase of intra-regional agri-food trade intensity and faster increase of intra-regional agri-food trade intensity than extra-regional one. Therefore, strengthening the geographical specialization of agri-food trade (inward orientation) was accompanied by, on the one hand, disparities in agricultural labour productivity in the member countries, on the other hand, increasing labour productivity in agriculture in all countries of the grouping. Changes rate in the agricultural labour productivity differs, which is a consequence of considerable disparities in the level of economic development, socio-economic policy and accordingly agricultural development among the members of this grouping, both in the production structure as well as in an access to the means of production and the possibility to replace labour work with capital. NAFTA represents the grouping in which preferential agreement was signed by developed and developing countries (North-South relations). The main reason of growing agricultural labour productivity in Canada and the USA, was mainly an increase in agricultural value added that was accompanied by the decrease in the number of workers in agricultural sector. However the changes in agricultural value added were faster than changes in agricultural labour resources. At the same time it should be noted that these changes were already taking place when there was a relatively very high initial level of labour productivity in agriculture. It is worth to notice here that NAFTA is a major player in the global agri-food market, although its importance is systematically reduced. The share of agri-food export of NAFTA in the world agri-food export decreased from 25% (the early 80’s) to 16% (the end of the first decade of the 21s century), while the share of agri-food export in total export of NAFTA fell twice in the same period (respectively from 22% to 11%).

- In the EAC countries the divergence process in agricultural labour productivity took place under conditions of low productivity growth or its decline. This process was generally accompanied by stable situation reflected in values of the trade interdependence indicators. Agri-food trade was relatively geographically specialized towards member countries but the power of this specialization didn’t strengthen or weaken. This is also supported by the development of the intra-regional agri-food trade introversion index. The EAC members are developing countries of Africa, representing, in contrast to the groups presented above, South – South relations. Export of EAC agri-food trade accounted for approximately 60% of its total export in 1997-2010, while the share of agri-food export of EAC in the world agri-food export was below 0.5%. Low agricultural labour productivity, a high share of agriculture in GDP, lack of adequate infrastructure of agribusiness, low level of socio-economic development prevent the EAC countries to compete in the global agri-food
market. Taking into account the issues mentioned above, it can be concluded that these restrictions are barriers to strengthen trade relations both within the group and with third countries.

No significant changes in the values of convergence indicator were observed in the case of countries forming CACM and CAN and representing South-South relations. These are the groupings in which the process of convergence or divergence has not been identified in terms of agricultural labour productivity. In most of the countries belonging to those groupings the value added per worker in agriculture (mainly in CACM) and employment in agriculture (mainly in CAN) increased.

- Taking into account trade flows, it can be concluded that it was gradual increase of the share of intra-regional agri-food trade in both these groupings during the period concerned. In addition, the intra-regional agri-food trade intensity was increasing faster than the extra-regional agri-food trade intensity, that reinforced the relative geographical specialization of agri-food trade towards the member countries.

- CACM and CAN are groupings of the developing countries with a relatively high share of agriculture in GDP. The share of agri-food export of these groups in their total export was respectively at the level of approximately 50% and 30% in the time considered. At the same period these groupings had very little significance in the world market, their share of agri-food export in the world agri-food export amounted approximately 1% for CACM and 1.5% for CAN. Increase of agri-food trade intensity can be connected with an increase in agricultural production as a result of the greater involvement of labour resources by low and relatively stable productivity. It can be said that the increase of intra-regional agri-food trade intensity is a kind of alternative to the limited ability to compete in the world market. This raises the question, if the growth of intra-regional agri-food trade intensity can increase production capacity and productivity of production factors and improve the competitive position of these groupings in the world market in long period of time.

Bibliography:


Iapadre L. (2004), Regional Integration Agreements and the Geography of World Trade: Statistical Indicators and Empirical Evidence, Dipartimento di Sistemi e Istituzioni per l’Economia, Facoltà di Economia, Università dell’Aquila and CIDEI, University of Rome “La Sapienza”, Preliminary draft, 1 September, pp. 3-5, 6-9.


