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USING INPUT-OUTPUT TABLES TO MEASURE THE CONTRIBUTION OF INDUSTRIES TO THE TRADE BALANCE

Abstract

The Belarusian economy is in a state of balance since 2016: trade deficit and gross foreign debt were reduced, the local currency strengthened. The problem is in resumption of economic growth, while avoiding trade deficit. The role of structural policy is to control the rate of growth of specific industries. Those industries that provide trade surplus should grow faster.

Government was stimulated both investment and consumer demand in the period from 2006 to 2014. As a result, GDP growth reached 5-12%, but subsequently the gross foreign debt exceeded 75% of GDP.

We have found that economic growth stimulation through quantitative easing in a small open economy usually leads to imbalances. Furthermore, imbalances reach critical levels if exports declining. In 2016 the situation with exports was extremely unfavorable for Belarus. Therefore, if government could not abandon stimulation entirely, it should still apply it selectively, in order to avoid imbalances. For this purpose, we propose to differentiate the industries in their contribution to the trade balance.

We offer a tool for assessing the contribution of each sector of economy (industry, or a product) to the trade balance. Baseline data are presented in the Input-Output tables, and the methodology is based on the Trade in Value Added (TiVA) indicators. Particularly, we line up the aggregate value chains for each final product, distinguishing foreign and domestic value added in gross exports and final demand for each industry.

The estimates of the Belarusian economy made it possible to divide the industries into three groups, according to their contribution to the trade balance:

Group 1: Products that contribute trade surplus. Domestic value added embodied in these products exceeds domestic final demand, taking into account the intermediate and final imports. This group includes: petroleum products, chemicals, transport services, business services (including software development).

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Group 2: Products creating trade deficit. Final demand for these products exceeds domestic value added – they are construction services, as well as manufacturing products: machinery and equipment, electronics and vehicles.

Group 3: Relatively neutral to the trade balance products, which include garment, wood, retailing, and some others.

For instance, it was found that the construction industry creates $3,5-4,5 billion of net imports, while total gross imports equals $44-48 billion in 2012 – 2014. In this period, petroleum products contributed approximately the same amount (if take into consideration export margins) to the domestic value added embodied in gross exports. In 2016 exports of petroleum products declined on a half. The volume of construction works was also halved, that allowed avoiding trade imbalance.

Key words: *Belarus, Input-Output tables, trade balance, value added.*

JEL classification: *F14, O12*

КОРИШЋЕЊЕ ИНПУТ-АУТПУТ ТАБЕЛА ЗА МЕРЕЊЕ ДОПРИНОСА ИНДУСТРИЈА ТРГОВИНСКОМ БИЛАНСУ

Апстракт

Белоруска економија је у стању равнотеже од 2016. године: трговински дефицит и велики спољни дуг су смањени, а домаћа валута је ојачана. Проблем је повећање привредног раста, уз избегавање трговинског дефицита. Улога структуралне политике је да контролише стопу раста специфичних индустрија. Индустрије које обезбеђују трговински суфицит треба да расту брже.

Влада је стимулисала и инвестициону и личну потрошњу у периоду од 2006. до 2014. године. Као резултат тога, раст БДП-а је достигао 5-12%, али је, последично, укупни спољни дуг премашио 75% БДП-а.

Открили смо да стимулисање економског раста помоћу квантитативних олакшица у малој отвореној економији обично доводи до неравнотеже. Штавише, неравнотежа достиже критични ниво, ако се извоз смањи. У 2016. ситуација са извозом је била екстремно неповољна за Белорусију.

Стога, ако влада не може да у потпуности укине подстицање (стимулисање) економије, требало би да подстицање економије примењује селективно како би се избегле неравнотеже. За ову сврху, предлажемо диференцирање индустрија по њиховом доприносуу трговинском билансу.

Предлажемо алат за процену доприноса свако сектора економије (индустрије, или производње) трговинском билансу. Основни подаци су презентовани у инпут-аутпут табелама, а методологија се заснива на индикаторима the Trade in Value Added (TiVA). Посебно истичемо укупни (агрегатни) ланац вредности за сваки финални производ, разликујући, при том, домаћу и страну додатну вреност у укупном извозу од финалне тражње за сваку индустрију.

Процене белоруске економије омогућиле су да се индустрије поделе у три групе, према њиховом доприносу трговинском билансу:

Група 1: Производи (индустрије) који доприносе трговинском суфициту. Домаћа додатна вредност садржана у овим производима превазилази домаћу финалну тражњу, узимајући у обзир интермедијални (међупроизводни) и финални (крајњи) увоз. Ова група укључује: нафтне деривате, хемикалије, услуге транспорта, пословне услуге (укључујући развој софтвера).

Група 2: Производи који доводе до трговинског дефицита. Финала (укупна) тражња за овим производима превазилази домаћу додату вредност. Реч је о грађевинским услугама и индустријским производма као што су: машине и опрема, електроника и возила).

*Група 3: Производи који не утичу на трговински биланс укључују одећу, дрво, малопродају и слично.*

На пример, открили смо да грађевинска индустрија ствара 3.5-4.5 трилиона долара нето увоза, док укупни (бруто) увоз износи 44-48 билиона долара у периоду од 2012. до 2014. У овом периоду, нафтни деривати допринели су приближно у истом износу (ако узети у обзир извоз марже) домаћој додатној вредности укљученој у бруто извозу. У 2016. извоз нафтних деривата је смањен за 50 одсто. Обим грађевинских радова је, такође, преполовљен, чиме је избегнут трговински дефицит.

Кључне речи: *Белорусија, инпут-аутпут табеле, трговински биланс, додатна вредност.*

Introduction

The Belarusian economy has been being in the recession since 2015 but during previous 15 years its growth rates had exceeded the world average and reached 12% per year. High growth rates of the Belarusian economy were provided either by favorable conditions for exports when the demand for Belarusian products in foreign markets had been increased (2000-2008) or by monetary stimulation of consumer and investment demand in the domestic market (2006-2014).

The economic growth stimulation by the government resulted in trade imbalance, which reached 15% of GDP in 2010, as well as an increase of the external debt. Payments for servicing external debt worsened the current account even with the trade surplus (Figure 1). Since 2015 when the economies of the main trade partners of Belarus - Russia and Ukraine – have been being in a state of recession and the volume of Belarusian exports to these countries has decreased, the need to move Belarusian economy to balanced growth became obvious. Balanced economic growth means the one that does not lead to trade imbalance and the growth of debts of the economy sectors.

Figure 1: Payment balance and GDP growth rates in the Republic of Belarus.
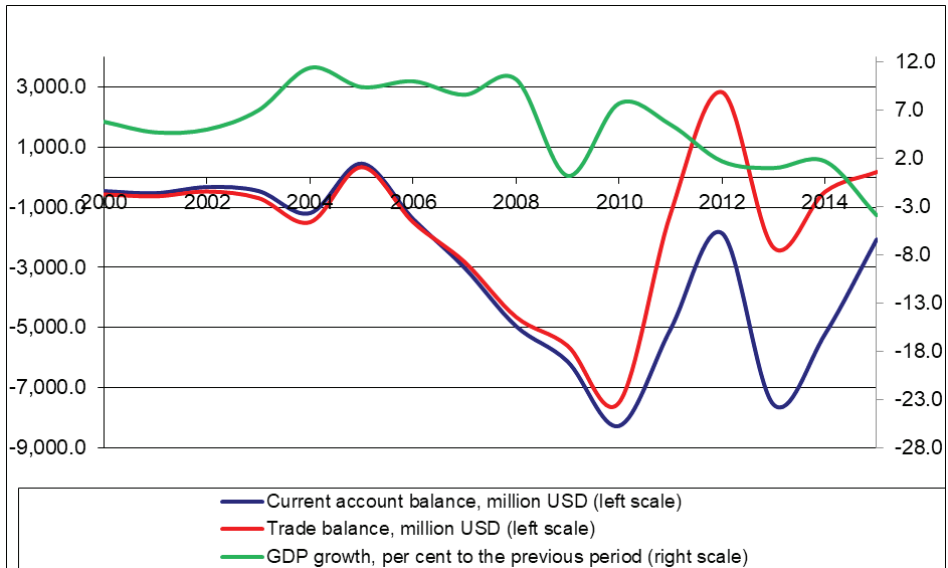
Program of economic and social development of the Republic of Belarus for 2016-2020 (Chapter 5) has prioritized balanced development, the key terms of which include deficit-free balance of payments and budget with a reduction in gross external debt and inflation (About the statement of Program of economic and social development of the Republic of Belarus for 2016-2020, 2016). And if we assume that the accelerated development of certain industries leads to an increase in trade imbalances and accordingly external debt while the development of other industries on the contrary reduces trade imbalance, then one of the main tasks of structural policy is to regulate the economy growth rates aimed to achieve a positive foreign trade balance.

Theoretical concept known as the Thirlwall's balance of payments constraint (Thirlwall, 2003) is used to estimate and predict the balanced growth of emerging economies.

Thirlwall's balance of payments constrained growth model postulates that the balance of payments position of a country is the main constraint on economic growth, because it imposes a limit on demand to which supply can adapt (Ghani, 2006). Later evidence for Thirlwall's law was found for Argentina, Brazil, South Korea, Malaysia, and the Philippines (Gouvea, 2010).

Governments of emerging economies often meet decrease in exports and increase domestic output to reach high economic growth. An increase in domestic output, by increasing imports, can lead to a deficit in the balance of payments, which may require either a fall in demand or a real exchange rate depreciation in order to ensure the sustainability of the external deficit. Hence, an unsustainable external deficit sooner or later requires a correction, which puts a brake on further output growth (Bajo-Rubio, 2014).

Based on (Elliott, Rhodd, 1999) results, economic growth is not only constrained by export and capital flows, but additionally is adversely affected by debt service payments which rob the economy of much needed resources to promote economic growth.

All these negative effects appeared in Belarus after domestic output stimulation. As any open less developed economy, Belarusian economy could not grow faster than its equilibrium balance of payment grows (Kolesnikova, Luchenok, 2015).

Methodology of the study

Thirlwall's model developed in 1970th and well known from his earlier publications (Thirlwall, Hussain, 1982) based on the previously developed models of Harrod (1940th) and Kaldor (1960th) (Celi G., Sportelli M., 2007). It assumes estimates of the income elasticity of demand for imports and dynamic simulations of economic growth based on initial data of exports and imports, investments and savings, etc. (McGregor P.G., Swales J.K., 1986).

In this study we used the Input-Output tables and the Trade in Value Added (TiVA) methodology as a data source and the basis for assessing the balance of economic growth. Using this methodology and based on the information provided we calculated the contribution to GDP and trade balance procured by each industry.

The Input-Output tables is a powerful toolkit for economic analysis that allows estimating cross-sectorial correlation in the context of the basic macroeconomic indicators. In previous years, it was used in Belarus principally for forecasting of domestic output and final demand (Soshnikova et al, 2001). Gradually the nation standard of Input-Output tables and the national industrial classifer were transformed closer to the international standards described for example in (Yamano, Ahmad, 2006).

Since the fall of 1990s Input-Output tables began to used worldwide for international trade analyzing by value added when the volumes of exports and imports began to be estimated not in the prices of goods and services but by the value added that each country buys and sells, produces and consumes in the process of international cooperation.

The basics of the methodology of statistical accounting of international value-added trade were published in scientific studies in the second half of the 1990s and since 2011 international organizations such as UNCTAD, Eurostat, OECD, WTO launched online services with access to databases where the value added created and consumed in the world has been distributed across countries and industries. The developed methodology is based on interconnected Input-Output tables for each country and involves the use of a set of indicators reflecting the degree of a country integration into global value chains based on the ratio of own and imported value added in gross exports and final demand (Bykau A., Kolb O., 2017).

One of the key indicators in value-added trade assessment is the indicator "domestic value added embodied in gross exports" calculated on the basis of direct costs (the Leontief matrix) using a special recursive procedure (Cappariello R., 2012). The indicator allows estimating of the share of value added in the gross output of the final output not only in this industry but also in other related industries integrated into the production chain within the national economy.

The contribution of exports to GDP and economic growth of the Belarusian economy is quite a topical problem because of a high openness of the economy and the need to overcome the trade deficit. First estimations have been made by Gotovskiy and Gutsol (2007), and then Belousov (2016), Grichik (2016), Bykau and Kolb (2017) have improved methodology using TiVA indicators like 'vertical specialization' or 'domestic value added embodied in gross exports'.

Then we have come to the conclusion that using this methodology allows us to divide the produced gross added value into two parts both in the whole national economy as and in the context of separate industries:

- gross value added in the export of products;
- gross value added created due to domestic sales in the consist of final products used for final consumption and gross capital formation.

Estimating the contribution of the second of the mentioned above components to GDP allows to specify a quantitative relationship between domestic demand and trade balance, broken down by industry. Total demand in the domestic market can be estimated in the cost of consumed goods and services. This cost includes the full value of domestic end-use products for the domestic market as well as the cost of consumer imports. The value of domestic final consumption products in turn can be divided into value added of national origin and intermediate imports in the composition of products. Thus the total demand in the domestic market conditionally includes the following components:

- import of final products;
- import of intermediate products in the whole production chain within that part of the final production produced in the national economy which is sold on the domestic market;
- domestic value added in the composition of domestic final products sold on the domestic market.

We suppose homogeneity of products of one sector consumed in the domestic market as a part of the total demand and also exported. Homogeneity means the same import capacity and correspondingly equal shares of the domestic value added in the gross output in products of one industry supplying on domestic market and on exports;

In Belarus the main method of GDP estimating is production method while the income method contains statistical discrepancies. Therefore it is possible to establish the link between the foreign trade balance and the elements of GDP using the income method to estimate the total demand for the national economy and in the context of its industries. The estimated foreign trade balance will differ to real balance on the amount of statistical discrepancies.

In accordance with this method, the gross value added produced in the economy is equal to the sum of final consumption, gross capital formation and net exports. It means the value of net exports as the difference between exports and imports, is determined by the equality (1)

$$X - M = GDP - (FC+CF) - \varepsilon \qquad (1)$$

Where
X is exports;
M is imports,

GDP is gross domestic product;
FC is final consumption;
CF is gross capital formation;
ε is statistical discrepancies.

Then we assume that the gross value added is formed from the value added in exports and value added created due to the sale of final products in the domestic market. In turn the total demand in the domestic market, equal to the final consumption and gross capital formation, consists of demand for domestic and foreign final products. Domestic final products include both value added and intermediate imports. Considering that we represent equality (1) in the form of formula (2) which relates the foreign trade balance to the elements of value added and imports:

$$X - M = (VAD + VAE) - (VAD + IFD + IFF) \pm MG - \varepsilon \qquad (2)$$

Where
VAD is domestic value added created due to the sale in the domestic market;
VAE is domestic value added embodied in exports;
IFD is import component of domestic final products sold in the domestic market;
IFF is imports of the final products;
MG is transport, trade and tax margins.

All indicators of formulas (1) and (2) are initially calculated in basic prices. For the transition to market prices, it is necessary to distribute margins on the domestic market and export margins to value added and final demand. Then it is possible estimate the contribution of the supply of goods and services (the first summand) and the demand on goods and services (the second summand) to the trade balance:

$$X - M = (VAD + MGd + VAE + MGe) - (VAD + MGd + IFD + IFF) - \varepsilon \quad (3)$$

Where
MGd is transport, trade and tax margins on the domestic market;
MGe is transport, trade and tax margins in exports;

There are several important preliminary conclusions that follow from formula (2) and characterize the relationship of the foreign trade balance with the elements of GDP and final demand:

1. Total demand in the domestic market is in fact the main factor in the imports growth and the build-up of external debt in the national economy. On the one hand, ready-made final products are imported to meet the needs of the domestic market. But even if it is replaced by domestic products imports can not practically be reduced to zero since any kind of domestic products contains a certain share of intermediate imports.

2. Thus the foreign trade balance does not depend on the absolute quantity of the value added in the composition of the final products sold on the domestic market (VAD): in the formula (3) this indicator is reduced. It also does not depend on margins on the domestic markert which redistribute but do not create incomes. Therefore for balanced economic growth it is more preferable to increase the consumption of domestic products with a minimum import component. Such products as a rule are services.

3. The foreign trade balance does not depend on the import intensity of the products exported: in formula (2) this indicator is absent. Indeed, the exported domestic products consist of the domestic value added and intermediate imports. At the same time the outflow of money from the economy to purchase intermediate imports as part of the exported product is compensated by the influx of cash receipts from the export of this product. Therefore even in case of an extremely high import intensity the exported product allows the creation of value added.

Mentioned above preliminary conclusions in general correspond with the conclusions of other researchers of aggregated value chains in the Belarusian economy, made using the Input-Output tables (Grichik M., 2016).

Results and conclusions

The target result of the developed methodology is the dividing of the contribution to the result of foreign trade by industries of the economy. The use of the balance of payments data does not allow this because there is no information on domestic value added in exported products i.e. there is no relations between industries in it.

The Figure 2 shows the results of calculating the equivalent of the foreign trade balance for each industry using the formula (2). As it was mentioned above, trade balance does not depend on margins on the domestic market but depends on export margins especially for product with high margins, e.g. petroleum products.
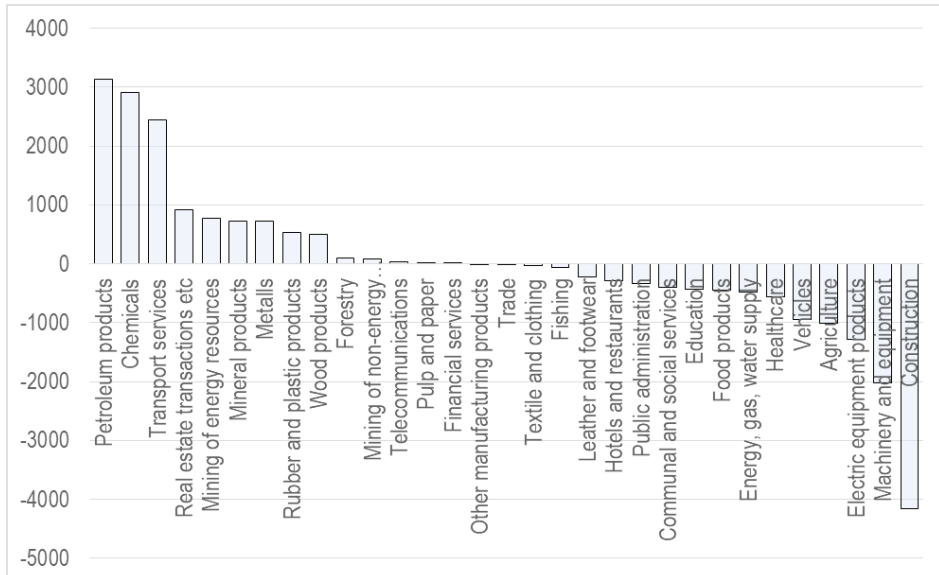
There are three groups of products in the Belarusian economy could be allocated:

Group 1: export-oriented products for which output significantly exceeds the final demand in the national economy taking into account intermediate and final imports.

In 2014 such group includes petroleum products, chemicals, transport services, other mineral products, metals and real estate transactions[3].

Group 2: products domestic demand for which is the main source of imports in the national economy. It is construction as well as all groups of technical manufacturing products (machinery and equipment, electronics and vehicles);

Group 3: Other products (industries) that are relatively neutral to the result of foreign trade.

The criterion or the main condition for the balanced economic growth is the foreign trade surplus. Actually, it was near zero in 2014 but due to statistical errors, the estimated trade balance is surplus. Naturally this does not mean that any industry should be in trade surplus but it is important the trade deficit for the products of Group 2 to be compensated by the trade surplus for the products of Group 1.

The national economy is characterized by a certain specialization in the international trade and this specialization can be fairly clear defined by the products of group 1. In our case as it turned out this is not machinery including automobile and tractor-building as it was many years before and still generally accepted. Belarusian economy has deepened specialization on the primary raw materials processing (petroleum products, fertilizers, plastic and rubber, metals, wood products, building materials).

The share of technical manufacturing products in the total production volume and value added is quiet high but the domestic demand for it slightly exceeds production capacity. The share of equipment, vehicles and electronics in the total production volume has been declining for a long time, and Belarus is gradually losing its competitive advantage in this product, which is extremely important for industrial and innovative development of the economy.

It is believed that investment in construction can revive the economy in a state of recession due to the flow of income to related industries as well as the growth of total final demand and gross capital formation. Perhaps in large and relatively closed economies this rule works but in a small open economy in Belarus about 25% of the gross output in construction is intermediate imports including metals, fuel and energy. Increased investment in construction leads to GDP growth but also causes an increase in intermediate imports and debts of the economy sectors. It is no coincidence that in the conditions of the recession of 2016 the amount of financing for construction and installation works has been reduced (Bykau A., Khvalko T., 2017). This not-quite-popular solution slowed the recovery of economic growth but allowed to avoid trade imbalances.

Obviously the growth of a small open economy only due to the stimulation of domestic demand can not be balanced. To compensate the decline in exports that occurred in 2015 - 2016, we should look for new export opportunities in industries traditionally oriented on domestic market, for example health care and education. It is obvious that the promotion of products of these industries for export requires a lot of effort.

The proposed methodology thus provides and summarizes information for extensive analysis of the sectoral structure of the economy linking economic growth with the results of foreign trade in the context of industries. Mentioned above conclusions

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[3] The industry of "Real estate transactions, rental and services to consumers" includes software development services, which make a significant contribution to the export of services in Belarus.

characterize it as a useful tool for macroeconomic analysis with wide possibilities for subsequent application.

References

About the statement of Program of economic and social development of the Republic of Belarus for 2016-2020 (2016).The Decree of the president of the Republic of Belarus № 466. (in Russian).

Bajo-Rubio O (2014). Balance-constrained growth rates: generalizing Thirlwall's law. Applied Economics Letters. 21 (9): 593–596.

Belousov AV. (2016). Belarus's import capacity of export as a factor of participation in global chains of value creation: Belorusskiy ekonomicheskiy zhurnal. 3: 63–80. (In Russian)

Bykau A., Kolb O. (2017). Global value chains: evolution, strategies, prospects for Belarus. Modern forms of business organization: international experience and development prospects in Belarus. Council for the Development of Entrepreneurship in the Republic of Belarus, Minsk: 97 – 123. (in Russian).

Bykau A., Khvalko T. (2017). Conditions and limitations for growth in construction industry: The empirical evidence from Belarus. Issues in Business Management and Economics. April, 2017. Vol.5 (3): 37-44.

Cappariello R. (2012). Domestic value added content of exports: a cross-country comparison for the major European economies. In Proceedings of the 20th International Input-Output Conference 2014 in Bratislava, Slovakia: 5.

Celi G., Sportelli M. Harrod's (2007). Dynamics and the Kaldor-Thirlwall Export-led Growth . CELPE's Discussion Papers 104: 58.

Elliott D, Rhodd R (1999). Explaining growth rate differences in highly indebted countries: an extension to Thirlwall and Hussain. Appl. Econ. 31:1145-1148.

Ghani GM (2006). Balance of payments constrained growth model: an examination of Thirlwall's Hypothesis using McCombie's Individual Country Method. Applied Economics Letters 13: 763–768.

Gotovskiy AV, Gutsol PN (2007) Contribution of exports to economic growth of the Republic of Belarus: Belorusskiy ekonomicheskiy zhurnal. 2: 4 – 16 (in Russian).

Gouvea R., Lima G. (2010). Structural change, balance-of payments constraint, and economic growth: evidence from the multispectral Thirlwall's law. J. Post Keynesian Econ. 33(1): 185.

Grichik M. (2016) The effects of participation of small open economies in GVCs on their trade balance. Economics, Modelling, Forecasting. Iss. 10: 88 – 96 (in Russian).

Kolesnikova I, Luchenok A (2015). The essence of stable development, criteria and indicators for assessing. Macroeconomic aspects of the balanced growth of the national economy. Minsk, Belarusian Navuka: 5 - 19. (in Russian).

McGregor PG., Swales JK. (1986). Balance of payments constrained growth: a rejoinder to Professor Thirwall. Applied Economics 18: 1265 – 1274.

Soshnikova LA, Tamashevich VN, Konovalenko EV. (2001). Methodological issues of cross-sectoral balance analysis: Voprosy statistiki. 12: 3–7. (In Russian)

The system of Input-Output tables of the Republic of Belarus for 2014 (2016) Minsk, The National Statistical Committee of the Republic of Belarus: 104 (in Russian).

Thirlwall A., Hussain (1982). The balance-of-payments constraint, capital flows and growth rate differences between developing countries: Oxford Economic Papers. 34: 498-510.

Thirlwall A (2003). Trade, the Balance of Payments and Exchange Rate Policy in Developing Countries. Northampton, MA, Edward Elgar: 156.

Trade in Value-Added: concepts, methodologies and challenges (joint OECD-WTO note): 28. http://www.oecd.org/sti/ind/49894138.pdf (Accessed 5 March 2017).

Yamano N., Ahmad N. (2006). The OECD Input-Output database: 2006 edition: STI working paper. Statistical Analysis of Science, Technology and Industry: Paris, OECD: 12.